Rate Constants for Reactions of Inorganic Radicals in Aqueous Solution

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Rate constants have been compiled for reactions of various inorganic radicals produced by radiolysis or photolysis, as well as by other chemical means, in aqueous solutions. Data are included for the reactions of $\cdot CO_2^-$, $CO_3\cdot^-$, O_3, $\cdot N_3$, $\cdot NH_2$, $\cdot NO_2$, $NO_3\cdot$, $\cdot PO_3^{2-}$, $PO_4\cdot^{2-}$, $SO_2\cdot^-$, $\cdot SO_3^-$, $SO_4\cdot^-$, $SO_5\cdot^-$, $SeO_3\cdot^-$, $(SCN)_2\cdot^-$, $Cl_2\cdot^-$, $Br_2\cdot^-$, $I_2\cdot^-$, $ClO_2\cdot$, $BrO_2\cdot$, and miscellaneous related radicals, with inorganic and organic compounds.

Key words: aqueous solution; carbonate radical; chemical kinetics; chlorine dioxide; inorganic radicals; halogen radicals; nitrogen radicals; oxygen radicals; ozone; phosphate radicals; phosphorus radicals; photolysis; radiolysis; rate constants; sulfur radicals.

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1. Introduction

Since the publication of the original compilation on this topic in 1979[1] the number of measured rate constants for reactions of inorganic radicals has more than doubled. Because of the importance of these radicals as basic chemical species, in the study of electron transfer theory, as well as in atmospheric and industrial processes, it is necessary to update the compilation. The present tables include the rate constants presented in the original compilation, with some revisions where appropriate, and rate constants published through mid 1987. The tables cover those radicals given in the original version as well as several others which were excluded before for various reasons.

Most of the rate constants presented here were determined by pulse radiolysis or flash photolysis. Values determined by other techniques were included when they seemed reliable and when absolute rate constants could be derived from the data. Relative rates are not included as such. All the values were determined in aqueous or predominantly aqueous systems.

The radicals covered in this compilation react with other radicals and with inorganic and organic compounds mostly by electron transfer oxidation or reduction. In certain cases they react by hydrogen abstraction, addition, substitution, or atom transfer.

2. General Methods

The radicals included in this compilation were produced in most cases by pulse radiolysis in aqueous solutions. The radiolysis of water forms short-lived intermediates: hydrated electrons, hydrogen atoms, and hydroxyl radicals,[2,3,4] which react rapidly with appropriate solutes to yield the desired secondary radicals.

In certain cases, these secondary radicals exhibit sufficiently intense optical absorption in the visible or near UV range that permits kinetic spectrophotometric measurements of the rates of their formation and decay. By following the decay rate as a function of added solute concentration one can determine the absolute second order rate constant for the reaction of the radical with the added solute. In other cases, when the radical does not exhibit intense absorption, it is often possible to determine absolute rate constants by following the buildup of the species produced from the added solute upon reaction with the radical.

When none of these methods is applicable, the rate constants are determined by competition kinetics. In such cases a reaction with a known absolute rate constant is chosen as a reference and the yield of the product of this reaction is determined as a function of the ratio of concentrations of the reference solute and other added solute. From a plot of the yield ratios versus the concentration ratios one derives the relative rate constants of the two competing reactions and, based on the known rate constant for the reference reaction, one then calculates the value for the unknown reaction. This competition method assumes constant radiation yield in all solutions examined and gives somewhat less precise results than the direct absolute method. Nevertheless, it has been applied successfully to many systems. In these Tables we have recalculated rate constants derived from competition kinetics by using the most accurate absolute rate constant for the reference compound applied.

Radicals produced by flash or laser photolysis are studied essentially by the same kinetic approaches described above. Other kinetic methods, such as those involving stopped-flow techniques or competition kinetics based on final product analysis, will be mentioned with the specific radicals where they were used.

A number of rate constants were determined by monitoring radical concentrations with the ESR technique. A few absolute rate constants were determined by time resolved ESR, but most experiments were based on monitoring radical concentration under steady-state conditions and deriving the rate constant from the known rate of radical production and the second order decay rate constants. ESR detection also was utilized for competition kinetic experiments.

3. Radical Production and Properties

3.1. Carbon Dioxide Radical Anion

The $\cdot CO_2^-$ radical is produced by the reaction of e_{aq} with CO_2 or by the reaction of $\cdot OH$ and $\cdot H$ with formate ion or formic acid.

$$e_{aq}^- + CO_2 \rightarrow \cdot CO_2^-$$

$$\cdot OH + HCO_2^- \rightarrow H_2O + \cdot CO_2^-$$

$$\cdot H + HCO_2^- \rightarrow H_2 + \cdot CO_2^-$$

The $\cdot CO_2^-$ radical exhibits optical absorption only in the UV range, with a maximum at 235 nm, $\epsilon = 3000$ L mol^{-1} cm^{-1},[5] decreasing to about 20% at 300 nm, which is not convenient for kinetic measurements. Therefore, most rate constants for reactions of $\cdot CO_2^-$ with solutes were determined by following the buildup of the solute radical.

The $\cdot CO_2^-$ radical is present in this form throughout most of the pH range and only protonates in strongly acidic solutions. The pK_a for $\cdot CO_2H$ was found to be 1.4.[6]

$$\cdot CO_2H \rightleftharpoons H^+ + \cdot CO_2^-$$

Protonation results in a small change in absorbance and probably only minor changes in kinetics, although the latter aspect has not been studied in detail.

The $\cdot CO_2^-$ radical is a strongly reducing species, with a redox potential of -2.0 V vs. NHE.[7] It transfers an electron very rapidly to quinones, nitro and nitroso compounds, pyridinium and viologen ions, porphyrins, oxygen, and many other organic and inorganic compounds. Because of this property, formate ions are used frequently to convert $\cdot OH$ and $\cdot H$ into one-electron reducing species so that all the primary radicals of water radiolysis result in eventual reduction of the added solute, i.e. in production of a single reduced species.

3.2. Carbonate Radical

The $CO_3\cdot^-$ radical is produced for most experiments by reaction of $\cdot OH$ radicals with carbonate ions.

$$\cdot OH + CO_3^{2-} \rightarrow OH^- + CO_3\cdot^-$$

It can be produced also by oxidation of carbonate with $SO_4\cdot^-$ radicals, by photoionization of carbonate, or by photolysis of certain carbonato-metal complexes, e.g.

$$Co(NH_3)_4CO_3^+ + h\nu \rightarrow CO_3\cdot^- + Co^{2+} + 4\ NH_3$$

The $CO_3\cdot^-$ radical exhibits a broad optical absorption in the visible range, with a maximum at 600 nm, $\epsilon =$ 1860 L mol^{-1} cm^{-1},[8] and with about 160 nm width at half-maximum. Therefore, it is possible to monitor the formation and reactions of this radical in the 500-700 nm range, although most experiments were carried out at the 600 nm maximum.

The carbonate radical was suggested to be in the protonated form in neutral solutions. The pK_a for the process

$$\dot{C}O_3H \rightleftharpoons CO_3\cdot^- + H^+$$

was reported to be 9.6[9] or about 7.9,[10] but it does not result in any observable changes in optical or ESR spectra.[11]

The majority of the rate constants for reactions of $CO_3\cdot^-$ and $\dot{C}O_3H$ were determined by following the decay of the 600 nm absorption, either by pulse radiolysis or flash photolysis techniques. The carbonate radical acts predominantly as an electron acceptor; it oxidizes many organic and inorganic compounds, e.g. phenols, anilines, sulfur compounds, histidine, tryptophan, certain metal ions, iodide, nitrite, sulfite, and thiocyanate ion. Hydrogen abstraction by the carbonate radical is generally very slow. Certain reactions of this radical were suggested to involve oxygen atom or oxide transfer.

3.3. Ozone

Ozone is typically produced by an electric discharge in gas-phase oxygen and then dissolved in solution. Ozone which is free of most oxygen can be obtained conveniently by first adsorbing the ozone onto silica gel at Dry Ice temperature and then sweeping it off with an inert gas.

O_3 exhibits a strong absorption in the UV, centered about 260 nm with $\epsilon = 3300$ L mol^{-1} cm^{-1} and a width at half-maximum of about 50 nm.[12] In most cases, the kinetics of ozone reactions are followed by monitoring this absorption, although in some cases where the other reactant interfered, the O_3 concentration at different times was determined by allowing it to react with, and bleach, indigotrisulfonate. In a few cases, reaction kinetics were determined by monitoring the other reactant in the presence of excess ozone. Since ozone is reasonably stable in aqueous solutions, and since there are no satisfactory radiolytic or photolytic sources, rate measurements have been performed by mixing a solution containing ozone with one containing the other reactant. For the faster reactions, rapid mixing stopped-flow techniques are used.

Ozone is a moderate one-electron oxidant, with a redox potential of 1.01 V.[13] It also readily reacts by oxygen atom transfer and by addition to carbon-carbon double bonds. In non-aqueous solutions, the mechanisms of the organic reactions of ozone have been the subject of extensive study.[14] In aqueous solution, the use of ozone as a disinfectant has led to the determination of a large number of rate constants for its reactions with potential wastewater constituents. Due to its importance in atmospheric chemistry, a large number of rate constants also have been determined for its reactions in the gas phase.[15]

3.4. Azide Radical

The azide radical is produced by reaction of the azide ion with $\cdot OH$ radicals.

$$\cdot OH + N_3^- \rightarrow OH^- + \cdot N_3$$

The reaction of azide with $\cdot H$ atoms in slightly acidic solutions also results in formation of $\cdot N_3$.

$$\cdot H + HN_3 \rightarrow H_2 + \cdot N_3$$

The azide radical exhibits moderate optical absorption only in the UV range, with a sharp maximum at 274 nm, $\epsilon = 2025$ L mol^{-1} cm^{-1},[16] the spectrum being only 20 nm wide at half-maximum height. The narrowness of this spectrum makes it particularly difficult to obtain molar absorptivities which are reproducible in different laboratories, because of the sensitivity of these measurements to the exact wavelength and slit width used. Nevertheless, second order decay rate constants can be correct despite using different values of ϵ, as long as they rely on the absorbance measured under the same experimental conditions. Because of the nature of its absorption spectrum, most rate constants for reactions of the azide radical were determined by following the buildup of the species produced from the other reactant.

The azide radical is a strong one-electron oxidant, with a redox potential of 1.3 V vs. NHE.[17,18] Its oxidation reactions are particularly rapid, even more rapid than the reactions of some stronger oxidants such as $Br_2\cdot^-$. This is probably due to a high self-exchange rate for $\cdot N_3/N_3^-$, estimated at 4×10^4 L mol^{-1} s^{-1}.[17] $\cdot N_3$ oxidizes most phenoxide ions and anilines with nearly diffusion-controlled rate constants. It exhibits certain selectivity in its reactions with neutral phenols and with other weaker reductants. It also reacts rapidly with tryptophan, methionine, histidine, phenothiazines, porphyrins, iodide, sulfite, ferrocyanide, etc.

3.5. Amino Radical

The $\cdot NH_2$ radical is produced by reaction of $\cdot OH$ with ammonia at high pH.

$$\cdot OH + NH_3 \rightarrow H_2O + \cdot NH_2$$

Ammonium ions do not react with $\cdot OH$. Reaction of hydrated electrons with hydroxylamine also yields $\cdot NH_2$, but this reaction has been used less frequently for kinetic measurements on $\cdot NH_2$.

The $\cdot NH_2$ radical exhibits only weak absorption in the UV and a very weak band ($\epsilon = 80$ L mol^{-1} cm^{-1}) centered around 530 nm,[19] neither of which is convenient for kinetic measurements. Therefore, rate constants for reactions of $\cdot NH_2$ have been determined by following the buildup of the product from the other reactant. The $\cdot NH_2$ radical was suggested to protonate in acid solutions, with $pK_a = 2.3$,[20] but little information is available on the protonated form.

Although $\cdot NH_2$ is isoelectronic with $\cdot OH$, it is a much weaker oxidant. It also reacts more slowly in hydrogen abstraction reactions and appears to be almost inactive toward addition. In this sense it resembles $\cdot O^-$ radicals more than it resembles $\cdot OH$. This resemblance is expressed also in the findings that both $\cdot O^-$ and $\cdot NH_2$ react with oxygen in aqueous solutions. $\cdot NH_2$ does not appear to react with oxygen in the gas phase.[21]

The redox potential for one-electron oxidation by $\cdot NH_2$ is unknown but was estimated[22] to be similar to that of sulfite radical, i.e. about 0.6 V vs. NHE. $\cdot NH_2$ oxidizes phenoxide ions with high selectivity, the rate constants vary from 10^5 to 10^9 L mol^{-1} s^{-1}. It also oxidizes ascorbate rapidly but does not appear to react with aniline or benzoate.

3.6. Nitrogen Dioxide Radical

The $\cdot NO_2$ radical is produced by reaction of $\cdot OH$ with nitrite ion or by reaction of e_{aq}^- with nitrate ion.

$$\cdot OH + NO_2^- \rightarrow OH^- + \cdot NO_2$$

$$e_{aq}^- + NO_3^- \rightarrow \dot{N}O_3^{2-} + H_2O \rightarrow 2\ OH^- + \cdot NO_2$$

To use the former reaction, a nitrite solution saturated with N_2O is required, and the nitrite concentration should not be too high in order to minimize competition for hydrated electrons by NO_2^-. When using nitrate as the source of $\cdot NO_2$, the $\cdot OH$ may interfere with the subsequent reactions, so that it may be advantageous to scavenge it with a low concentration of nitrite.

The $\cdot NO_2$ radical exhibits weak broad optical absorption around 300-500 nm, with a minor peak at 400 nm, $\epsilon = 200$ L mol^{-1} cm^{-1},[23] and another peak below 280 nm which was not possible to monitor. Because of the weakness of this absorption, most kinetic measurements utilized the absorption of the product radical to follow the rates of $\cdot NO_2$ reactions with solutes.

The second order decay of $\cdot NO_2$ was monitored at the 400 nm range. This decay is very rapid and leads to equilibrium with the dimer, N_2O_4, predominantly in favor of the latter. Since both $\cdot NO_2$ and N_2O_4 may oxidize a substrate, but the latter reacts much more slowly, the observed kinetics may reflect a mixture of the two processes and thus great care must be taken to isolate the two processes in order to determine accurate rate constants for $\cdot NO_2$.

The $\cdot NO_2$ radical reacts as a one-electron oxidant. Its redox potential was estimated to be 1.03 V vs. NHE.[24] It oxidizes phenoxide ions, anilines, phenothiazines, thiols, and ascorbate with moderate rate constants. The self-exchange rate constant for $\cdot NO_2/NO_2^-$ was calculated to be 8×10^{-3} L mol^{-1} s^{-1} in its reactions with substitution-inert transition metal complexes[24] and about 1 L mol^{-1} s^{-1} in its reactions with organic compounds.[25]

3.7. Nitrogen Trioxide Radical

This radical is produced by direct action of radiation on nitrate ion or nitric acid or by reaction of $\cdot OH$ with nitric acid (not nitrate ion).

$$\cdot OH + HNO_3 \rightarrow H_2O + NO_3\cdot$$

The former reaction may be utilized in neutral solution and the latter in acid solution; in both cases high concentrations are required to obtain reasonable yields, although in acid solutions the yield is obviously higher. These requirements limit the kinetic measurements to very high ionic strength and/or very high acidity. Furthermore, in the latter case, rate constants can be determined only for compounds which are stable in the presence of nitric acid. $NO_3\cdot$ has been produced also by flash photolysis of $Ce(NO_3)_4$.

The $NO_3\cdot$ radical exhibits weak optical absorption throughout the UV and visible range, with a minor peak at about 340 nm and three narrow peaks at 595, 640, and 675 nm. The most intense absorption is that at 640 nm, which was reported to have $\epsilon = 250$ L mol^{-1} cm^{-1},[26] but was found more recently to be considerably higher, about 800-1000 L mol^{-1}cm^{-1}.[27,28] Most kinetic measurements utilized this latter peak to follow the decay of $NO_3\cdot$ radicals in order to determine their rate of reaction with other solutes. In certain cases, the buildup of product absorption was also monitored.

Although $NO_3\cdot$ is a somewhat weaker oxidant than $\cdot OH$ or $SO_4\cdot^-$ radicals, it is a very strong oxidant, with a redox potential probably in the range of 2.3-2.5 V vs. NHE.[29] This radical oxidizes anisole, Cl^-, Ag^+, and Tl^+ moderately rapidly. It also abstracts hydrogen from alcohols and other aliphatic compounds and adds to double bonds. All the rate constants for $NO_3\cdot$ are somewhat lower than those for $SO_4\cdot^-$.

The rate constant for the second order decay of $NO_3\cdot$ was difficult to establish in most systems due to the presence of varying concentrations of other species, e.g. $\cdot NO_2$. Therefore, most of the reported rate constants were omitted from the Table, except where corrections were made for the secondary chemistry.

3.8. Phosphite Radical

The $\cdot PO_3^{2-}$ radical is produced by hydrogen abstraction from phosphite.

$$\cdot OH + HPO_3^{2-} \rightarrow H_2O + \cdot PO_3^{2-}$$

$$\cdot H + HPO_3^{2-} \rightarrow H_2 + \cdot PO_3^{2-}$$

These reactions involve abstraction of the hydrogen bound to the phosphorus and the resulting radical is a phosphorus-centered radical. This radical exists in the protonated form in acid solutions. The pK_a for the equilibrium

$$\cdot PO_3H^- \rightleftharpoons \cdot PO_3^{2-} + H^+$$

was determined to be 5.8.[30] Both forms of the radical exhibit optical absorption below 300 nm with no observable maximum down to 230 nm. The ϵ at 240 nm for the basic form is 4000 and for the acid form 1500 L mol^{-1} cm^{-1}.[30] Rate constants for reactions of phosphite radicals were determined by following either the decay of the radical absorption or the buildup of product absorption.

The phosphite radicals act as both oxidizing and reducing agents. They reduce tetranitromethane very rapidly and oxidize thiols moderately rapidly. Their reaction with disulfides was found to involve neither of the above electron transfer processes, but rather a substitution mechanism. Phosphite radicals also react with oxygen to form a peroxyl radical, PO_5^{2-}.

3.9. Phosphate Radical

The $PO_4\cdot^{2-}$ radical and its protonated forms are produced from peroxodiphosphate ions by reaction with hydrated electrons,

$$P_2O_8^{4-} + e_{aq}^- \rightarrow PO_4\cdot^{2-} + PO_4^{3-}$$

or by direct UV photolysis of this ion to produce two radicals. Pulse radiolysis of very high concentrations of phosphate also yields the radicals.

The phosphate radical exists in three acid-base forms, $H_2PO_4\cdot$, $HPO_4\cdot^-$, and $PO_4\cdot^{2-}$, with pK_a values of 5.7 and 8.9.[31]

$$H_2PO_4\cdot \rightleftharpoons HPO_4\cdot^- + H^+$$

$$HPO_4\cdot^- \rightleftharpoons PO_4\cdot^{2-} + H^+$$

All forms of this radical exhibit moderate optical absorptions in the 500 nm range, with only slight differences: $H_2PO_4\cdot$ $\lambda = 520$ nm, $\epsilon = 1850$, $HPO_4\cdot^-$ $\lambda = 510$ nm, $\epsilon = 1550$, and $PO_4\cdot^{2-}$ $\lambda = 530$ nm, $\epsilon = 2150$ L mol^{-1} cm^{-1}.[31] The rate constants for reactions of these radicals were determined in most cases by following the decay of their broad absorptions in the 500-540 nm range.

Phosphate radicals abstract hydrogen from saturated organic compounds, add to olefins, and oxidize many organic and inorganic compounds. $H_2PO_4\cdot$ is somewhat similar in its reactivity to $SO_4\cdot^-$, but the other forms are less reactive, both in hydrogen abstraction and in electron transfer reactions. For example, $PO_4\cdot^{2-}$ oxidizes I^- rapidly, $HPO_4\cdot^-$ can oxidize also Br^-, and $H_2PO_4\cdot$ can oxidize even Cl^-. The same radicals abstract hydrogen from 2-propanol with rate constants of 1.8, 2.5, and 14 $\times$ 10^7 L mol^{-1} s^{-1}, respectively. The phosphate radicals oxidize phenoxide ions, phenols, and anilines with moderate or high rate constants, the acidic form oxidizes also benzoic acid fairly rapidly.

3.10. Sulfur Dioxide Radical Anion

The sulfur dioxide radical anion, $SO_2\cdot^-$, also called the dithionite radical, is most often studied by investigating the reactions of dithionite, $S_2O_4^{2-}$, which contains a small amount of the radical anion at equilibrium in aqueous solution.

$$S_2O_4^{2-} \rightleftharpoons 2\ SO_2\cdot^-$$

Kinetic measurements must be carried out at low enough concentration that the rate of the radical reaction is slow compared to the rate of the monomerization reaction. Most studies have involved the use of conventional or stopped-flow spectrophotometry, following the decay of the non-radical reactant or the buildup of the reduced product. The rate of reduction of the substrate is determined as a function of the dithionite concentration and a square-root dependence is taken to imply that the reaction is due to the radical anion, since

$$[SO_2\cdot^-] = K_{eq}^{1/2}\,[S_2O_4^{2-}]^{1/2}$$

where K_{eq} is the equilibrium constant. The absolute rate constants, then, are calculated with the equation

$$k = k_{obs}/K_{eq}^{1/2}\,[S_2O_4^{2-}]^{1/2}$$

There have been a few reported determinations of this equilibrium constant. Some of these results[32,33,34] are presented in Fig. 1, plotted against the ionic strength, I. The older results[35,36] are somewhat lower than these, and do not appear to show the expected ionic strength dependence. The line is a hand-fit to the lower ionic strength data and corresponds to the equation

$$\log(K_{eq}) = -8.6 - 0.56(I)^{1/2}$$

This equation was then used to calculate the equilibrium constants which are in turn used to calculate the absolute rate constants reported in Table 13.

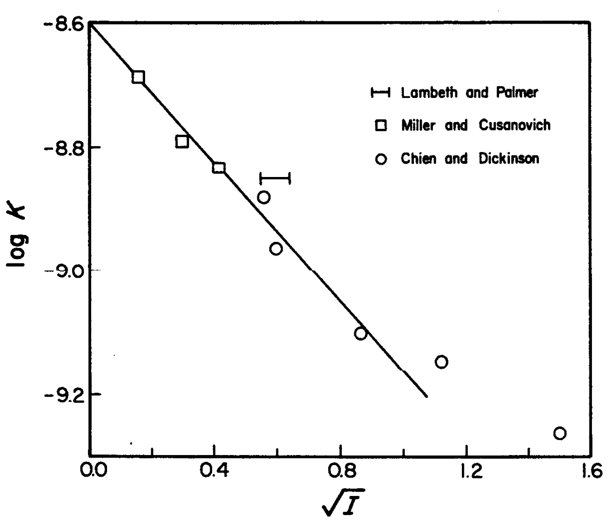

FIG. 1. Equilibrium constant, K, for $S_2O_4^{2-} \rightleftharpoons 2\ SO_2\cdot^-$ at different ionic strengths, I. Data are from Lambeth and Palmer[32], Miller and Cusanovich[33], and Chien and Dickinson[34].

The $SO_2\cdot^-$ radical also can be formed by the reduction of SO_2 in acid solutions, for example

$$(CH_3)_2\dot{C}OH + SO_2 \rightarrow (CH_3)_2CO + H^+ + SO_2\cdot^-$$

A few direct determinations of rate constants by pulse radiolysis have been reported employing this method of radical generation.

The $SO_2\cdot^-$ radical is a strongly reducing species, with a redox potential of -0.31 V at pH 2 and above.[37] At lower pH, the potential increases, probably corresponding to the protonation of the radical. It exhibits a moderate optical absorption in the UV, with a maximum at 255 nm and $\epsilon = 1770\ L\ mol^{-1}\ cm^{-1}$ and a width at half-maximum of about 40 nm.[38] An attempt to derive a consistent self-exchange rate constant for this radical was unsuccessful, with values ranging over several orders of magnitude.[37]

3.11. Sulfite Radical

The $\cdot SO_3^-$ radical is most commonly produced by the reaction of $\cdot OH$ with sulfite or bisulfite.

$$\cdot OH + SO_3^{2-} \rightarrow OH^- + \cdot SO_3^-$$

The production of this radical by the flash photolysis of $S_2O_6^{2-}$ also has been reported. The $\cdot SO_3^-$ radical also can be produced chemically by oxidation of sulfite or bisulfite by ceric ions and has been observed by ESR from the interaction of bisulfite with some enzymatic systems. Kinetic information on this radical, however, has come almost solely from pulse radiolysis experiments.

The $\cdot SO_3^-$ radical exhibits an optical absorption centered at 250 nm, $\epsilon = 1380\ L\ mol^{-1}\ cm^{-1}$, with a width at half-maximum of about 70 nm and a long, weak tail extending to 400 nm.[38] This absorption is inconvenient for most kinetic work and typically the build-up of the product radical from a reaction is followed. In cases where the product does not have a useful absorption, rate constants are determined by competition kinetics.

The $\cdot SO_3^-$ radical is a mild oxidant, with a one-electron redox potential of 0.84 V at pH 3.6, 0.63 V vs. NHE at pH 7.[39] It is a very selective oxidant, reacting rapidly with hydroxybenzenes at high pH, but slowly or not at all at lower pH. The radical does not appear to abstract hydrogen atoms, but it does appear to add to double bonds, although too slowly to measure by pulse radiolysis. The $\cdot SO_3^-$ radical appears to be a very poor reductant; there are no confirmed examples of it being oxidized by a one-electron transfer process. It is oxidized by the $CO_3\cdot^-$ radical, but by O^- transfer. In the aqueous phase, $\cdot SO_3^-$ reacts with O_2 by addition to produce $SO_5\cdot^-$. In the gas phase, the equivalent reaction results in the oxidation of $H\dot{S}O_3$ to SO_3 with formation of $H\dot{O}_2$.

3.12. Sulfate Radical

The $SO_4\cdot^-$ radical is produced by reduction of peroxodisulfate ion with various one-electron reductants. For kinetic studies most experiments utilized the hydrated electron in a pulse radiolysis experiment.

$$e_{aq}^- + S_2O_8^{2-} \rightarrow SO_4\cdot^- + SO_4^{2-}$$

Other studies were carried out using UV photolysis.

$$S_2O_8^{2-} + h\nu \rightarrow 2\ SO_4\cdot^-$$

A slow reaction between $\cdot OH$ radicals and HSO_4^- ions also may be applied to the formation of $SO_4\cdot^-$ at high concentrations of sulfuric acid.

$$\cdot OH + HSO_4^- \rightarrow H_2O + SO_4\cdot^-$$

The $SO_4\cdot^-$ radical has a broad optical absorption with a maximum at 450 nm, $\epsilon = 1100\ L\ mol^{-1}\ cm^{-1}$.[40] The rate constants for reactions of this radical were determined in most cases by following the decay of this absorption, and in some cases the formation of the product from the other reactant also was monitored. This radical may protonate in strongly acidic solutions but no pK_a value has been determined.

The $SO_4\cdot^-$ radical is a very strong one-electron oxidant, with a redox potential estimated to be between 2.5 and 3.1 V vs. NHE.[41] It is a stronger oxidant than the phosphate or nitrate radicals and is probably similar to $\cdot OH$. With many organic compounds $SO_4\cdot^-$ reacts as a more efficient oxidant than $\cdot OH$ because it is more selective for oxidation while $\cdot OH$ may react rapidly also by hydrogen abstraction or addition. $SO_4\cdot^-$ also reacts by hydrogen abstraction and addition, but these reactions generally take place with lower rate constants than those of $\cdot OH$.

$SO_4\cdot^-$ oxidizes Cl^- rapidly in neutral solution and is thus useful for the production of $Cl_2\cdot^-$ at pH 7, which is difficult to achieve with $\cdot OH$. $SO_4\cdot^-$ also oxidizes OH^- with a moderate rate constant and is thus converted into $\cdot OH$ at high pH. There is no apparent oxidation of water.

This radical oxidizes phenols and anilines with nearly diffusion-controlled rates but many of these reactions could not be measured because of thermal oxidation of the substrates with peroxodisulfate. $SO_4\cdot^-$ also oxidizes methoxybenzenes and benzene with high rate constants. In the latter case the radical cation undergoes very rapid reaction with water to form the hydroxycyclohexadienyl radical, the same product formed upon reaction of $\cdot OH$ with benzene. Reaction with benzoic acid also forms the radical cation initially but this radical decarboxylates very rapidly to give the phenyl radical. Radical cations produced from toluene and similar compounds undergo deprotonation to yield benzyl type radicals. Thus the initial radical cation produced by reaction of the sulfate radical with aromatics may follow various paths to a more stable radical.

Hydrogen abstraction from an aliphatic compound results very often in a radical that can reduce peroxodisulfate and this leads to a chain reaction. In certain cases this chain reaction may interfere with the kinetic measurements on the rate of hydrogen abstraction. In Table 15 we have selected the values that are least likely to be complicated by the chain reaction.

3.13. Peroxomonosulfate Radical

The $SO_5\cdot^-$ radical is produced by the reaction of $\cdot SO_3^-$ with O_2.

$$\cdot SO_3^- + O_2 \rightarrow SO_5\cdot^-$$

The radical also can be produced by the reaction of $\cdot OH$ with peroxomonosulfate.

$$\cdot OH + HSO_5^- \rightarrow H_2O + SO_5\cdot^-$$

The $SO_5\cdot^-$ radical exhibits a broad optical absorption centered about 260 nm, $\epsilon = 1030\ L\ mol^{-1}\ cm^{-1}$, with a width at half-maximum of about 80 nm.[38] This absorption is inconvenient for most kinetic work and typically the build-up of the product radical from a reaction is monitored. Competition kinetics also has been used to determine the kinetics of the reaction of $SO_5\cdot^-$ with sulfite and bisulfite. A simple competition scheme like that discussed earlier could not be used, since the primary reaction under consideration leads to products which reform the reactant. In this case, computer modeling was necessary to extract the rate constant.

The $SO_5\cdot^-$ radical is a stronger oxidant than $\cdot SO_3^-$, with an estimated redox potential of 1.1 V at pH 7.[39] It is still quite selective in its reactions, oxidizing hydroxybenzenes at high pH rapidly but only slowly or not at all at low pH. The radical possibly also reacts by oxygen-atom transfer with sulfite or bisulfite.

$$SO_5\cdot^- + SO_3^{2-} \rightarrow SO_4\cdot^- + SO_4^{2-}$$

In such a case, the $SO_4\cdot^-$ would react rapidly with the SO_3^{2-}, regenerating $\cdot SO_3^-$, and thus making it difficult to distinguish this reaction from an electron transfer path.

$$SO_5\cdot^- + SO_3^{2-} + H^+ \rightarrow HSO_5^- + \cdot SO_3^-$$

3.14. Selenite Radical

The selenite radical is produced by the reaction of $\cdot OH$ with H_2SeO_3, $HSeO_3^-$, or SeO_3^{2-}, e.g.

$$\cdot OH + SeO_3^{2-} \rightarrow OH^- + SeO_3\cdot^-$$

It also can be produced by the reduction of selenate with the hydrated electron.

$$e_{aq}^- + SeO_4^{2-} \rightarrow HSeO_4\cdot^{2-} + OH^-$$

The selenite radical exhibits a moderate absorption at about 420 nm, $\epsilon = 1470\ L\ mol^{-1}\ cm^{-1}$, with a width at half-maximum of about 120 nm.[42] This absorption is strong enough to allow the kinetics of $SeO_3\cdot^-$ reactions to be monitored. The radical has been reported to protonate, with pK_a values of 7.4 and 3.9,[43] but this observation has been disputed.[42] This latter work suggests that the radical adds OH^- above pH 12, with a pK of 0.1.

$$OH^- + SeO_3\cdot^- \rightleftharpoons HSeO_4\cdot^{2-}$$

A redox potential of 1.68 V for the $SeO_3\cdot^-$ radical has been estimated from the above equilibrium constant and the equilibrium constant for the reaction of $\cdot OH$ with selenite at high pH.[42]

$$\cdot OH + SeO_3^{2-} \rightleftharpoons HSeO_4\cdot^{2-}$$

This value is much higher than the redox potential for $\cdot SO_3^-$, and this fact is reflected in the higher reactivity of $SeO_3\cdot^-$ as an oxidant.

3.15. Dithiocyanate Radical

The $(SCN)_2\cdot^-$ radical is produced by the very rapid reaction of $\cdot OH$ with thiocyanate ions.

$$\cdot OH + SCN^- \rightarrow OH^- + \cdot SCN$$

$$\cdot SCN + SCN^- \rightleftharpoons (SCN)_2\cdot^-$$

The subsequent equilibrium occurs with a forward rate constant nearly diffusion controlled and the equilibrium constant is near 10^5 L mol^{-1}.[44] Thus even millimolar concentrations of thiocyanate lead very rapidly to the $(SCN)_2\cdot^-$ radical.

This radical has a broad absorption spectrum with a maximum at 472 nm, $\epsilon = 7580$ L mol^{-1} cm^{-1}.[45] Because of all the above characteristics, thiocyanate is used routinely for chemical dosimetry of pulsed radiation, using either aerated or N_2O-saturated neutral unbuffered solutions.

$(SCN)_2\cdot^-$ is a moderately strong one-electron oxidant, with a redox potential of 1.31 V vs. NHE.[46] Although the redox potential is similar to that of $\cdot N_3$ the rate constants for reactions of $(SCN)_2\cdot^-$ are generally much slower. For example, $(SCN)_2\cdot^-$ oxidizes phenoxide ions fairly rapidly, methionine and cysteine slowly, but its reaction with histidine, thymine, and phenylalanine are too slow to be observed by pulse radiolysis. Hydrogen abstraction and addition reactions are also very slow and could not be observed.

3.16. Dihalogen Radical Anions

It is convenient to discuss $Cl_2\cdot^-$, $Br_2\cdot^-$, and $I_2\cdot^-$ together because of their obvious similarity. They are all produced from the halides by reaction with $\cdot OH$ radicals followed by rapid complexation with another anion, as described above for thiocyanate. All three halides react rapidly with $\cdot OH$ and all the dihalogen radical anions have high stability constants (near 10^5 L mol^{-1}).[47,48] Because of other equilibria, however, the $Cl_2\cdot^-$ radical can be produced efficiently by this method only in acidic solutions, while $Br_2\cdot^-$ and $I_2\cdot^-$ can be produced practically at all pH values. To produce $Cl_2\cdot^-$ in neutral solutions it is possible to use $SO_4\cdot^-$ as the oxidant of Cl^-. $Br_2\cdot^-$ and $I_2\cdot^-$ are also produced by photolysis of the ions.

The dihalogen radical anions are easily monitored by their optical absorptions. They exhibit broad absorptions with maxima at 340 nm for $Cl_2\cdot^-$, 360 nm for $Br_2\cdot^-$, and 380 nm for $I_2\cdot^-$, all with ϵ near 10^4 L mol^{-1} cm^{-1}.[19] Therefore, most rate constants for the reactions of these radicals were determined by following the decay of these absorptions.

The reactivities of these radicals generally decrease in the order $Cl_2\cdot^-$, $Br_2\cdot^-$, $I_2\cdot^-$ (with $(SCN)_2\cdot^-$ generally between $Br_2\cdot^-$ and $I_2\cdot^-$). $Cl_2\cdot^-$ can abstract hydrogen from organic compounds slowly but the parallel reactions of the other radicals are barely detectable in the pulse experiment. The reaction of $Cl_2\cdot^-$ with some unsaturated compounds produces Cl adducts, and presumably the other dihalogen radicals may react in a similar fashion, although little information is available to confirm this.

The main reactions of the dihalogen radical anions are those of one-electron oxidation. The redox potentials of the radicals were reported to be $E(Cl_2\cdot^-/2Cl^-) = 2.09$ V,[49] $E(Br_2\cdot^-/2Br^-) = 1.63$ V,[49] and $E(I_2\cdot^-/2I^-) = 1.03$ V[46] vs. NHE.

3.17. Chlorine Dioxide

The $ClO_2\cdot$ radical can be produced for study by pulse radiolysis by the reaction of chlorite with hydroxyl radicals

$$\cdot OH + ClO_2^- \rightarrow OH^- + ClO_2\cdot$$

Since the radical is stable in aqueous solutions, $ClO_2\cdot$ also can be produced by the action of other oxidizing reagents, for example persulfate, on chlorite, stripped from the solution with a carrier gas, and concentrated to make a stock solution.

The $ClO_2\cdot$ radical exhibits a moderate optical absorption in the visible, with a maximum at 358 nm, $\epsilon = 1250$ L mol^{-1} cm^{-1} and a width at half-maximum of about 80 nm.[50] The spectrum is unusual for the condensed-phase in that it shows vibrational structure, making this a very characteristic spectrum. Since the radical formed is stable, $ClO_2\cdot$ is a particularly good candidate for calibrating the dose in pulse radiolysis systems.

Rate constants for the reactions of $ClO_2\cdot$ have been determined by pulse radiolysis, stopped-flow, and kinetic spectrophotometric techniques. At different pH values, all three techniques have been applied to the reaction of $ClO_2\cdot$ with phenol. These studies span almost eight orders of magnitude in the value of the measured rate constants. Many of the studies of the reactions of $ClO_2\cdot$ involving kinetic spectrophotometry, particularly with amines, were carried out at low pH, where most of the amine is in the unreactive, protonated form. The rate constant for the reaction of $ClO_2\cdot$ with the unprotonated amine was then determined by dividing the observed first-order rate constant for the loss of $ClO_2\cdot$ by the concentration of the unprotonated amine at that pH. These are the values reported in the Tables.

$ClO_2\cdot$ is a moderate one-electron oxidant, with a redox potential of 0.936 V vs. NHE at 298 K.[51] Since both the radical and the anion are stable, extensive studies of this couple have been carried out at several temperatures. The self-exchange rate for $ClO_2\cdot$ has been estimated to be about 2×10^2 L mol^{-1} s^{-1}.[25,52]

3.18. Bromine Dioxide

Although the $BrO_2\cdot$ radical can be produced by the oxidation of BrO_2^- by $\cdot OH$, this approach is not commonly used due to the difficulty in obtaining BrO_2^-. Rather, the reduction of BrO_3^- by the electron is used.

$$BrO_3^- + e_{aq}^- + 2\,H^+ \rightarrow BrO_2\cdot + H_2O$$

The $BrO_2\cdot$ radical exhibits a broad optical absorption at 475 nm with $\epsilon = 1000$ L mol^{-1} cm^{-1} and a width at half-maximum of about 120 nm.[53] Therefore, it is possible to monitor reactions by following the decay of this absorption or by monitoring the build-up of the absorption of product radicals, which frequently absorb more strongly.

The $BrO_2\cdot$ radical has been of recent interest due to its likely role in the oscillating Belousov-Zhabotinskii reaction. Its redox potential has been estimated to be 1.33 V[54] making it a moderately strong oxidant.

4. Comparison of the Reactivities of Various Radicals

At the time of the previous compilation,[1] there were a substantial number of rate measurements for only a few radicals. In the present compilation, several additional radicals have extensive data sets associated with them. This allows us to compare the reactivity of these radicals towards a number of different types of reactants.

4.1. Oxidizing Radicals

In Table 1, we have gathered rate constants for the reactions of 16 oxidizing radicals with a number of organic and inorganic reactants. The reactants were included both because they are frequently chosen to test the reactivity of radicals and because they represent a wide range of reactant type. This Table was constructed to illustrate trends and should not be used as a substitute for the main tables. Often, additional data are found in the main tables, for example rate constants at other pH values. Further, the rate constants in Table 1 are often uncritical averages of several values.

Under each rate constant, we have included the pH at which this value was determined or for which it is applicable. We have tried to choose results at the same pH for the different radicals, but in some cases this was not possible. This limitation arises from the mode of preparation of the radicals or their stabilities at various pH values. For example, the $CO_3\cdot^-$ radical can be prepared only in neutral or alkaline solutions while the $Cl_2\cdot^-$ radical only in acidic or neutral solutions. Another example is $SO_4\cdot^-$ which is unstable in alkaline solutions because it reacts rapidly with hydroxide ions.

Where the pH is different, this must be taken into account when comparing reactivity. A change in pH may affect the reactivity as a result of acid-base equilibria involving either the radical or the compound. The pK_a values for the radicals were discussed above and in several cases the different reactivities of the various forms of the radical are evident from the Tables. The difference in reactivity for acid-base forms of a compound are demonstrated by the case of phenol/phenoxide ions in Table 1, where the ion is more reactive by 1-7 orders of magnitude. Similar differences are known or can be expected for all other phenols and their derivatives, anilines, ascorbate, and many other organic and inorganic compounds which undergo acid-base processes.

As an example of how this table can be used, we compare the rate constants for reactions of $CO_3\cdot^-$ with rate constants for reactions of O_3. In most cases, the $CO_3\cdot^-$ radical reacts several orders of magnitude faster than O_3; for sulfite and nitrite, the exceptions seem to indicate the likelihood of atom transfer rather than electron transfer mechanism. The rate constant for the reaction of ozone with phenoxide appears to be too high, and since the value was derived from a long extrapolation from low pH data, the present comparison suggests that this result may be incorrectly too high.

For each radical, the reactivities with the various compounds follow a generally similar pattern, except where the mechanism of reaction may differ. A log-log plot of the reactivities of one radical versus those of another radical shows this general trend but with deviations from straight line of an order of magnitude or more. Such plots may be useful in pointing out the reactants which may react with two radicals by different mechanisms.

For a particular reactant, the variation in reactivity typically reflects the change in redox potential of the radical. There are notable exceptions, for example between $ClO_2\cdot$ and $\cdot NO_2$ or between $Br_2\cdot^-$ and $\cdot N_3$, due to wide differences in self-exchange rates. For the latter pair, the redox potential of $\cdot N_3/N_3^-$ is only 1.3 V while that of $Br_2\cdot^-/2Br^-$ is 1.6 V and yet the rate constants for oxidation by $\cdot N_3$ are higher than those by $Br_2\cdot^-$ due to the much higher self-exchange rate for $\cdot N_3/N_3^-$.

4.2. Reducing Radicals

The radicals $\cdot CO_2^-$, $SO_2\cdot^-$, and $\cdot PO_3^{2-}$ react predominantly as reducing agents and, therefore, their reactivities cannot be compared with those of the radicals in Table 1. Probably the only reaction common to these three radicals and to some of those in Table 1 is their reaction with O_2, and even this reaction takes place by different mechanisms, i.e. electron transfer from $\cdot CO_2^-$ and $SO_2\cdot^-$ but addition of $\cdot PO_3^{2-}$, $\cdot SO_3^-$, and $\cdot NH_2$ to oxygen. All these reactions take place with high rate constants. Most of the other oxidizing radicals do not react with O_2.

Table 2 presents a comparison of the reactivities of the three reducing radicals, along with the reactivities of $O_2\cdot^-$ taken from a recent compilation,[55] with several inorganic and organic compounds. It is clear from the table that the strong reductant $\cdot CO_2^-$ reacts with all listed compounds very rapidly, in most cases near the diffusion-controlled rate. $SO_2\cdot^-$ also is a commonly used reductant but its reduction potential is much lower than that of $\cdot CO_2^-$ (see discussion above on each radical). Therefore, as expected, the rate constants for $SO_2\cdot^-$ are somewhat lower, and in the case of the two viologens the reactions are thermodynamically favored to take place in the opposite direction, i.e. the radicals BV^+ and MV^+ reduce SO_2 (at pH 1) with rate constants of nearly 10^9 L mol^{-1} s^{-1}.[37] The reactivity of $\cdot PO_3^{2-}$ was tested with only a limited number of compounds and this radical was found to behave mainly as a reductant, e.g. in its reaction with tetranitromethane. The high reactivity shown for lipoate and other disulfides does not appear to involve electron transfer but rather a displacement of an RS group with $\cdot PO_3^{2-}$.

The superoxide radical, $O_2\cdot^-$, is a mild reductant with a reduction potential slightly less than that of $SO_2\cdot^-$. The rates of electron transfer from $O_2\cdot^-$ are generally lower than those of $SO_2\cdot^-$ and $\cdot CO_2^-$. The differences do not appear to be consistent, probably due to variations in self-exchange rates in the reactions of $O_2\cdot^-$ with various reactants.[56] As in the case of $SO_2\cdot^-$, the radical from methyl viologen, MV^+, transfers an electron to O_2 very rapidly while the reverse reaction is slow, in the case of $O_2\cdot^-$ too slow to measure.

5. Arrangement of Tables 3-29

The Tables 3-29 are arranged similarly with inorganic reactants listed first, grouped alphabetically by the symbol for the main element. Within the groupings by element the arrangement is in order of increasing oxidation state; for metals aquated ions are listed first followed by complexes with neutral ligands (amines), then complexes with ionic ligands, then polynuclear metal species. The inorganic reactants are followed by the organic reactants, arranged alphabetically by name. Biopolymers, such as enzymes, are listed at the end of each table, alphabetically by name. Systematic names are used in the table for the reactants, unless the reactant is better known by a common name and has a complex structure. Alternate names are given in the chemical name index.

In the case of metal ions whose the structure may not be known due to hydrolysis or coordination of anions from the solution, the metal species have been indicated only by their oxidation number (Stock number), e.g. Ce(IV). Water molecules coordinated to metal ions have generally been omitted, e.g. Cr^{2+} is listed not $Cr(H_2O)_6^{2+}$.

The products of the reactions are included when they are known reasonably well or when they have been discussed in the paper reporting the data. In some cases, where representation of the product by a formula was difficult but the type of reaction was known, the reaction type has been included in lieu of products, e.g. redn., e.t., or addn., for reduction, electron transfer, or addition, respectively. In some cases the representation of the product indicates the part of the substrate molecule on which reaction occurs.

The indexes, which follow the tables, have been generated from the RCDC registry file. The chemical name index may contain alternate names to those listed in the tables (systematic names and synonyms); inverted names are also included in the index whenever they were present in the registry file. A molecular formula index is also provided as an aid to locating particular reactants. The indexes refer to the reactants in Tables 3-29 and give the entry numbers in the various tables where data for those reactants appear. The prefix is the table number, thus 8.5 refers to entry 5 in Table 8.

When observed rate data over a pH range were used to calculate k for an individual ionic form, that is noted in the comments. In most cases the rate constant listed is k_{obs} at the quoted pH. In some cases the observed k may be for a mixture of ionic forms of the substrate. Ionic strength corrections have only been given when reported by the authors, except in the case of SO_2^- (see Sec. 3.10). The rate data are assumed to be at ambient temperature unless otherwise noted in the comments.

The method of generation of the radical is given by symbols such as p.r. (pulse radiolysis), and f.p. (flash photolysis), identified in the list of abbreviations and symbols (Sec. 6) and other details about the determination and the system are given in the comment. Temperature and pressure are assumed to be ambient, otherwise the conditions have been noted.

The references, which follow the tables, are listed by serial number assigned by the Radiation Chemistry Data Center and included in the RCDC Bibliographic Data Base. The data contained in these tables are stored in a computer-searchable database. Information about online access may be obtained from the Radiation Chemistry Data Center.

6. List of Abbreviations and Symbols

A	frequency factor
abs.	absorption
abstr.	abstraction
ABTS	2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonate)
addn.	addition

anal.	analysis
tert-BuOH	*tert*-butyl alcohol (2-methyl-2-propanol)
BV	benzyl viologen
calcd.	calculated
c.k.	competition kinetics
concn.	concentration
condy.	conductivity
contg.	containing
cor.	corrected
D_{37}	radiation dose at which 37% of the substrate is inactivated
detd.	determined
d.k.	decay kinetics (decay of radical absorption and bleaching of substrate absorption)
DMPO	5,5-dimethyl-1-pyrroline-1-oxyl
ϵ	extinction coefficient (molar absorptivity)
E_a	activation energy
EtOH	ethanol
esr	electron spin resonance
estd.	estimated
e.t.	electron transfer
f.p.	flash photolysis
formn.	formation
γ-r.	gamma radiolysis
G	radiation yield (molecules per 100 eV)
$\Delta H\ddagger$	activation enthalpy
I	ionic strength
J	joules (4.184 J = 1 cal)
K	equilibrium constant
k	rate constant
k_f	specific rate of the forward reaction
k_r	specific rate of the reverse reaction
L	ligand
meas.	measured
MeOH	methanol
MV	methyl viologen
N	newton (133 $N\ m^{-2}$ = 1 torr)
obs.	observed
o.d.	optical density
opt.	optical
Ph	phenyl
PNBPA	*p*-nitrobenzoato(pentaammine)cobalt(III) ion
p.b.k.	product buildup kinetics
phot.	photolysis
pK_a	negative logarithm of the acid dissociation constant, e.g., where $AH + H_2O \rightleftharpoons A^- + H_3O^+$
p.r.	pulse radiolysis
prod.	product
PrOH	propanol
redn.	reduction
rel.	relative
RNO	*N,N*-dimethyl-4-nitrosoaniline
$\Delta S\ddagger$	activation entropy
satd.	saturated
SDS	sodium dodecylsulfate
s.f.	stopped-flow
soln.	solution
TAN	2,2,6,6-tetramethyl-4-piperidone *N*-oxyl
therm.	thermal
TMB	1,3,5-trimethoxybenzene

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TABLE 1. Comparison of the reactivities, k (L mol^{-1} s^{-1}), of oxidizing radicals with inorganic and organic compounds at the pH specified in parenthesis

	$CO_3^{\cdot-}$	O_3	$\cdot N_3$	$\cdot NH_2$	$NO_2\cdot$	$NO_3\cdot$	$PO_4^{\cdot 2-}$	$\cdot SO_3^-$	$SO_4^{\cdot-}$	$SO_5^{\cdot-}$	$(SCN)_2^{\cdot-}$	$Cl_2^{\cdot-}$	$Br_2^{\cdot-}$	$I_2^{\cdot-}$	$ClO_2\cdot$	$BrO_2\cdot$
Br^-	$<5\times10^5$ (11)	2×10^2 (4)				4×10^9 (7)	6.5×10^6 (9)		3.5×10^9 (7)						$<10^{-2}$ (7)	
N_3^-		4×10^6 (7)					1.1×10^8 (7)		$\sim3\times10^9$ (7)			1.2×10^9 (7)	4×10^8 (7)	$<5\times10^5$ (7)		
NO_2^-	4×10^6 (11)	3×10^5 (4)				1.2×10^9 (7)	1.4×10^7 (7)		9×10^9 (7)		2.2×10^6 (7)	2.5×10^8 (7)	2×10^7 (7)		1.1×10^2 (4-10)	2×10^6 (9)
SO_3^{2-}	1.3×10^7 (11)	1.5×10^9 (>8)	2.4×10^9 (>8)	NR	3.5×10^7 (12)	2×10^9 (7)	4.1×10^7 (12)		$>2\times10^9$ (>8)	1.3×10^7 (9)	1.1×10^8 (9)	3.4×10^8 (3)	2×10^8 (10)	1.9×10^8 (11)	2.7×10^6 (11)	9.5×10^8 (9)
Fe^{2+}		2×10^5 (2)	$>1.7\times10^9$			8×10^6 (<0)			1×10^9			1.4×10^7 (1)	3.6×10^6 (1)	3.6×10^6		
$Fe(CN)_6^{4-}$	2.7×10^8 (12)		4×10^9 (7)		4×10^6 (7)			$<10^6$ (7)					2.8×10^7 (7)		7.4×10^7 (9)	1.9×10^9
H_2O_2	8×10^5 (9)	7×10^{-3} (6)	$<5\times10^6$				2.7×10^7 (9)		1.2×10^7 (7)			1.4×10^5 (1)	$<10^3$ (7)			
Formate	1.1×10^5 (6)	1×10^2 (>5)					2.2×10^7 (12)		1.7×10^8 (7)		$<2\times10^3$ (7)	1.9×10^6 (7)	$<10^3$ (7)		$<10^{-2}$ (7)	
2-Propanol	$\sim4\times10^4$ (12)	3 (2-7)		$<10^4$ (11)		2.4×10^6 (<0)	1.8×10^7 (12)	$<10^3$	3.2×10^7 (7)			1.5×10^5 (1)				
Phenol	2×10^7 (7)	1.3×10^3 (2-6)	5×10^7 (6)								$\sim1\times10^7$ (8)	$\sim4\times10^8$ (1)	6×10^6 (6)		0.2 (<7)	$\sim3\times10^5$ (7)
Phenoxide	3.5×10^8 (12)	1.4×10^9 (>11)	4.3×10^9 (12)	3×10^6 (12)	8.5×10^6 (12)		5.9×10^8 (12)	6×10^5 (11)		8×10^4 (11)	3.4×10^8 (12)		5×10^8 (10)	5.7×10^7 (12)	2.7×10^7 (>11)	2.6×10^9 (12)
4-Methoxy-phenoxide	5.2×10^8 (12)		4.2×10^9 (12)	9×10^6 (11)	1.4×10^8 (12)		8.2×10^8 (11)	1.1×10^8 (12)		1.3×10^8 (12)					7.4×10^8 (12)	
4-Methyl-phenoxide	4.8×10^8 (12)			4×10^6 (11)	3×10^7 (12)			NR (12)			5.5×10^8 (12)		3.7×10^8 (12)	1×10^8 (12)	2.6×10^8 (12)	
Hydroquinone		1.5×10^6 (3)	4.5×10^9 (12)	2×10^8 (11)	1.1×10^9 (12)			1.2×10^8 (11)		2×10^7 (9.5)		1.5×10^9 (1-9)	7×10^7 (7)		9×10^8 (>12)	2.7×10^8 (7)
Aniline	5.4×10^8 (7)	9×10^7 (>6)	4×10^9 (6-12)	$<10^5$ (11)				$<10^6$ (13)		3×10^6 (13)	1×10^8 (10)		2.1×10^8 (6-11)	4.4×10^6 (10)	4.5×10^5 (7)	
Ascorbate	1.1×10^9 (11)	6×10^7 (5)	3×10^9 (7)	7.3×10^8 (11)	2×10^7 (7)			9×10^6 (5-10)		8×10^7 (7)	5×10^8 (7)	6×10^8 (2)	$\sim1\times10^9$ (7)	3.1×10^8 (10)		
Tyrosine	2×10^8 (11)		3.5×10^9 (12)						3×10^9 (7)		3.2×10^8 (11)	2.7×10^8 (2)	5×10^8 (13)	$<10^6$ (7)		
Tryptophan	4.4×10^8 (12)	7×10^6 (3-7)	4×10^9 (6-12)					8×10^4 (3)	2.3×10^9 (7)		4.6×10^8 (11)	2.6×10^9 (2)	7×10^8 (7-10)	$\sim1.4\times10^7$ (12)		
Histidine	8×10^6 (11)	2.1×10^5 (>7)	2×10^7 (11)						2.5×10^9 (7)		$<10^6$ (7-13)	1.4×10^7 (2)	1.9×10^7 (9)	$<10^6$ (7)		
Methionine	3×10^7 (7)	4×10^6 (3-7)	$<10^6$ (7)						1.1×10^9 (7)		3×10^8 (>9)	4×10^9 (1)	2×10^9 (11)	$<10^7$ (11)		
Cysteine	3×10^8 (11)	4×10^4 (3)	3×10^9 (11)		3×10^8 (9)						$\sim9\times10^8$ (12)	8.5×10^8 (2)	$\sim1.6\times10^9$ (11)	$\sim1.1\times10^9$ (11)	$\sim1\times10^3$ (3)	

TABLE 2. Comparison of the reactivities, k (L mol^{-1} s^{-1}), of reducing radicals with inorganic and organic compounds at the pH specified in parenthesis

	$CO_2^{\cdot -}$	$SO_2^{\cdot -}$	$\cdot PO_3^{2-}$	$O_2^{\cdot -}$
O_2	3×10^9 (7)	2×10^9 (7)	1.1×10^9 (9)	
$Fe(CN)_6^{3-}$	7×10^8 (6,11)	2×10^8 (7)		2.7×10^2 (9)
$MnTMpyP^{5+}$	5×10^9 (7)	2×10^7 (7)		4×10^7 (8)
Nitro Blue Tetrazolium	6.4×10^9 (10)	1.4×10^8 (9)		5.9×10^4 (7-11)
Tetranitro-methane	4×10^9 (3-7)		1.6×10^9 (9)	1.9×10^9 (6)
Benzoquinone	7×10^9 (7)			8×10^9 (7)
Duroquinone		1.4×10^9 (1)		1×10^7 (7)
Benzyl viologen	$\sim 1 \times 10^{10}$ (7)	9×10^7 (8)		
Methyl viologen	$\sim 1 \times 10^{10}$ (7)	9×10^6 (7-9)		(1×10^4)
Lipoate ion	5.6×10^8 (6-9)		4×10^8 (12)	

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution

No. Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1 Carbon dioxide radical anion						
$\cdot CO_2^- + \cdot CO_2^- \rightarrow$	6.5×10^8	7	0.1	p.r.	D.k. at 235 nm, $\epsilon = 3000$ L mol^{-1} cm^{-1}, in 0.1 mol L^{-1} formate soln.	86A327
	5.0×10^8	7	0.16	p.r.	D.k. at 280 nm in N_2O-satd. soln. contg. 2×10^{-3} mol L^{-1} phosphate-0.16 mol L^{-1} formate buffer; $\epsilon = 1200$ L mol^{-1} cm^{-1}.	86A394
	5.0×10^8	7.0	0.16	p.r.	D.k. at 285 nm using $\epsilon = 1000$ L mol^{-1} cm^{-1}.	84A153
	3.8×10^8	2.7-13	→0	p.r.	D.k. at 250 nm in N_2O-satd. 0.1 mol L^{-1} formate soln.; $\epsilon = 2050$ L mol^{-1} cm^{-1} (1100 at pH 0); k cor. to $I = 0$; pK_a ($\cdot CO_2H$) = 1.4; at pH 0 $k = 8.5 \times 10^8$.	730085
	4.5×10^8	2.8-7		p.r.	D.k. in CO-satd. soln. at 260 nm ($\epsilon = 2200$ L mol^{-1} cm^{-1}) as well as condy. change; same result in N_2O-satd. formate soln.	700303
	7.5×10^8	3.1,9	0.5	p.r.	D.k. at 255 nm in N_2O-satd. soln. contg. formate, as well as in CO_2-satd. soln. contg. formate; $\epsilon_{max} = 3000$ L mol^{-1} cm^{-1} at 235 nm; at pH 13 $k = 8.5 \times 10^8$.	690446
	5×10^8	5	→0	p.r.	D.k. at 250 nm in CO_2satd. soln. contg. 10^{-2} mol L^{-1} formate; $\epsilon = 2250$ L mol^{-1} cm^{-1}.	650384
2 Silver(I) ion						
$\cdot CO_2^- + Ag^+ \rightarrow AgCO_2$		nat		p.r.	Ag^+ was reduced in 10^{-2} mol L^{-1} formate soln. contg. CO_2 by a complex mechanism.	78A410
3 Bicarbonate ion						
$\cdot CO_2^- + HCO_3^- \rightarrow CO_3^{\cdot -} + HCO_2^-$	2×10^3			γ-r.	Computer fitting using initial yields of oxalate and formate, as well as transient absorbance, in O_2-free soln. contg. 0.5-1 mol L^{-1} ammonium bicarbonate; complex mechanism	86A502
4 Carbonate radical ion						
$\cdot CO_2^- + CO_3^{\cdot -} \rightarrow CO_2 + CO_3^{2-}$	5×10^7			γ-r.	Computer fitting using initial yields of oxalate and formate, as well as transient absorbance, in O_2-free soln. contg. 0.5-1 mol L^{-1} ammonium bicarbonate; complex mechanism	86A502
5 Cadmium(II) ion						
$\cdot CO_2^- + Cd^{2+} \rightarrow Cd^+ + CO_2$	$\sim 1 \times 10^5$			p.r.	Est. from increase in Cd^+ in 0.1 mol L^{-1} Cd^{2+} soln. contg. 0.1 mol L^{-1} HCO_2^-, CO_2-satd.	751027
	5.1×10^6	nat		p.r.	No details given.	751153
6 Cobalt(II) ion						
$\cdot CO_2^- + Co^{2+} \rightarrow CO_2 + Co^+$	$10^2 < k < 10^5$	nat		p.r.	Est. from lack of increase in Co^+ in 0.1 mol L^{-1} Co^{2+} soln. upon addn. of 0.1 mol L^{-1} formate, as well as γ-r. expts. [730039].	751027
7 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecobalt(II) ion						
$\cdot CO_2^- + Co(4,11\text{-dieneN}_4)^{2+} \rightarrow$	$<1 \times 10^7$	6.5		p.r.	No reaction obs. in soln. contg. 0.1 mol L^{-1} formate.	761001

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
8	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,14-dienecobalt(II) ion**						
	$\cdot CO_2^- + Co(4,14\text{-dieneN}_4)^{2+} \rightarrow$	$<1 \times 10^7$	6.5		p.r.	No reaction in 0.1 mol L^{-1} formate.	761001
9	**2,3,9,10-Tetramethyl-1,4,8,11-tetraazacyclotetradeca-1,3,8,10-tetraenecobalt(II) ion**						
	$\cdot CO_2^- + Co(\text{tetraeneN}_4)^{2+} \rightarrow CO_2 + Co(\text{tetraeneN}_4)^+$	4.7×10^9	6.5	0.1	p.r.	P.b.k. in 0.1 mol L^{-1} formate.	761001
10	**2,2'-Bipyridinecobalt(II) ion**						
	$\cdot CO_2^- + Co(bpy)^{2+} \rightarrow Co(bpy)CO_2^+$	6.0×10^6		0.2	p.r.	P.b.k.; total k for radical consumption.	85A034
11	**4,4'-Dimethyl-2,2'-bipyridinecobalt(II) ion**						
	$\cdot CO_2^- + Co(dmb)^{2+} \rightarrow Co(dmb)CO_2^+$	1.1×10^7		0.5	p.r.	P.b.k.; total k for radical consumption.	85A034
12	**Bis(2,2'-bipyridine)cobalt(II) ion**						
	$\cdot CO_2^- + Co(bpy)_2^{2+} \rightarrow Co(bpy)_2CO_2^+$	1.6×10^7		0.2	p.r.	P.b.k.; total k for radical consumption; 70% addn., also electron transfer.	85A034
13	**Bis(4,4'-dimethyl-2,2'-bispyridine)cobalt(II) ion**						
	$\cdot CO_2^- + Co(dmb)_2^{2+} \rightarrow Co(dmb)_2CO_2^+$	1.1×10^7		0.5	p.r.	P.b.k.; total k for radical consumption.	85A034
14	**Tris(2,2'-bipyridine)cobalt(II) ion**						
	$\cdot CO_2^- + Co(bpy)_3^{2+} \rightarrow CO_2 + Co(bpy)_3^+$	3.5×10^7		0.2	p.r.	P.b.k.; total k for radical consumption; also 10% addn.	85A034
15	**Tris(4,4'-dimethyl-2,2'-bispyridine)cobalt(II) ion**						
	$\cdot CO_2^- + Co(dmb)_3^{2+} \rightarrow CO_2 + Co(dmb)_3^+$	1.7×10^7		0.5	p.r.	P.b.k.: total k for radical consumption; also 40% addn.	85A034
16	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatocobaltate(II) ion**						
	$\cdot CO_2^- + CoTPPS^{4-} \rightarrow CO_2 + CoTPPS^{5-}$	1.7×10^8 2.6×10^8	8 13		p.r.	D.k. in N_2O-satd. soln. contg. formate.	83A088
17	**3,10,17,24-Tetrasulfophthalocyaninecobalt(II) ion**						
	$\cdot CO_2^- + Co(tspc)^{4-} \rightarrow CO_2 + Co(tspc)^{5-}$	1.5×10^8	3-11	0.1	p.r.	P.b.k. at 460 nm in N_2O-satd. soln. contg. (1-5) $\times 10^{-5}$ mol L^{-1} $Co(pts)^{4-}$ and 0.1 mol L^{-1} Na formate (substrate present as dimer).	83A238
		2.7×10^8			p.r.	P.b.k. at 450 nm in N_2O-satd. soln. contg. formate (substrate present as dimer).	82A433
18	**Nitrilotriacetatocobaltate(II) ion**						
	$\cdot CO_2^- + CoNTA^- \rightarrow [NTACo(CO_2)]^{2-}$	7.3×10^7	7	0.2	p.r.	P.b.k. at 270 nm in N_2O-satd. soln. contg. 0.2 mol L^{-1} formate.	79A255
19	**Cobal(II)amin**						
	$\cdot CO_2^- + B12r \rightarrow CO_2 + B12s$	8.2×10^8	9.2	0.1	p.r.	D.k. at 311 and 478 nm as well as p.b.k. at 386 and 280 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	741105
20	**Hexaamminecobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_6^{3+} \rightarrow CO_2 + Co(NH_3)_6^{2+}$	1.1×10^8	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^- +$ PNBPA).	731075
		4.0×10^7	4.8		p.r.	D.k. in N_2O-satd. soln. contg. 0.01 mol L^{-1} formate.	72A018

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution — Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
21	**Pentaammine(aqua)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5H_2O^{3+} \rightarrow CO_2 + Co(NH_3)_5H_2O^{2+}$	1.7×10^8	5.2		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
22	**Pentaammine(hydroxy)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5OH^{2+} \rightarrow$	$<3 \times 10^7$	7.8		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate;; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
23	**Pentaammine(pyridine)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5py^{3+} \rightarrow CO_2 + Co(NH_3)_5py^{2+}$	3.3×10^8	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
24	**Tris(2,2'-bipyridine)cobalt(III) ion**						
	$\cdot CO_2^- + Co(bpy)_3^{3+} \rightarrow CO_2 + Co(bpy)_3^{2+}$	7.8×10^9	6.9	0.1	p.r.	P.b.k. at 330 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	79A034
		7.6×10^9	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
25	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecobalt(III) ion**						
	$\cdot CO_2^- + Co(4,11\text{-diene}N_4)^{3+} \rightarrow CO_2 + Co(4,11\text{-diene}N_4)^{2+}$	8.1×10^8	2.5		p.r.	P.b.k.	761203
26	**2,3,9,10-Tetramethyl-1,4,8,11-tetraazacyclotetradeca-1,3,8,10-tetraenecobalt(III) ion**						
	$\cdot CO_2^- + Co(\text{tetraene}N_4)^{3+} \rightarrow CO_2 + Co(\text{tetraene}N_4)^{2+}$	6.4×10^9	2.5		p.r.	P.b.k.	761203
27	**Dichloro(5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene)cobalt(III) ion**						
	$\cdot CO_2^- + Co(4,11\text{-diene}N_4)Cl_2^+ \rightarrow CO_2 + Co(4,11\text{-diene}N_4)Cl_2$	1.1×10^9	2.5		p.r.	P.b.k.	761203
28	**Pentaammine(chloro)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5Cl^{2+} \rightarrow CO_2 + Co(NH_3)_5Cl^+$	1.5×10^8	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
29	**Pentaammine(nitrito-*N*)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5NO_2^{2+} \rightarrow$	$<2 \times 10^7$	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
30	**Pentaammine(nitrato-*O*)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5NO_3^{2+} \rightarrow CO_2 + Co(NH_3)_5NO_3^+$	2.1×10^8	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
31	**(Acetato)pentaamminecobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5O_2CCH_3^{2+} \rightarrow CO_2 + Co(NH_3)_5O_2CCH_3^+$	1.1×10^8	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
32	**Pentaammine(phenylacetato)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5O_2CCH_2C_6H_5^{2+} \rightarrow CO_2 + Co(NH_3)_5O_2CCH_2C_6H_5^+$	7.0×10^7	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
33	**Pentaammine(benzoato)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5O_2CC_6H_5^{2+} \rightarrow CO_2 + Co(NH_3)_5O_2CC_6H_5^+$	4.5×10^7	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
34	**Pentaammine(4-cyanobenzoato)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5O_2CC_6H_4CN^{2+} \rightarrow CO_2 + Co(NH_3)_5O_2CC_6H_4CN^+$	4.6×10^7	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
35	**Pentaammine(2-nitrobenzoato)cobalt(III) ion**						
	$\cdot CO_2^- + O_2NC_6H_4CO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CO_2Co(NH_3)_5^+$	2.0×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 × 10^{-5} mol L^{-1} complex.	86A340 771027
36	**Pentaammine(3-nitrobenzoato)cobalt(III) ion**						
	$\cdot CO_2^- + O_2NC_6H_4CO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CO_2Co(NH_3)_5^+$	1.5×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 × 10^{-5} mol L^{-1} complex.	86A340 771027
37	**Pentaammine(4-nitrobenzoato)cobalt(III) ion (PNBPA)**						
	$\cdot CO_2^- + O_2NC_6H_4CO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CO_2Co(NH_3)_5^+$	1.9×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 × 10^{-5} mol L^{-1} complex.	86A340 771027 720340
38	**Pentaammine(2,4-dinitrobenzoato)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5O_2CC_6H_3(NO_2)_2^{2+} \rightarrow CO_2 + Co(NH_3)_5O_2CC_6H_3(NO_2)_2^+$	7.5×10^9	7.0		p.r.	P.b.k. in N_2O-satd. soln. contg. formate and 1-3 × 10^{-4} mol L^{-1} complex.	771027
39	**Pentaammine(3,5-dinitrobenzoato)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5O_2CC_6H_3(NO_2)_2^{2+} \rightarrow CO_2 + Co(NH_3)_5O_2CC_6H_3(NO_2)_2^+$	8.1×10^9	7.0		p.r.	P.b.k. in N_2O-satd. soln. contg. formate and 1-3 × 10^{-4} mol L^{-1} complex.	771027
40	**Pentaammine(2-nitrophenylacetato)cobalt(III) ion**						
	$\cdot CO_2^- + O_2NC_6H_4CH_2CO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CH_2CO_2Co(NH_3)_5^+$	1.3×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 × 10^{-5} mol L^{-1} complex.	86A340
41	**Pentaammine(3-nitrophenylacetato)cobalt(III) ion**						
	$\cdot CO_2^- + O_2NC_6H_4CH_2CO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CH_2CO_2Co(NH_3)_5^+$	1.5×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 × 10^{-5} mol L^{-1} complex.	86A340
42	**Pentaammine(4-nitrophenylacetato)cobalt(III) ion**						
	$\cdot CO_2^- + O_2NC_6H_4CH_2CO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CH_2CO_2Co(NH_3)_5^+$	1.4×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 × 10^{-5} mol L^{-1} complex.	86A340
		1.2×10^9	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
43	**Pentaammine(2,4-dinitrophenylacetato)cobalt(III) ion**						
	$\cdot CO_2^- + (O_2N)_2C_6H_3CH_2CO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + (O_2N)_2C_6H_3CH_2CO_2Co(NH_3)_5^+$	3.9×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 × 10^{-5} mol L^{-1} complex.	86A340
44	**Pentaammine(2-nitrocinnamato)cobalt(III) ion**						
	$\cdot CO_2^- + O_2NC_6H_4CH{=}CHCO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CH{=}CHCO_2Co(NH_3)_5^+$	1.9×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 × 10^{-5} mol L^{-1} complex.	86A340

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref
45	**Pentaammine(3-nitrocinnamato)cobalt(III) ion**						
	$\cdot CO_2^- + O_2NC_6H_4CH{=}CHCO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CH{=}CHCO_2Co(NH_3)_5^+$	1.2×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 $\times$ 10^{-5} mol L^{-1} complex.	86A340
46	**Pentaammine(4-nitrocinnamato)cobalt(III) ion**						
	$\cdot CO_2^- + O_2NC_6H_4CH{=}CHCO_2Co(NH_3)_5^{2+} \rightarrow CO_2 + O_2NC_6H_4CH{=}CHCO_2Co(NH_3)_5^+$	1.4×10^9	7	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2-10 $\times$ 10^{-5} mol L^{-1} complex.	86A340
47	**Pentaammine(pyridinecarboxylato-*O*)cobalt(III) ion**						
	$\cdot CO_2^- + Co(NH_3)_5O_2CC_5H_4N^{2+} \rightarrow CO_2 + Co(NH_3)_5O_2CC_5H_4N^+$	5.1×10^7	6.9		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + PNBPA).	731075
48	**Bis(ethylenediamine)pyrazinecarboxylatocobalt(III) ion**						
	$\cdot CO_2^- + Co(en)_2O_2CC_4H_3N_2^{2+} \rightarrow CO_2 + Co(en)_2O_2CC_4H_3N_2^+$	3×10^9	5.5	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate and (0.5-5) $\times$ 10^{-4} mol L^{-1} complex.	82A146
49	**Hexaammine-μ-(acetato)bis(μ-hydroxy)dicobalt(III)] ion**						
	$\cdot CO_2^- + CH_3CO_2[Co(NH_3)_3]_2(OH)_2^{3+} \rightarrow CO_2 + CH_3CO_2[Co(NH_3)_3]_2(OH)_2^+$	5.8×10^7			p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	83A140
50	**Hexaammine-μ-(fluoroacetato)bis(μ-hydroxy)dicobalt(III)] ion**						
	$\cdot CO_2^- + CH_2FCO_2[Co(NH_3)_3]_2(OH)_2^{3+} \rightarrow CO_2 + CH_2FCO_2[Co(NH_3)_3]_2(OH)_2^{2+}$	1.1×10^8			p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	83A140
51	**Hexaammine-μ-(difluoroacetato)bis(μ-hydroxy)dicobalt(III)] ion**						
	$\cdot CO_2^- + CHF_2CO_2[Co(NH_3)_3]_2(OH)_2^{3+} \rightarrow CO_2 + CHF_2CO_2[Co(NH_3)_3]_2(OH)_2^{2+}$	2.4×10^8			p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	83A140
52	**Hexaammine-μ-(trifluoroacetato)bis(μ-hydroxy)dicobalt(III)] ion**						
	$\cdot CO_2^- + CF_3CO_2[Co(NH_3)_3]_2(OH)_2^{3+} \rightarrow CO_2 + CF_3CO_2[Co(NH_3)_3]_2(OH)_2^{2+}$	3.5×10^8			p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	83A140
53	**Octaammine-μ-amido-μ-superoxidodicobalt(III) ion**						
	$\cdot CO_2^- + O_2[Co(NH_3)_4]_2NH_2^{4+} \rightarrow CO_2 + O_2[Co(NH_3)_4]_2NH_2^{3+}$	5.4×10^9	~5	0.1	p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	81A009
54	**Tetrakis(ethylenediamine)-μ-amido-μ-superoxidodicobalt(III) ion**						
	$\cdot CO_2^- + O_2[Co(en)_2]_2NH_2^{4+} \rightarrow CO_2 + O_2[Co(en)_2]_2NH_2^{3+}$	5.7×10^9	~5	0.1	p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	81A009
55	**Decakis(cyano)-μ-superoxidodicobaltate(III) ion**						
	$\cdot CO_2^- + O_2[Co(CN)_5]_2^{5-} \rightarrow CO_2 + O_2[Co(CN)_5]_2^{6-}$	1.7×10^7	~5	0.1	p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	81A009
56	**Cyanocob(III)alamin**						
	$\cdot CO_2^- + B12 \rightarrow$	$<1 \times 10^7$			p.r.	No change in o.d. in N_2O or CO_2-satd. soln. contg. 0.1 mol L^{-1} formate, or CO_2-satd. soln. contg. 0.1 mol L^{-1} *tert*-BuOH.	741105

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
57	**Hydroxocob(III)alamin**						
	$\cdot CO_2^- + B12a \rightarrow CO_2 + B12r$	1.5×10^9	9.2		p.r.	D.k. at 350 nm as well as p.b.k. at 310 nm in CO_2-satd. soln. contg. *tert*-BuOH.	741105
58	**Chromium(II)**						
	$\cdot CO_2^- + Cr(II) \rightarrow Cr^{III}CO_2^-$	1.1×10^9	1.4		p.r.	D.k. in soln. contg. 1 mol L^{-1} formic acid; product spectrum similar to products containing C-Cr bonds [741146].	731057
59	**Chromium(III) ion**						
	$\cdot CO_2^- + Cr(III) \rightarrow$		1.4		p.r.	No reaction obs. in soln. contg. 1 mol L^{-1} formic acid.	731057
60	**Copper(II) ion**						
	$\cdot CO_2^- + Cu^{2+} \rightarrow CO_2 + Cu^+$	1.5×10^8	6.8	0.1	p.r.	D.k. at 260 nm in N_2O-satd. formate (0.1 mol L^{-1}) soln.	78A176
61	**1,4,8,11-Tetraazacyclotetradecanecopper(II) ion**						
	$\cdot CO_2^- + Cu(cyclam)^{2+} \rightarrow CO_2 + Cu(cyclam)^+$	3×10^9			p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate and (2-30) $\times$ 10^{-5} mol L^{-1} $CuL(ClO_4)_2$.	82A320
62	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanecopper(II) ion**						
	$\cdot CO_2^- + Cu(aneN_4)^{2+} \rightarrow CO_2 + Cu(aneN_4)^+$	2.5×10^9			p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate and (2-30) $\times$ 10^{-5} mol L^{-1} $CuL(ClO_4)_2$.	82A320
63	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecopper(II) ion**						
	$\cdot CO_2^- + Cu(4,11\text{-}dieneN_4)^{2+} \rightarrow CO_2 + Cu(4,11\text{-}dieneN_4)^+$	2.3×10^9	7		p.r.	P.b.k. at 410 nm.	761039
64	**2,2,4,11,13-Hexamethyl-1,5,10,14-tetraazacyclooctadeca-4,13-dienecopper(II) ion**						
	$\cdot CO_2^- + Cu(4,13\text{-}dieneN_4)^{2+} \rightarrow CO_2 + Cu(4,13\text{-}dieneN_4)^+$	5.0×10^7			p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate and (2-30) $\times$ 10^{-5} mol L^{-1} $CuL(ClO_4)_2$.	82A320
65	**Glycylglycylglycinatocopper(II) complex**						
	$\cdot CO_2^- + Cu(Gly_3)^- \rightarrow CO_2 + Cu(Gly_3)^{2-}$	2.8×10^8	9.1		p.r.	D.k. at 550 nm (Cu^{II}) in N_2O-satd. formate (10^{-2} mol L^{-1}) soln. contg. Cu(II) and gly_3 in 1:5, 1:3 and 1:2 ratio.	761016
66	**Copper(II) tetraglycine**						
	$\cdot CO_2^- + Cu(Gly_4)^{2-} \rightarrow CO_2 + Cu(Gly_4)^{3-}$	6.5×10^8	7.3-10	1.0	p.r.	P.b.k. in soln. contg. 1 mol L^{-1} formate ion.	80A304
67	**Histidinecopper(II) complex**						
	$\cdot CO_2^- + Cu(His)_2 \rightarrow CO_2 + Cu(His)_2^-$	4.1×10^8	11		p.r.	D.k. at 600 nm (Cu^{II}) in N_2O-satd. soln. contg. formate.	771138
68	**Glycylhistidinecopper(II) complex**						
	$\cdot CO_2^- + Cu(GlyHis) \rightarrow CO_2 + Cu(GlyHis)^-$	4.5×10^8 1.6×10^7	6.6 11		p.r.	D.k. at 565 nm (Cu^{II}) in N_2O-satd. soln. contg. formate.	771138
69	**β-Alanylhistidinecopper(II) complex**						
	$\cdot CO_2^- + Cu(\beta\text{-}AlaHis) \rightarrow CO_2 + Cu(\beta\text{-}AlaHis)^-$	3.5×10^8	7.5-11		p.r.	D.k. at 600 nm (Cu^{II}) in N_2O-satd. soln. contg. formate.	771138
70	**Glutathionecopper(II), oxidized**						
	$\cdot CO_2^- + Cu^{II}(GSSG)_n \rightarrow CO_2 + Cu^{I}(GSSG)_n$	1.0×10^8	11		p.r.	D.k. at 595 nm (Cu^{II}) in N_2O-satd. soln. contg. formate ion; 10% of the $\cdot CO_2^-$ reacted with the disulfide $\rightarrow$ $GSSG^-$ (p.b.k. at 410 nm).	761016

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
71	**Bleomycin-copper(II) complex**						
	$\cdot CO_2^- + BLM\text{-}Cu(II) \rightarrow CO_2 + BLM\text{-}Cu(I)$	6.7×10^8	7		p.r.	P.b.k. at 365 nm in N_2O-satd. soln. contg. 2×10^{-2} mol L^{-1} formate and 2×10^{-4} mol L^{-1} bleomycin-copper complex; intermediate suggested to be $BLM\text{-}CuCO_2^+$.	87A184
72	**3,10,17,24-Tetrasulfophthalocyaninecopper(II) ion**						
	$\cdot CO_2^- + Cu(tspc)^{4-} \rightarrow CO_2 + Cu(tspc)^{5-}$	1.9×10^8			p.r.	P.b.k. at 550 nm in N_2O-satd. soln. contg. formate, substrate present as dimer.	82A433
73	**Europium(III) ion**						
	$\cdot CO_2^- + Eu(III) \rightarrow CO_2 + Eu(II)$	$>7 \times 10^6$	1.4		p.r.	Estd. from p.b.k. at 250 nm (Eu^{II}).	731057
74	**Iron(II) protoporphyrin**						
	$\cdot CO_2^- + PFe^{II} \rightarrow CO_2 + PFe^{I}$	8×10^7	10	0.1	p.r.	Pseudo-first-order reaction obs. in N_2O-satd. soln. contg. (2-10) $\times 10^{-5}$ mol L^{-1} substrate and 0.1 mol L^{-1} formate ion.	85A006
75	**Ferricyanide ion**						
	$\cdot CO_2^- + Fe(CN)_6^{3-} \rightarrow CO_2 + Fe(CN)_6^{4-}$	7.0×10^8	6.0, 11	0.1	p.r.	D.k. at 420 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	83A091
		1.1×10^9	7	0.3	p.r.	D.k. at 410 nm in soln. contg. 0.3 mol L^{-1} formate ion; ionic strength effects reported.	690522
76	**Pentacyano(nitrosyl)ferrate(III) ion**						
	$\cdot CO_2^- + Fe(CN)_5NO^{2-} \rightarrow CO_2 + Fe(CN)_5NO^{3-}$	4.0×10^8	7	0.1	p.r.	P.b.k. in N_2O-satd. 0.1 mol L^{-1} formate soln.	771120
		3.7×10^8	7	0.02	p.r.	P.b.k. at 450 nm in N_2O-satd. 2×10^{-2} mol L^{-1} formate soln.	690052
77	**Ethylenediaminetetraacetatoferrate(III) ion**						
	$\cdot CO_2^- + FeEDTA^- \rightarrow CO_2 + FeEDTA^{2-}$	5×10^7	3.8-10		p.r.	D.k. at 300 and 325 nm in O_2-satd. soln. contg. formate ion.	771088
77a	**Ethylenediaminebis[2-(2-hydroxyphenyl)acetato]iron(III) ion**						
	$\cdot CO_2^- + FeEHPG^+ \rightarrow CO_2 + FeEHPG$	7.3×10^6	7.0		p.r.	D.k. at 475 nm in N_2O-satd. soln. contg. formate ion.	87A281
78	**5,10,15,20-Tetrakis[4-(*N,N,N*-trimethylammonio)pheny]lporphinatoiron(III) ion**						
	$\cdot CO_2^- + FeTAPP^{5+} \rightarrow CO_2 + FeTAPP^{4+}$	3.7×10^9	11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	84A426
79	**5,10,15,20-Tetrakis-4-(*N*-methylpyridyl)porphinatoiron(III) ion**						
	$\cdot CO_2^- + FeTMpyP^{5+} \rightarrow CO_2 + FeTMpyP^{4+}$	4.0×10^9	11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	84A426
		1.3×10^{10}	8		p.r.	D.k. in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} formate ion.	86A118
		7.5×10^9	5.6-8.3	0.1	p.r.	D.k. at 420 as well as p.b.k. at 445 and 560 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} HCO_2^-.	82A119
		7.1×10^9	7.8	0.05	p.r.	P.b.k. at 580 nm as well as d.k. at 350 nm in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} formate.	81A207
80	**5,10,15,20-Tetrakis-4-(*N*-methylpyridyl)porphinatoiron(III) ion dicyano complex**						
	$\cdot CO_2^- + FeTMpyP(CN)_2^{3+} \rightarrow CO_2 + FeTMpyP(CN)_2^{2+}$	5×10^9	10.1	0.1	p.r.	D.k. at 435 as well as p.b.k. at 470 nm in soln. contg. 2.0×10^{-3} mol L^{-1} KCN and 1-5 $\times 10^{-5}$ mol L^{-1} Fe^{III} complex.	82A119

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
81	**5,10,15,20-Tetrakis-4-(*N*-methylpyridyl)porphinatoiron(III)-diimidazole complex**						
	$\cdot CO_2^- + FeTMpyP(Im)_2^{5+} \rightarrow CO_2 + FeTMpyP(Im)_2^{4+}$	6×10^8	9.1	0.5	p.r.	P.b.k. at 450 nm in N_2O-satd. soln. contg. 0.5 mol L^{-1} formate and 2×10^{-2} mol L^{-1} imidazole.	82A119
82	**5,10,15,20-Tetrakis-4-(*N*-methylpyridyl)porphinatoiron(III)-dihistidine complex**						
	$\cdot CO_2^- + FeTMpyP(His)_2^{5+} \rightarrow CO_2 + FeTMpyP(His)_2^{4+}$	2×10^8	8.0	0.5	p.r.	P.b.k.	82A119
83	**$\alpha,\alpha,\alpha,\beta$-Tetrakis(*N*-methylisonicotinamidophenyl)porphinatoiron(III) ion**						
	$\cdot CO_2^- + FePFP^{5+} \rightarrow CO_2 + FePFP^{4+}$	5.9×10^9	6-8	0.1	p.r.	D.k. at 420 nm (Fe^{III}) as well as p.b.k. at 440 nm (Fe^{II}) in soln. contg. (5-50) $\times 10^{-6}$ mol L^{-1} Fe^{III} and 0.1 mol L^{-1} formate.	86A154
84	**$\alpha,\alpha,\alpha,\beta$-Tetrakis(*N*-methylisonicotinamidophenyl)porphinatoiron(III) ion dicyano complex**						
	$\cdot CO_2^- + FePFP(CN)_2^{3+} \rightarrow CO_2 + FePFP(CN)_2^{2+}$	3.9×10^9	10.2		p.r.	D.k. at 420 nm (Fe^{III}) as well as p.b.k. at 440 nm (Fe^{II}) in soln. contg. (10-50) $\times 10^{-6}$ mol L^{-1} Fe^{III}, 10^{-3} mol L^{-1} carbonate, 5×10^{-4} mol L^{-1} KCN and 0.1 mol L^{-1} formate.	86A154
85	**$\alpha,\alpha,\alpha,\beta$-Tetrakis(*N*-methylisonicotinamidophenyl)porphinatoiron(III) ion diimidazole complex**						
	$\cdot CO_2^- + FePFP(1\text{-}MeIm)_2^{5+} \rightarrow CO_2 + FePFP(1\text{-}MeIm)_2^{4+}$	3.1×10^9	6-8	0.1	p.r.	P.b.k. at 434 nm (Fe^{II}) in N_2O-satd. soln. contg. (5-50) $\times 10^{-6}$ mol L^{-1} Fe^{III}, 0.1 mol L^{-1} formate and 3.4×10^{-2} mol L^{-1} ligand (pK_a 1-MeIm = 7.0).	86A154
86	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatoferrate(III) ion**						
	$\cdot CO_2^- + FeTPPS^{3-} \rightarrow CO_2 + FeTPPS^{4-}$	1.8×10^9	5		p.r.	D.k. in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} formate ion.	86A118
		1.5×10^9	11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	84A426
87	**5,10,15,20-tetrakis(4-sulfonatophenyl)porphinatoferrate(III) μ-oxo-dimer**						
	$\cdot CO_2^- + (TPPS)Fe\text{-}O\text{-}Fe(TPPS)^{8-} \rightarrow (TPPS)Fe^{III}\text{-}O\text{-}Fe^{II}(TPPS)^{9-}$	$\sim 2 \times 10^9$	9		p.r.	D.k. in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} formate ion.	86A118
88	**3,10,17,24-Tetrasulfophthalocyanineiron(III) ion**						
	$\cdot CO_2^- + Fe(tspc)^{3-} \rightarrow CO_2 + Fe(tspc)^{4-}$	3.4×10^8			p.r.	P.b.k. at 500-520 nm in N_2O-satd. soln. contg. formate, substrate present as dimer.	82A433
89	**Hemin c**						
	$\cdot CO_2^- + Hem\text{-}Fe^{III} \rightarrow CO_2 + Hem\text{-}Fe^{II}$	1.3×10^9	7.0		p.r.	P.b.k. in N_2O-satd. soln. contg. 0.02 mol L^{-1} formate.	75A241
89a	**Ferrate(VI) ion**						
	$\cdot CO_2^- + FeO_4^{2-} \rightarrow CO_2 + FeO_4^{3-}$	3.5×10^8	9.5-10.5		p.r.	D.k. at 510 nm in N_2O-satd. soln. contg. 0.02 mol L^{-1} formate, 4×10^{-5} mol L^{-1} diethylenetriaminepentaacetate ion; same results at pH 12.3.	87A381
90	**Mercury(II) iodide**						
	$\cdot CO_2^- + HgI_2 \rightarrow CO_2 + Hg(I)$	3.0×10^9			p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	78A165
91	**Mercury(II) cyanide**						
	$\cdot CO_2^- + Hg(CN)_2 \rightarrow CO_2 + Hg(I)$	3.4×10^9			p.r.	P.b.k. at 285 nm in N_2O-satd. soln. contg. 0.01 mol L^{-1} formate.	751203

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
92	**Iodine**						
	$\cdot CO_2^- + I_2 \rightarrow I_2^{\cdot -} + CO_2$	7×10^9			p.r.	P.b.k. in N_2O-satd. 10^{-2} mol L^{-1} formate soln. contg. 1.5×10^{-4} mol L^{-1} I_2 and 10^{-4} mol L^{-1} I^-.	86A070
93	**Hypoiodous acid**						
	$\cdot CO_2^- + HOI \rightarrow HOI^- + CO_2$	5.7×10^8	9		p.r.	P.b.k. ($HOI^- \rightarrow OH^- + I\cdot \rightarrow I_2^-$) in soln. contg. formate ion, I^-, and 10^{-2} mol L^{-1} borax buffer.	86A901
94	**Iodate ion**						
	$\cdot CO_2^- + IO_3^- \rightarrow CO_2 + HIO_3^-$	1.3×10^8		0.1	p.r.	P.b.k. at 480 nm in N_2O-satd. soln. contg. 2 or 4×10^{-3} mol L^{-1} IO_3^- and 0.1 mol L^{-1} formate ion.	85A037
95	**Indium(III) ion**						
	$\cdot CO_2^- + In^{3+} \rightarrow$	$<1 \times 10^4$	2		p.r.	No reaction	83A206
96	**Hexachloroiridate(IV) ion**						
	$\cdot CO_2^- + IrCl_6^{2-} \rightarrow CO_2 + IrCl_6^{3-}$	1.7×10^9	6-7		p.r.	D.k. at 490 nm in N_2O-satd. soln. contg. formate.	82A041
97	**Manganese(II) ion**						
	$\cdot CO_2^- + Mn^{2+} \rightarrow$	$<2 \times 10^5$			p.r.	No effect of Mn^{2+} on d.k. of $\cdot CO_2^-$ at 280 or 256 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} formate.	761109
98	**5,10,15,20-Tetrakis-[4-(*N*,*N*,*N*-trimethylammonio)phenyl]porphinatomanganese(III) ion**						
	$\cdot CO_2^- + MnTAPP^{5+} \rightarrow CO_2 + MnTAPP^{4+}$	4.2×10^9 3.6×10^9	6.7-9.3 11		p.r.	D.k. at 465 nm, as well as p.b.k. at 440 nm in soln. contg. 10^{-2} mol L^{-1} formate ion; pK_a = 8.2, 10.8.	86A313
99	**5,10,15,20-Tetrakis-4-(*N*-methylpyridyl)porphinatomanganese(III) ion**						
	$\cdot CO_2^- + MnTMpyP^{5+} \rightarrow CO_2 + MnTMpyP^{4+}$	5.5×10^9 5.0×10^9	6.7 9.3		p.r.	D.k. at 465 nm, as well as p.b.k. at 440 nm in soln. contg. 10^{-2} mol L^{-1} formate ion; pK_a = 8.0, 10.6.	86A313
		3.5×10^9	11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	84A426
100	**α,α,α,β-Tetrakis(*N*-methylisonicotinamidophenyl)porphinatomanganese(III) ion**						
	$\cdot CO_2^- + MnPFP^{5+} \rightarrow CO_2 + MnPFP^{4+}$	6.0×10^9	7.0		p.r.	D.k. at 465 nm, as well as p.b.k. at 440 nm in soln. contg. 10^{-2} mol L^{-1} formate ion.	86A313
101	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatomanganate(III) ion**						
	$\cdot CO_2^- + MnTPPS^{3-} \rightarrow CO_2 + MnTPPS^{4-}$	4.2×10^9	11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	84A426
102	**Nitrous oxide**						
	$\cdot CO_2^- + N_2O + H_2O \rightarrow CO_2 + N_2 + \cdot OH + OH^-$	1.6×10^3	4.4	0.1	γ-r.	Calcd. from $G(CO_2)$ vs. dose rate; rel. to $2k(\cdot CO_2^- + \cdot CO_2^-) = 1.3 \times 10^9$; N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion; chain reaction.	85G029
103	**Nickel(I) ion**						
	$\cdot CO_2^- + Ni^+ \rightarrow NiCO_2$	6.6×10^9	5.0		p.r.	D.k. at 300 nm (as well as p.b.k.) in soln. contg. $NiSO_4$ and formate ion.	741037
104	**Nickel(II) ion**						
	$\cdot CO_2^- + Ni^{2+} \rightarrow CO_2 + Ni^+$	$10^2 < k < 10^5$			p.r.	Est. from lack of increase in Ni^+ in 0.1 mol L^{-1} Ni^{2+} on addn. of 0.1 mol L^{-1} formate ion, as well as γ-r. experiments [730039].	751027

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
105	**Tetracyanonickelate(II) ion**						
	$\cdot CO_2^- + Ni(CN)_4^{2-} \rightarrow CO_2 + Ni(CN)_4^{3-}$	1.2×10^9		0.1	p.r.	P.b.k. at 240 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion and 5, 10 and 48 $\times 10^{-5}$ mol L^{-1} Ni complex.	74107
106	**1,4,7,10-Tetraazacyclotridecanenickel(II) ion**						
	$\cdot CO_2^- + NiL^{2+} \rightarrow CO_2 + NiL^+$	1.7×10^9	5.5	0.1	p.r.	P.b.k. in Ar-satd. soln. contg. 0.1 mol L^{-1} formate ion and 1-10 $\times 10^{-4}$ mol L^{-1} Ni complex.	85A1
107	**1,4,8,11-Tetraazacyclotetradecanenickel(II) ion**						
	$\cdot CO_2^- + Ni(cyclam)^{2+} \rightarrow CO_2 + Ni(cyclam)^+$	5.2×10^9	6.0	0.1	p.r.	P.b.k. in Ar-satd. soln. contg. 0.1 mol L^{-1} Na formate and (1-10) $\times 10^{-4}$ mol L^{-1} complex.	85A0
108	**1,4,8,11-Tetramethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion**						
	$\cdot CO_2^- + NiL^{2+} \rightarrow CO_2 + NiL^+$	1.5×10^9	6.0	0.1	p.r.	P.b.k. in Ar-satd. soln. contg. 0.1 mol L^{-1} Na formate and (1-10) $\times 10^{-4}$ mol L^{-1} complex.	85A0
109	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion**						
	$\cdot CO_2^- + Ni(aneN_4)^{2+} \rightarrow CO_2 + Ni(aneN_4)^+$	5.7×10^9	7.0	0.1	p.r.	P.b.k. in Ar-satd. soln. contg. 0.1 mol L^{-1} formate; Ni(I) is also formed by reaction of e_{aq}^-.	76103
110	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienenickel(II) ion**						
	$\cdot CO_2^- + Ni(4,11\text{-dieneN}_4)^{2+} \rightarrow CO_2 + Ni(4,11\text{-dieneN}_4)^+$	6.7×10^9	7.0	0.1	p.r.	P.b.k. in Ar-satd. 0.1 mol L^{-1} formate.	76103
111	**1,4,5,7,7,8,11,12,14,14-Decamethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion**						
	$\cdot CO_2^- + NiL^{2+} \rightarrow CO_2 + NiL^+$	4×10^6	6.0	0.1	p.r.	P.b.k. in Ar-satd. soln. contg. 0.1 mol L^{-1} Na formate and (1-10) $\times 10^{-4}$ mol L^{-1} complex.	85A0
112	**3,14-Dimethyl-4,7,10,13-tetraazahexadeca-3,13-diene-2,15-dione dioximatonickel(IV) ion**						
	$\cdot CO_2^- + NiL^{2+} \rightarrow CO_2 + NiL^+$	1.2×10^{10}	2.2-4.1		p.r.	P.b.k.	85A3
113	**Oxygen**						
	$\cdot CO_2^- + O_2 \rightarrow CO_2 + O_2\cdot^-$	2.0×10^9	8.0	0.1	p.r.	Oxygen-satd. 0.1 mol L^{-1} formate soln.; product obs. at 260 nm.	76107
		4.2×10^9	6.8	0.18	p.r.	D.k. at 270 nm and 300 nm in 0.18 mol L^{-1} formate ion.	76113
		2.4×10^9	7	0.3	p.r.	C.k. in 0.3 mol L^{-1} formate soln.; rel. to $k(\cdot CO_2^- + Fe(CN)_6^{3-}) = 1.1 \times 10^9$.	69052
114	**Hydrogen peroxide**						
	$\cdot CO_2^- + H_2O_2 \rightarrow$	7.3×10^5	6.8		γ-r.	Steady state; obs. $G(H_2O_2)$ in N_2O-satd. soln. contg. formate ion	87G0
		$\leq 7 \times 10^5$	7		phot.	Calcd. from assumed chain mechanism in CO-H_2O_2 soln.; $k \leq 2.2 \times 10^6$ assuming $2k(\cdot CO_2^- + \cdot CO_2^-) \leq 10^{10}$, recalcd. in [745144] assuming $2k(\cdot CO_2^- + \cdot CO_2^-) = 3 \times 10^9$.	63700
115	**Pentaammineosmium(III)-μ-(isonicotinylprolylprolylprolinato)-pentaamminecobalt(III) ion**						
	$\cdot CO_2^- + [(NH_3)_5Os^{III}iso(Pro)_3Co^{III}(NH_3)_5]^{5+} \rightarrow CO_2 + [(NH_3)_5Os^{II}iso(Pro)_3Co^{III}(NH_3)_5]^{4+}$	4×10^9		0.1	p.r.	P.b.k. at 525 nm in soln. contg. 0.1 mol L^{-1} formate ion.	85A39

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
116	**Lead(II) ions**						
	$\cdot CO_2^- + Pb^{2+} \rightarrow CO_2 + Pb^+$	2.6×10^8	3.9	0.05	p.r.	P.b.k. at 330 nm in soln. contg. 0.05 mol L^{-1} formate ion.	82A425
117	**Tris(2,2'-bipyridine)rhodium(III) ion**						
	$\cdot CO_2^- + Rh(bpy)_3^{3+} \rightarrow CO_2 + Rh(bpy)_3^{2+}$	6.2×10^9	7	0.1	p.r.	P.b.k. at 270 nm as well as d.k. at 320 and 350 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion.	81A134
118	**Tris(2,2'-bipyridine)ruthenium(II) ion**						
	$\cdot CO_2^- + Ru(bpy)_3^{2+} \rightarrow$	$<1 \times 10^6$	7		p.r.	No reduction.	78A068
119	**Tris(2,2'-bipyrazine)ruthenium(II) ion**						
	$\cdot CO_2^- + Ru(bpz)_3^{2+} \rightarrow CO_2 + Ru(bpz)_2(bpz\cdot^-)^{2+}$	1.3×10^{10}	3-11	0.1	p.r.	P.b.k. at ~360 and 400 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	86A422
120	**Hexaammineruthenium(III) ion**						
	$\cdot CO_2^- + Ru(NH_3)_6^{3+} \rightarrow CO_2 + Ru(NH_3)_6^{2+}$	2.0×10^9	4.8		p.r.	D.k. in N_2O-satd. 10^{-2} mol L^{-1} formate soln.; e-transfer.	72A018
121	**Pentaammine(nitroso)ruthenium(III) ion**						
	$\cdot CO_2^- + Ru(NH_3)_5NO^{3+} \rightarrow CO_2 + Ru(NH_3)_5NO^{2+}$	3.1×10^9	6.6	0.5	p.r.	P.b.k. at 280 nm in N_2O-satd. soln. contg. 0.5 mol L^{-1} formate ion.	751049
122	**Pentaammine(isonicotinamide)ruthenium(III) ion**						
	$\cdot CO_2^- + Ru(NH_3)_5isn^{3+} \rightarrow CO_2 + Ru(NH_3)_5isn^{2+}$	1.0×10^{10}	4.9	0.1	p.r.	P.b.k. at 480 nm in N_2O-satd. soln. contg. formate.	80A317
123	**Sulfur dioxide**						
	$\cdot CO_2^- + SO_2 \rightarrow CO_2 + SO_2\cdot^-$	7.6×10^8	3.1		p.r.	Soln. contg. 1 mol L^{-1} formate; rel. to $2k(\cdot CO_2^- + \cdot CO_2^-) = 7.6 \times 10^8$.	751118
124	**Tetrathionate ion**						
	$\cdot CO_2^- + S_4O_6^{2-} \rightarrow CO_2 + S_4O_6^{3-}$	5.8×10^7			p.r.	P.b.k. at 370 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate, as well as d.k. at 280 nm.	731027
125	**Scandium(III)**						
	$\cdot CO_2^- + Sc(III) \rightarrow$		1.4		p.r.	No reaction in soln. contg. 1 mol L^{-1} formic acid and 1×10^{-2} mol L^{-1} Sc(III).	731057
126	**Titanium(III) ions**						
	$\cdot CO_2^- + Ti^{3+} + H^+ \rightarrow Ti^{3+}CO_2H$	4×10^6	0.5		p.r.	Soln. contg. sulfuric and formic acids; competition with radical combination; complex formn. deduced from transient spectra.	79A341
		$\sim 5 \times 10^6$	1.4		p.r.	D.k. in 1 mol L^{-1} formic acid soln.; $pK_a(\cdot CO_2H) = 1.4$.	731057
127	**Thallium(I) ion**						
	$\cdot CO_2^- + Tl^+ \rightarrow CO_2 + Tl^0$	2.3×10^6	13		p.r.	P.b.k. at 420 nm in soln. contg. 1 mol L^{-1} formate and 1.5×10^{-2} mol L^{-1} Tl^+; reaction also obs. for neutral and acid soln.	80A123
128	**12-Tungstate ion(6-), dihydrogen**						
	$\cdot CO_2^- + H_2W_{12}O_{40}^{6-} \rightarrow CO_2 + H_2W_{12}O_{40}^{7-}$	1.2×10^8 $\sim 1 \times 10^7$	~1 5-6		p.r.	P.b.k. at 650 nm in N_2O-satd. soln. contg. ~0.5 mol L^{-1} formate, $HClO_4$ at pH 1 and ~0.01 mol L^{-1} phosphate buffer at pH 5-6.	83A308

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
129	**12-Tungstoferrate ion(5-)**						
	$\cdot CO_2^- + FeW_{12}O_{40}^{5-} \rightarrow CO_2 + FeW_{12}O_{40}^{6-}$	4.1×10^8 1.7×10^8	~1 5-6		p.r.	P.b.k. at 650 nm in N_2O-satd. soln. contg. ~0.5 mol L^{-1} formate, $HClO_4$ at pH 1 and ~0.01 mol L^{-1} phosphate buffer at pH 5-6.	83A368
130	**12-Tungstophosphate ion(3-)**						
	$\cdot CO_2^- + PW_{12}O_{40}^{3-} \rightarrow CO_2 + PW_{12}O_{40}^{4-}$	3.0×10^9	~1		p.r.	P.b.k. at 650 nm in N_2O-satd. soln. contg. ~0.5 mol L^{-1} formate and $HClO_4$; heteropoly compound unstable at pH >1.2.	83A368
131	**12-Tungstosilicate ion(4-)**						
	$\cdot CO_2^- + SiW_{12}O_{40}^{4-} \rightarrow CO_2 + SiW_{12}O_{40}^{5-}$	6.4×10^8 8.4×10^8	~1 5-6		p.r.	P.b.k. at 650 nm in N_2O-satd. soln. contg. ~0.5 mol L^{-1} formate, $HClO_4$ at pH 1 and ~0.01 mol L^{-1} phosphate buffer at pH 5-6.	83A368
132	**Ytterbium(III)**						
	$\cdot CO_2^- + Yb(III) \rightarrow$		1.4		p.r.	No reaction in soln. contg. 1 mol L^{-1} formic acid and 10^{-2} mol L^{-1} Yb(III).	731057
133	**Zinc(I) ion**						
	$\cdot CO_2^- + Zn^+ + H^+ \rightarrow Zn^{2+} + HCO_2^-$	$\sim 4 \times 10^9$			p.r.	Est. from first-order decay at 310 nm (Zn^+) in formate-$ZnSO_4$ soln.	771011
134	**Zinc(II) ion**						
	$\cdot CO_2^- + Zn^{2+} \rightarrow$	$<2 \times 10^4$			p.r.	No reaction in 0.5 mol L^{-1} $ZnSO_4$.	771011
		$<1 \times 10^2$			p.r.	Est. from lack of increase in Zn^+ in 0.1 mol L^{-1} Zn^{2+} soln. upon addn. of 0.1 mol L^{-1} formate ion, as well as γ-r. experiments [730039].	751027
135	**Acetophenone**						
	$\cdot CO_2^- + C_6H_5COCH_3 \rightarrow C_6H_5\dot{C}O^-CH_3 + CO_2$	1×10^7	12		p.r.	P.b.k. at 440 nm.	680308
136	**Acridine**						
	$\cdot CO_2^- + A + H^+ \rightarrow CO_2 + \cdot AH$	$\sim 3 \times 10^8$	7		p.r.	P.b.k.; at pH 13 adduct is formed ($\cdot CO_2^- + A \rightarrow \cdot ACO_2^-$).	79A305
137	**Acriflavine (3,6-Diamino-10-methylacridinium)**						
	$\cdot CO_2^- + ACFl^+ \rightarrow CO_2 + [ACFl]\cdot$	3.7×10^8			p.r.	D.k. (dye) in Ar-satd. 0.1 mol L^{-1} formate; same product as concurrent fast reaction with e_{aq}^-.	700241
138	**Acrylamide**						
	$\cdot CO_2^- + H_2C{=}CHCONH_2 \rightarrow$ addn.	$\sim 4 \times 10^7$	~5		p.r.	Electron transfer not obs.	700052
139	**Adenosine 5'-monophosphate**						
	$\cdot CO_2^- + AMP \rightarrow$	$<1 \times 10^6$	8.3		p.r.	P.b.k. at 550 nm (A^-) in N_2O-satd. 0.1 mol L^{-1} formate.	680441
140	**Adriamycin**						
	$\cdot CO_2^- + {}^+HAdH_2 \rightarrow CO_2 + HAdH_2\cdot$ $\cdot CO_2^- + AdH^- + H_2O \rightarrow CO_2 + OH^- + AdH_2\cdot^-$	3.5×10^9 3.4×10^9 1.8×10^9	1.1 6.5 11.5		p.r.	P.b.k. at 380, 475, and 720 nm in N_2O-satd. soln. contg. formate and 1-9 $\times 10^{-5}$ mol L^{-1} adriamycin.	85A360

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
141	**Alloxan**						
	$\cdot CO_2^- + Al \rightarrow CO_2 + Al\cdot^-$	3.7×10^7	4.8	0.1	p.r.	P.b.k. at 310 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; cor. for decay of $\cdot CO_2^-$.	80A197
142	**9,10-Anthraquinone-2,6-disulfonate ion**						
	$\cdot CO_2^- + 2,6\text{-diSO}_3AQ^{2-} \rightarrow CO_2 + [2,6\text{-diSO}_3AQ]\cdot^{3-}$	2.4×10^9	7.0		p.r.	P.b.k. in N_2O-satd. soln. contg. formate.	731104
143	**9,10-Anthraquinone-1-sulfonate ion**						
	$\cdot CO_2^- + 1\text{-SO}_3AQ^- \rightarrow CO_2 + [1\text{-SO}_3AQ]\cdot^{2-}$	3.3×10^9	7		p.r.	P.b.k.; at pH 3 $k = 1.0 \times 10^9$.	720391
144	**9,10-Anthraquinone-2-sulfonate ion**						
	$\cdot CO_2^- + 2\text{-SO}_3AQ^- \rightarrow CO_2 + [2\text{-SO}_3AQ]\cdot^{2-}$	1.6×10^9	7		p.r.	P.b.k. at 400 nm in N_2O-satd. soln. contg. formate.	731104
		3.1×10^9	7		p.r.	P.b.k. in soln. contg. formate; at pH 3 $k = 2.8 \times 10^9$.	720391
145	**1,4-Benzoquinone**						
	$\cdot CO_2^- + Q \rightarrow CO_2 + Q\cdot^-$	7×10^9	6.9	0.1	p.r.	P.b.k. at 430 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	730049
		6.6×10^9	7.0		p.r.	P.b.k. at 400 nm in N_2O-satd. soln. contg. formate.	731104
		6.6×10^9	~7	0.2	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.2 mol L^{-1} formate.	710619
146	**2,2'-Bipyridine**						
	$\cdot CO_2^- + bpyH^+ \rightarrow CO_2 + bpyH\cdot$ $\cdot CO_2^- + bpy \rightarrow$	5.0×10^8 $<10^6$	4.4 7	0.2	p.r.	P.b.k. at 375 nm in N_2O-satd. soln. contg. 0.2 mol L^{-1} formate.	79A148
147	**1,1'-Bis(carboxyethyl)-4,4'-bipyridinium**						
	$\cdot CO_2^- + CQ^{2+} \rightarrow CO_2 + CQ\cdot^+$	2.0×10^9	7.0	0.2	p.r.	P.b.k. at 680 nm in N_2O-satd. soln. contg. 0.2 mol L^{-1} formate.	761169
148	**1,1'-Bis(4-cyanophenyl)-4,4'-bipyridinium**						
	$\cdot CO_2^- + CV^{2+} \rightarrow CO_2 + CV\cdot^+$	1.4×10^{10}	6.8	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	78A321
149	**1,1'-Bis(2-hydroxyethyl)-4,4'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP\cdot^+$	1.9×10^{10}	6.8	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	78A321
150	**Bis(2-hydroxyethyl)trisulfide**						
	$\cdot CO_2^- + (HOCH_2CH_2)_2S_3 \rightarrow CO_2 + HOCH_2CH_2SS\cdot + HOCH_2CH_2S^-$	5×10^8	5.7		p.r.	P.b.k. at 370 nm in N_2O-satd. soln. contg. formate.	82A307
151	**5-Bromouracil**						
	$\cdot CO_2^- + 5\text{-BrU} \rightarrow CO_2 + 5\text{-BrU}\cdot^-$	$>1 \times 10^8$			p.r.		690826
152	**1,1''-Butanediylbis(1'-methyl-4,4'-bipyridinium)**						
	$\cdot CO_2^- + BTQ^{4+} \rightarrow CO_2 + BTQ\cdot^{3+}$	1.5×10^{10}	7.3	0.1	p.r.	Obs. radical formation in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion and 5-10 $\times$ 10^{-5} mol L^{-1} viologen.	86A266
153	**Camphor**						
	$\cdot CO_2^- + C_{10}H_{16}O \rightarrow$	$<1 \times 10^6$	13		p.r.	D.k. of $\cdot CO_2^-$ at 260 nm. in N_2O-satd. soln. contg. formate was unaffected by 10^{-3} mol L^{-1} camphor.	79A191

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
154	**Carbon tetrachloride**						
	$\cdot CO_2^- + CCl_4 \rightarrow$				p.r.	Condy.; no reaction obs.	710778
155	**2-Carboxy-1-methylpyridinium ion**						
	$\cdot CO_2^- + CH_3N^+C_5H_4CO_2^- \rightarrow CO_2 + CH_3\dot{N}C_5H_4CO_2^-$	7×10^8			p.r.	N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	82A146
156	**1-Chloro-4-nitrobenzene**						
	$\cdot CO_2^- + ClC_6H_4NO_2 \rightarrow CO_2 + ClC_6H_4NO_2\cdot^-$	3×10^8			p.r.		77R167
157	**Crystal Violet cation**						
	$\cdot CO_2^- + CV^+ \rightarrow CO_2 + CV\cdot$	1.6×10^9	7		p.r.	D.k. at 520 nm as well as p.b.k. at ~400 nm.	731078
158	**Cystamine**						
	$\cdot CO_2^- + RSSR \rightarrow CO_2 + RSSR\cdot^-$	$<3 \times 10^7$	9.6		p.r.	P.b.k. at 410 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion, up to 3×10^{-3} mol L^{-1} cystamine and 4×10^{-4} mol L^{-1} cysteamine.	84A232
159	**Daunomycin**						
	$\cdot CO_2^- + D \rightarrow CO_2 + D\cdot^-$	2.0×10^9	7	0.1	p.r.	P.b.k. at ≥600 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	85A001
160	**Diamide**						
	$\cdot CO_2^- + [=NCON(CH_3)_2]_2 \rightarrow CO_2 + [NCON(CH_3)_2]_2\cdot^-$	$\sim 2.5 \times 10^9$			p.r.	P.b.k. at 400 nm.	751194
161	**1,1'-Dibenzyl-4,4'-bipyridinium**						
	$\cdot CO_2^- + BV^{2+} \rightarrow CO_2 + BV\cdot^+$	1.7×10^{10}	6.8	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	78A321
		6.7×10^9	7.0	0.2	p.r.	P.b.k. at 680 nm in N_2O-satd. soln. contg. 0.2 mol L^{-1} formate.	761169
162	**2,6-Dichloroindophenol**						
	$\cdot CO_2^- + DCIP^- \rightarrow CO_2 + DCIP\cdot^{2-}$	3.5×10^9	7		p.r.	D.k. at 600 nm in N_2O-satd. soln. contg. formate, as well as p.b.k. at ~400 nm; 100% *e*-transfer.	731078
163	***trans*-4,5-Dihydroxy-1,2-dithiane**						
	$\cdot CO_2^- + RSSR \rightarrow CO_2 + RSSR\cdot^-$	1.1×10^8	9	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	82A171
164	**5,8-Dihydroxy-1,4-naphthoquinone**						
	$\cdot CO_2^- + NQ(OH)_2 \rightarrow CO_2 + \cdot NQ(OH)_2^-$	5.1×10^9	5.8	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	83A039
	$\cdot CO_2^- + NQ(OH)(O^-) \rightarrow$	2.2×10^9	9.2	0.1			
	$\cdot CO_2^- + NQ(O^-)_2 \rightarrow$	1.4×10^9	13.0	0.2			
165	**1,1'-Dimethyl-4,4'-bipyridinium**						
	$\cdot CO_2^- + MV^{2+} \rightarrow CO_2 + MV\cdot^+$	$\sim 1 \times 10^{10}$	nat.	→0	p.r.	P.b.k. at 600 nm in N_2O-satd. soln. contg. 0.1-1.5 mol L^{-1} formate ion ($k = 4 \times 10^9$ at the latter concn.).	86A327
		1.5×10^{10}		0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	731074
166	**1,1'-Dimethyl-4,4'-bipyridinium radical ion (1+)**						
	$\cdot CO_2^- + MV\cdot^+ \rightarrow$	$\sim 1 \times 10^9$	nat.	0.1	γ-r.	Estd. from effect of dose on absorbance in N_2O-satd. soln contg. 0.1 mol L^{-1} formate.	86A327
167	**4,4'-Dimethyl-1,1'-ethylene-2,2'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP\cdot^+$	1.1×10^{10}	7.0		p.r.	P.b.k. in O_2-free soln. at ~380 nm.	84A292

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
168	**Dimethyl fumarate**						
	$\cdot CO_2^- + CH_3O_2CCH{=}CHCO_2CH_3 \rightarrow CO_2 + [CH_3O_2CCHCHCO_2CH_3]^{\cdot -}$	9×10^8	7.0		p.r.	>80% e-transfer.	730097
169	**1,3-Dimethyllumichrome**						
	$\cdot CO_2^- + Fl + H^+ \rightarrow CO_2 + FlH\cdot$	6.3×10^8	6, 10	0.1	p.r.	P.b.k. at ~450 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	82B104
170	***N,N*-Dimethyl-4-nitrosoaniline (RNO)**						
	$\cdot CO_2^- + Me_2NC_6H_4NO \rightarrow CO_2 + [Me_2NC_6H_4NO]^{\cdot -}$	1.8×10^9	7	0.25	p.r.	D.k. at 440 nm in N_2O-satd. soln. contg. 0.25 mol L^{-1} formate.	690156
		1.9×10^9			p.r.	D.k. at 440 nm in N_2O-satd. soln. contg. formate ion.	680066
171	**5,5-Dimethyl-1-pyrroline-1-oxyl**						
	$\cdot CO_2^- + DMPO \rightarrow DMPO\text{-}CO_2^-$	7.5×10^8	11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	84A426
172	**4,4'-Dimethyl-1,1'-tetramethylene-2,2'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP^{\cdot +}$	4.2×10^9	7.0		p.r.	P.b.k. in O_2-free soln. at ~380 nm.	84A292
173	**4,4'-Dimethyl-1,1'-trimethylene-2,2'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP^{\cdot +}$	5.8×10^9	7.0		p.r.	P.b.k. in O_2-free soln. at ~380 nm.	84A292
174	**2,4-Dinitrobenzoate ion**						
	$\cdot CO_2^- + (NO_2)_2C_6H_3CO_2^- \rightarrow CO_2 + [(NO_2)_2C_6H_3CO_2]^{\cdot 2-}$	1.8×10^9	7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate.	761111
175	**2,5-Dinitrobenzoate ion**						
	$\cdot CO_2^- + (NO_2)_2C_6H_3CO_2^- \rightarrow CO_2 + [(NO_2)_2C_6H_3CO_2]^{\cdot 2-}$	1.9×10^9	7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate.	761111
176	**3,4-Dinitrobenzoate ion**						
	$\cdot CO_2^- + (NO_2)_2C_6H_3CO_2^- \rightarrow CO_2 + [(NO_2)_2C_6H_3CO_2]^{\cdot 2-}$	1.8×10^9	7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate.	761111
177	**3,5-Dinitrobenzoate ion**						
	$\cdot CO_2^- + (NO_2)_2C_6H_3CO_2^- \rightarrow CO_2 + [(NO_2)_2C_6H_3CO_2]^{\cdot 2-}$	2.5×10^9	7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate.	761111
178	**1-(2,4-Dinitrophenyl)pyridinium**						
	$\cdot CO_2^- + (NO_2)_2C_6H_3py^+ \rightarrow CO_2 + [(NO_2)_2C_6H_3py]\cdot$	4×10^8			p.r.		77R167
179	**1,1'-Diphenyl-4,4'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP^{\cdot +}$	1.3×10^{10}	6.8	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion.	78A321
180	**Dithiothreitol**						
	$\cdot CO_2^- + HSCH_2CHOHCHOHCH_2SH \rightarrow HCO_2^- + \cdot SCH_2CHOHCHOHCH_2SH +$	8.3×10^8	8.1		p.r.	P.b.k. at 400 nm (cyclized radical anion) in N_2O-satd. soln. contg. DTT.	87G007
181	**Eosin dianion**						
	$\cdot CO_2^- + C_{20}H_6Br_4O_5^{2-} \rightarrow$	2.5×10^8	8.5-9.0		p.r.	P.b.k. at 405 nm in soln. contg. 10^{-2} mol L^{-1} HCO_2^- and 10^{-3} mol L^{-1} H_2O_2; product is semiquinone.	670038
182	**1,1'-Ethylene-2,2'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP^{\cdot +}$	1.2×10^{10}	7.0	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion and 2×10^{-3} mol L^{-1} phosphate buffer.	84A292

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
182	**1,1'-Ethylene-2,2'-bipyridinium**—Continued						
		1.2×10^{10}	6.8	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion.	78A321
		4.0×10^{9}	7.0	0.2	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.2 mol L^{-1} formate ion.	761169
183	***N*-Ethylmaleimide**						
	$\cdot CO_2^- + NEM \rightarrow CO_2 + NEM\cdot^-$	5.4×10^{9}	6-7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate; 100% *e*-transfer based on abs. spectra.	720144
184	**Flavine adenine dinucleotide**						
	$\cdot CO_2^- + FAD \rightarrow CO_2 + FAD\cdot^-$	7×10^{8}	10	0.06	p.r.	P.b.k. at 370 nm in N_2O-satd. soln. contg. formate ion.	84A045
		1.2×10^{9}	7		p.r.	Unpublished data.	82G120
185	**Flavine mononucleotide**						
	$\cdot CO_2^- + FMN \rightarrow CO_2 + FMN\cdot^-$	3.0×10^{9} 1.0×10^{9}	6.0 11.0	0.1	p.r.	N_2O-satd. soln. cont. 0.1 mol L^{-1} formate.	83A091
186	**Fluorescein dianion**						
	$\cdot CO_2^- + Fl^{2-} \rightarrow$	2.6×10^{7}	10.4		p.r.	P.b.k. in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} formate; product is semiquinone.	680172
187	***N*-Formylkynurenine**						
	$\cdot CO_2^- + FK + H^+ \rightarrow CO_2 + FKH\cdot$	$>3 \times 10^{7}$	7.6	0.1	p.r.	P.b.k. (semiquinone) in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	757361
188	**Fumarate ion, hydrogen**						
	$\cdot CO_2^- + HO_2CCH{=}CHCO_2^- \rightarrow$	2.0×10^{7}	4.0		p.r.	>30% *e*-transfer; no *e*-transfer at pH 10.0.	730097
189	***cis*-2-(2-Furyl)-3-(5-nitro-2-furyl)acrylamide**						
	$\cdot CO_2^- + C_{11}H_8N_2O_5 \rightarrow CO_2 + C_{11}H_8N_2O_5^-$	3.0×10^{9}	7.4		p.r.	P.b.k. at 680 nm in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} formate ion and 2×10^{-3} mol L^{-1} sodium phosphate.	84A208
190	***trans*-2-(2-Furyl)-3-(5-nitro-2-furyl)acrylamide**						
	$\cdot CO_2^- + C_{11}H_8N_2O_5 \rightarrow CO_2 + C_{11}H_8N_2O_5^-$	2.0×10^{9}	7.4		p.r.	P.b.k. at 680 nm in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} formate ion and 2×10^{-3} mol L^{-1} sodium phosphate.	84A208
191	**Glutathione, oxidized**						
	$\cdot CO_2^- + GSSG \rightarrow$	$<1 \times 10^{7}$			p.r.	No 420 nm abs. ($RSSR^-$) obs. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	720388
192	**Glycine anhydride**						
	$\cdot CO_2^- + \underline{CH_2CONHCH_2CONH} \rightarrow$	$<1 \times 10^{7}$	6.2		p.r.	No *e*-transfer obs. in N_2O-satd. soln. contg. 0.2 mol L^{-1} formate.	710554
193	**Hematoporphyrin IX**						
	$\cdot CO_2^- + P \rightarrow CO_2 + P^-$	4×10^{7}	13.0		p.r.	P.b.k. at 600-650 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	741040
194	**1-(2-Hydroxyethyl)-2-methyl-5-nitroimidazole (Metronidazole)**						
	$\cdot CO_2^- + HOCH_2CH_2Im(CH_3)NO_2 \rightarrow CO_2 + [HOCH_2CH_2Im(CH_3)NO_2]\cdot^-$	1.7×10^{9} 1.1×10^{9} 1.1×10^{9} 8.7×10^{8}	4 6 8 11.5		p.r.	P.b.k. in buffered N_2O-satd. soln. contg. 0.1 or 1 mol L^{-1} formate contg. 0.1-1 $\times 10^{-3}$ mol L^{-1} nitroimidazole; pK_a = 2.5.	87A208

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
194	**1-(2-Hydroxyethyl)-2-methyl-5-nitroimidazole (Metronidazole)**—Continued						
		8×10^8			p.r.	D.k. at 320 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion; also c.k. gave 8×10^8 rel. to $k(\cdot CO_2^- + TAN) = 6 \times 10^8$.	741135
195	**2-Hydroxy-1,4-naphthoquinone**						
	$\cdot CO_2^- + (OH)NQ \rightarrow CO_2 + (OH)NQ\cdot^-$	2.0×10^9	7.0		p.r.	P.b.k. at 400 nm in N_2O-satd. soln. contg. formate.	731104
196	**5-Hydroxy-1,4-naphthoquinone**						
	$\cdot CO_2^- + OH\text{-}NQ \rightarrow CO_2 + OH\text{-}NQ\cdot^-$	4.4×10^9 3.8×10^9 1.3×10^9	1.2 6.4 10.5		p.r.	P.b.k. at 385 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate, 2-5.4 $\times$ 10^{-5} mol L^{-1} juglone (pK_a = 8.65) and 4 $\times$ 10^{-3} mol L^{-1} phosphate buffer.	87A234
197	**6-Hydroxy-5-nitrothymine, conjugate base**						
	$\cdot CO_2^- + {}^-OTNO_2 \rightarrow CO_2 + {}^-OTNO_2\cdot^-$	9.0×10^7	6.5		p.r.	D.k. at 340 nm.	80A210
198	**6-Hydroxy-5-nitrothymine**						
	$\cdot CO_2^- + HOTNO_2 \rightarrow CO_2 + HOTNO_2\cdot^-$	1.7×10^8	2		p.r.	P.b.k. at 430 nm.	80A210
199	**Indigodisulfonate ion**						
	$\cdot CO_2^- + IDS^{2-} \rightarrow CO_2 + IDS\cdot^{3-}$	2.1×10^9	7.0		p.r.	P.b.k. at 400 nm, as well as d.k. at 610 nm in N_2O-satd. soln. contg. formate.	731078
200	**Indophenolate ion**						
	$\cdot CO_2^- + O{=}C_6H_4{=}NC_6H_4O^- \rightarrow CO_2 + [O{=}C_6H_4{=}NC_6H_4O]\cdot^{2-}$	2.8×10^9	9.0		p.r.	P.b.k. at ~400 nm, as well as d.k. at 610 nm in N_2O-satd. soln. contg. formate.	731078
201	**3-Iodo-L-tyrosine**						
	$\cdot CO_2^- + IC_6H_3(OH)CH_2CH(NH_3^+)CO_2^- \rightarrow CO_2 + I^- + \cdot C_6H_3(OH)CH_2CH(NH_3^+)CO_2^-$	1.3×10^5	3.0		X-r.	Est. from dependence of tyrosine yields on irrad. time in soln. contg. 10^{-2} mol L^{-1} formate assuming $2k(\cdot CO_2^- + \cdot CO_2^-) = 5.0 \times 10^8$.	720610
202	**Lipoamide**						
	$\cdot CO_2^- + LS_2 \rightarrow CO_2 + LS_2\cdot^-$	5.5×10^8	9	0.1	p.r.	P.b.k. at 400 nm in soln. contg. 0.1 mol L^{-1} Na formate and 0.25-1 $\times$ 10^{-3} mol L^{-1} lipoamide.	84A011
203	**Lipoate ion**						
	$\cdot CO_2^- + RSSR \rightarrow CO_2 + RSSR\cdot^-$	9×10^8 5.6×10^8	3.5 6.1-9.2		p.r.	P.b.k. at 410 nm.	751195
		5.5×10^8	7	0.1	p.r.	P.b.k. at 410 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion.	700560
204	**Lumichrome**						
	$\cdot CO_2^- + Fl \rightarrow CO_2 + Fl\cdot^-$	2.5×10^9 4.7×10^8	6 10	0.1	p.r.	P.b.k. at ~450 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	82B104
		1.8×10^9	7		p.r.	Unpubl.	82G120
205	**Lumiflavine**						
	$\cdot CO_2^- + LF \rightarrow CO_2 + LF\cdot^-$	3.0×10^9 2.1×10^9	9 11.2		p.r.	P.b.k.	85A389
		3.6×10^9	7		p.r.	P.b.k. at 550 nm in N_2O-satd. soln. contg. formate ion.	83A073

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
206	**Lumiflavine semiquinone**						
	$\cdot CO_2^- + LFH\cdot \rightarrow CO_2 + LFH^- + $	1.7×10^9	7		p.r.	Decay to LFH^- and LF_0 from calcd. concn.-time profile.	83A07:
207	**Maleate ion, hydrogen**						
	$\cdot CO_2^- + HO_2CCH{=}CHCO_2^- \rightarrow$	1.1×10^8	5.2		p.r.	≥ 65% e-transfer; no e-transfer at at pH 10.5 (dianion).	730097
208	**Methoxatine**						
	$\cdot CO_2^- + MTX \rightarrow CO_2 + [MTX]\cdot^-$	3.3×10^8	7.3		p.r.	P.b.k. at 460 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate, 5×10^{-3} mol L^{-1} phosphate and $\sim 2 \times 10^{-4}$ mol L^{-1} methoxatine.	86A52(
209	**8-Methyl-7,8-bis,nor-5-deazalumiflavin**						
	$\cdot CO_2^- + dFl_{ox} \rightarrow$	2.0×10^9	5.4-9.2	0.1	p.r.	P.b.k. at 560 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion; initial product suggested to be adduct.	81A43
210	**Methylene Blue**						
	$\cdot CO_2^- + MB^+ \rightarrow CO_2 + MB\cdot$	$\sim 7 \times 10^8$	−5.7		p.r.	D.k. at 580 nm in soln. contg. 0.1 mol L^{-1} formate.	650396
		$\sim 1 \times 10^9$	−0.8				
		$\sim 2 \times 10^9$	1.8				
		5.6×10^9	~9				
211	**1-Methyllumichrome**						
	$\cdot CO_2^- + Fl + H^+ \rightarrow CO_2 + FlH\cdot$	1.9×10^9	6	0.1	p.r.	P.b.k. at ~450 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	82B10
		3.4×10^8	10	0.1			
212	**3-Methyllumichrome**						
	$\cdot CO_2^- + Fl + H^+ \rightarrow CO_2 + FlH\cdot$	3.2×10^9	6	0.1	p.r.	P.b.k. at ~450 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate.	82B10
		5.5×10^8	10	0.1			
213	**2-Methyl-1,4-naphthoquinone**						
	$\cdot CO_2^- + CH_3\text{-}NQ \rightarrow CO_2 + CH_3\text{-}NQ\cdot^-$	4.8×10^9	7		p.r.	P.b.k. at 400 nm in N_2O-satd. soln. contg. formate.	731047 731104
		5.4×10^9	6.9		p.r.	P.b.k. at 400 nm in N_2O-satd. soln. contg. formate; 100% e-transfer.	723057
214	**1-Methylnicotinamide**						
	$\cdot CO_2^- + CH_3N^+C_5H_4CONH_2 \rightarrow CO_2 + CH_3\dot{N}C_5H_4CONH_2$	4.6×10^9	8.5	0.1	p.r.	P.b.k. at 420 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	680441
215	**2-Methyl-5-nitroimidazole**						
	$\cdot CO_2^- + CH_3ImNO_2 \rightarrow CO_2 + [CH_3ImNO_2]\cdot^-$	5.8×10^8	4		p.r.	P.b.k. in buffered N_2O-satd. soln. contg. 0.1 or 1 mol L^{-1} formate contg. $0.1\text{-}1 \times 10^{-3}$ mol L^{-1} nitroimidazole; pK_a = 1.1, 9.7.	87A20
		5.5×10^8	6				
		6.9×10^8	8				
		1.4×10^8	11.5				
216	**Nicotinamide adenine dinucleotide**						
	$\cdot CO_2^- + NAD^+ \rightarrow CO_2 + NAD\cdot$	1.6×10^9	6.4	0.1	p.r.	P.b.k. at 400 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	680441
217	**Nifuroxime**						
	$\cdot CO_2^- + NF \rightarrow CO_2 + NF\cdot^-$	2.7×10^9			p.r.	P.b.k. at 390 nm in CO_2-satd. soln. contg. *tert*-BuOH or 0.2 mol L^{-1} formate; 100% e-transfer.	731099
218	**Nitro Blue Tetrazolium**						
	$\cdot CO_2^- + NBT^{2+} \rightarrow CO_2 + NBT\cdot^+$	6.4×10^9	10	0.1	p.r.	P.b.k. at 405 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	80A085

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
219	**4-Nitroacetophenone**						
	$\cdot CO_2^- + PNAP \rightarrow CO_2 + PNAP^-$	7×10^8			p.r.	Radical from formate.	77R167
		1.0×10^9	10		p.r.	P.b.k. at 550 nm in N_2O-satd. soln. contg. formate ion.	730122
220	**Nitrobenzene**						
	$\cdot CO_2^- + C_6H_5NO_2 \rightarrow CO_2 + C_6H_5\dot{N}O_2^-$	4.6×10^8 7.5×10^8 5.8×10^8	0 2.5 9.4		p.r.	P.b.k.	730085
		5.6×10^8 1.0×10^9	~3 6-7		p.r.	P.b.k. at 295 nm in N_2O-satd. soln. contg. 10^{-3} mol L^{-1} formate;	700303
221	**2-Nitrobenzoate ion**						
	$\cdot CO_2^- + NO_2C_6H_4CO_2^- \rightarrow CO_2 + [NO_2C_6H_4CO_2]\cdot^{2-}$	2.4×10^8	7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate; at pH 0.8 k was the same ± 20-30%.	761111
222	**3-Nitrobenzoate ion**						
	$\cdot CO_2^- + NO_2C_6H_4CO_2^- \rightarrow CO_2 + [NO_2C_6H_4CO_2]\cdot^{2-}$	6.3×10^8	7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate; at pH 0.8 k was the same ± 20-30%.	761111
223	**4-Nitrobenzoate ion**						
	$\cdot CO_2^- + NO_2C_6H_4CO_2^- \rightarrow CO_2 + [NO_2C_6H_4CO_2]\cdot^{2-}$	8.0×10^8	7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate; at pH 0.8 k was the same ± 20-30%.	761111
224	**4-Nitroimidazole**						
	$\cdot CO_2^- + ImNO_2 \rightarrow CO_2 + [ImNO_2]\cdot^-$	6.3×10^8 6.1×10^8 2.2×10^8 1.4×10^8	4 6 8 11.5		p.r.	P.b.k. in buffered N_2O-satd. soln. contg. 0.1 or 1 mol L^{-1} formate contg. 0.1-1 $\times 10^{-3}$ mol L^{-1} nitroimidazole; pK_a = −0.2, 9.4; at pH 8 $k = 4.0 \times 10^9$ was also quoted.	87A208
225	**Nitrosobenzene**						
	$\cdot CO_2^- + C_6H_5NO \rightarrow CO_2 + C_6H_5\dot{N}O^-$	4.0×10^9			p.r.	P.b.k. at 450 nm in soln. contg. formate ion.	660433
226	**4-Phenyl-*N-tert*-butylnitrone**						
	$\cdot CO_2^- + PBN \rightarrow$	1.5×10^7			p.r.		82A184
227	**Pterin**						
	$\cdot CO_2^- + C_6H_5N_5O \rightarrow$	4.6×10^8 $\ll 10^7$	7.0 9.5-13.0		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion; 100% e-transfer at pH 7.	761060
228	**Purine**						
	$\cdot CO_2^- + C_5H_4N_4 \rightarrow$	$<1 \times 10^7$	6.0		p.r.	P.b.k. in N_2O-satd. soln.	751060
229	**Pyrazine**						
	$\cdot CO_2^- + C_4H_4N_2 \rightarrow$	$<1 \times 10^7$	5, 11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	741127
230	**Pyridazine**						
	$\cdot CO_2^- + C_4H_4N_2 \rightarrow$	$<1 \times 10^7$	5, 11		p.r.	<10% e-transfer.	741127
231	**α-(4-Pyridyl 1-oxide)-*N-tert*-butylnitrone**						
	$\cdot CO_2^- + POBN \rightarrow POBN\text{-}CO_2^-$	6.1×10^8	11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion.	84A426

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
232	**Pyrimidine**						
	$\cdot CO_2^- + C_4H_4N_2 \rightarrow$	$<1 \times 10^7$	5, 11		p.r.	P.b.k. in N_2O-satd. soln. contg. formate ion; <10% e-transfer.	741127
233	**Rhodamine B**						
	$\cdot CO_2^- +$ Rh B $\rightarrow CO_2 +$ Rh B_{red}	1.8×10^8			p.r.	D.k. at 510 nm as well as p.b.k. at 410 nm in soln. contg. 0.1 mol L^{-1} formate ion.	676053
234	**Riboflavine**						
	$\cdot CO_2^- + RF \rightarrow CO_2 + RF\cdot^-$	1.7×10^9	7.0		p.r.	P.b.k. at 560 nm in N_2O-satd. soln. contg. formate ion.	731104
		3.0×10^9 3.6×10^9 1.4×10^9	−2 3,5.9 11.5		p.r.	D.k. at 420 nm, as well as p.b.k. at 560 nm (semiquinone) in N_2O-satd. soln. contg. formate ion.	690283
235	**1,1'-Tetramethylene-2,2'-bipyridinium ion**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP\cdot^+$	9×10^9	7.0	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2×10^{-3} mol L^{-1} phosphate buffer.	84A292
		7×10^9	6.8	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion.	78A321
236	**4,5,4',5'-Tetramethyl-1,1'-ethylene-2,2'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP\cdot^+$	9×10^9	7.0		p.r.	P.b.k. in O_2-free soln. at ~380 nm.	84A292
237	**2,2,6,6-Tetramethyl-4-piperidone *N*-oxyl**						
	$\cdot CO_2^- +$ TAN $\rightarrow$	7.0×10^8	7-8		p.r.	P.b.k. at 310 nm in N_2O-satd. soln. contg. formate.	710618
		5.4×10^8	7-8		p.r.	C.k. in N_2O-satd. soln. contg. formate; rel. to $k(\cdot CO_2^- + Fe(CN)_6^{3-}) = 1.1 \times 10^9$.	710618
238	**4,5,4'5,'-Tetramethyl-1,1'-tetramethylene-2,2'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP\cdot^+$	4.2×10^9	7.0		p.r.	P.b.k. in O_2-free soln. at ~380 nm.	84A292
239	**4,5,4',5'-Tetramethyl-1,1'-trimethylene-2,2'-bipyridinium**						
	$\cdot CO_2^- + BP^{2+} \rightarrow CO_2 + BP\cdot^+$	6.3×10^9	7.0		p.r.	P.b.k. in O_2-free soln. at ~380 nm.	84A292
240	**Tetranitromethane**						
	$\cdot CO_2^- + C(NO_2)_4 \rightarrow C(NO_2)_3^- + \cdot NO_2 + CO_2$	4×10^9			p.r.	P.b.k.; independent of pH between 3 and 7.	700303
241	**2-Thioriboflavine**						
	$\cdot CO_2^- + Fl \rightarrow CO_2 + Fl\cdot^-$	4.0×10^9 1.3×10^9	7 10		p.r.	D.k. at 490 nm in N_2O-satd. soln. contg. 2.0×10^{-2} mol L^{-1} formate, 10^{-2} mol L^{-1} phosphate buffer.	86B055
242	**Thymine**						
	$\cdot CO_2^- +$ 5-MeU $\rightarrow$	$\sim 5 \times 10^4$	7-8		γ-r.	Estd. from dependence of $G(-T)$ on thymine concn. in soln. contg. Na formate and N_2O.	701103
243	**1,1'-Trimethylene-2,2'-bipyridinium ion**						
	$\cdot CO_2^- + TQ^{2+} \rightarrow CO_2 + TQ\cdot^+$	1.1×10^{10}	7.0	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2×10^{-3} mol L^{-1} phosphate buffer.	84A292
		1.1×10^{10}	6.8	0.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	78A321
244	**2,4,6-Trinitrobenzoate ion**						
	$\cdot CO_2^- + (NO_2)_3C_6H_2CO_2^- \rightarrow CO_2 + [(NO_2)_3C_6H_2CO_2]\cdot^{2-}$	3.4×10^9	7		p.r.	P.b.k. in N_2O-satd. soln. contg. formate; k at pH 0.8 within 20-30%.	761111

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
245	**Albumin (serum)**						
	$\cdot CO_2^- +$ Albumin $\rightarrow CO_2 +$ [Albumin]$^-$	8×10^8 7×10^8	6.4 7.6		p.r.	P.b.k. at 420 nm (RSSR)$^-$ in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	83A083
245a	**Apotransferrin**						
	$\cdot CO_2^- +$ Apotransferrin $\rightarrow$	3.8×10^8	7.0		p.r.	P.b.k. at 420 nm in N_2O-satd. soln. contg. formate ion.	87A281
246	**Ascorbate oxidase**						
	$\cdot CO_2^- +$ AAO $\rightarrow$		6, 7.5	0.1	p.r.	D.k. at 610 and 330 nm in deoxygenated soln. contg. 10^{-2} mol L^{-1} phosphate buffer, 10^{-4} mol L^{-1} EDTA and formate ion; 3.5×10^4 and 2.2×10^4 s^{-1}; very fast reaction followed by slower intramolecular processes.	83A147
247	**Carboxypeptidase A**						
	$\cdot CO_2^- +$ CPD-A $\rightarrow CO_2 +$ [CPD-A]$\cdot^-$	7×10^8			p.r.	P.b.k. at 410 nm (electron adduct).	731060
248	**Ceruloplasmin**						
	$\cdot CO_2^- +$ Cu $\rightarrow$	4×10^9				Unpublished data., I. Pecht and M. Faraggi.	731064
249	**Cytochrome C**						
	$\cdot CO_2^- +$ Cyt C (Fe^{3+}) $\rightarrow CO_2 +$ Cyt C (Fe^{2+})	7.0×10^8	7	0.16	p.r.	D.k. at 320 to 550 nm in N_2O-satd. soln. contg. 2×10^{-3} mol L^{-1} phosphate-0.16 mol L^{-1} formate buffer; cytochrome C from yeast (Hansenula anomala).	86A394
		2×10^9	7.0	0.003	p.r.	N_2O-purged soln. contg. 2×10^{-3} mol L^{-1} formate, 10^{-3} mol L^{-1} phosphate and 10^{-5} mol L^{-1} cyt C; $E_a = 14$ kJ mol^{-1}.	82A281
		2.1×10^9	7.0	0.1	p.r.	P.b.k. at 550 nm in soln. contg. 1.85 $\times 10^{-5}$ mol L^{-1} cyt c, 0.1 mol L^{-1} Na formate and 1×10^{-3} mol L^{-1} phosphate buffer.	82A366
		1.0×10^8	~7	0.1	p.r.	D.k. in formate soln.	79A312
		1.3×10^9	7.0	0.01	p.r.	P.b.k. at 550 nm in 1 atm N_2O, and 0.01 mol L^{-1} formate.	78A288
		7×10^8 5.0×10^8	7.4 8.5	0.1	p.r.	P.b.k. in N_2O-satd. 0.1 mol L^{-1} formate.	771096
		1.0×10^9 6.3×10^8	6.2 8.7	0.1	p.r.	Abs. change at 450 and 550 nm in 0.1 mol L^{-1} formate soln; at pH 6.2 $E_a = 11$ kJ mol^{-1} and $A = 1.0 \times 10^{11}$; ionic strength effects studied.	761127
		6.9×10^8 2.5×10^8	7 10.8	~0.03	p.r.	P.b.k. at 550 nm in N_2O-satd. soln. contg. formate.	751012
		2.8×10^9 7.9×10^8	2 7	0.1	p.r.	P.b.k. at 550 nm in soln. contg. 0.03-1 mol L^{-1} formate; ionic strength effects studied.	710327
		9.4×10^8 7.4×10^8	2.0 6.7		p.r.		771128
250	**Cytochrome C, acetylated**						
	$\cdot CO_2^- +$ Ac-cyt C $\rightarrow$	1.5×10^9	~7	0.1	p.r.	D.k. at 550 nm in formate soln.; ionic strength effects studied.	79A312

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
251	**Cytochrome C, carboxymethylated**						
	$\cdot CO_2^-$ + Cxm-cyt C →	1.3×10^8	~7	0.1	p.r.	D.k. at 550 nm in formate soln.	79A312
		1.4×10^8	7		p.r.	Radical from formate ion.	78A288
252	**Cytochrome C, succinylated**						
	$\cdot CO_2^-$ + Succ-cyt C →	4.0×10^9	~7	0.1	p.r.	D.k. at 550 nm in formate soln.	79A312
253	**Cytochrome C_3**						
	$\cdot CO_2^-$ + cyt C_3 →	2.1×10^8	8.1		p.r.	D.k. in N_2O-satd. 1.6×10^{-1} mol L^{-1} formate soln. assuming $2k(\cdot CO_2^- + \cdot CO_2^-) = 1.8 \times 10^9$; from D. vulgaris; only 2 of the hemes react.	78A232
254	**Cytochrome P-450**						
	$\cdot CO_2^-$ + cyt P-450 →					No redn. obs. in N_2O-satd. soln. contg. formate.	79A036
255	**Cytochrome c 551**						
	$\cdot CO_2^-$ + cyt C 551 →	3.7×10^9 7.4×10^8 4.5×10^8	5.6 7.0 7.0	0.1 0.09 0.01	p.r.	D.k. at 550 nm in soln. contg. 0.1 mol L^{-1} Na formate; depends on pH and ionic strength.	84A430
256	**Deoxyribonucleic acid**						
	$\cdot CO_2^-$ + DNA →	2.5×10^4	9.2		γ-r.	Estd. from D_{37} values at various dose rates in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate, 0.01 mol L^{-1} $MgCl_2$ and 0.01 mol L^{-1} Na tetraborate and single stranded ΦX174 DNA	83R032
257	**Dopa-melanin**						
	$\cdot CO_2^-$ + Dopa-melanin →	10^6-10^7	7.4		p.r.	D.k. in soln. contg. 0.1 mol L^{-1} formate; k based on monomer of mol. wt. 150; from autoxidation of DL-dihydroxyphenylalanine.	86A227
258	**Ferredoxin (spinach)**						
	$\cdot CO_2^-$ + Ferredoxin (spinach) →	6.2×10^7	7.3		p.r.	D.k. at 420 nm in N_2O-satd. soln. contg. 1.0 mol L^{-1} formate.	81A279
		8.0×10^7	7.5		p.r.	D.k. at 420 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate.	731064
259	**Flavocytochrome b_2 (Fe^{3+})**						
	$\cdot CO_2^-$ + Fl b_2 (Fe^{3+}) → CO_2 + Fl b_2 (Fe^{2+})	2.1×10^8	7.0	0.16	p.r.	D.k. at 547 and 440 nm in N_2O-satd. formate soln. in phosphate buffer; cor. for $2k(\cdot CO_2^- + \cdot CO_2^-) = 1.1 \times 10^9$.	84A153
260	**Glucose oxidase**						
	$\cdot CO_2^-$ + GOX → redn. on flavin moiety	2.5×10^8	6.0		p.r.	P.b.k. at 560 nm in deaerated soln. contg. 3.5×10^{-5} mol L^{-1} GOX and 0.1 mol L^{-1} formate; nearly quantitative electron transfer.	84A473
261	**High-potential iron-sulfur protein (Chromatium vinosum D), reduced**						
	$\cdot CO_2^-$ + $Hipip_r$ →		7.0		p.r.	No reaction in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na formate contg. 5.0×10^{-3} mol L^{-1} phosphate.	80A432

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
262	**Laccase**						
	$\cdot CO_2^-$ + Cu-OXD → addn.	$>7 \times 10^9$	6.0		p.r.	Transient adduct obs. in soln. contg. 0.01 mol L^{-1} potassium phosphate; addn. followed by Cu^{2+} redn.; complex kinetics.	82A422
263	**Lysozyme**						
	$\cdot CO_2^-$ + RSSR → CO_2 + $RSSR^-$	1.5×10^8	4.8 ~6 10.8		p.r.	P.b.k. at 420 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate and 2×10^{-4} mol L^{-1} lysozyme; value from graph.	82A466
264	**Methemerythrin**						
	$\cdot CO_2^-$ + Fe^{3+}methem →	6.8×10^7	8.2	0.03	p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} formate; octamer from T. pyroides.	79A204
265	**Methemoglobin**						
	$\cdot CO_2^-$ + Fe^{3+} Hb →	$<8 \times 10^6$	9		p.r.	N_2O-satd. soln. contg. 0.1 mol L^{-1} formate ion.	81R003
266	**Metmyoglobin**						
	$\cdot CO_2^-$ + Fe^{3+}Mb →	2.9×10^9	8.2	0.03	p.r.	D.k. at 300 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} formate ion.	79A204
		2.0×10^9	7		p.r.	Redn. in soln. contg. 10^{-2} mol L^{-1} formate.	78A288
267	**$Cu^{II}Ru^{III}$ Plastocyanin**						
	$\cdot CO_2^-$ + Plastocyanin-CuRu →	7×10^8	7.0		p.r.	D.k. at 597 nm (Cu^{II}) in N_2O-satd. soln. contg. 0.10 mol L^{-1} phosphate and 0.10 mol L^{-1} formate; Plastocyanin from A. variabilis modified by addn. of $Ru(NH_3)_5^{3+}$ to His59; 65% redn. at Cu, 35% redn. at Ru.	87A033
268	**Riboflavin binding protein**						
	$\cdot CO_2^-$ + RBP → redn. on flavin moiety	7.0×10^7 2.6×10^7 2.2×10^7	5.2 7.0 9.0		p.r.	P.b.k. at 450 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; flavin reduction rate.	85A169
269	**Ribonuclease**						
	$\cdot CO_2^-$ + RNase →	3×10^8	7.3		p.r.	C.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} formate; rel. to $k(\cdot CO_2^-$ + lipoate) = 4.1×10^8.	85A169
270	**Ruthenium(III)-modified cytochrome c Fe^{3+}**						
	$\cdot CO_2^-$ + $Fe^{III}Ru^{III}$ Cyt c → $Fe^{II}Ru^{III}$ Cyt c	1.8×10^9	7.0		p.r.	Soln. cont. 0.1 mol L^{-1} Na formate and 0.1 mol L^{-1} phosphate buffer.	84A062
	$\cdot CO_2^-$ + $Fe^{III}Ru^{III}$ Cyt c → $Fe^{III}Ru^{II}$ Cyt c	5.4×10^9	7.0		p.r.	Soln. cont. 0.1 mol L^{-1} Na formate and 0.1 mol L^{-1} phosphate buffer.	84A062
271	**Superoxide dismutase**						
	$\cdot CO_2^-$ + SOD →	7.9×10^8	6.8		p.r.	D.k. at 680 nm in N_2O-satd. soln. contg. 0.1-0.01 mol L^{-1} formate ion and 12.5-100 $\times 10^{-6}$ mol L^{-1} SOD; bovine liver enzyme (Cu^{2+}).	85A436
272	**Transferrin, dicupric complex**						
	$\cdot CO_2^-$ + Transferrin, dicupric complex →	5.2×10^6	9		p.r.	Calcd from fraction Cu(II) reduced (obs. at 435 nm) and model including competing reactions, in 0.1 mol L^{-1} formate and 2.5×10^{-2} mol L^{-1} $KHCO_3$.	82A086

TABLE 3. Rate constants for reactions of the carbon dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
273	**Transferrin, diferric complex**						
	$\cdot CO_2^-$ + Transferrin, diferric complex → Fe(III) redn.	2.1×10^6	9		p.r.	Calcd. from fraction Fe(III) reduced (obs. at 470 nm) and model including competing reactions, in 0.1 mol formate and 2.5×10^{-2} mol L^{-1} $KHCO_3$.	82A086
273a	**Transferrin, ferric complex**						
	$\cdot CO_2^-$ + Transferrin, ferric complex → protein redn.	3.8×10^8	7.0		p.r.	P.b.k. at 420 nm in N_2O-satd. soln. contg. formate ion; bleaching at 465 nm (Fe^{III} reduction) gave an estimated $k = 2.1 \times 10^6$.	87A281
274	**Transferrin, dimanganic complex**						
	$\cdot CO_2^-$ + Transferrin, dimanganic complex →	5.1×10^6	9		p.r.	Calcd. from fraction Mn(III) reduced (obs. at 420 nm) and model including competing reactions, in 0.1 mol formate and 2.5×10^{-2} mol L^{-1} $KHCO_3$.	82A086
275	**Zinc(II) insulin complex**						
	$\cdot CO_2^-$ + Zinc(II) insulin →	6×10^8	9.0	0.05	p.r.	P.b.k. at 420 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} formate; based on monomer concn. (1.5-2.0 × 10^{-5} mol L^{-1}); k decreased to 2×10^8 on the fourth pulse.	80A204

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Carbonate radical ion**						
	$CO_3^{\cdot -} + CO_3^{\cdot -} \rightarrow$	1.4×10^7	12.5	0.2	f.p.	D.k. at 600 nm in 5×10^{-3} mol L^{-1} carbonate soln.	86A476
					p.r.	D.k. at 600 nm; decreases 0-70°C; 2 $CO_3^{\cdot -} \rightleftharpoons C_2O_6^{2-} \rightarrow$ products; $K_{eq} < 1$, $2k_{obs} = K_{eq}k_p$, $E_{app} = \Delta H_{eq} + (E_a)_p = -8 \pm 4$ kJ mol^{-1}; also see [78A256] for mechanism.	85A427
		9×10^6		0.1	p.r.	D.k. at 600 nm in 0.05 mol L^{-1} sodium carbonate soln. using $\epsilon = 1830$ L mol^{-1} cm^{-1}.	84A155
		1.0×10^7			p.r.	D.k.; no temperature dependence 10-70°C.	83A389
		5×10^6	10-13	$\rightarrow 0$	f.p.	D.k.; $\epsilon(600) = 1860$ L mol^{-1} cm^{-1}	78A443
		9.3×10^6	8.0-8.5		f.p.	D.k. at 600 nm in soln. contg. $S_2O_8^{2-}$ and HCO_3^-.	77A230
		7.5×10^6		$\rightarrow 0$	p.r.	D.k. in N_2O-satd. soln. contg. 0.1-4 mol L^{-1} K_2CO_3; extrapolated from 0.1 mol L^{-1} soln., $\epsilon = 1860$ L mol^{-1} cm^{-1}.	761209
		9.5×10^6 1.5×10^7	10.2 12.7		p.r.	D.k. at 600 nm in N_2O-satd. soln.; $\epsilon = 1830$ L mol^{-1} cm^{-1}; 0.1 mol L^{-1} K_2CO_3.	737100
		2×10^7	7-9	0.1	f.p.	D.k. at 600 nm in air-satd. $Co(NH_3)_4CO_3^+$ soln.; $\epsilon = 1830$ L mol^{-1} cm^{-1}.	737109
		6.2×10^6	8.4-13.5	$\rightarrow 0$	p.r.	D.k. at 600 nm in N_2O-satd. soln.; $\epsilon = 1860$ L mol^{-1} cm^{-1}; $k_{obs} \simeq 5 \times 10^7$ at pH 13-13.5.	660139
2	**Bromide ion**						
	$CO_3^{\cdot -} + Br^- \rightarrow$	$<5 \times 10^5$	~11		p.r.	No reaction.	78A901
3	**Hypobromite ion**						
	$CO_3^{\cdot -} + BrO^- \rightarrow BrO + CO_3^{2-}$	4.3×10^7	13	0.4	p.r.	D.k.	680153
4	**Bromite ion**						
	$CO_3^{\cdot -} + BrO_2^- \rightarrow BrO_2^{\cdot} + CO_3^{2-}$	5.0×10^7		0.15	f.p.	D.k. at 600 nm in O_2-free soln. contg. 2×10^{-3} mol L^{-1} $KBrO_4$ and 5×10^{-2} mol L^{-1} Na_2CO_3.	757099
		1.1×10^8	13	0.4	p.r.	D.k.	680153
5	**Carbon dioxide radical anion**						
	$CO_3^{\cdot -} + {\cdot}CO_2^- \rightarrow CO_2 + CO_3^{2-}$	5×10^7			γ-r.	Calcd. by computer fitting with initial yields of formate and oxalate in O_2-free soln. contg. 0.5-1 mol L^{-1} ammonium bicarbonate; complex mechanism.	86A502
6	**Cyanate ion**						
	$CO_3^{\cdot -} + NCO^- \rightarrow$	$\sim 1 \times 10^3$			p.r.	D.k. at 600 nm.	87A220
7	**Hypochlorite ion**						
	$CO_3^{\cdot -} + ClO^- \rightarrow CO_3^{2-} + ClO^{\cdot}$	5.1×10^5	11.6		p.r.	D.k. at 600 nm in N_2O-satd. soln. contg. 0.5 mol L^{-1} carbonate ion and 2-15 $\times 10^{-3}$ mol L^{-1} ClO^-.	87A907
8	**Chlorite ion**						
	$CO_3^{\cdot -} + ClO_2^- \rightarrow CO_3^{2-} + ClO_2^{\cdot}$	3.1×10^7	11.7		p.r.	D.k. at 600 nm in 0.1 mol L^{-1} Na_2CO_3 soln.	86A059

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
9	**Cobalt(II) ion**						
	$CO_3^{\cdot -} + Co^{2+} \rightarrow$	2.8×10^6	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
		4.4×10^6	7.0	0.03			737109
10	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecobalt(II) ion**						
	$CO_3^{\cdot -} + Co(4,11\text{-}dieneN_4)^{2+} \rightarrow$	7.3×10^8	4.7	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
11	**2,3,9,10-Tetramethyl-1,4,8,11-tetraazacyclotetradeca-1,3,8,10-tetraenecobalt(II) ion**						
	$CO_3^{\cdot -} + Co(tetraeneN_4)^{2+} \rightarrow$	6.9×10^8	4.7	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
12	**Tetraammine(diaqua)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_4(H_2O)_2^{3+} \rightarrow$	1.4×10^7	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737109
13	**Pentaammine(aqua)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5H_2O^{3+} \rightarrow$	$\sim 3 \times 10^4$	<5.6	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.; pK_a for complex = 6.6.	78A380
		1.7×10^6	>7.6				
14	**Hexaamminecobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_6^{3+} \rightarrow$	$<5 \times 10^4$	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
15	**Pentaammine(bromo)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5Br^{2+} \rightarrow$	5.7×10^6	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
16	**Pentaammine(chloro)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5Cl^{2+} \rightarrow$	2.0×10^6	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
17	**Tetraammine(carbonato)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_4CO_3^{+} \rightarrow$	$<1 \times 10^6$	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737109
18	**Pentaammine(nitrito-*N*)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5NO_2^{2+} \rightarrow$	1.0×10^8	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
19	**Pentaammine(hydrogen phosphato)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5OPO_3H^{+} \rightarrow$	$<4 \times 10^5$	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
20	**Pentaammine(sulfito)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5OSO_2^{+} \rightarrow$	1.1×10^6	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
21	**Pentaammine(sulfato)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5OSO_3^{+} \rightarrow$	1.5×10^6	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
22	**(Acetato)pentaamminecobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5O_2CCH_3^{2+} \rightarrow$	1.1×10^6	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
23	**Pentaammine(benzoato)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(NH_3)_5O_2CC_6H_5^{2+} \rightarrow$	7×10^5	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
24	**Tris(ethylenediamine)cobalt(III) ion**						
	$CO_3^{\cdot -} + Co(en)_3^{3+} \rightarrow$	$<1 \times 10^5$	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
25	**Pentaammineaquachromium(III) ion**						
	$CO_3\cdot^- + Cr(NH_3)_5H_2O^{3+} \rightarrow$	4×10^5 7×10^5	<4.3 >6.3	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.; pK_a for complex = 5.3.	78A380
26	**Pentaammine(chloro)chromium(III) ion**						
	$CO_3\cdot^- + Cr(NH_3)_5Cl^{2+} \rightarrow$	$<1 \times 10^5$	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
27	**Copper(II) ion**						
	$CO_3\cdot^- + Cu^{2+} \rightarrow$	$\sim 1 \times 10^4$	4.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
28	**Ferrocyanide ion**						
	$CO_3\cdot^- + Fe(CN)_6^{4-} \rightarrow Fe(CN)_6^{3-} + CO_3^{2-}$	2.7×10^8	11.6		p.r.	D.k. at 600 nm as well as p.b.k. at 420 nm for ferricyanide ion in soln. contg. 0.072 mol L^{-1} Na_2CO_3, 1.22 × 10^{-4} mol L^{-1} ferrocyanide, 0.03% oxygen and 0.1 atm N_2O; at pH 13 $k \sim (3.5\text{-}4.0) \times 10^8$.	660139
29	**Iodide ion**						
	$CO_3\cdot^- + I^- \rightarrow I\cdot + CO_3^{2-}$	1.3×10^8	~11	→0	p.r.	D.k. at 600 nm.	78A901
30	**Pentaammine(chloro)iridium(III) ion**						
	$CO_3\cdot^- + Ir(NH_3)_5Cl^{2+} \rightarrow$	2.4×10^7	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
31	**Manganese(II) ion**						
	$CO_3\cdot^- + Mn^{2+} \rightarrow$	1.5×10^7	6.0	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
32	**Amino radical**						
	$CO_3\cdot^- + \cdot NH_2 \rightarrow CO_2 + NH_2O^-$	1.5×10^9	7.8		p.r.	D.k. at 600 nm in soln. contg. 5 × 10^{-2} mol L^{-1} ammonium bicarbonate; radicals from equal reactivity of ·OH with NH_3 and HCO_3^-.	86A502
33	**Nitrogen dioxide**						
	$CO_3\cdot^- + \cdot NO_2 \rightarrow CO_2 + NO_3^-$	1.0×10^9	~11		p.r.	Est. from opt. and condy. d.k.	78A256
34	**Nitrite ion**						
	$CO_3\cdot^- + NO_2^- \rightarrow \cdot NO_2 + CO_3^{2-}$	4.0×10^5	~11	→0	p.r.	D.k. at 600 nm.	78A256
35	**Nickel(II) ion**						
	$CO_3\cdot^- + Ni^{2+} \rightarrow$	$<1 \times 10^4$	5.8	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
36	**Tris(carbonato)dioxoneptunate(V) ion**						
	$CO_3\cdot^- + NpO_2(CO_3)_3^{5-} \rightarrow CO_3^{2-} + NpO_2(CO_3)_3^{4-}$	1.5×10^7			p.r.	D.k. at 600 nm in 0.05 mol L^{-1} sodium carbonate soln.; Np(V) produced by hydrated electron reaction.	84A155
37	**Superoxide radical ion**						
	$CO_3\cdot^- + O_2\cdot^- \rightarrow CO_3^{2-} + O_2$	6.5×10^8	7.4, 11.4	0.1	p.r.	D.k. at 600 nm assuming $G(O_2\cdot^-)$ = 3.3 and $G(CO_3\cdot^- + CO_3\cdot)$ = 2.7, $\epsilon_{600}(CO_3\cdot^-)$ = 1910 L mol^{-1} cm^{-1}.	85A427
		4×10^8	~11.8	0.6	f.p.	D.k. at 260 nm (O_2^-), ϵ = 1850 L mol^{-1} cm^{-1} and 600 nm ($CO_3\cdot^-$) in O_2-satd. soln., ϵ = 1860 L mol^{-1} cm^{-1}; product (CO_5^{2-} ?) has ϵ(260 nm) = 410 L mol^{-1} cm^{-1}.	700247

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
38	**Hydrogen peroxide**						
	$CO_3^{\cdot -} + H_2O_2 \rightarrow HO_2^{\cdot} + HCO_3^-$	4.3×10^5				Cited from [86A902].	86A502
		$\leq 5 \times 10^5$			p.r.		83A165
		8×10^5	8-9	3	f.p.	D.k. at 600 nm in N_2—satd. soln.; pH-dependent (9-13).	700247
39	**Hydroperoxide ion**						
	$CO_3^{\cdot -} + HO_2^- \rightarrow O_2^{\cdot -} + HCO_3^-$	3×10^7				computer fitting.	86A502
		1.0×10^7			p.r.		83A165
		5.6×10^7	13-14	3	f.p.	D.k. at 600 nm in N_2—satd. soln.; pH-dependent (9-13).	700247
41	**Ozone**						
	$CO_3^{\cdot -} + O_3 \rightarrow$	$<1 \times 10^5$	10.4		p.r.	D.k. of $CO_3^{\cdot -}$ in soln. contg. 0.1 mol L^{-1} HCO_3^- and 9×10^{-5} mol L^{-1} ozone.	83A117
42	**Ozonide ion**						
	$CO_3^{\cdot -} + O_3^{\cdot -} \rightarrow O_3 + CO_3^{2-}$	6×10^7	12-13.8		p.r.	D.k. at 430 nm (O_3^-), 600 nm ($CO_3^{\cdot -}$) and p.b.k. at 260 nm (O_3) in soln. contg. 10^{-2}-1 mol L^{-1} Na_2CO_3, ~0.9 mol L^{-1} N_2O (4×10^6 N m^{-2}) and 1.2×10^{-3}-0.12 mol L^{-1} O_2 (0.1-10 $\times 10^6$ N m^{-2}); computer simulation.	82A134
43	***cis*-Bis(glycinato)platinum(II)**						
	$CO_3^{\cdot -}$ + *cis*-Pt(Gly)$_2$ $\rightarrow$	4.4×10^9	8.5	0.05	p.r.	D.k. in 0.05 mol L^{-1} $NaHCO_3$.	771053
44	***trans*-Bis(glycinato)platinum(II)**						
	$CO_3^{\cdot -}$ + *trans*-Pt(Gly)$_2$ $\rightarrow$	3.4×10^9	8.5	0.05	p.r.	D.k. in 0.05 mol L^{-1} $NaHCO_3$.	771053
45	**Tris(carbonato)dioxoplutonate(V) ion**						
	$CO_3^{\cdot -} + PuO_2(CO_3)_3^{5-} \rightarrow CO_3^{2-} + PuO_2(CO_3)_3^{4-}$	2.7×10^7			p.r.	D.k. at 600 nm in 0.05 mol L^{-1} sodium carbonate soln.; Pu(V) produced by hydrated electron reaction.	84A155
46	**Tris(carbonato)dioxoplutonate(VI) ion**						
	$CO_3^{\cdot -} + PuO_2(CO_3)_3^{4-} \rightarrow CO_3^{2-} + PuO_2(CO_3)_3^{3-}$	1.5×10^7 5×10^6	12.5 12.5	0.26 0.05	f.p.	D.k. at 600 nm in soln. contg. 5-10 $\times 10^{-3}$ mol L^{-1} Na_2CO_3 and (50-125) $\times 10^{-6}$ mol L^{-1} Pu(VI).	86A476
47	**Pentaammine(aqua)rhodium(III) ion**						
	$CO_3^{\cdot -} + Rh(NH_3)_5H_2O^{3+} \rightarrow$	1×10^5 $<5 \times 10^4$	>6.9 <4.9	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.; pK_a for complex = 5.9.	78A380
48	**Pentaammine(chloro)rhodium(III) ion**						
	$CO_3^{\cdot -} + Rh(NH_3)_5Cl^{2+} \rightarrow$	$<1 \times 10^4$	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
49	**Pentaammine(aqua)ruthenium(III) ion**						
	$CO_3^{\cdot -} + Ru(NH_3)_5(H_2O)^{3+} \rightarrow$	1.8×10^8 1.4×10^9	<3.2 >5.2	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.; pK_a for complex = 4.2.	78A380
50	**Hexaammineruthenium(III) ion**						
	$CO_3^{\cdot -} + Ru(NH_3)_6^{3+} \rightarrow$	6.0×10^6	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
51	**Chloropentaammineruthenium(III) ion**						
	$CO_3\cdot^- + Ru(NH_3)_5Cl^{2+} \rightarrow$	7.7×10^6	6.5	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
52	**Tris(2,2'-bipyridine)ruthenium(II) ion**						
	$CO_3\cdot^- + Ru(bpy)_3^{2+} \rightarrow$	4.0×10^8		0.02	p.r.	D.k. of the Ru complex in N_2O-satd. soln. contg. 0.005 mol L^{-1} each of HCO_3^- and CO_3^{2-}.	771093
53	**Thiocyanate ion**						
	$CO_3\cdot^- + SCN^- \rightarrow SCN\cdot + CO_3^{2-}$	8×10^5	~11		p.r.	D.k. at 600 nm.	78A901
54	**Sulfite radical ion**						
	$CO_3\cdot^- + \dot{S}O_3^- \rightarrow CO_2 + SO_4^{2-}$	5.5×10^8	9.6		p.r.	D.k. at 260 nm; also condy. study.	78A256
55	**Sulfite ion**						
	$CO_3\cdot^- + SO_3^{2-} \rightarrow CO_3^{2-} + \dot{S}O_3^-$	1.3×10^7	~11	→0	p.r.	D.k. at 600 nm.	78A256
56	**Selenate(VI) ion**						
	$CO_3\cdot^- + SeO_4^{2-} \rightarrow CO_3^{2-} + SeO_4\cdot^-$	4.3×10^7	13.1		p.r.	D.k.	78A259
57	**Triscarbonatodioxouranate(V) ion**						
	$CO_3\cdot^- + UO_2(CO_3)_3^{5-} \rightarrow UO_2(CO_3)_3^{4-} + CO_3^{2-}$	4.9×10^8			p.r.	D.k. at 600 nm in 0.05 mol L^{-1} sodium carbonate soln.; U(V) produced by hydrated electron reaction.	84A155
58	**Uranyl(VI) ion**						
	$CO_3\cdot^- + UO_2^{2+} \rightarrow$	$\sim 1.5 \times 10^5$	nat.		f.p.	D.k. at 580 nm in 10^{-2} mol L^{-1} $NaHCO_3$; results somewhat irreproducible.	767279
59	**Zinc(II) ion**						
	$CO_3\cdot^- + Zn^{2+} \rightarrow$	$<1 \times 10^4$	4.7	0.04	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	78A380
60	**Acetanilide**						
	$CO_3\cdot^- + C_6H_5NHCOCH_3 \rightarrow$	3.2×10^5	7.0	0.06	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	757313
61	**Acetate ion**						
	$CO_3\cdot^- + CH_3CO_2^- \rightarrow$	6×10^2	12.1-12.7		f.p.	D.k. at 600 nm in air-satd. soln. contg. 0.05 mol L^{-1} $Na_2S_2O_8$, 0.5 mol L^{-1} Na_2CO_3; $CO_3\cdot^-$ generated from $SO_4^- + CO_3^{2-} \rightarrow SO_4^{2-} + CO_3^-$.	727383
62	**Acetone**						
	$CO_3\cdot^- + CH_3COCH_3 \rightarrow$	1.6×10^2	12.1-12.7		f.p.	D.k. at 600 nm in air-satd. soln. contg. 0.05 mol L^{-1} $Na_2S_2O_8$, 0.5 mol L^{-1} Na_2CO_3; $CO_3\cdot^-$ from reaction of $SO_4^- + CO_3^{2-}$.	727383
63	**Acetonitrile**						
	$CO_3\cdot^- + CH_3CN \rightarrow$	3.2×10^3	12.1-12.7		f.p.	D.k. at 600 nm in air-satd. soln. contg. 0.05 mol L^{-1} $Na_2S_2O_8$, 0.5 mol L^{-1} Na_2CO_3; $CO_3\cdot^-$ from reaction of $SO_4^- + CO_3^{2-}$.	727383

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
64	**Acetophenone**						
	$CO_3^{\cdot -} + C_6H_5COCH_3 \rightarrow$	3×10^5			p.r.	D.k. at 600 nm; $CO_3^{\cdot -}$ also reacts with acetophenone-OH adduct, $k = 1.5 \times 10^9$.	78A901
65	***N*-Acetylcysteine**						
	$CO_3^{\cdot -}$ + AcCysSH $\rightarrow$	$\sim 1 \times 10^7$ 1.8×10^8	7 12.0		f.p.	D.k. at 600 nm; rate pH dependent; value from graph; $CO_3^{\cdot -}$ generated from $Co(NH_3)_4CO_3^+$.	757110
66	***N*-Acetylglycine**						
	$CO_3^{\cdot -}$ + AcGly $\rightarrow$	$<1 \times 10^4$	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
67	***N*-Acetylglycylglycine**						
	$CO_3^{\cdot -}$ + AcGlyGly $\rightarrow$	$<1 \times 10^4$	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
68	***N*-Acetyltryptophan**						
	$CO_3^{\cdot -}$ + AcTrpH $\rightarrow$	4.2×10^8 6.2×10^8	7 11.8	0.1	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737109
69	**Alanine**						
	$CO_3^{\cdot -}$ + Ala $\rightarrow$	$<1 \times 10^3$	7.0	0.06	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
70	**4-Aminobenzoate ion**						
	$CO_3^{\cdot -} + 4\text{-}H_2NC_6H_4CO_2^- \rightarrow$	2.0×10^8	8.5		f.p.	D.k. at 600 nm in soln. contg. 2×10^{-5} mol L^{-1} $Co(NH_3)_4CO_3^+$ and $5\text{-}7 \times 10^{-6}$ mol L^{-1} 4-aminobenzoate.	84A510
71	**Aniline**						
	$CO_3^{\cdot -} + C_6H_5NH_2 \rightarrow HCO_3^- + C_6H_5\dot{N}H$	5.0×10^8	8.5		f.p.	D.k. at 600 nm in soln. contg. 2×10^{-5} mol L^{-1} $Co(NH_3)_4CO_3^+$ and $3\text{-}5 \times 10^{-6}$ mol L^{-1} aniline.	84A510
		6.0×10^8			p.r.	D.k. at 600 nm.	78A901
		5.4×10^8	7.0	0.06	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	757313
72	**Anisole**						
	$CO_3^{\cdot -} + C_6H_5OCH_3 \rightarrow$	2.8×10^5			p.r.	D.k. at 600 nm; $CO_3^{\cdot -}$ also reacts with anisole-OH adduct, $k \approx 3 \times 10^9$.	78A901
73	**Anthrasemiquinone-2,6-disulfonate, radical ion**						
	$CO_3^{\cdot -} + [(SO_3)_2AQ]^{\cdot 3-} \rightarrow CO_3^{2-} + [(SO_3)_2AQ]^{2-}$	$\sim 1.5 \times 10^9$	7-13		f.p.	D.k. in $NaHCO_3$ soln.	727335 737569 727464
74	**Anthrasemiquinone-2,7-disulfonate, radical ion**						
	$CO_3^{\cdot -} + [(SO_3)_2AQ]^{\cdot 3-} \rightarrow CO_3^{2-} + [(SO_3)_2AQ]^{2-}$	1.9×10^9			f.p.	D.k. at 600 nm in air-satd. soln. contg. 0.05 mol L^{-1} $Na_2S_2O_8$ and 0.5 mol L^{-1} Na_2CO_3; $CO_3^{\cdot -}$ from reaction of $SO_4^{\cdot -} + CO_3^{2-}$; semiquinone formed from CO_3^{2-} and triplet anthraquinonesulfonate.	727383
75	**Anthrasemiquinone-1-sulfonate, radical ion**						
	$CO_3^{\cdot -} + [SO_3AQ]^{\cdot 2-} \rightarrow CO_3^{2-} + SO_3AQ^-$	4.6×10^9			f.p.	D.k. at 600 nm in air-satd. soln.	727383

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
76	**Anthrasemiquinone-2-sulfonate, radical ion**						
	$CO_3\cdot^- + [SO_3AQ]\cdot^{2-} \rightarrow CO_3^{2-} + SO_3AQ^-$	2.2×10^9			f.p.	D.k. at 600 nm in air-satd. soln.	727383
77	**Arginine**						
	$CO_3\cdot^- + Arg \rightarrow$	9×10^4	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
78	**Ascorbate ion**						
	$CO_3\cdot^- + AH^- \rightarrow CO_3^{2-} + H^+ + \cdot A^-$	1.1×10^9	11		p.r.	D.k. at 600 nm in N_2O-satd. 0.5 mol L^{-1} carbonate soln.	733006
79	**Aspartate monoanion**						
	$CO_3\cdot^- + Asp^- \rightarrow$	$<1 \times 10^4$	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
80	**Benzene**						
	$CO_3\cdot^- + PhH \rightarrow$	$<5 \times 10^4$	11.7		p.r.	Benzene (1.4×10^{-3} mol L^{-1}) had no effect on decay of $CO_3\cdot^-$; $CO_3\cdot^-$ reacts with benzene-OH adduct, $k = 2 \times 10^9$.	78A901
		3×10^3	7.0	0.00	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln; uncertainty 50-100%.	757313
81	**Benzophenone**						
	$CO_3\cdot^- + (C_6H_5)_2CO \rightarrow$	1.5×10^6			f.p.	D.k. at 550 nm in O_2-free 0.3 mol L^{-1} carbonate soln.	717574
82	**Benzylamine**						
	$CO_3\cdot^- + C_6H_5CH_2NH_2 \rightarrow$	7.5×10^5	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
83	**4-Bromoaniline**						
	$CO_3\cdot^- + BrC_6H_4NH_2 \rightarrow HCO_3^- + BrC_6H_4\dot{N}H$	3.8×10^8	8.5		f.p.	D.k. at 600 nm in soln. contg. 2×10^{-5} mol L^{-1} $Co(NH_3)_4CO_3^+$.	84A510
84	**4-Bromophenoxide ion**						
	$CO_3\cdot^- + BrC_6H_4O^- \rightarrow CO_3^{2-} + BrC_6H_4O\cdot$	1.8×10^8	12.2	0.3	p.r.	D.k. at 570 nm in N_2O-satd. carbonate soln.	771098
85	**Butylamine**						
	$CO_3\cdot^- + CH_3(CH_2)_3NH_2 \rightarrow$	4.0×10^5	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
86	***tert*-Butylamine**						
	$CO_3\cdot^- + (CH_3)_3CNH_2 \rightarrow$	5.8×10^4	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
87	**Chloroacetate ion**						
	$CO_3\cdot^- + ClCH_2CO_2^- \rightarrow$	$\leq 2.0 \times 10^3$	12.1-12.7	1.65	f.p.	D.k. at 600 nm in air-satd. $S_2O_8^{2-}$ soln.; $CO_3\cdot^-$ generated by $SO_4^- + CO_3^{2-} \rightarrow SO_4^{2-} + CO_3\cdot^-$.	727383
88	**4-Chloroaniline**						
	$CO_3\cdot^- + ClC_6H_4NH_2 \rightarrow HCO_3^- + ClC_6H_4\dot{N}H$	4.3×10^8	8.5		f.p.	D.k. at 600 nm in soln. contg. 2×10^{-5} mol L^{-1} $Co(NH_3)_4CO_3^+$.	84A510
89	**4-Chlorophenoxide ion**						
	$CO_3\cdot^- + ClC_6H_4O^- \rightarrow CO_3^{2-} + ClC_6H_4O\cdot$	1.9×10^8	12.2	0.3	p.r.	D.k. at 570 nm in N_2O-satd. carbonate soln.	771098

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
90	**Chlorophyll *a***						
	$CO_3\cdot^-$ + Chl a → CO_3^{2-} + [Chl-a]$\cdot^+$	2.0×10^8			p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} Br^-; rate for aqueous phase, k in micellar phase = 1.6×10^8.	81N140
91	**Cyclohexylamine**						
	$CO_3\cdot^-$ + c-$C_6H_{11}NH_2$ →	7.2×10^5	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
92	**Cysteine**						
	$CO_3\cdot^-$ + CysSH → HCO_3^- + CysS$\cdot$	4.6×10^7 3.5×10^8 2.5×10^8	7.0 ~10 12	0.03	f.p.	D.k. at 600 nm; HCO_3 or $CO_3\cdot^-$ generated from $Co(NH_3)_4CO_3^+$; values from graph.	737352, 757110
		2.7×10^8	11.2	0.3	p.r.	D.k. in N_2O-satd. soln.	720036
93	**Cysteine, methyl ester**						
	$CO_3\cdot^-$ + $HSCH_2CH(NH_3^+)CO_2CH_3$ → HCO_3^- + $\cdot SCH_2CH(NH_3^+)CO_2CH_3$	$\sim 1 \times 10^7$	4-10	0.03	f.p.	D.k. at 600 nm; value from graph; HCO_3 or $CO_3\cdot^-$ generated from $Co(NH_3)_4CO_3^+$.	757110
94	**Cystine dimethyl ester**						
	$CO_3\cdot^-$ + $S_2[CH_2CH(NH_2)CO_2CH_3)_2$ →	7.2×10^6	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
95	**1,4-Diazabicyclo[2.2.2]octane**						
	$CO_3\cdot^-$ + DABCO → CO_3^{2-} + DABCO$\cdot^+$	1.7×10^7	11.5		f.p.	D.k. at 620 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
96	**Dibutylamine**						
	$CO_3\cdot^-$ + $[CH_3(CH_2)_3]_2NH$ →	5.0×10^6	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
97	**Diethylamine**						
	$CO_3\cdot^-$ + $(C_2H_5)_2NH$ →	3.8×10^6	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
98	**Diethyl disulfide**						
	$CO_3\cdot^-$ + $C_2H_5SSC_2H_5$ →	4.5×10^7 6.6×10^7	~8 ~11		p.r.	D.k. at 600 nm in N_2O-satd. soln.; 0.1-1.0 mol L^{-1} HCO_3^- or CO_3^{2-}.	761143
99	***N,N*-Diethylhydroxylamine**						
	$CO_3\cdot^-$ + $(C_2H_5)_2NOH$ →	4.3×10^7			p.r.	D.k. in soln. contg. 0.1 mol L^{-1} Na carbonate and $0.26\text{-}10 \times 10^{-3}$ mol L^{-1} amine.	79A162
100	**2,3-Dihydrophthalazine-1,4-dione**						
	$CO_3\cdot^-$ + -NHN$^-$- → CO_3^{2-} + -$\dot{N}$-NH-	$\geq 8 \times 10^8$			p.r.	D.k. in N_2O-satd. soln. contg. carbonate ion; substrate oxidized as monoanion, pK_a ~ 7; benzo-, 6-amino-, 6-hydroxy-, and 6-(dimethylamino)- derivatives gave the same results.	86A399

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
101	**2,3-Dihydrophthalazine-1,4-dione-2-yl**						
	$CO_3^{\cdot-}$ + -$\dot{N}$-NH- → CO_3^{2-} + -N=N- + H^+	≥10^9			p.r.	D.k. in N_2O-satd. soln. contg. carbonate ion; also benzo-, 5-amino-, 6-amino-, 6-hydroxy-, and 6-(dimethylamino)- derivatives gave the same results.	86A399
102	***N,N*-Dimethylaniline**						
	$CO_3^{\cdot-}$ + $C_6H_5N(CH_3)_2$ → CO_3^{2-} + $[C_6H_5N(CH_3)_2]^{\cdot+}$	1.4×10^9			p.r.	D.k. at 600 nm, as well as condy.	78A901
		1.8×10^9	7.0	0.06	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	757313
103	***N,N*-Dimethylbenzylamine**						
	$CO_3^{\cdot-}$ + $C_6H_5CH_2N(CH_3)_2$ →	3.4×10^6	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
104	***N,N*-Dimethyl-*tert*-butylamine**						
	$CO_3^{\cdot-}$ + $(CH_3)_3CN(CH_3)_2$ →	3.0×10^6	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
105	**Dimethyl disulfide**						
	$CO_3^{\cdot-}$ + CH_3SSCH_3 → CO_3^{2-} + $[CH_3SSCH_3]^{\cdot+}$	1.0×10^8 8.0×10^7	~8 11		p.r.	D.k. at 600 nm in N_2O-satd. soln.; 0.1-1.0 mol L^{-1} HCO_3^- or CO_3^{2-}.	761143
105a	**2,3-Dimethylindole**						
	$CO_3^{\cdot-}$ + Me_2InH → CO_3^{2-} + $Me_2In^{\cdot}$ + H^+	2.5×10^9	9.3		p.r.	D.k. at 600 nm.	87A247
106	***N,N*-Dimethyl-4-nitrosoaniline**						
	$CO_3^{\cdot-}$ + $Me_2NC_6H_4NO$ → CO_3^{2-} + $[Me_2NC_6H_4NO]^{\cdot+}$	5.3×10^8			p.r.	D.k. at 440 nm in N_2O-satd. soln. contg. CO_3^{2-}.	680066
107	**Dipropylamine**						
	$CO_3^{\cdot-}$ + $(CH_3CH_2CH_2)_2NH$ →	4.5×10^6	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
108	**3,3'-Dithiobis(propionate ion)**						
	$CO_3^{\cdot-}$ + RSSR → CO_3^{2-} + $[RSSR]^{\cdot+}$	1.3×10^7	7-12		f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$; value from graph.	757110
		1.3×10^7 3.0×10^7	6.8 11.5	0.1	f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$.	737109
109	**Dithiothreitol**						
	$CO_3^{\cdot-}$ + $HSCH_2CHOHCHOHCH_2SH$ → HCO_3^- + $^{\cdot}SCH_2CHOHCHOHCH_2SH$	4.1×10^8	10.5	0.3	p.r.	D.k. at 600 nm in N_2O-satd. carbonate soln.	731020
110	**Duroquinone**						
	$CO_3^{\cdot-}$ + DQ →	$<1 \times 10^6$	12		p.r.	No reaction; previously reported [767587] $k = 2 \times 10^9$ suggested to be for different reaction.	78A901

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
111	**Ethanol**						
	$CO_3\cdot^- + C_2H_5OH \rightarrow CH_3\dot{C}HOH + CO_3^{2-}$	1.5×10^4	12.5		f.p.	D.k. at 600 nm in air-satd. soln. contg. 0.05 mol L^{-1} $Na_2S_2O_8$ and 0.5 mol L^{-1} Na_2CO_3; $CO_3\cdot^-$ generated from $SO_4^- + CO_3^{2-}$; also reported 2.1×10^4 [697104], and $\sim 1.5 \times 10^4$ [707262, 717574].	727383
112	**Ethoxybenzene**						
	$CO_3\cdot^- + C_6H_5OC_2H_5 \rightarrow CO_3^{2-} + [C_6H_5OC_2H_5]\cdot^+$	4.1×10^5	7.0	0.06	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	757313
113	**Ethyl 4-aminobenzoate**						
	$CO_3\cdot^- + H_2NC_6H_4CO_2C_2H_5 \rightarrow HCO_3^- + H\dot{N}C_6H_4CO_2C_2H_5$	2.0×10^8	8.5		f.p.	D.k. at 600 nm in soln. contg. 2×10^{-5} mol L^{-1} $Co(NH_3)_4CO_3^+$.	84A510
114	**Ethylenediaminetetraacetate ion**						
	$CO_3\cdot^- + [CH_2N(CH_2CO_2^-)_2]_2 \rightarrow$	1.1×10^6		$\rightarrow 0$	p.r.	D.k. at 600 nm.	78A901
115	**4-Fluoroaniline**						
	$CO_3\cdot^- + FC_6H_4NH_2 \rightarrow HCO_3^- + FC_6H_4\dot{N}H$	6.2×10^8	8.5		f.p.	D.k. at 600 nm in soln. contg. 2×10^{-5} mol L^{-1} $Co(NH_3)_4CO_3^+$.	84A510
116	**Formate ion**						
	$CO_3\cdot^- + HCO_2^- \rightarrow \cdot CO_2^- + HCO_3^-$	1.5×10^5				Equilibrium reaction efficient at low dose and large bicarbonate concn. (0.5-1 mol L^{-1}); computer fitting.	86A502
		1.6×10^5		$\rightarrow 0$	p.r.	D.k. at 600 nm.	78A901
		1.1×10^5	6.4	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737109
117	**Glucose**						
	$CO_3\cdot^-$ + glucose $\rightarrow$	7×10^4	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
118	**Glutathione**						
	$CO_3\cdot^-$ + GSH $\rightarrow HCO_3^-$ + GS$\cdot$	5.3×10^6	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
119	**Glutathione, oxidized**						
	$CO_3\cdot^-$ + GSSG $\rightarrow CO_3^{2-}$ + [GSSG]$\cdot^+$	1.3×10^6	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
120	**Glycine**						
	$CO_3\cdot^-$ + Gly $\rightarrow$	$<1 \times 10^3$	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
121	**Glycylglycine**						
	$CO_3\cdot^-$ + GlyGly $\rightarrow$	2×10^4	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
122	**Glycylglycylglycine**						
	$CO_3\cdot^-$ + GlyGlyGly $\rightarrow$	4×10^4	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
123	**Glycylglycyltryptophan**						
	$CO_3\cdot^-$ + GlyGlyTrpH $\rightarrow HCO_3^-$ + GlyGlyTrp$\cdot$	7×10^8 4×10^8	6-7 10		f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	747296
124	**Glycylhistidine**						
	$CO_3\cdot^-$ + GlyHis $\rightarrow$	4.3×10^6	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
125	**Glycyltryptophan**						
	$CO_3\cdot^- + GlyTrpH \rightarrow HCO_3^- + GlyTrp\cdot$	8.2×10^8 4.5×10^8	6 10		f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$; value from graph	747296
		7.2×10^8	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
126	**Glycyltyrosine**						
	$CO_3\cdot^- + GlyTyrOH \rightarrow HCO_3^- + GlyTyrO\cdot$	3.0×10^7	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
127	**Hexamethylenetetramine**						
	$CO_3\cdot^- + C_6H_{12}N_4 \rightarrow$	1.7×10^4	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
128	**Histidine**						
	$CO_3\cdot^- + His \rightarrow$	$\sim 1 \times 10^6$ 8.5×10^6	~5 ~10	0.03	f.p.	D.k. at 600 nm; (values from graph); $CO_3\cdot^-$ generated from $Co(NH_3)_4CO_3^+$.	757110
		5.6×10^6	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
		7×10^6	11.2	0.3	p.r.	D.k. in N_2O-satd. soln.	720036
129	**4-Hydroxybenzoate ion**						
	$CO_3\cdot^- + HOC_6H_4CO_2^- \rightarrow CO_3^{2-} + \cdot OC_6H_4CO_2^- + H^+$	7.9×10^7	12.2	0.3	p.r.	D.k. at 570 nm in N_2O-satd. carbonate soln.	771098
130	**6-Hydroxy-2-hydroxymethyl-2,5,7,8-tetramethylchromane**						
	$CO_3\cdot^- + ArOH \rightarrow CO_3^{2-} + ArO\cdot + H^+$	2.2×10^9	11.2		p.r.	Aryloxy radical formn. in N_2O-satd. soln. cont. 0.1 mol L^{-1} sodium carbonate.	83A389
131	**Imidazole**						
	$CO_3\cdot^- + Im \rightarrow$	5.5×10^5	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
132	**Indole**						
	$CO_3\cdot^- + InH \rightarrow CO_3^{2-} + In\cdot + H^+$	3.0×10^8	9.3		p.r.	D.k. at 600 nm.	87A247
		4.1×10^8	6-13		f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$; value from graph.	747296
		3.2×10^8	7, 12	0.1	f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$.	737109
133	**Indole-3-propionate ion**						
	$CO_3\cdot^- + InCH_2CH_2CO_2^- \rightarrow HCO_3^- + \cdot InCH_2CH_2CO_2^-$	4.2×10^8 4.1×10^8 5.5×10^8 6.8×10^8	7-11 7.0 9.0 12.0	0.03 0.1 0.1	f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$.	747296 737109 72F542
134	**Isobutylamine**						
	$CO_3\cdot^- + (CH_3)_2CHCH_2NH_2 \rightarrow$	4.0×10^5	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
135	**Isopropylamine**						
	$CO_3\cdot^- + (CH_3)_2CHNH_2 \rightarrow$	5.0×10^5	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
136	**Luminol**						
	$CO_3\cdot^- + \text{-NHNH-} \rightarrow CO_3^{2-} + \text{-}\dot{N}\text{-NH-} + H^+$	$\geq 8 \times 10^8$			p.r.	D.k. in N_2O-satd. soln. contg. carbonate ion; substrate oxidized as monoanion, pK_a ~ 7.	86A399
137	**Maleic hydrazide, conjugate base**						
	$CO_3\cdot^- + MH^- \rightarrow CO_3^{2-} + MH\cdot$	7.7×10^8	>7.5		p.r.		83A165
138	**3-Mercaptopropionate ion**						
	$CO_3\cdot^- + HSCH_2CH_2CO_2^- \rightarrow CO_3^{2-} + \cdot SCH_2CH_2CO_2^- + H^+$	~3×10^7 2.4×10^8	~7 12.0	0.03	f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$; values from graph.	757110
139	**Methanol**						
	$CO_3\cdot^- + CH_3OH \rightarrow \cdot CH_2OH + HCO_3^-$	$\leq 3 \times 10^3$	6.4	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737109
		5×10^3	12.5		f.p.	D.k. at 600 nm in air-satd. soln. contg. 0.5 mol L^{-1} Na_2CO_3; $CO_3\cdot^-$ generated from $SO_4^- + CO_3^{2-} \rightarrow SO_4^{2-} + CO_3^-$.	727383
140	**Methionine**						
	$CO_3\cdot^- + Met \rightarrow CO_3^{2-} + Met\cdot^+$	2×10^7 5×10^7	7 11.0		f.p.	D.k. at 600 nm; $CO_3\cdot^-$ generated from $Co(NH_3)_4CO_3^+$; values from graph.	757110
		3.6×10^7	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
		1.2×10^8	11.2	0.3	p.r.	D.k. in N_2O-satd. soln.	720036
141	**4-Methoxyphenoxide ion**						
	$CO_3\cdot^- + CH_3OC_6H_4O^- \rightarrow CO_3^{2-} + CH_3OC_6H_4O\cdot$	5.2×10^8	12.2	0.3	p.r.	D.k. at 570 nm in N_2O-satd. carbonate soln.	771098
142	**Methyl radical**						
	$CO_3\cdot^- + \cdot CH_3 \rightarrow CH_3OCO_2^-$	3×10^9			p.r.	D.k. at 600 nm in Na_2CO_3–CH_3Cl soln.	78A256
143	***N*-Methylaniline**						
	$CO_3\cdot^- + C_6H_5NHCH_3 \rightarrow HCO_3^- + C_6H_5\dot{N}CH_3$	1.8×10^9			p.r.	D.k. at 600 nm.	78A901
144	**4-Methylaniline**						
	$CO_3\cdot^- + CH_3C_6H_4NH_2 \rightarrow HCO_3^- + CH_3C_6H_5\dot{N}H$	9.1×10^8	8.5		f.p.	D.k. at 600 nm in soln. contg. 2×10^{-5} mol L^{-1} $Co(NH_3)_4CO_3^+$.	84A510
145	***S*-Methylcysteine**						
	$CO_3\cdot^- + CH_3SCH_2CH(NH_3^+)CO_2^- \rightarrow CO_3^{2-} + CH_3\dot{S}CH_2CH(NH_3^+)CO_2^-$	~2.5×10^7 5×10^7	7 11.0	0.03	f.p.	D.k. at 600 nm; $CO_3\cdot^-$ generated from $Co(NH_3)_4CO_3^+$; values from graph.	737352 757110
145a	**1-Methylindole**						
	$CO_3\cdot^- + MeIn \rightarrow CO_3^{2-} + MeIn\cdot^+$	8.5×10^8	9.3		p.r.	P.b.k. at 345 nm.	87A247
145b	**2-Methylindole**						
	$CO_3\cdot^- + MeInH \rightarrow CO_3^{2-} + MeIn\cdot + H^+$	1.4×10^9	9.3		p.r.	D.k. at 600 nm.	87A247
145c	**3-Methylindole**						
	$CO_3\cdot^- + MeInH \rightarrow CO_3^{2-} + MeIn\cdot + H^+$	1.5×10^9	9.3		p.r.	D.k. at 600 nm.	87A247

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
146	**4-Methylphenoxide ion**						
	$CO_3\cdot^- + CH_3C_6H_4O^- \rightarrow CO_3^- + CH_3C_6H_4O\cdot$	4.8×10^8	12.2	0.3	p.r.	D.k. at 570 nm in N_2O-satd. carbonate soln.	771098
147	***N*-Methylpiperidine**						
	$CO_3\cdot^- + C_6H_{13}N \rightarrow$	2.6×10^6	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
148	**2-Methyl-2-propanol**						
	$CO_3\cdot^- + (CH_3)_3COH \rightarrow$	$\leq 2 \times 10^2$	6.4	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737109
149	***N*-Methyltryptophan**						
	$CO_3\cdot^- + MeTrp \rightarrow CO_3^{2-} + MeTrp\cdot^+$	4.3×10^8 $\sim 6 \times 10^8$	7 12	0.1	f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$; values from graph.	747296
150	**Metiazinic acid, conjugate base**						
	$CO_3\cdot^- + MZ^- \rightarrow CO_3^{2-} + MZ\cdot$	3.2×10^9			p.r.	D.k. at 600 nm in N_2O-satd. soln. contg. 1 mol L^{-1} Na_2CO_3.	81A162
151	**1-Naphthoxide ion**						
	$CO_3\cdot^- + NpO^- \rightarrow CO_3^{2-} + NpO\cdot$	3.1×10^9	11.2		p.r.	Aryloxy radical formn. in N_2O-satd. soln. cont. 0.1 mol L^{-1} sodium carbonate.	83A389
152	**2-Naphthoxide ion**						
	$CO_3\cdot^- + NpO^- \rightarrow CO_3^{2-} + NpO\cdot$	1.3×10^9	11.2		p.r.	Aryloxy radical formn. in N_2O-satd. soln. cont. 0.1 mol L^{-1} sodium carbonate.	83A389
153	**4-Nitroaniline**						
	$CO_3\cdot^- + O_2NC_6H_4NH_2 \rightarrow HCO_3^- + O_2NC_6H_4\dot{N}H$	7.3×10^7	8.5		f.p.	D.k. at 600 nm in soln. contg. 2 × 10^{-5} mol L^{-1} $Co(NH_3)_4CO_3^+$ and 9-16 × 10^{-6} mol L^{-1} 4-nitroaniline.	84A510
154	**Nitromethane**						
	$CO_3\cdot^- + CH_3NO_2 \rightarrow$	1×10^6 1.5×10^7	7 12		f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.; product obs. by esr [725050].	757110
155	**4-Nitrophenoxide ion**						
	$CO_3\cdot^- + NO_2C_6H_4O^- \rightarrow CO_3^{2-} + NO_2C_6H_4O\cdot$	4.8×10^7	12.2	0.3	p.r.	D.k. at 570 nm in N_2O-satd. carbonate soln.	771098
156	**Norpseudopelletierine *N*-oxyl**						
	$CO_3\cdot^- + NPPN \rightarrow$	1.1×10^9		0.015	p.r.	D.k. at 600 nm in N_2O-satd. carbonate soln.	710061
157	**Penicillamine**						
	$CO_3\cdot^- + PenSH \rightarrow HCO_3^- + PenS\cdot$	$\sim 2 \times 10^7$ 2.4×10^8 1.2×10^8	4 9.5 12		f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$; values from graph.	757110
158	**Phenol**						
	$CO_3\cdot^- + C_6H_5OH \rightarrow HCO_3^- + C_6H_5O\cdot$	4.9×10^6	7.0	0.06	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	757313
		2.2×10^7	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
159	**Phenoxide ion**						
	$CO_3\cdot^- + C_6H_5O^- \rightarrow CO_3^{2-} + C_6H_5O\cdot$	4.7×10^8	11.2		p.r.	Aryloxy radical formn. in N_2O-satd. soln. cont. 0.1 mol L^{-1} sodium carbonate.	83A389

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
159	**Phenoxide ion**—Continued						
		3.3×10^8			p.r.	D.k. at 600 nm.	78A901
		2.4×10^8	12.2	0.3	p.r.	D.k. at 570 nm in N_2O-satd. carbonate soln.	771098
		5×10^7	12		f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	757313
160	**Phenylalanine**						
	$CO_3{\cdot}^- + Phe \rightarrow$	5×10^4	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
		$<1 \times 10^6$	11.2	0.3	p.r.	D.k. in N_2O-satd. soln.	720036
161	**Phenylalanylglycine**						
	$CO_3{\cdot}^- + PheGly \rightarrow$	4.0×10^5	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
162	**Piperidine**						
	$CO_3{\cdot}^- + C_5H_{11}N \rightarrow$	3.3×10^6	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401
163	**1-Propanol**						
	$CO_3{\cdot}^- + CH_3CH_2CH_2OH \rightarrow$	1.9×10^4	12.1-12.7		f.p.	D.k. at 600 nm in air-satd. soln. contg. 0.05 mol L^{-1} $Na_2S_2O_8$ and 0.5 mol L^{-1} Na_2CO_3; $CO_3{\cdot}^-$ generated from $SO_4^- + CO_3^{2-} \rightarrow SO_4^{2-} + CO_3^-$.	727383
164	**2-Propanol**						
	$CO_3{\cdot}^- + (CH_3)_2CHOH \rightarrow (CH_3)_2\dot{C}OH + HCO_3^-$	5×10^4			p.r.	D.k. at 600 nm.	78A901
		$\leq 4 \times 10^4$	6.4	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737109
		3.9×10^4	12.1-12.7		f.p.	D.k. at 600 nm in air-satd. soln. contg. 0.05 mol L^{-1} $Na_2S_2O_8$ and 0.5 mol L^{-1} Na_2CO_3; $CO_3{\cdot}^-$ generated from $SO_4^- + CO_3^{2-} \rightarrow SO_4^{2-} + CO_3^-$.	727383
165	**2,2,6,6-Tetramethyl-4-piperidone *N*-oxyl**						
	$CO_3{\cdot}^- + TAN \rightarrow$	4.8×10^8		0.015	p.r.	D.k. at 600 nm in N_2O-satd. carbonate soln.	710061
		4.6×10^8	10-11		p.r.	D.k. at 600 nm in air-satd. soln.	710618
166	**Thymine**						
	$CO_3{\cdot}^- + 5\text{-MeU} \rightarrow$	$<1 \times 10^4$	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
167	**Toluene**						
	$CO_3{\cdot}^- + C_6H_5CH_3 \rightarrow$	4.3×10^4	7.0	0.06	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	757313
168	**Trichloroacetate ion**						
	$CO_3{\cdot}^- + Cl_3CCO_2^- \rightarrow$	$\leq 2 \times 10^2$	12.1-12.7		f.p.	D.k. in air-satd. soln. contg. 0.5 mol L^{-1} Na_2CO_3 and 0.05 mol L^{-1} $Na_2S_2O_8$; $CO_3{\cdot}^-$ generated from $SO_4^- + CO_3^{2-} \rightarrow SO_4^{2-} + CO_3^-$.	727383
169	**Triethylamine**						
	$CO_3{\cdot}^- + (C_2H_5)_3N \rightarrow$	6.4×10^6	11.5		f.p.	D.k. at 600 nm in soln. contg. 0.2 mol L^{-1} Na carbonate and 10^{-3} mol L^{-1} $K_2S_2O_8$.	85A401

TABLE 4. Rate constants for reactions of the carbonate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
170	**Tryptamine**						
	$CO_3^{\cdot-} + TrpH \rightarrow HCO_3^- + Trp\cdot$	1.3×10^9 $\sim 9 \times 10^8$	8 12	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$; values from graph.	747296
171	**Tryptophan**						
	$CO_3^{\cdot-} + TrpH \rightarrow HCO_3^- + Trp\cdot$	7×10^8 6.2×10^8 4.3×10^8	7 9 12		f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$; values from graph.	737352 747296
		4.4×10^8	11.2	0.3	p.r.	D.k. in N_2O-satd. soln.	720036
172	**Tryptophan, methyl ester**						
	$CO_3^{\cdot-} + TrpH \rightarrow HCO_3^- + Trp\cdot$	9.5×10^8 5.8×10^8	7 11	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.; values from graph.	747296
173	**Tryptophanamide**						
	$CO_3^{\cdot-} + TrpH \rightarrow HCO_3^- + Trp\cdot$	1.4×10^9 8×10^8	7 9.5	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.; values from graph.	747296
174	**Tryptophylglycine**						
	$CO_3^{\cdot-} + TrpHGly \rightarrow HCO_3^- +$ TrpGly	7×10^8 $\sim 4 \times 10^8$	6 9	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.; values from graph.	747296
175	**Tyrosine**						
	$CO_3^{\cdot-} + TyrOH \rightarrow CO_3^{2-} +$ $TyrO\cdot + H^+$	1.4×10^8	11	0.03	f.p.	D.k. at 600 nm; $CO_3^{\cdot-}$ generated from $Co(NH_3)_4CO_3^+$; k pH dependent.	757110
		4.5×10^7	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
		2.9×10^8	11.2	0.3	p.r.	D.k. in N_2O-satd. soln.	720036
176	**Uracil**						
	$CO_3^{\cdot-} + U \rightarrow$	$<1 \times 10^4$	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
177	**Urea**						
	$CO_3^{\cdot-} + H_2NCONH_2 \rightarrow$	$<1 \times 10^3$	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$ soln.	737352
178	**α-Chymotrypsin**						
	$CO_3^{\cdot-}$ + α-Chymotrypsin →	1.0×10^9	11.3	0.12	p.r.	D.k. in N_2O-satd. soln.; mol wt. 20,000; concn. effect.	741096
		1.2×10^9	7-11	0.03	f.p.	D.k. at 600 nm; mol. wt. 25,000; HCO_3 or $CO_3^{\cdot-}$ generated from $Co(NH_3)_4CO_3^+$; k independent of pH.	737352, 757110
179	**Lysozyme**						
	$CO_3^{\cdot-}$ + Lys →	5.5×10^8	7.0-12	0.03	f.p.	D.k. at 600 nm; radical generated from $Co(NH_3)_4CO_3^+$.	737352, 757110
180	**Ribonuclease**						
	$CO_3^{\cdot-}$ + RNase →	5.0×10^7 1.4×10^8	7.0 11.0	0.03	f.p.	D.k. at 600 nm; radical from $Co(NH_3)_4CO_3^+$; value from graph; mol. wt. 13,700.	737352 757110
181	**Trypsin**						
	$CO_3^{\cdot-}$ + Tryp →	6.8×10^8	7.0	0.03	f.p.	D.k. at 600 nm in $Co(NH_3)_4CO_3^+$; mol. wt. 23,800.	737352

TABLE 5. Rate constants for reactions of ozone in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Hydrated electron**					
	$O_3 + e_{aq}^- \rightarrow O_3^{\cdot -}$	3.6×10^{10}	9	p.r.	C.k.; obs. abs. at 430 nm (O_3^-) in soln. contg. 0.15 mol L^{-1} HCO_3^- and 2×10^{-4} mol L^{-1} ozone; rel. to $k(e_{aq}^- + O_2) = 1.9 \times 10^{10}$.	83A117
2	**Silver(I) ion**					
	$O_3 + Ag^+ \rightarrow AgO^+ + O_2$	3.5×10^{-2}			Nitric acid soln.; $T = 0$°C.	37A001
3	**Dihydrogen borate ion**					
	$O_3 + H_2BO_3^- \rightarrow$	$<4 \times 10^{-3}$	8		D.k. at 258 nm in soln. contg. 1 mol L^{-1} borate and 3×10^{-2} mol L^{-1} $NaHCO_3$; pK_a = 9.	85A221
4	**Hydrogen borate ion**					
	$O_3 + HBO_3^{2-} \rightarrow$	$<6 \times 10^{-2}$			D.k. at 258 nm in soln. contg. 1 mol L^{-1} borate and 3×10^{-2} mol L^{-1} $NaHCO_3$; calcd. from pH study.	85A221
5	**Bromide ion**					
	$O_3 + Br^- \rightarrow BrO^- + O_2$	1.6×10^2	3-7		D.k. at 258 nm in soln. contg. 0.05-3 $\times$ 10^{-3} mol L^{-1} Br^-, 4-100 $\times$ 10^{-6} mol L^{-1} ozone and 0-21 $\times$ 10^{-3} mol L^{-1} carbonate. at pH 2 E_a = 37 kJ mol^{-1} (1-30°C).	83A407
		2.3×10^2	3		D.k. at 260 nm; k studied at 5-30°C in soln. contg. 5-20 $\times$ 10^{-5} mol L^{-1} Br^- and 1-5 $\times$ 10^{-5} mol L^{-1} ozone at pH 1.2-3.6, as well as in neutral and alkaline soln.; k increases with [H^+].	81A436
		3.0×10^2	6.3	s.f.	D.k. at 260 nm.	80U374
		9.0×10^1			Steady state; $T = 0$°C.	42A001
6	**Hypobromous acid**					
	$O_3 + HOBr \rightarrow$	$\leq 1 \times 10^{-2}$	<4			83A407
7	**Hypobromite ion**					
	$O_3 + BrO^- \rightarrow$	5.2×10^2	8.5-10.4		$k_{total} = 2k_a + k_b$. D.k. at 258 nm in soln. contg. 0.1-0.37 $\times$ 10^{-3} mol L^{-1} OBr^-, 5-25 $\times$ 10^{-6} mol L^{-1} ozone and 0-8 $\times$ 10^{-2} mol L^{-1} HCO_3^- or *tert*-BuOH; pK_a HOBr = 8.76; at pH 8.2 E_a = 60 kJ mol^{-1} (10-30°C).	83A407
	$O_3 + BrO^- \rightarrow O_2 + BrO_2^-$	$k_a = 1.0 \times 10^2$			k_a evaluated from steady-state experiments.	83A407
	$O_3 + BrO^- \rightarrow O_2 + O_2 + Br^-$	$k_b = 3.3 \times 10^2$	6-7		k_b evaluated from steady-state experiments and $k_{total} - 2k_a$.	83A407
8	**Bromite ion**					
	$O_3 + BrO_2^- \rightarrow$	$>1 \times 10^5$	5		D.k. at 258 nm in soln. contg. 0.02 mol L^{-1} BrO_2^-.	85A221
9	**Bromate ion**					
	$O_3 + BrO_3^- \rightarrow$	10^{-3}	4		D.k. at 258 nm in soln. contg. 5×10^{-2} mol L^{-1} BrO_3^-.	85A221
10	**Bicarbonate ion**					
	$O_3 + HCO_3^- \rightarrow$	$<<1 \times 10^{-2}$	8-10		D.k. at 258 nm in soln. contg. 0.1 mol L^{-1} carbonate; pK_a = 10.3.	85A221
11	**Carbonate ion**					
	$O_3 + CO_3^{2-} \rightarrow$	$<1 \times 10^{-1}$	8-10		Calcd. from d.k. at 258 nm in soln. contg. 0.1 mol L^{-1} carbonate.	85A221

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
12	**Carbonate radical ion**					
	$O_3 + CO_3^{\cdot -} \rightarrow$	$<1 \times 10^5$	10.4	p.r.	D.k. of $CO_3^{\cdot -}$ in soln. contg. 0.1 mol L^{-1} HCO_3^- and 9×10^{-5} mol L^{-1} ozone.	83A117
13	**Cyanide ion**					
	$O_3 + CN^- \rightarrow OCN^- + O_2$	10^3-10^5			D.k. at 258 nm in soln. contg. 4-8 $\times 10^{-2}$ mol L^{-1} cyanide and 10^{-2} mol L^{-1} *tert*-BuOH; calcd. from pH study; chain reaction.	85A221
		2.6×10^3	2.5-12.0	s.f.	D.k. at 260 nm in soln. contg. 1.9×10^{-4}-0.46 mol L^{-1} cyanide and 1.0-3.1 $\times 10^{-4}$ mol L^{-1} ozone; k estd. from decay rate in soln. contg. 0.05 mol L^{-1} carbonate and 0.1-0.2 mol L^{-1} *tert*-BuOH as OH scavengers (pH 11.2); reaction with HCN negligible.	85A473
14	**Hydrogen cyanide**					
	$O_3 + HCN \rightarrow$	$\leq 10^{-3}$	3.5-4.5		D.k. at 258 nm in soln. contg. 4-8 $\times 10^{-2}$ mol L^{-1} cyanide and 10^{-2} mol L^{-1} *tert*-BuOH; pK_a = 9.2.	85A221
15	**Cyanic acid/Cyanate ion**					
	$O_3 + HOCN \rightarrow$	$\leq 10^{-2}$	7		D.k. at 258 nm in soln. contg. 2 mol L^{-1} HOCN; pK_a = 6.8.	85A221
16	**Chloride ion**					
	$O_3 + Cl^- \rightarrow ClO^- + O_2$	$<3 \times 10^{-3}$	2-4		D.k. at 258 nm in soln. contg. 1-4 mol L^{-1} HCl.	85A221
		2×10^{-3}			D.k.; T = 0°C; E_a = 17.6 kcal mol^{-1} derived from study at 0 and 9.5°C; also studied [H$^+$] dependence.	40A002
17	**Hypochlorite ion**					
	$O_3 + ClO^- \rightarrow$	1.7×10^2	5-9.5		$k_{total} = k_a + 2k_b$. D.k. at 258 nm in soln. contg. 0.17-18 $\times 10^{-4}$ mol L^{-1} ClO^- and 30-160 $\times 10^{-6}$ mol L^{-1} ozone and *tert*-BuOH; E_a = 57 kJ mol^{-1} detd. over 11-34°C; reaction with HOCl is negligible.	83A409
	$O_3 + ClO^- \rightarrow O_2 + O_2 + Cl^-$				$k_a = 1.1 \times 10^2$	
	$O_3 + ClO^- \rightarrow O_2 + ClO_2^-$				$k_b = 3.0 \times 10^1$	
18	**Chlorine dioxide**					
	$O_3 + ClO_2\cdot \rightarrow ClO_3 + O_2$	1.1×10^3	3-11	s.f.	D.k. at 260 and 360-420 nm in soln. contg. 4-40 $\times 10^{-4}$ mol L^{-1} ClO_2 and 2-7 $\times 10^{-5}$ mol L^{-1} O_3.	85A039
		1.1×10^3	2-9		D.k. at 258 nm in soln. contg. 0.2-2 $\times 10^{-4}$ mol L^{-2} ClO_2 and 10-30 $\times 10^{-3}$ mol L^{-1} *tert*-BuOH.	85A221
19	**Chlorite ion**					
	$O_3 + ClO_2^- \rightarrow ClO_2\cdot + O_3^{\cdot -}$	4×10^6	3-11	s.f.	D.k. at 260, and p.b.k. at 360 nm, in soln. contg. 2.5-10 $\times 10^{-5}$ mol L^{-1} ClO_2^- and 1 $\times 10^{-5}$ mol L^{-1} ozone; $k_r = 1.8 \times 10^5$ (p.r.).	85A039
		$>1 \times 10^4$	4		D.k. at 258 nm in soln. contg. 6 $\times 10^{-5}$ mol L^{-1} ClO_2^-.	85A221
20	**Chlorate ion**					
	$O_3 + ClO_3^- \rightarrow$	$<<10^{-4}$	2		D.k. at 258 nm in soln. contg. 0.5 mol L^{-1} ClO_3^-.	85A221

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
21	**Perchlorate ion**					
	$O_3 + ClO_4^- \rightarrow$	$<<2 \times 10^{-5}$	2		D.k. at 258 nm in soln. contg. 4 mol L^{-1} ClO_4^-.	85A221
22	**Cobalt(II) ion**					
	$O_3 + Co^{2+} \rightarrow CoOH^{2+} + O_2 + \cdot OH$	6.2×10^{-1}			Formation of $CoAc^{2+}$ in perchloric + acetic acids containing Co^{2+} (1-11 $\times 10^{-4}$ mol L^{-1}); T = 0-2°C.	49A001
		6.5×10^{-1}			D.k.; T = 0°C.	49A002
23	**Iron(II) ion**					
	$O_3 + Fe^{2+} \rightarrow$	$\geq 5 \times 10^5$	2		D.k. at 258 nm in soln. contg. 3×10^{-3} mol L^{-1} *tert*-BuOH.	85A221
		1.7×10^5			Flow technique; P.b.k. in soln. contg. 10^{-4}-10^{-1} mol L^{-1} Fe^{2+}, 5-50 $\times 10^{-5}$ mol L^{-1} ozone and perchloric acid (1.0 mol L^{-1}); product ~60% Fe^{3+} + $FeOH^{2+}$ and ~ 40% $(FeOH)_2^{4+}$.	65M066
24	**Hydrogen ion**					
	$O_3 + H_3O^+ \rightarrow$	$<4 \times 10^{-4}$			D.k. at 258 nm not accelerated even at low pH values; at pH 2 half-life $>2 \times 10^5$ s.	82A470
25	**Hydrogen atom**					
	$O_3 + H\cdot \rightarrow \cdot OH + O_2$	3.7×10^{10}	2	p.r.	C.k.; calcd. from abs. change at 260 nm (O_3) and 220 nm (OH and HO_2) in H_2SO_4 soln. satd. with O_2, contg. 2.5-17.5 $\times 10^{-5}$ mol L^{-1} ozone.; rel. to $k(H + O_2) = 2 \times 10^{10}$.	83A117
26	**Iodide ion**					
	$O_3 + I^- \rightarrow$	$>5 \times 10^6$	5.4	s.f.	D.k. at 260 nm.	80U374
27	**Iodate ion**					
	$O_3 + IO_3^- \rightarrow$	$<10^{-4}$	3		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.2 mol L^{-1} iodate.	85A221
28	**Periodate ion**					
	$O_3 + IO_4^- \rightarrow$	$<10^{-2}$	2		D.k. at 258 nm in soln. contg. 1.5×10^{-3} mol L^{-1} periodate.	85A221
29	**Hydrazoic acid**					
	$O_3 + HN_3 \rightarrow$	$<4 \times 10^3$	1.6-2.5		D.k. at 258 nm in soln. contg. 2-3 $\times 10^{-5}$ mol L^{-1} azide and 10^{-4} mol L^{-1} *tert*-BuOH; pK_a = 4.7.	85A221
30	**Azide ion**					
	$O_3 + N_3^- \rightarrow$	4.0×10^6			D.k. at 258 nm in soln. contg. 2-3 $\times 10^{-5}$ mol L^{-1} azide and 10^{-4} mol L^{-1} *tert*-BuOH; calcd. from pH study.	85A221
31	**Ammonium ion**					
	$O_3 + NH_4^+ \rightarrow$				No reaction; estd. from d.k. at 258 nm at pH 2, 7-8 in soln. contg. 3-22 $\times 10^{-3}$ mol L^{-1} substrate and 2×10^{-2} mol L^{-1} $NaHCO_3$; pK_a = 9.3; k calcd. from study at pH 2, 7-8.	83A415
32	**Ammonia**					
	$O_3 + NH_3 \rightarrow$	2.0×10^1	2, 7-8		D.k. at 258 nm in soln. contg. 3-22 $\times 10^{-3}$ mol L^{-1} substrate and 2×10^{-2} mol L^{-1} $NaHCO_3$; calcd. from study at pH 2, 7-8.	83A415 78A136
		4.4×10^1		s.f.	D.k. at 260 nm.	80U374

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
33	**Hydroxylamine**					
	$O_3 + NH_2OH \rightarrow$	2.1×10^4			D.k at 258 nm in soln. contg. 0.2-3 mol L^{-1} hydroxylamine and 10^{-2} mol L^{-1} *tert*-BuOH; calcd. from pH study.	85A221
34	**Hydroxylammonium ion**					
	$O_3 + NH_3OH^+ \rightarrow$	<2	2-5		D.k at 258 nm in soln. contg. 0.2-3 mol L^{-1} hydroxylamine and 10^{-2} mol L^{-1} *tert*-BuOH; pK_a = 6.0.	85A221
35	**Bromimide**					
	$O_3 + NHBr_2 \rightarrow$	~10	5-8.3		D.k. at 258 nm in soln. contg. 0.001-0.08 × 10^{-3} mol L^{-1} substrate and 0-14 mol L^{-1} HCO_3^-.	85A221
36	**Bromamide**					
	$O_3 + NH_2Br \rightarrow H^+ + NO_3^- + O_2$	$\sim 4 \times 10^1$	5-8.3		D.k. at 258 nm in soln. contg. 0.01-0.2 × 10^{-3} mol L^{-1} substrate and 0-14 mol L^{-1} HCO_3^-; k = 28 calcd. from loss of NH_2Br.	85A221
37	**Chlorimide**					
	$O_3 + NHCl_2 \rightarrow$	1.3	2.6		D.k. at 258 nm in soln. contg. 1.5 × 10^{-3} mol L^{-1} substrate and 10^{-2} mol L^{-1} *tert*-BuOH.	83A409
38	**Chloramide**					
	$O_3 + NH_2Cl \rightarrow NO_3^- + Cl^- + O_2 + H^+$	2.6×10^1	6.2, 8.0		D.k. at 258 nm in soln. contg. 0.35-3 × 10^{-3} substrate and 0-10^{-2} mol L^{-1} *tert*-BuOH.	83A409
39	**Nitrous oxide**					
	$O_3 + N_2O \rightarrow$	$<10^{-3}$	2.5		D.k. at 258 nm in soln. contg. 2.4 × 10^{-2} mol L^{-1} nitrous oxide.	85A221
40	**Nitrous acid**					
	$O_3 + HNO_2 \rightarrow$	$<5 \times 10^2$	1.8-5		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 4-100 × 10^{-5} and 3-20 × 10^{-3} mol L^{-1} nitrite, resp., and 10^{-2} mol L^{-1} *tert*-BuOH; pK_a = 3.1.	85A221
41	**Nitrite ion**					
	$O_3 + NO_2^- \rightarrow$	3.7×10^5			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 4-100 × 10^{-5} and 3-20 × 10^{-3} mol L^{-1} nitrite, resp., and 10^{-2} mol L^{-1} *tert*-BuOH; calcd. from pH study.	85A221
		3.3×10^5	4	s.f.	D.k. at 260 nm.	80U374
		1.6×10^5	5.9	s.f.	D.k. at 265 nm in soln. contg. 2-5 × 10^{-6} mol L^{-1} ozone and 2.5-10 × 10^{-5} mol L^{-1} $NaNO_2$; T = 9.6°C.	72M261
42	**Nitrate ion**					
	$O_3 + NO_3^- \rightarrow$	$<10^{-4}$	2		D.k. at 258 nm in soln. contg. 1.3 mol L^{-1} nitrate.	85A221
43	**Water**					
	$O_3 + H_2O \rightarrow$	$<10^{-7}$			Estd. from d.k. at 258 nm in soln. contg. 10^{-2} mol L^{-1} $NaHCO_3$ at pH 8-10.	85A221

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
44	**Hydroxide ion**					
	$O_3 + OH^- \rightarrow HO_2^- + O_2$	4.8×10^1	11-13	s.f.	Primary step in chain reactions; obs. d.k. of O_3 at 260 nm (ϵ = 3314 L mol^{-1} cm^{-1}) in soln. contg. 3×10^{-5} mol L^{-1} O_3 and ~4×10^{-4} mol L^{-1} acetate ion, as well as p.b.k. at 430 nm (O_3^-) in soln. also contg. O_2; obs. effect of [acetate] and [carbonate] on d.k.; initial decay as well as CO_3^- buildup, in carbonate-contg. soln. used to determine k.	82A027
	$O_3 + OH^- \rightarrow HO_2\cdot + O_2\cdot^-$	7.0×10^1			D.k. at 258 nm.	82A470
45	**Hydroxyl radical**					
	$O_3 + \cdot OH \rightarrow HO_2\cdot + O_2$	1×10^8	10.3	p.r.	C.k.; rel. to $k(\cdot OH + CO_3^{2-}) = 3.5 \times 10^8$.	84A270
		1.1×10^8	1,9-10	p.r.	P.b.k. at 430 nm (O_3^-) at pH 9-10, as well as d.k. at 280-310 nm (O_3) at pH 1.	84A270
46	**Superoxide radical ion**					
	$O_3 + O_2\cdot^- \rightarrow O_3\cdot^- + O_2$	1.5×10^9	8.4-10.3	p.r.	P.b.k. at 430 nm in soln. contg. ~0.05 mol L^{-1} HCO_3^-/CO_3^{2-} or 0.01 mol L^{-1} acetate ion and ~10^{-4} mol L^{-1} ozone.	83A117
		1.6×10^9	6.3, 7.3	p.r.	P.b.k. at 430 nm in 1-50 $\times 10^{-4}$ mol L^{-1} phosphate buffer.	84A164
47	**Hydroperoxide ion**					
	$O_3 + HO_2^- \rightarrow HO_2\cdot + O_3\cdot^-$	5.5×10^6	5-6		D.k. at 258 nm in soln. contg. 0-6 $\times 10^{-3}$ mol L^{-1} hydrogen peroxide and 1.5×10^{-3} mol L^{-1} MeHgOH; calcd. from observations at pH 5-6 and p$K_a(H_2O_2)$ = 11.6.	82A470
48	**Hydrogen peroxide**					
	$O_3 + H_2O_2 \rightarrow H_2O + O_2$	$<10^{-2}$	5-6		D.k. at 258 nm in soln. contg. 0-6 $\times 10^{-3}$ mol L^{-1} hydrogen peroxide and 1.5×10^{-3} mol L^{-1} MeHgOH; pK_a = 11.6.	82A470
		6.5×10^{-3}				409003
49	**Dihydrogen phosphate ion**					
	$O_3 + H_2PO_4^- \rightarrow$	$<2 \times 10^{-4}$	4		D.k. at 258 nm in soln. contg. 1 mol L^{-1} phosphate.	85A221
50	**Phosphoric acid**					
	$O_3 + H_3PO_4 \rightarrow$	$<2 \times 10^{-2}$	4		D.k. at 258 nm in soln. contg. 1 mol L^{-1} phosphate; calcd. using pK_a = 2.2.	85A221
51	**Bisulfide ion**					
	$O_3 + HS^- \rightarrow$	3×10^9			Continuous flow, soln. contg. 0.01-1 $\times 10^{-3}$ mol L^{-1} substrate and ~ 5×10^{-3} mol L^{-1} *tert*-BuOH; calcd. from pH study.	85A221
52	**Hydrogen sulfide**					
	$O_3 + H_2S \rightarrow$	~3×10^4	1-4.5		Continuous flow, soln. contg. 0.01-1 $\times 10^{-3}$ mol L^{-1} substrate and 5×10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 7.	85A221
53	**Sulfur dioxide**					
	$O_3 + SO_2 \rightarrow$	2.4×10^4			Evaluated from reported data.	86Z071
54	**Hydrogen sulfite ion**					
	$O_3 + HSO_3^- \rightarrow$	3.7×10^5			Evaluated from reported data; E_a = 46.0 kJ mol^{-1} [77M362].	86Z071

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
55	**Sulfite ion**					
	$O_3 + SO_3^{2-} \rightarrow$	1.5×10^9			Evaluated from reported data; $E_a = 43.9$ kJ mol^{-1} [77M362].	86Z071
56	**Hydrogen sulfate ion**					
	$O_3 + HSO_4^- \rightarrow$	$<10^{-4}$	2		D.k. at 258 nm in soln. contg. 1 mol L^{-1} sulfate; p$K_a = 2.0$; $k \leq 10^{-4}$ for SO_4^{2-}.	85A221
57	**Acetaldehyde**					
	$O_3 + CH_3CHO \rightarrow$	1.5	2		D.k. at 258 nm in soln. contg. 2-10 $\times 10^{-2}$ mol L^{-1} substrate.	83A408
58	**Acetate radical ion**					
	$O_3 + \cdot CH_2CO_2^- \rightarrow \dot{O}_3CH_2CO_2^-$	1-1.5 $\times 10^9$	9-10	p.r.	D.k. at 350 nm ($\cdot CH_2CO_2^-$), as well as p.b.k. at 430 nm (O_3^-), in N_2O-satd. soln. contg. (1-2) $\times 10^{-4}$ mol L^{-1} ozone and (1-10) $\times 10^{-2}$ mol L^{-1} acetate ion; computer simulation; ; product decomposes to $\cdot O_2^-$, CO_2 and CH_2O.	87A138
59	**Acetate ion**					
	$O_3 + CH_3CO_2^- \rightarrow$	$\leq 3 \times 10^{-5}$			D.k. at 258 nm; calcd. from study at pH 2.5-5.	83A415
60	**Acetic acid**					
	$O_3 + CH_3CO_2H \rightarrow$	$\leq 3 \times 10^{-5}$			D.k. at 258 nm in soln. contg. 1 mol L^{-1} substrate; p$K_a = 4.75$; k calcd. from study at pH 2.5, 5.	83A415
61	**Acetone**					
	$O_3 + CH_3COCH_3 \rightarrow$	3.2×10^{-2}	2		D.k. at 258 nm in soln. contg. 2-20 $\times 10^{-2}$ mol L^{-1} substrate.	83A408
62	***N*-Acetylglycine**					
	O_3 + AcGly $\rightarrow$	3×10^{-1} 1.7	3.7 6.5	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
63	***N*-α-Acetylhistidine**					
	O_3 + AcHis $\rightarrow$	8.5×10^5	4.5-5.9	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; p$K_a = 7.2$.	84M375
64	***N*-α-Acetyllysine**					
	O_3 + AcLys $\rightarrow$	1.0×10^5	6.0-7.1	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; p$K_a = 10.53$.	84M375
65	***N*-ε-Acetyllysine**					
	O_3 + AcLys $\rightarrow$	2.4×10^4	3.2-6.9	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; p$K_a = 9.46$.	84M375
66	***N*-Acetylserine**					
	O_3 + AcSer $\rightarrow$	1.5 5.8 13.5	5.7 6.3 6.8	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
67	**Acrylonitrile**					
	$O_3 + H_2C{=}CHCN \rightarrow$	8.3×10^2 8.7×10^2 8.3×10^2	6.2 7.0 7.9	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; $E_a = 35$ kJ mol^{-1}.	84M375
68	**Alanine, conjugate acid**					
	$O_3 + AlaH^+ \rightarrow$	$\sim 3 \times 10^{-3}$	2		D.k. at 258 nm in soln. contg. 0.6 mol L^{-1} substrate.	83A415

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
69	**Alanine**					
	O_3 + Ala →	6.4×10^4			D.k. at 258 nm in soln. contg. 0.1-80 × 10^{-3} mol L^{-1} substrate; pK_a = 10.0; k calcd. from study at pH 5, 7.	83A41
70	**Alanine, negative ion**					
	O_3 + Ala$^-$ →	7.6×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 4.1-7.0 and pK_a = 9.87; E_a = 44.8 kJ mol^{-1}.	84M37
71	**β-Alanine**					
	O_3 + β-Ala →	6.2×10^4	5, 6		D.k. at 258 nm in soln. contg. 4-160 × 10^{-3} mol L^{-1} substrate; pK_a = 10.3; k calcd. from study at pH 5, 6.	83A41
72	**Allylbenzene**					
	$O_3 + C_6H_5CH_2CH{=}CH_2$ →	1.2×10^5	2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 3-4 × 10^{-6} mol L^{-1} substrate and 2 × 10^{-3} mol L^{-1} PrOH.	83A40
73	**Aniline**					
	$O_3 + C_6H_5NH_2$ →	9.0×10^7			D.k. at 258 nm in soln. contg. 2-15 × 10^{-6} mol L^{-1} substrate and 1 × 10^{-2} mol L^{-1} *tert*-BuOH; pK_a = 4.6; k calcd. for deprotonated amine from study at pH 1.2-2.	83A41
74	**Anisole**					
	$O_3 + C_6H_5OCH_3$ →	2.9×10^2	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.5-8 × 10^{-4} mol L^{-1} substrate and 10^{-3} mol L^{-1} PrOH.	83A40
75	**Arginine, negative ion**					
	O_3 + Arg$^-$ →	5.7×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 3.5-7.0 and pK_a = 8.99.	84M37
76	**Ascorbic acid/Ascorbate ion**					
	$O_3 + AH_2/AH^-$ →	6.9×10^5	2.0	s.f.	D.k.; soln. contg. Na phosphate; pK_a = 4.1.	85N23
		1.2×10^6	2.3			
		8.0×10^6	3.2			
		4.1×10^7	3.6			
		5.6×10^7	4.8			
77	**Asparagine, negative ion**					
	$O_3 + H_2NCOCH_2CH(NH_2)CO_2^-$ →	4.2×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer k calcd. for deprotonated amine from obs. k at pH 3.7-7.2; and pK_a = 8.85.	84M37
78	**Aspartate ion**					
	O_3 + Asp$^-$ →	4.1×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer k calcd. for deprotonated amine from obs. k at pH 4.2-6.8; and pK_a = 9.82.	84M37
79	**Benzaldehyde**					
	$O_3 + C_6H_5CHO$ →	2.5	1.7		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 2-10 × 10^{-3} mol L^{-1} substrate.	83A40
80	**Benzene**					
	O_3 + PhH →	2	1.7-3		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 1-10 × 10^{-3} mol L^{-1} substrate.	83A40

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
81	**Benzenesulfonate ion**					
	$O_3 + C_6H_5SO_3^- \rightarrow$	2.3×10^{-1}	1.7-2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 1-80 × 10^{-2} mol L^{-1} substrate and 0.05-0.8 mol L^{-1} *tert*-BuOH.	83A408
82	**Benzimidazole**					
	$O_3 + C_7H_6N_2 \rightarrow$	<10	acid			81M438
83	**Benzoate ion**					
	$O_3 + C_6H_5CO_2^- \rightarrow$	1.2	5		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 1-10 × 10^{-2} mol L^{-1} substrate and 0.1-1 mol L^{-1} *tert*-BuOH.	83A408
84	**Benzo[*a*]pyrene**					
	$O_3 + C_{20}H_{12} \rightarrow$	6×10^3	1-7	s.f.	D.k. at 365 nm (7 × 10^{-8} mol L^{-1} benzopyrene).	83A414
85	**Benzylamine**					
	$O_3 + C_6H_5CH_2NH_2 \rightarrow$	6.3×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer k calcd. for deprotonated amine from obs. k at pH 2.5-7.4; and pK_a = 9.33.	84M375
86	**Bromoform**					
	$O_3 + CHBr_3 \rightarrow$	≤2 × 10^{-2}	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 7 × 10^{-3} mol L^{-1} substrate.	83A408
87	**1-Butanol**					
	$O_3 + CH_3(CH_2)_3OH \rightarrow$	6×10^{-1} 6×10^{-1} 7×10^{-1} 1.1	2.1 3.2 5.8 7.2	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
		5.8×10^{-1}	2		D.k. at 258 nm in soln. contg. 1-10 × 10^{-3} mol L^{-1} substrate.	83A408
88	**2-Butanone**					
	$O_3 + C_2H_5COCH_3 \rightarrow$	7×10^{-2}	2		D.k. at 258 nm in soln. contg. 1-10 × 10^{-2} mol L^{-1} substrate.	83A408
89	**Butylamine**					
	$O_3 + CH_3(CH_2)_3NH_2 \rightarrow$	1.2×10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 5.7-8.0 and pK_a = 10.77.	84M375
		1.7×10^5			D.k. at 258 nm in soln. contg. 0.01-10 × 10^{-3} mol L^{-1} substrate and 2 × 10^{-2} mol L^{-1} $NaHCO_3$; pK_a = 10.7, k calcd. for deprotonated amine from study at pH 6-7; k < 0.02 for protonated amine.	83A415
90	***sec*-Butylamine**					
	$O_3 + C_2H_5CH(NH_2)CH_3 \rightarrow$	5.2×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 5.4-7.9 and pK_a = 10.63.	84M375
91	***tert*-Butylamine**					
	$O_3 + (CH_3)_3CNH_2 \rightarrow$	4.5×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 2.4-7.5 and pK_a = 10.83.	84M375
92	**Butyrate ion**					
	$O_3 + n\text{-}C_3H_7CO_2^- \rightarrow$	≤6 × 10^{-3}			D.k. at 258 nm; calcd. from study at pH 2-4.	83A415

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
93	**Butyric acid**					
	$O_3 + CH_3CH_2CH_2CO_2H \rightarrow$	$\leq 6 \times 10^{-3}$			D.k. at 258 nm in soln. contg. 0.05 mol L^{-1} substrate; pK_a = 4.8.; k calcd. from study at pH 2-4.	83A415
94	**Carbon tetrachloride**					
	$O_3 + CCl_4 \rightarrow$	$<5 \times 10^{-3}$	2		D.k. at 258 nm in soln. contg. 5×10^{-3} mol L^{-1} substrate.	83A408
96	**Carboxymethylperoxyl radical**					
	$O_3 + \cdot OOCH_2CO_2^- \rightarrow$				small	85A221
97	**Catechol**					
	$O_3 + 1,2\text{-}C_6H_4(OH)_2 \rightarrow$	3.1×10^5	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M383
98	**Chlorobenzene**					
	$O_3 + C_6H_5Cl \rightarrow$	7.5×10^{-1}	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.8-3 $\times$ 10^{-3} mol L^{-1} substrate and 1×10^{-3} mol L^{-1} PrOH; rel. to $k(O_3 + ArH)$ where ArH = benzene, toluene or *o*-xylene.	83A408
99	**Chloroform**					
	$O_3 + CHCl_3 \rightarrow$	$\leq 1 \times 10^{-1}$	2		D.k. at 258 nm in soln. contg. 1-4 $\times 10^{-2}$ mol L^{-1} substrate.	83A408
100	**1-Chloronaphthalene**					
	O_3 + NpCl $\rightarrow$	$\sim 2 \times 10^2$	5.6		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 2.9-3.7 $\times$ 10^{-6} mol L^{-1} naphthalene and 0.5-1.2 $\times$ 10^{-5} mol L^{-1} ozone.	86M314
101	**2-Chlorophenol**					
	$O_3 + ClC_6H_4OH \rightarrow$	1.1×10^3			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.004-1 $\times$ 10^{-3} mol L^{-1} substrate and 3×10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 8.3; k calcd. from study at pH 1.8-4.	83A415
102	**2-Chlorophenoxide ion**					
	$O_3 + 2\text{-}ClC_6H_4O^- \rightarrow$	2×10^8			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.004-1 $\times$ 10^{-3} mol L^{-1} substrate and 3×10^{-3} mol L^{-1} *tert*-BuOH; k calcd. from study at pH 1.8-4.	83A415
103	**4-Chlorophenol**					
	$O_3 + ClC_6H_4OH \rightarrow$	6.0×10^2			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.002-1 $\times$ 10^{-3} mol L^{-1} substrate and 3×10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 9.2; k calcd. from study at pH 1.5-6.	83A415
104	**4-Chlorophenoxide ion**					
	$O_3 + 4\text{-}ClC_6H_4O^- \rightarrow$	6×10^8			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.002-1 $\times$ 10^{-5} mol L^{-1} substrate and 3×10^{-3} mol L^{-1} *tert*-BuOH; k calcd. from study at pH 1.5-6.	83A415
105	**Creatine**					
	$O_3 + H_2NC(=NH)N(CH_3)CH_2CO_2^- \rightarrow$	$\sim 5 \times 10^{-1}$	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 5×10^{-2} mol L^{-1} substrate and 1×10^{-2} mol L^{-1} *tert*-BuOH.	83A415

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
106	**Creatinine**					
	$O_3 + C_4H_7N_3O \rightarrow$	~2	2, 6		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 7-50 × 10^{-3} mol L^{-1} substrate and 1-4 × 10^{-2} mol L^{-1} *tert*-BuOH.	83A415
107	**Cumene**					
	$O_3 + C_6H_5CH(CH_3)_2 \rightarrow$	1.1 × 10^1	2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 1.4 × 10^{-4} mol L^{-1} substrate and 0.1 mol L^{-1} *tert*-BuOH; rel. to k(O_3 + ArH) where ArH = benzene, toluene or *o*-xylene.	83A408
108	**Cyclopentanol**					
	O_3 + *c*-$C_5H_9OH \rightarrow$	2.0	2		D.k. at 258 nm in soln. contg. 2-20 × 10^{-3} mol L^{-1} substrate.	83A408
109	**Cysteine**					
	O_3 + CysSH →	4.2 × 10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; pK_a = 8.14; k calcd. from study at pH 1.7-3.6.	84M375
		3.0 × 10^4	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.3-3 × 10^{-5} mol L^{-1} substrate and 1 × 10^{-2} mol L^{-1} *tert*-BuOH.	83A415
110	**Cysteine, negative ion**					
	O_3 + Cys$^-$ →	2.4 × 10^6		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from study at pH 1.7-3.6.	84M375
111	**Cystine**					
	$O_3 + S_2[CH_2CH(NH_3^+)CO_2^-]_2 \rightarrow$	5.5 × 10^2 1 × 10^3	1.8 3.1		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.02-0.2 × 10^{-3} mol L^{-1} substrate and 1 × 10^{-2} mol L^{-1} *tert*-BuOH.	83A415
112	**1,4-Dichlorobenzene**					
	$O_3 + C_6H_4Cl_2 \rightarrow$	<3	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 5 × 10^{-5} mol L^{-1} substrate and 0.5 × 10^{-3} mol L^{-1} *tert*-BuOH.	83A408
113	**1,1-Dichloroethylene**					
	$O_3 + H_2C{=}CCl_2 \rightarrow$	1.1 × 10^2	2.0		D.k. at 258 nm in soln. contg. 4-40 × 10^{-5} mol L^{-1} substrate.	83A408
114	***cis*-1,2-Dichloroethylene**					
	O_3 + ClCH=CHCl →	<8 × 10^2	2.0		D.k. at 258 nm in soln. contg. 6-20 × 10^{-5} mol L^{-1} substrate; 5% trans.	83A408
115	***trans*-1,2-Dichloroethylene**					
	O_3 + ClCH=CHCl →	5.7 × 10^3	2.0		D.k. at 258 nm in soln. contg. 3-10 × 10^{-5} mol L^{-1} substrate and 10^{-3} mol L^{-1} *tert*-BuOH.	83A408
116	**Dichloromethane**					
	$O_3 + CH_2Cl_2 \rightarrow$	≤1 × 10^{-1}	2		D.k. at 258 nm.	83A408
117	**2,3-Dichlorophenol**					
	$O_3 + Cl_2C_6H_3OH \rightarrow$	<2 × 10^3	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.03-0.3 × 10^{-3} mol L^{-1} substrate and 3 × 10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 7.7.	83A415

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
118	**2,4-Dichlorophenol**					
	$O_3 + Cl_2C_6H_3OH \rightarrow$	$<1.5 \times 10^3$			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.03-0.3 × 10^{-3} mol L^{-1} substrate and 3 × 10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 7.8; calcd. from study at pH 1.5-3.	83A41
119	**2,4-Dichlorophenoxide ion**					
	$O_3 + Cl_2C_6H_3O^- \rightarrow$	$\sim 8 \times 10^9$			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.03-0.3 × 10^{-3} mol L^{-1} substrate and 3 × 10^{-3} mol L^{-1} *tert*-BuOH; calcd. from study at pH 1.5-3.	83A41
120	**Diethylamine**					
	$O_3 + (C_2H_5)_2NH \rightarrow$	6.2×10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 4.1-7.5 and pK_a = 10.49.	84M37
121	**Diethyl ether**					
	$O_3 + (C_2H_5)_2O \rightarrow$	1.1	2		D.k. at 258 nm in soln. contg. 1.7-14 × 10^{-2} mol L^{-1} substrate.	83A40
122	**Diethyl malonate**					
	$O_3 + C_2H_5O_2CCH_2CO_2C_2H_5 \rightarrow$	6×10^{-2}	2		D.k. at 258 nm in soln. contg. 8-70 × 10^{-3} mol L^{-1} substrate.	83A40
123	***N,N*-Dimethylacetamide**					
	$O_3 + CH_3CON(CH_3)_2 \rightarrow$	5×10^{-2} 5×10^{-1} 7×10^{-1}	2.5 3.3 7.0	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M37
124	**Dimethylamine**					
	$O_3 + (CH_3)_2NH \rightarrow$	1.9×10^7			D.k. at 258 nm in soln. contg. 0.04-4 × 10^{-3} mol L^{-1} substrate; calcd. from k_{obs} = 0.13 ± 0.2 at pH 5-6.	83A41
125	**Dimethylammonium ion**					
	$O_3 + (CH_3)_2NH_2^+ \rightarrow$	$<1 \times 10^{-1}$	5-6		D.k. at 258 nm in soln. contg. 0.04-4 × 10^{-3} mol L^{-1} substrate; also studied by d.k. of ozone (detd. by bleaching of indigotrisulfonate) at pH 2; pK_a = 11.0.	83A41
126	**Dimethylchloramine**					
	$O_3 + (CH_3)_2NCl \rightarrow$	1.9×10^3	1.6, 4.1		D.k. at 258 nm in soln. contg. 3-26 × 10^{-5} mol L^{-1} substrate and 0-10 × 10^{-3} mol L^{-1} *tert*-BuOH; cor. for protonation, assuming k = 0 (pK = 0.46).	83A40
127	**5,5-Dimethyl-1,3-cyclohexanedione**					
	$O_3 + (CH_3)_2C_6H_6(=O)_2 \rightarrow$	$>4 \times 10^5$	2		Soln. contg. 2.7 × 10^{-6} mol L^{-1} substrate.	83A40
128	**2,3-Dimethylphenol**					
	$O_3 + (CH_3)_2C_6H_3OH \rightarrow$	2.7×10^4	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M38
129	**2,4-Dimethylphenol**					
	$O_3 + (CH_3)_2C_6H_3OH \rightarrow$	1.1×10^5	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M38
130	**2,6-Dimethylphenol**					
	$O_3 + (CH_3)_2C_6H_3OH \rightarrow$	2.1×10^4	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M38
131	**3,4-Dimethylphenol**					
	$O_3 + (CH_3)_2C_6H_3OH \rightarrow$	1.1×10^5	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M38

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
132	**Dimethyl sulfoxide**					
	$O_3 + CH_3SOCH_3 \rightarrow$	8.2 7.5 7.2 8.1	2.3 4.5 6.0 7.0	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
133	**1,4-Dioxane**					
	$O_3 + \text{-}O(CH_2)_2O(CH_2)_2\text{-} \rightarrow$	3.2×10^{-1}	2		D.k. at 258 nm in soln. contg. 6-50 × 10^{-3} mol L^{-1} substrate.	83A408
134	**Dipropyl sulfide**					
	$O_3 + (CH_3CH_2CH_2)_2S \rightarrow$	$>2 \times 10^5$	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 8 × 10^{-6} mol L^{-1} substrate and 2 × 10^{-3} mol L^{-1} *tert*-BuOH.	83A408
135	**Ethanethiol**					
	$O_3 + C_2H_5SH \rightarrow$	$>2 \times 10^5$	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 8 × 10^{-6} mol L^{-1} substrate and 2 × 10^{-3} mol L^{-1} *tert*-BuOH.	83A408
136	**Ethanol**					
	$O_3 + C_2H_5OH \rightarrow$	4.5×10^{-1} 5.9×10^{-1} 1.4 3.6	2.1 3.4 7.0 7.9	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
		3.7×10^{-1}	2		D.k. at 258 nm in soln. contg. 6-60 × 10^{-3} mol L^{-1} substrate.	83A408
137	**Ethylbenzene**					
	$O_3 + C_6H_5C_2H_5 \rightarrow$	1.4×10^1	2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.25-1 × 10^{-3} mol L^{-1} substrate and 0.1 mol L^{-1} *tert*-BuOH; rel. to $k(O_3 + ArH)$ where ArH = benzene, toluene or *o*-xylene.	83A408
138	**Formaldehyde**					
	$O_3 + HCHO \rightarrow$	1×10^{-1}	2		D.k. at 258 nm in soln. contg. 7-60 × 10^{-2} mol L^{-1} substrate.	83A408
139	**Formate ion**					
	$O_3 + HCO_2^- \rightarrow$	1.0×10^2			D.k. at 258 nm; k calcd. from study at pH 2-4.	83A415
140	**Formic acid**					
	$O_3 + HCO_2H \rightarrow$	5			D.k. at 258 nm in soln. contg. 1-20 × 10^{-3} mol L^{-1} substrate and 10^{-3} mol L^{-1} PrOH; pK_a = 3.75; calcd. from study at pH 2-4.	83A415
141	**Fumarate ion**					
	$O_3 + trans\text{-}^-O_2CCH{=}CHCO_2^- \rightarrow$	6×10^3 1×10^5	2 5		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.01-0.1 mol L^{-1} substrate and 1.5 × 10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 3.0, 4.4.	83A415
142	**Fumaric acid**					
	$O_3 + HO_2CCH{=}CHCO_2H \rightarrow$	$\sim 6 \times 10^3$	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 1-10 × 10^{-4} mol L^{-1} substrate and 1.5 × 10^{-3} mol L^{-1} *tert*-BuOH.	83A408
143	**Glucose**					
	O_3 + glucose $\rightarrow$	4.5×10^{-1} 9×10^{-1}	2 6		D.k. at 258 nm in soln. contg. 5-100 × 10^{-3} mol L^{-1} substrate.	83A408

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
144	**Glutamate ion**					
	$O_3 + Glu^- \rightarrow$	2.6×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 4.3-6.8 and pK_a = 9.47.	84M375
145	**Glutamine**					
	$O_3 + Gln \rightarrow$	2.6×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 3.4-7.0 and pK_a = 9.28.	84M375
146	**Glutarate ion**					
	$O_3 + C_5H_6O_4^{2-} \rightarrow$	8×10^{-3}			D.k. at 258 nm; calcd. from study at pH 4-6.	83A415
147	**Glutaric acid**					
	$O_3 + HO_2C(CH_2)_3CO_2H \rightarrow$	$<8 \times 10^{-3}$			D.k. at 258 nm in soln. contg. 0.2-0.6 mol L^{-1} substrate; pK_a = 4.3, 5.4; calcd. from study at pH 4-6.	83A415
148	**Glutathione**					
	$O_3 + GSH \rightarrow$	2×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; pK_a = 8.75; k calcd. from study at pH 1.9-3.1.	84M375
149	**Glutathione, negative ion**					
	$O_3 + GS^- \rightarrow$	4×10^6		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. from study at pH 1.9-3.1.	84M375
150	**Glycine**					
	$O_3 + Gly \rightarrow$	1.3×10^5			D.k. at 258 nm in soln. contg. 0.03-3 × 10^{-3} mol L^{-1} substrate; pK = 9.9; k for zwitterion calcd. from study at pH 6-7.	83A415
151	**Glycine, conjugate acid**					
	$O_3 + H_3N^+CH_2CO_2H \rightarrow$	$\sim 5 \times 10^{-2}$	2		D.k. at 258 nm in soln. contg. 0.6 mol L^{-1} substrate.	83A415
152	**Glycine, negative ion**					
	$O_3 + H_2NCH_2CO_2^- \rightarrow$	2.1×10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 2.4-7.6 and pK_a = 9.78; E_a = 33 kJ mol^{-1}.	84M375
153	**Glyoxylate ion**					
	$O_3 + HCOCO_2^- \rightarrow$	1.9			D.k. at 258 nm; calcd. from study at pH 1.5-5.	83A415
154	**Glyoxylic acid**					
	$O_3 + HCOCO_2H \rightarrow$	1.7×10^{-1}			D.k. at 258 nm in soln. contg. 1-15 × 10^{-3} mol L^{-1} substrate and 1.5 × 10^{-2} mol L^{-1} *tert*-BuOH; pK_a = 3.2; k calcd. from study at pH 1.5-5.	83A415
155	**2-Hexenoate ion**					
	$O_3 + CH_3CH_2CH_2CH{=}CHCO_2^- \rightarrow$	3.4×10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; pK_a = 6.69; k calcd. from study at pH 2.4-7.2.	84M375
156	**3-Hexenoate ion**					
	$O_3 + CH_3CH_2CH{=}CHCH_2CO_2^- \rightarrow$	1.9×10^6		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; no pH dependence.	84M375

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
157	**1-Hexen-3-ol**					
	$O_3 + CH_3CH_2CH_2CH(OH)$-$CH{=}CH_2$ →	~1.0×10^5	2.0		D.k. at 258 nm in soln. contg. 3×10^{-6} mol L^{-1} substrate and 4×10^{-3} mol L^{-1} PrOH.	83A408
158	**1-Hexen-4-ol**					
	$O_3 + CH_3CH_2CHOHCH_2CH{=}CH_2$ →	~1.8×10^5	2.0		D.k. at 258 nm in soln. contg. 3×10^{-6} mol L^{-1} substrate and 4×10^{-3} mol L^{-1} *tert*-BuOH.	83A408
159	**Histidine, negative ion**					
	$O_3 + His^-$ →	2.1×10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 2.2-7 and pK_a = 6.	84M375
160	**Hydroquinone**					
	$O_3 + 1,4\text{-}C_6H_4(OH)_2$ →	1.5×10^6	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M383
161	**Hydroxymethanesulfonate ion**					
	$O_3 + HOCH_2SO_3^-$ →	$<1 \times 10^{-1}$	3-6		D.k. at 258 nm in soln. contg. 10^{-2} mol L^{-1} substrate.	85A221
162	**Imidazole**					
	O_3 + Im →	2.4×10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 2.3-7.2 and pK_a = 6.95; E_a = 27 kJ mol^{-1}.	84M375
		4.0×10^5			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.007-0.7 $\times 10^{-3}$ mol L^{-1} substrate; calcd. from study at pH 2-6.	83A415
163	**Imidazolium ion**					
	$O_3 + ImH^+$ →	2.2×10^1			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.007-0.7 $\times 10^{-3}$ mol L^{-1} substrate; pK_a = 7.1, calcd. from $k_{obs} = 2.3\text{-}15 \times 10^4$ at pH 2-6.	83A415
164	**L-Isoleucine, negative ion**					
	$O_3 + Ile^-$ →	5.6×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 3.3-7.0 and pK_a = 9.76.	84M375
165	**Leucine, negative ion**					
	$O_3 + Leu^-$ →	5.3×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 4.9-7.0 and pK_a = 9.74.	84M375
166	**Linoleic acid**					
	O_3 + LH →	1×10^6	2.7	s.f.	D.k. at 255 nm in phosphate buffer contg. SDS.	86A428 85N238
167	**Lysine, negative ion**					
	$O_3 + Lys^-$ →	3.1×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 4.0-7.0 and pK_a = 9.18.	84M375
168	**Maleate ion**					
	O_3 + *cis*-$^-O_2CCH{=}CHCO_2^-$ →	2.4×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. from obs. k at pH 2.1-7.9 and pK_a = 6.07.	84M375
		1×10^3 5×10^3	2 6		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.01-0.07 mol L^{-1} substrate and 1.5×10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 1.8, 6.1.	83A415

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
169	**Malonate ion**					
	$O_3 + CH_2(CO_2^-)_2 \rightarrow$	7			D.k. at 258 nm; calcd. from study at pH 2.	83A415
170	**Malonic acid**					
	$O_3 + HO_2CCH_2CO_2H \rightarrow$	<4			D.k. at 258 nm in soln. contg. 2-20 × 10^{-3} mol L^{-1} substrate; pK_a = 2.8, 5.7; k calcd. from study at pH 2.	83A415
172	**Methanol**					
	$O_3 + CH_3OH \rightarrow$	~2 × 10^{-2}	2-5		D.k. at 258 nm in soln. contg. 0.6 mol L^{-1} substrate.	83A408
173	**Methionine**					
	O_3 + Met →	4 × 10^8	2.4-7.0		C.k. in soln. contg. 0.1 mol L^{-1} buffer; rel. to $k(O_3$ + TrpH).	84M375
		>5 × 10^5	2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 3 × 10^{-6} mol L^{-1} substrate and 1 × 10^{-3} mol L^{-1} *tert*-BuOH.	83A415
174	**Methionine sulfone**					
	O_3 + Met(SO_2) →	1.5 × 10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; pK_a = 9.21; calcd. for deprotonated amine from study at pH 3.2-7.4.	84M375
175	**Methionine sulfoxide**					
	O_3 + Met(SO) →	6.6 × 10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; pK_a = 9.21; calcd. for deprotonated amine from study at pH 2.3-7.4.	84M375
176	***N*-Methylacetamide**					
	$O_3 + CH_3CONHCH_3 \rightarrow$	6 × 10^{-1}	7.2	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
177	**Methylamine**					
	$O_3 + CH_3NH_2 \rightarrow$	<1.4 × 10^5			D.k. at 258 nm in soln. contg. 0.02-2 × 10^{-3} mol L^{-1} substrate and 2 × 10^{-2} mol L^{-1} $NaHCO_3$; pK_a = 10.7, calcd. from study at pH 7-8.	83A415
178	**Methyl benzoate**					
	$O_3 + C_6H_5CO_2CH_3 \rightarrow$	1.1	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 1 mol L^{-1} substrate and 0.1 mol L^{-1} *tert*-BuOH; rel. to $k(O_3$ + ArH) where ArH = benzene, toluene or *o*-xylene.	83A408
179	**Methylchloramine**					
	$O_3 + CH_3NHCl \rightarrow$	8.1 × 10^2	4.2, 6.1		D.k. at 258 nm in soln. contg. 3.9-17 × 10^{-5} mol L^{-1} substrate, 0-10 × 10^{-3} mol L^{-1} *tert*-BuOH.	83A409
180	**Methyldichloramine**					
	$O_3 + CH_3NCl_2 \rightarrow$	<10^{-2}	2		D.k. at 258 nm in soln. contg. 2.1 × 10^{-3} mol L^{-1} substrate, 10^{-2} mol L^{-1} *tert*-BuOH.	83A409
181	**4-Methylimidazole**					
	$O_3 + C_4H_6N_2 \rightarrow$	3.1 × 10^6		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 2.2-6.9 and pK_a = 7.52.	84M375

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
182	**Methyl linoleate**					
	$O_3 + C_{19}H_{34}O_2 \rightarrow$	1.1×10^{6}	4.2, 5.7	s.f.	D.k. at 255 nm in phosphate buffer contg. SDS.	86A428 85N238
183	**2-Methylnaphthalene**					
	$O_3 + C_{10}H_7CH_3 \rightarrow$	$\sim 1 \times 10^3$	5.6		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 4-4.5 $\times$ 10^{-6} mol L^{-1} naphthalene and 0.4-1.1 $\times$ 10^{-5} mol L^{-1} ozone.	86M314
184	**Methyl oleate**					
	$O_3 + C_{19}H_{36}O_2 \rightarrow$	$\sim 9 \times 10^5$	2-6.8	s.f.	D.k. at 255 nm in phosphate buffer contg. SDS.	86A428 85N238
185	**2-Methylphenol**					
	$O_3 + CH_3C_6H_4OH \rightarrow$	6.2×10^3	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M383
		1.2×10^4	1.5, 2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.01-0.1 10^{-3} mol L^{-1} substrate and 7 $\times$ 10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 10.2.	83A415
186	**3-Methylphenol**					
	$O_3 + 3\text{-}CH_3C_6H_4OH \rightarrow$	6.2×10^3	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M383
		1.3×10^4	1.5, 2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 4 $\times$ 10^{-6} mol L^{-1} substrate and 7 $\times$ 10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 10.0.	83A415
187	**4-Methylphenol**					
	$O_3 + CH_3C_6H_4OH \rightarrow$	1.5×10^4	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M383
		3.0×10^4	1.5, 2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.01 $\times$ 10^{-3} mol L^{-1} substrate and 7 $\times$ 10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 10.2.	83A415
188	**2-Methyl-2-propanol**					
	$O_3 + (CH_3)_3COH \rightarrow$	$\sim 3 \times 10^{-3}$	2-6		D.k. at 258 nm in soln. contg. 0.6 mol L^{-1} substrate.	83A408
189	**Naphthalene**					
	$O_3 + C_{10}H_8 \rightarrow$	$\sim 1.5 \times 10^3$	5.6		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 4-7 $\times$ 10^{-4} mol L^{-1} naphthalene and 0.6-1.1 $\times$ 10^{-5} mol L^{-1} ozone; $E_a \approx 8$ kcal mol^{-1}.	86M314
		3.0×10^3	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.2-14 $\times$ 10^{-5} mol L^{-1} substrate and 10^{-3} mol L^{-1} *tert*-BuOH.	83A408
190	**Nitrilotriacetate ion**					
	$O_3 + NTA^{3-} \rightarrow$	8.3×10^1	2		D.k. at 258 nm in soln. contg. 2.25 $\times$ 10^{-4} mol L^{-1} O_3 and 1.05-3.61 $\times$ 10^{-3} NTA.	80U373
191	**Nitrobenzene**					
	$O_3 + C_6H_5NO_2 \rightarrow$	9×10^{-2}	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 5-10 $\times$ 10^{-3} mol L^{-1} nitrobenzene and 0.5-1 mol L^{-1} *tert*-BuOH.	83A408

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
192	**4-Nitrophenol**					
	$O_3 + 4\text{-}O_2NC_6H_4OH \rightarrow$	$<5 \times 10^1$			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.01-1.4 $\times 10^{-3}$ mol L^{-1} substrate and 2-7 $\times 10^{-3}$ mol L^{-1} *tert*-BuOH; pK_a = 7.2; k calcd. from study at pH 1.5-3.0.	83A415
193	**4-Nitrophenoxide ion**					
	$O_3 + 4\text{-}NO_2C_6H_4O^- \rightarrow$	1.6×10^7			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.01-1.4 $\times 10^{-3}$ mol L^{-1} substrate and 2-7 $\times 10^{-3}$ mol L^{-1} *tert*-BuOH; calcd. from study at pH 1.5-3.0.	83A415
194	***N*-Nitrosodimethylamine**					
	$O_3 + (CH_3)_2NNO \rightarrow$	$\sim 1 \times 10^1$	5		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 4 $\times 10^{-3}$ mol L^{-1} substrate and 1-60 $\times 10^{-3}$ mol L^{-1} *tert*-BuOH.	83A415
195	**1-Octanol**					
	$O_3 + CH_3(CH_2)_7OH \rightarrow$	$\leq 8 \times 10^{-1}$	2		D.k. at 258 nm in soln. contg. 0.8-1.4 $\times 10^{-3}$ mol L^{-1} substrate.	83A408
196	**Octanal**					
	$O_3 + CH_3(CH_2)_6CHO \rightarrow$	8	1.8-5		D.k. at 258 nm in soln. contg. 1-2 $\times 10^{-4}$ mol L^{-1} substrate.	83A408
197	**Oleic acid**					
	$O_3 + CH_3(CH_2)_7CH{=}CH(CH_2)_7CO_2H \rightarrow$	1×10^6	2.5-3.1	s.f.	D.k. at 255 nm in phosphate buffer contg. SDS.	86A428 85N238
198	**Oxalate ion**					
	$O_3 + {}^-O_2CCO_2{}^- \rightarrow$	$\leq 4 \times 10^{-2}$			D.k. at 258 nm in soln. contg. 0.1-0.5 mol L^{-1} substrate; pK_a = 1.2, 4.2; k calcd. from study at pH 5-6.	83A415
199	**Pentachlorophenol**					
	$O_3 + C_6Cl_5OH \rightarrow$	$>3 \times 10^5$	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.3 $\times 10^{-3}$ mol L^{-1} substrate and 3 $\times 10^{-3}$ mol L^{-1} AcOH; pK_a = 4.7.	83A415
200	**2-Pentanone**					
	$O_3 + CH_3CH_2CH_2COCH_3 \rightarrow$	$\sim 2 \times 10^{-2}$	2		D.k. at 258 nm in soln. contg. 6 $\times 10^{-3}$ mol L^{-1} substrate.	83A408
201	**Phenanthrene**					
	$O_3 + C_{14}H_{10} \rightarrow$	1.6×10^4	7	s.f.	D.k. at 292 nm (1.6 $\times 10^{-6}$ mol L^{-1} phenanthrene).	83A414
202	**Phenol**					
	$O_3 + C_6H_5OH \rightarrow$	1.3×10^3			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.4-4 $\times 10^{-5}$ mol L^{-1} substrate and 3 $\times 10^{-3}$ mol L^{-1} *tert*-BuOH; pK_a = 9.9; k calcd. from study at pH 2-6.	83A415
203	**Phenoxide ion**					
	$O_3 + C_6H_5O^- \rightarrow$	1.4×10^9			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.4-4 $\times 10^{-5}$ mol L^{-1} substrate and 3 $\times 10^{-3}$ mol L^{-1} *tert*-BuOH; calcd. from study at pH 2-6.	83A415

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
204	**Phenylalanine, negative ion**					
	$O_3 + Phe^- \rightarrow$	3.8×10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 2,3-7.0 and pK_a = 9.24.	84M375
205	**L-Proline, negative ion**					
	$O_3 + Pro^- \rightarrow$	4.3×10^6		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 1.9-8.2 and pK_a = 10.6.	84M375
206	**1-Propanol**					
	$O_3 + CH_3CH_2CH_2OH \rightarrow$	3.7×10^{-1}	2		D.k. at 258 nm in soln. contg. 6-60 × 10^{-3} mol L^{-1} substrate.	83A408
207	**2-Propanol**					
	$O_3 + (CH_3)_2CHOH \rightarrow$	1.9 2.5 2.8 2.9 3.5	2 2.2 3.1 5.9 7.0	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
		1.9	2-6		D.k. at 258 nm in soln. contg. 2-30 × 10^{-3} mol L^{-1} substrate.	83A408
208	**Propionaldehyde**					
	$O_3 + C_2H_5CHO \rightarrow$	2.5	2		D.k. at 258 nm in soln. contg. 3-30 × 10^{-2} mol L^{-1} substrate.	83A408
209	**Propionate ion**					
	$O_3 + CH_3CH_2CO_2^- \rightarrow$	1×10^{-3}			D.k. at 258 nm; calcd. from study at pH 2-5.	83A415
210	**Propionic acid**					
	$O_3 + C_2H_5CO_2H \rightarrow$	$<4 \times 10^{-4}$			D.k. at 258 nm in soln. contg. 1 mol L^{-1} substrate; pK_a = 4.9; k calcd. from study at pH 2-5.	83A415
211	**Propyl acetate**					
	$O_3 + CH_3CO_2CH_2CH_2CH_3 \rightarrow$	3×10^{-2}	2		D.k. at 258 nm in soln. contg. 13 × 10^{-2} mol L^{-1} substrate and 1.5 × 10^{-2} mol L^{-1} *tert*-BuOH.	83A408
212	**Propylamine**					
	$O_3 + CH_3CH_2CH_2NH_2 \rightarrow$	$<1 \times 10^{-2}$	2		D.k. at 258 nm.	83A408
213	**Propylammonium ion**					
	$O_3 + CH_3(CH_2)_2NH_3^+ \rightarrow$	$\leq 1 \times 10^{-2}$	2		D.k. at 258 nm in soln. contg. 2-4 × 10^{-1} mol L^{-1} substrate.	83A415
214	**Pyrene**					
	$O_3 + C_{16}H_{10} \rightarrow$	4×10^4	1-7	s.f.	D.k. at 334 nm (2.5 × 10^{-7} mol L^{-1} pyrene).	83A414
215	**Pyridine**					
	$O_3 + py \rightarrow$	3			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 3 × 10^{-2} mol L^{-1} substrate and 7 × 10^{-2} mol L^{-1} *tert*-BuOH; k calcd. from study at pH 3-7.	83A415
216	**Pyridinium ion**					
	$O_3 + pyH^+ \rightarrow$	1×10^{-2}			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 3 × 10^{-2} mol L^{-1} substrate and 7 × 10^{-4} mol L^{-1} *tert*-BuOH; pK_a = 5.2, calcd. from k_{obs} = 0.05-3 at pH 3-7.	83A415

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
217	**Resorcinol**					
	$O_3 + 1,3\text{-}C_6H_4(OH)_2 \rightarrow$	9.8×10^4	2.5-3	s.f.	C.k.; rel. to $k(O_3 + C_6H_5OH) = 1.4 \times 10^3$.	84M383
		$>3 \times 10^5$	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 3×10^{-6} mol L^{-1} substrate.	83A415
218	**Salicylate ion**					
	$O_3 + 2\text{-}HOC_6H_4CO_2^- \rightarrow$	3.0×10^4			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.03-1 $\times$ 10^{-5} mol L^{-1} substrate and 4×10^{-3} mol L^{-1} *tert*-BuOH; calcd. from study at pH 3-7; pK_a = 3, 13.4.	83A415
219	**Salicylic acid**					
	$O_3 + HOC_6H_4CO_2H \rightarrow$	$<5 \times 10^2$	1.2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.1-1 $\times$ 10^{-1} mol L^{-1} substrate and 4×10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 3.	83A415
220	**Serine, negative ion**					
	$O_3 + Ser^- \rightarrow$	1.3×10^5		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 2.6-7.0 and pK_a = 9.21.	84M375
221	**Styrene**					
	$O_3 + C_6H_5CH{=}CH_2 \rightarrow$	$\sim 3 \times 10^5$	2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 7×10^{-6} mol L^{-1} substrate and 10^{-3} mol L^{-1} *tert*-BuOH.	83A408
222	**Succinate ion**					
	$O_3 + {}^-O_2CCH_2CH_2CO_2^- \rightarrow$	3×10^{-2}			D.k. at 258 nm; calcd. from study at pH 4-6.	83A415
223	**Succinic acid**					
	$O_3 + HO_2CCH_2CH_2CO_2H \rightarrow$	<3			D.k. at 258 nm in soln. contg. 0.1-0.7 mol L^{-1} substrate; pK_a = 4.2, 5.6; k calcd. from study at pH 4-6.	83A415
224	**Sucrose**					
	$O_3 + C_{12}H_{22}O_{11} \rightarrow$	5×10^{-1}	2.1	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
		1.1	3.5			
		2.8	6.9			
		1.6×10^1	7.8			
		1.2×10^{-1}	2		D.k. at 258 nm in soln. contg. 0.5-10 $\times$ 10^{-2} mol L^{-1} substrate and 2-20 $\times$ 10^{-2} mol L^{-1} *tert*-BuOH.	83A408
225	**Tetrachloroethylene**					
	$O_3 + Cl_2C{=}CCl_2 \rightarrow$	$<1 \times 10^{-1}$	2.0		D.k. at 258 nm in soln. contg. 7×10^{-4} mol L^{-1} substrate.	83A408
226	**Tetrahydrofuran**					
	$O_3 + THF \rightarrow$	6.1	2.2	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M375
		6.8	2.7			
		7.4	6.0			
		7.8	7.0			
		1.4×10^1	8.1			
227	**Threonine, negative ion**					
	$O_3 + Thr^- \rightarrow$	4.5×10^4		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 2.3-7.0 and pK_a = 9.10.	84M375

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
228	α-Tocopherol					
	O_3 + ArOH → ArO·	1.3×10^4	2.3	s.f.	D.k. at 255 , 292, or 283 nm in phosphate-buffer contg. SDS.	86A428 85N238
		1.5×10^4	2.8			
		2.2×10^4	2.9			
		1.1×10^5	4.8			
		3.2×10^5	6.3			
		6.6×10^5	6.8			
		7.5×10^5	7.0			
		7.3×10^5	7.1			
229	α-Tocopheryl acetate					
	O_3 + ArOAc →	1.3×10^4	2.3	s.f.	D.k. at 255 nm in phosphate-buffer contg. SDS.	86A428
		1.5×10^4	5.8			
		1.8×10^4	6.9			
230	Toluene					
	$O_3 + C_6H_5CH_3$ →	1.4×10^1	1.7		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.4-4 × 10^{-3} mol L^{-1} substrate.	83A408
231	1,2,4-Trichlorobenzene					
	$O_3 + C_6H_3Cl_3$ →	<1.6	2		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 5 × 10^{-5} mol L^{-1} substrate and 10^{-2} mol L^{-1} *tert*-BuOH.	83A408
232	Trichloroethylene					
	O_3 + ClCH=CCl$_2$ →	1.7×10^1	2.0		D.k. at 258 nm in soln. contg. 6-60 × 10^{-5} mol L^{-1} substrate.	83A408
233	2,4,5-Trichlorophenol					
	$O_3 + Cl_3C_6H_2OH$ →	$<3 \times 10^3$			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.2-0.3 × 10^{-3} mol L^{-1} substrate and 3 × 10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 6.9; k calcd. from study at pH 1.2-1.5.	83A415
234	2,4,5-Trichlorophenoxide ion					
	$O_3 + Cl_3C_6H_2O^-$ →	$>1 \times 10^9$			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.2-0.3 × 10^{-3} mol L^{-1} substrate and 3 × 10^{-3} mol L^{-1} *tert*-BuOH; calcd. from study at pH 1.2-1.5.	83A415
235	2,4,6-Trichlorophenol					
	$O_3 + Cl_3C_6H_2OH$ →	$<1 \times 10^4$			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.2-0.3 × 10^{-3} mol L^{-1} substrate and 3 × 10^{-3} mol L^{-1} *tert*-BuOH; pK_a = 6.1; k calcd. from study at pH 1.3-1.5.	83A415
236	2,4,6-Trichlorophenoxide ion					
	$O_3 + Cl_3C_6H_2O^-$ →	$>1 \times 10^8$			D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.2-0.3 × 10^{-3} mol L^{-1} substrate and 3 × 10^{-3} mol L^{-1} *tert*-BuOH; calcd. from study at pH 1.3-1.5.	83A415
237	Triethylamine					
	$O_3 + (C_2H_5)_3N$ →	2.1×10^6		s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 5.3-7.1 and pK_a = 11.1.	84M375

TABLE 5. Rate constants for reactions of ozone in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
238	**Trimethylacetate ion**					
	$O_3 + (CH_3)_3CCO_2^- \rightarrow$	$\sim 2 \times 10^{-3}$	5.1-5.8	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer.	84M371
239	**Trimethylamine**					
	$O_3 + (CH_3)_3N \rightarrow$	4.1×10^{6}			D.k. at 258 nm in soln. contg. 2-200 $\times 10^{-3}$ mol L^{-1} substrate and 1×10^{-3} mol L^{-1} PrOH; pK_a = 9.9, k calcd. for deprotonated amine from study at pH 3-5.	83A415
240	**1,2,3-Trimethylbenzene**					
	$O_3 + C_6H_3(CH_3)_3 \rightarrow$	4.0×10^{2}	1.7		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 6-20 $\times 10^{-5}$ mol L^{-1} substrate.	83A408
241	**1,3,5-Trimethylbenzene**					
	$O_3 + C_6H_3(CH_3)_3 \rightarrow$	7.0×10^{2}	1.7		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 5-10 $\times 10^{-5}$ mol L^{-1} substrate.	83A408
242	**Tryptophan**					
	O_3 + TrpH $\rightarrow$	7×10^{6}	2.4-7.0		C.k. in soln. contg. 0.1 mol L^{-1} buffer; rel. to k(O_3 + 3-hexenoate).	84M371
243	**Urea**					
	$O_3 + H_2NCONH_2 \rightarrow$	$\sim 5 \times 10^{-2}$	2-7		D.k. at 258 nm in soln. contg. 2-13 $\times 10^{-2}$ mol L^{-1} substrate.	83A408
244	**Uric acid**					
	$O_3 + C_5H_4N_4O_3 \rightarrow$	1.4×10^{6}	1.9-6.1	s.f.	D.k. in soln. contg. Na phosphate; pK_a = 5.4.	85N238
245	**Valine, negative ion**					
	O_3 + Val$^-$ $\rightarrow$	6.8×10^{4}	3.9-8.1	s.f.	D.k. at 285 nm in soln. contg. 0.1 mol L^{-1} buffer; k calcd. for deprotonated amine from obs. k at pH 3.9-8.1 and pK_a = 9.72.	84M371
246	***m*-Xylene**					
	$O_3 + C_6H_4(CH_3)_2 \rightarrow$	9.4×10^{1}	2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 2-5 $\times 10^{-4}$ mol L^{-1} substrate and 10^{-3} mol L^{-1} *tert*-BuOH.	83A408
247	***o*-Xylene**					
	$O_3 + C_6H_4(CH_3)_2 \rightarrow$	9.0×10^{1}	1.7-5		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 0.3-8 $\times 10^{-4}$ mol L^{-1} substrate.	83A408
248	***p*-Xylene**					
	$O_3 + C_6H_4(CH_3)_2 \rightarrow$	1.4×10^{2}	2.0		D.k. of ozone (detd. by bleaching of indigotrisulfonate) in soln. contg. 2-5 $\times 10^{-4}$ mol L^{-1} substrate and 10^{-3} mol L^{-1} *tert*-BuOH.	83A408

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Azide radical**					
	$\cdot N_3 + \cdot N_3 \rightarrow 3\ N_2$	4.4×10^9		p.r.	D.k. at 274 nm in N_2O-satd. soln. contg. NaN_3; $\epsilon = 2025$ L mol^{-1} cm^{-1}.	85A218
		4.5×10^9		p.r.	Half-life 5, 3.8 and 3.5 μs at pH 4.2, 7.5 and 11.1 resp.; D.k. in N_2O-satd. soln. contg. 0.05 mol L^{-1} NaN_3; cor. to baseline d.k. is first order k = $2.4 \times 10^5 s^{-1}$; $\cdot N_3 + N_3^- \rightarrow (N_3)_2^-$; no ϵ given.	82A005
		3×10^9		p.r.	D.k. at 278 nm in N_2O-satd. soln.; $\epsilon =$ 1300 L mol^{-1} cm^{-1}.	81A216
		3×10^9		p.r.	D.k.; $\epsilon(275) = 1300$ L mol^{-1} cm^{-1}.	79A202
		4.0×10^9		p.r.	D.k. in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} NaN_3; $\epsilon_{275} = 1400$ L mol^{-1} cm^{-1}.	761108
		4.5×10^9		p.r.	D.k. at 278 nm in N_2O-satd. soln. contg. azide ion; $\epsilon_{278} = 2300$ L mol^{-1} cm^{-1}; also p.b.k. at 242 nm gave $k = 6.5 \times 10^9$ from $k/\epsilon = 3.1 \times 10^6$ and $\epsilon = 2100$ L mol^{-1} cm^{-1} for the transient product.	700649
		3×10^9	~9	f.p.	D.k.; N_2-satd. soln. contg. NaN_3; $2k = 4 \times 10^6 \epsilon_{280}$ assuming $\epsilon_{280} = 1600$ L mol^{-1} cm^{-1}.	697031
2	**Tetrahydroborate(III) ion**					
	$\cdot N_3 + BH_4^- \rightarrow N_3^- + BH_4$	8×10^8	11.1	p.r.	P.b.k. in N_2O-satd. soln. contg. 2×10^{-2} mol L^{-1} NaN_3 and 3×10^{-4} mol L^{-1} $NaBH_4$.	86A469
3	**Bromide ion**					
	$\cdot N_3 + 2\ Br^- \rightarrow N_3^- + Br_2\cdot^-$	7×10^3 L^2 mol^{-2} s^{-1}		p.r.	D.k. at 360 hm in soln. contg. >1 mol L^{-1} Br^- and <10^{-3} mol L^{-1} N_3^-; $k_{obs} = k_f[N_3^-] + k_r[Br^-]^2$; $k_r = 4.0 \times 10^8$.	87C002
4	**Iron(II) ion**					
	$\cdot N_3 + Fe^{2+} \rightarrow Fe^{3+} + N_3^-$	$>2 \times 10^9$		p.r.	P.b.k. at 340 as well as 460 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} azide ion and (1-10) $\times 10^{-4}$ mol L^{-1} Fe^{2+}; obs. $Fe^{III}N_3^-$ complex formed from ferric ion and azide ion ($k = 8.4 \times 10^5$).	761108
5	**Ferrocyanide ion**					
	$\cdot N_3 + Fe(CN)_6^{4-} \rightarrow N_3^- + Fe(CN)_6^{3-}$	4.0×10^9		p.r.	P.b.k. at 410 nm in soln. contg. 5×10^{-2} mol L^{-1} azide ion and 10^{-4} mol L^{-1} $K_4Fe(CN)_6$; no ionic strength effect.	84A013
		3.4×10^9	7.0	p.r.	P.b.k.	79A202
6	**Iodide ion**					
	$\cdot N_3 + I^- \rightarrow N_3^- + I\cdot$	4.5×10^8		p.r.	P.b.k. at 380 nm (I_2^-) in N_2O-satd. soln. contg. excess NaN_3	87C002
7	**Hexachloroiridate(III) ion**					
	$\cdot N_3 + IrCl_6^{3-} \rightarrow N_3^- + IrCl_6^{2-}$	5.5×10^8	6.5	p.r.	P.b.k. at 487 or 434 nm in N_2O-satd. soln. contg. 0.01-0.1 mol L^{-1} NaN_3 and Na_3IrCl_6; k_r detd. by s.f., spin trapping with DMPO = 1.6×10^2.	86A223
8	**Azide ion**					
	$\cdot N_3 + N_3^- \rightarrow N_6\cdot^-$			p.r.	Obs. dimer radical absorption at 645 nm in N_2O-satd. soln. as a function of concn. of azide ion	84A013
				p.r.	D.k. in N_2O-satd. soln. contg. NaN_3; $k =$ 2.4×10^5 s^{-1} also 2d order contribution.	82A005

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
9	**Hydrogen peroxide**					
	$\cdot N_3 + H_2O_2 \rightarrow$			p.r.	No effect on d.k. of $\cdot N_3$ by $\sim 10^{-1}$ mol L^{-1} H_2O_2.	82A005
		$<5 \times 10^6$		p.r.	D.k. at 278 nm in soln. contg. H_2O_2 and NaOH at various concns.	81A216
10	**Hydroperoxide ion**					
	$\cdot N_3 + HO_2^- \rightarrow O_2\cdot^- + N_3^- + H^+$	3.2×10^9		p.r.	D.k. at 278 nm in soln. contg. H_2O_2 and NaOH at various concns.	81A216
11	**Superoxide**					
	$\cdot N_3 + O_2\cdot^- \rightarrow N_3^- + O_2$	1.2×10^{10}		p.r.	D.k. in O_2-satd. soln at 278 nm; cor. for $k(\cdot N_3 + \cdot N_3) = 3 \times 10^9$.	81A216
12	**Sulfite ion**					
	$\cdot N_3 + SO_3^{2-} \rightarrow N_3^- + \dot{S}O_3^-$	$\sim 2 \times 10^9$		p.r.	D.k.	86A191
		2.4×10^9		p.r.	C.k.	86A191
13	***N*-Acetyltryptophan**					
	$\cdot N_3$ + AcTrpH $\rightarrow N_3^-$ + AcTrp$\cdot$	4.4×10^9	7.5, 12	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3; radical cation forms which deprotonates.	86A110
14	***N*-Acetyltyrosinamide**					
	$\cdot N_3$ + AcTyrOH(NH_2) $\rightarrow N_3^-$ + AcTyrO$\cdot$(NH_2)	1.3×10^8	7.5	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3; radical cation forms which deprotonates.	86A110
15	**Adenosine**					
	$\cdot N_3$ + A $\rightarrow$	$\sim 1 \times 10^7$	7.6	p.r.	D.k. at 280 nm.	79A202
16	**Alanine**					
	$\cdot N_3$ + Ala $\rightarrow$	$<1 \times 10^5$	7.6	p.r.	D.k. at 280 nm	79A202
17	**2-Amino-(4-hydroxy-6-benzothiazolyl)propionate ion**					
	$\cdot N_3$ + AHBP$^-$ $\rightarrow N_3^-$ + AHBP$\cdot$	4.7×10^9	<12	p.r.	D.k. in alk. N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} NaN_3.	84A024
18	**2-Amino-(4-methoxy-6-benzothiazolyl)propionate ion**					
	$\cdot N_3$ + AMBP$^-$ $\rightarrow N_3^-$ + AMBP$\cdot$	2.4×10^8	<12	p.r.	D.k. in alk. N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} NaN_3.	84A024
19	**1-Aminonaphthalene-4-sulfonate ion**					
	$\cdot N_3$ + AnsH $\rightarrow N_3^-$ + AnsH$\cdot^+$	6.3×10^9		p.r.	P.b.k. at 550 nm.	78A328
20	**Aniline**					
	$\cdot N_3 + C_6H_5NH_2 \rightarrow N_3^- + [C_6H_5NH_2]\cdot^+$	4.2×10^9 4.5×10^9	~6 11-12	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.; in basic soln. the anilino radical is rapidly formed.	85A218
		3.9×10^9 4.4×10^9	5.9 12	p.r.	P.b.k. (anilino radical) in N_2O-satd. soln. contg. 10^{-4} mol L^{-1} aniline and azide ion.	85A428
21	**Anisole**					
	$\cdot N_3 + C_6H_5OCH_3 \rightarrow$	$<3 \times 10^6$	11-12	p.r.	P.b.k. at 330-500 nm; >0.1 mol L^{-1} NaN_3 soln.	85A218
22	**Ascorbate ion**					
	$\cdot N_3$ + AH$^-$ $\rightarrow N_3^-$ + H^+ + $\cdot$A$^-$	2.9×10^9	7.0	p.r.	P.b.k. in N_2O-satd. soln. contg. 2.5×10^{-2} mol L^{-1} azide ion and 10^{-2} mol L^{-1} phosphate; in 2×10^{-2} mol L^{-1} SDS $k = 3.4 \times 10^9$.	84A388

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
23	**Benzene**					
	$\cdot N_3 + PhH \rightarrow$	$<3 \times 10^6$	11-12	p.r.	No absorbing transient obs.; >0.1 mol L^{-1} NaN_3 soln.	85A218
24	**1,2,4-Benzenetriol**					
	$\cdot N_3 + C_6H_3(OH)_3 \rightarrow (HO)_2C_6H_3O\cdot + N_3^- + H^+$	5.3×10^9	6.5	p.r.	P.b.k. at 405 nm in soln. contg. 10^{-4} mol L^{-1} benzenetriol (pK_a = 9.1, 11.9, >13) and 0.1 mol L^{-1} NaN_3; product expected to be a mixture of 2,4-, 2,5- and 3,4-dihydroxyphenoxy radicals (pK_a = 4.75, 8.85); at pH 10.5 p.b.k. at 420 nm gave $k = 4.3 \times 10^9$.	87A104
25	**Benzoate ion**					
	$\cdot N_3 + C_6H_5CO_2^- \rightarrow$	$<3 \times 10^6$	11-12	p.r.	No absorbing transient obs.; >0.1 mol L^{-1} NaN_3 soln.	85A218
26	**Bilirubin dianion**					
	$\cdot N_3 + BR^{2-} \rightarrow N_3^- + BR\cdot^-$	7.0×10^9	10.9	p.r.	P.b.k. in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} NaN_3 and 10^{-3} mol L^{-1} NaOH.	83A302
27	**Biliverdin dianion**					
	$\cdot N_3 + BV^{2-} \rightarrow N_3^- + BV\cdot^-$	3.7×10^9	10.9	p.r.	P.b.k. in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} NaN_3 and 10^{-3} mol L^{-1} NaOH.	83A302
28	**Catechol**					
	$\cdot N_3 + C_6H_4(OH)_2 \rightarrow N_3^- + {}^-C_6H_4O\cdot + 2\,H^+$	3.8×10^9	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
29	**Chlorophyll *a***					
	$\cdot N_3$ + Chl a $\rightarrow$ [Chl a]$\cdot^+$ + N_3^-	2.2×10^9		p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} N_3^-.	81N146
30	**Chlorophyll *b***					
	$\cdot N_3$ + Chl b $\rightarrow$ [Chl b]$\cdot^+$ + N_3^-	1.8×10^9		p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} N_3^-.	81N146
31	**Chlorpromazine**					
	$\cdot N_3 + CZH^+ \rightarrow N_3^- + CZH\cdot^{2+}$	4.6×10^9	7.5	p.r.	P.b.k. at 505 nm in N_2O-satd. soln. contg. 0.01 mol L^{-1} NaN_3; overall rate constant, 47% electron transfer.	83A272
32	**2-Cyanophenol**					
	$\cdot N_3 + CNC_6H_4O^- \rightarrow N_3^- + CNC_6H_4O\cdot$	4.7×10^9	11-12	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
33	**3-Cyanophenol**					
	$\cdot N_3 + NCC_6H_4OH \rightarrow N_3^- + CNC_6H_4O\cdot + H^+$	2×10^7	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
	$\cdot N_3 + CNC_6H_4O^- \rightarrow N_3^- + CNC_6H_4O\cdot$	4.6×10^9	11-12			
34	**4-Cyanophenol**					
	$\cdot N_3 + NCC_6H_4OH \rightarrow N_3^- + CNC_6H_4O\cdot + H^+$	4×10^7	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
	$\cdot N_3 + CNC_6H_4O^- \rightarrow N_3^- + CNC_6H_4O\cdot$	3.8×10^9	11-12			
35	**Cysteine**					
	$\cdot N_3 + CysSH \rightarrow N_3^- + CysS\cdot + H^+$	1.4×10^7	6.3	p.r.	D.k. at 280 nm.	79A202
		2.7×10^9	10.5			

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
36	**(2,5S,S')-Cysteinyldopa**					
	$\cdot N_3$ + CysDOPA → [CysDOPA]· + N_3^- + H^+	2.1×10^9	~7	p.r.	P.b.k. at 340 nm in soln. contg. 5×10^{-2} mol L^{-1} NaN_3 and 1×10^{-4} mol L^{-1} substrate.	85A39
37	**(2S)-Cysteinyldopa**					
	$\cdot N_3$ + CysDOPA → [CysDOPA]· + N_3^- + H^+	2.3×10^9	~7	p.r.	P.b.k. at 320 nm in soln. contg. 5×10^{-2} mol L^{-1} NaN_3 and 1×10^{-4} mol L^{-1} substrate.	85A39
38	**(5S)-Cysteinyldopa**					
	$\cdot N_3$ + CysDOPA → [CysDOPA]· + N_3^- + H^+	3.1×10^9	~7	p.r.	P.b.k. at 310 nm in soln. contg. 5×10^{-2} mol L^{-1} NaN_3 and 1×10^{-4} mol L^{-1} substrate.	85A39
39	**L-Cystinylbisglycine**					
	$\cdot N_3$ + $(CysGly)_2$ → N_3^- + $[(CysGly)_2]^{\cdot+}$	~5×10^7	6.9	p.r.	D.k.	81A03
40	**L-Cystinylbis-L-tyrosine**					
	$\cdot N_3$ + $(CysTyrOH)_2$ →	1.8×10^8 5.4×10^8	6.9 8.4	p.r.	D.k.	81A03
41	**Dihydrolumiflavin**					
	$\cdot N_3$ + LFH^- → $LF^{\cdot-}$ + N_3^- + H^+	5×10^9	7, 9, 11	p.r.	P.b.k.; pK_a of semiquinone probably close to riboflavine semiquinone (8.3); pK_a of dihydrolumiflavin = 6.5	85A38
42	**2,3-Dihydro-1,4-phthalazinedione**					
	$\cdot N_3$ + -NHNH- → N_3^- + -$\dot{N}$-NH- + H^+	≥2×10^9	~7	p.r.	D.k. in N_2O-satd. soln. contg. azide ion; substrate oxidized as monoanion, pK_a ~ 7; also benzo-, 6-amino-, 6-hydroxy-, and 6-(dimethylamino)- derivatives gave the same results.	86A39
43	**2,3-Dihydrophthalazine-1,4-dione-2-yl**					
	$\cdot N_3$ + -$\dot{N}$-NH- → N_3^- + -N=N- + H^+	≥10^9	~7	p.r.	D.k. in N_2O-satd. soln. contg. azide ion; ; also benzo-, 5-amino-, 6-amino-, 6-hydroxy-, and 6-(dimethylamino)- derivatives gave the same results.	86A39
44	**3-(3,4-Dihydroxyphenyl)alanine**					
	$\cdot N_3$ + DOPA → [DOPA]· + N_3^- + H^+	3.4×10^9	~7-8	p.r.	P.b.k. at 305 nm in soln. contg. 5×10^{-2} mol L^{-1} NaN_3 and 1×10^{-4} mol L^{-1} substrate.	85A39 84A26
45	**2,3-Dihydroxy-2-propenal, conjugate base**					
	$\cdot N_3$ + TRH^- → $TR^{\cdot-}$ + N_3^- + H^+	4.0×10^9		p.r.	D.k. at 310 nm as well as p.b.k. at 400 nm; pK_a = 5.0, 13.0; pK_a (radical) = 1.4.	85A39
46	**1,3-Dimethoxybenzene**					
	$\cdot N_3$ + $C_6H_4(OCH_3)_2$ →	<7×10^6	11-12	p.r.	P.b.k.; radical cation not obs.; >0.1 mol L^{-1} NaN_3 soln.	85A21
47	**1,4-Dimethoxybenzene**					
	$\cdot N_3$ + $C_6H_4(OCH_3)_2$ →	<2×10^7	11-12	p.r.	P.b.k.; radical cation not obs.; >0.1 mol L^{-1} NaN_3 soln.	85A21
48	**5-Dimethylamino-1-naphthalenesulfonyl-L-tyrosine**					
	$\cdot N_3$ + DansylTyrOH → N_3^- + DansylTyrO· + H^+	~5×10^9	6.8	p.r.	D.k.	81A03
49	***N,N*-Dimethylaniline**					
	$\cdot N_3$ + $C_6H_5N(CH_3)_2$ → N_3^- + $[C_6H_5N(CH_3)_2]^{\cdot+}$	3.8×10^9 3.7×10^9	~6 11-12	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A21

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
49a	**2,3-Dimethylindole**					
	$\cdot N_3 + Me_2InH \rightarrow N_3^- + Me_2In\cdot + H^+$	1.6×10^{10}		p.r.	P.b.k. at 520 nm.	87A247
50	**Dodecylsulfate ion**					
	$\cdot N_3 + CH_3(CH_2)_{11}OSO_3^- \rightarrow$	$<1 \times 10^6$	7.6	p.r.	D.k. at 280 nm.	79A202
51	***l*-Ephedrine**					
	$\cdot N_3 + PhCH(OH)CH(CH_3)NHCH_3 \rightarrow$	5.7×10^7	11.0	p.r.	P.b.k. at 295 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3 and 2×10^{-3} mol L^{-1} ephedrine; no reaction at pH 7.	83A176
52	**4-Fluorophenoxide ion**					
	$\cdot N_3 + FC_6H_4O^- \rightarrow N_3^- + FC_6H_4O\cdot$	4.0×10^9	11-12	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
53	**Glycyltryptophan**					
	$\cdot N_3$ + GlyTrpH $\rightarrow N_3^-$ + GlyTrp$\cdot$ + H^+	$>3 \times 10^9$		p.r.	P.b.k.	79A310
54	**Histidine**					
	$\cdot N_3$ + His $\rightarrow$	$<10^6$ 1.7×10^7.	7.8 11.2	p.r.	D.k. at 280 nm, and p.b.k. at pH 11.2.	79A202
55	**Histidyltyrosine**					
	$\cdot N_3$ + HisTyrOH $\rightarrow N_3^-$ + HisTyrO$\cdot$ + H^+	$>2 \times 10^9$	11	p.r.	D.k.	81A032
56	**Hydroquinone**					
	$\cdot N_3 + C_6H_4(OH)_2 \rightarrow N_3^- + {}^-OC_6H_4O\cdot + 2\ H^+$	4.2×10^9 4.5×10^9	~6 11-12	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
57	**13-Hydroperoxylinoleate ion**					
	$\cdot N_3 + HO_2L^- \rightarrow N_3^- + H^+ + \cdot O_2L^-$	1.3×10^9	11.5	p.r.	C.k. with quercetin and kaempferol.	85A502
58	**4-Hydroxybenzoate ion**					
	$\cdot N_3 + HOC_6H_4CO_2^- \rightarrow N_3^- + H^+ + {}^-O_2CC_6H_4O\cdot$	2×10^7 4.0×10^9	~6 11-12	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
59	**4-Hydroxybenzothiazole**					
	$\cdot N_3$ + BTO$^-$ $\rightarrow N_3^-$ + BTO$\cdot$	4.7×10^9	<12	p.r.	D.k. in alk. N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} NaN_3.	84A024
59a	**Indole**					
	$\cdot N_3$ + InH $\rightarrow N_3^-$ + In$\cdot$ + H^+	9.5×10^9		p.r.	P.b.k. at 520 nm.	87A247
60	**Kaempferol [3,5,7-Trihydroxy-2-(4-hydroxyphenyl)-2-benzopyran-4-one]**					
	$\cdot N_3$ + KfOH $\rightarrow N_3^-$ + H^+ + KfO$\cdot$	6.9×10^9	10.5	p.r.	P.b.k. (phenoxyl radical)	85A502
61	**Linolenate ion**					
	$\cdot N_3 + CH_3(CH_2CH{=}CH)_3(CH_2)_7CO_2^- \rightarrow$	$\leq 4 \times 10^7$	11	p.r.	C.k.	86A191
62	**Luminol**					
	$\cdot N_3$ + -NHNH- $\rightarrow N_3^-$ + -$\dot{N}$-NH- + H^+	$\geq 2 \times 10^9$	~7	p.r.	D.k. in N_2O-satd. soln. contg. azide ion; substrate oxidized as monoanion, pK_a ~ 7.	86A399
63	**Maleic hydrazide**					
	$\cdot N_3 + MH^- \rightarrow M\cdot^- + N_3^- + H^+$	2.2×10^9	>7.5	p.r.	No reaction at pH 2.	83A165

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
64	**Methanol**					
	$\cdot N_3 + CH_3OH \rightarrow$	$<1 \times 10^6$	7.6	p.r.	D.k. at 280 nm	79A202
65	**Methionine**					
	$\cdot N_3$ + Met $\rightarrow$	$<1 \times 10^6$	6.5	p.r.	D.k. at 280 nm; at pH 11.4 $k = <5 \times 10^6$.	79A202
66	**2-Methoxyphenol**					
	$\cdot N_3 + (CH_3O)C_6H_4OH \rightarrow N_3^- + CH_3OC_6H_4O\cdot + H^+$	2.4×10^9	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
67	**3-Methoxyphenol**					
	$\cdot N_3 + (CH_3O)C_6H_4OH \rightarrow N_3^- + CH_3OC_6H_4O\cdot + H^+$	4.8×10^8	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
68	**4-Methoxyphenol**					
	$\cdot N_3 + (CH_3O)C_6H_4OH \rightarrow N_3^- + CH_3OC_6H_4O\cdot + H^+$	4.0×10^9	~6	p.r.	P.b.k. at 417 nm in N_2O-satd. soln. contg. 0.5 mol L^{-1} NaN_3 soln.	85A218
	$\cdot N_3 + CH_3OC_6H_4O^- \rightarrow N_3^- + CH_3OC_6H_4O\cdot$	4.2×10^9	11-12			
69	***N*-Methylaniline**					
	$\cdot N_3 + C_6H_5NHCH_3 \rightarrow N_3^- + [C_6H_5NHCH_3]\cdot^+$	4.7×10^9 5.8×10^9	~6 11-12	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
69a	**1-Methylindole**					
	$\cdot N_3$ + MeIn $\rightarrow N_3^-$ + MeIn$\cdot^+$	1.3×10^{10}	9.3	p.r.	P.b.k. at 520 nm.	87A247
69b	**2-Methylindole**					
	$\cdot N_3$ + MeInH $\rightarrow N_3^-$ + MeIn$\cdot$ + H^+	1.5×10^{10}	9.3	p.r.	P.b.k. at 520 nm.	87A247
69c	**3-Methylindole**					
	$\cdot N_3$ + MeInH $\rightarrow N_3^-$ + MeIn$\cdot$ + H^+	1.5×10^{10}		p.r.	P.b.k. at 520 nm.	87A247
70	**2-Methylphenol**					
	$\cdot N_3 + CH_3C_6H_4OH \rightarrow N_3^- + CH_3C_6H_4O\cdot + H^+$	4.4×10^8	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
71	**3-Methylphenol**					
	$\cdot N_3 + CH_3C_6H_4OH \rightarrow N_3^- + CH_3C_6H_4O\cdot + H^+$	1.8×10^8	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
72	**4-Methylphenol**					
	$\cdot N_3 + CH_3C_6H_4OH \rightarrow N_3^- + CH_3C_6H_4O\cdot + H^+$	1.5×10^9	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
73	**Metiazinic acid**					
	$\cdot N_3 + MZ^- \rightarrow N_3^- + MZ\cdot$	6.4×10^9	10	p.r.	P.b.k. at 270 and 530 nm in N_2O-satd. soln. contg. 0.01 mol L^{-1} NaN_3.	81A162
74	**Nicotinamide adenine dinucleotide**					
	$\cdot N_3 + NAD^+ \rightarrow$	$<2 \times 10^7$	6.9	p.r.	D.k. at 280 nm.	79A202
75	**Phenol**					
	$\cdot N_3 + C_6H_5OH \rightarrow C_6H_5O\cdot + N_3^- + H^+$	5×10^7	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
76	**Phenoxide ion**					
	$\cdot N_3 + C_6H_5O^- \rightarrow C_6H_5O\cdot + N_3^- + H^+$	4.3×10^9	11-12	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
77	**Phenylalanine**					
	$\cdot N_3$ + Phe $\rightarrow$	$<1 \times 10^6$	7.8	p.r.	D.k. at 280 nm.	79A202

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
78	**Pheophytin *a***					
	$\cdot N_3 + Ph\ a \rightarrow N_3^- + [Ph\ a]\cdot^+$	1.6×10^9		p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} N_3^-.	81N146
79	**Promethazine**					
	$\cdot N_3 + PZH^+ \rightarrow N_3^- + PZH\cdot^{2+}$	4.6×10^9	7.5	p.r.	P.b.k. at 505 nm in N_2O-satd. soln. contg. 0.01 mol L^{-1} NaN_3; overall rate constant, 66% electron transfer.	83A272
80	**Propyl gallate**					
	$\cdot N_3 + (HO)_3C_6H_2CO_2C_3H_7 \rightarrow N_3^- + H^+ + \cdot OC_6H_2(OH)_2CO_2C_3H_7$	4.2×10^9	7.0	p.r.	P.b.k. in N_2O-satd. soln. contg. 2.5×10^{-2} mol L^{-1} azide ion and 10^{-2} mol L^{-1} phosphate; in 2×10^{-2} mol L^{-1} SDS $k = 3.3 \times 10^9$.	84A388
81	**Pyridine**					
	$\cdot N_3 + py \rightarrow$	$<3 \times 10^5$	11-12	p.r.	No absorbing transient obs.; >0.1 mol L^{-1} NaN_3 soln.	85A218
82	**Quercetin [2-(3,4-Dihyroxyphenyl)-3,5,7-trihydroxy-4*H*-1-benzopyran-4-one]**					
	$\cdot N_3 + QOH \rightarrow N_3^- + H^+ + QO\cdot$	6.6×10^9	11.5	p.r.	P.b.k. (phenoxyl radical)	85A502
83	**Resorcinol**					
	$\cdot N_3 + C_6H_4(OH)_2 \rightarrow N_3^- + HOC_6H_4O\cdot + H^+$	1.0×10^9	~6	p.r.	P.b.k.; >0.1 mol L^{-1} NaN_3 soln.	85A218
84	**L-Seryl-L-tyrosyl-β-naphthylamide**					
	$\cdot N_3$ + SerTyrOH-βNA $\rightarrow N_3^-$ + SerTyrȮ-βNA + H^+	1.3×10^8	7.6	p.r.	D.k.	81A032
85	**Sesamol**					
	$\cdot N_3 + 3,4\text{-}(CH_2O_2)C_6H_3OH \rightarrow N_3^- + H^+ + 3,4\text{-}(CH_2O_2)C_6H_3O\cdot$	5.5×10^9	7.0	p.r.	P.b.k. in N_2O-satd. soln. contg. 2.5×10^{-2} mol L^{-1} azide ion and 10^{-2} mol L^{-1} phosphate; in 2×10^{-2} mol L^{-1} SDS $k = 6.0 \times 10^9$.	84A388
86	***N*-Stearoyltryptophan methyl ester**					
	$\cdot N_3 + STME \rightarrow N_3^- + H^+ + STME\cdot$	1.6×10^9	7.0	p.r.	P.b.k. at 520 nm in micellar soln. contg. 2×10^{-3} mol L^{-1} SDS, 0.1 mol L^{-1} phosphate buffer and 0.1 mol L^{-1} NaN_3; $k = 1.6 \times 10^9$ in tetradecyl trimethylammonium bromide soln.	86N145
87	**Sulfacetamide**					
	$\cdot N_3 + H_2NC_6H_4SO_2NHAc \rightarrow N_3^- + [H_2NC_6H_4SO_2NHAc]\cdot^+$	3.6×10^9	7.0	p.r.	P.b.k. at 420 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} NaN_3 and 10^{-4} mol L^{-1} substrate.	82A138
88	**6,7,8,9-Tetrahydro-4-hydroxythiazolo[4,5-*h*]isoquinoline-7-carboxylate ion**					
	$\cdot N_3 + THIC^{2-} \rightarrow N_3^- + THIC\cdot$	4.2×10^9	<12	p.r.	D.k. in alk. N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} NaN_3.	84A024
89	**6,7,8,9-Tetrahydro-4-methoxythiazolo[4,5-*h*]isoquinoline-7-carboxylate ion**					
	$\cdot N_3 + TMIC^- \rightarrow N_3^- + TMIC\cdot$	1.6×10^8	<12	p.r.	D.k. in alk. N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} NaN_3	84A024
90	**Tetrakis(4-sulfonatophenyl)porphine**					
	$\cdot N_3 + H_2TPPS^{4-} \rightarrow N_3^- + [H_2TPPS]\cdot^{3-}$	5×10^9	7	p.r.	N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} NaN_3.	82A152
91	**Tetraphenylborate ion**					
	$\cdot N_3 + Ph_4B^- \rightarrow N_3^- + Ph_4B\cdot$	1.4×10^9	~7	p.r.	P.b.k. in N_2O-satd. soln. contg. 2×10^{-2} mol L^{-1} NaN_3 and 1×10^{-3} mol L^{-1} $NaBPh_4$.	86A469

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
92	**Thymidine**					
	$\cdot N_3$ + T →	$<1 \times 10^8$	7.6	p.r.	D.k. at 280 nm	79A202
93	**α-Tocopherol**					
	$\cdot N_3$ + ArOH → N_3^- + H^+ + ArO·	1.8×10^9	7.0	p.r.	P.b.k. at 440 nm in micellar soln. contg. 2 × 10^{-3} mol L^{-1} SDS, 0.1 mol L^{-1} phosphate buffer and 0.1 mol L^{-1} NaN_3; k = 2.2×10^9 in tetradecyl trimethylammonium bromide soln.	86N145
		2.4×10^9	7.0	p.r.	P.b.k. in N_2O-satd. soln. contg. 2.5 × 10^{-2} mol L^{-1} azide ion and 10^{-2} mol L^{-1} phosphate; in 2 × 10^{-2} mol L^{-1} SDS.	84A388
94	**Toluene**					
	$\cdot N_3$ + $C_6H_5CH_3$ →	$<3 \times 10^6$	11-12	p.r.	No absorbing transient obs.; >0.1 mol L^{-1} NaN_3 soln.	85A218
95	**Tryptamine**					
	$\cdot N_3$ + TrpH → N_3^- + Trp· + H^+	4.3×10^9	7.5, 13	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3; radical cation forms which deprotonates.	86A110
96	**Tryptophan**					
	$\cdot N_3$ + TrpH → N_3^- + Trp· + H^+	4.1×10^9 4.4×10^9	7.5 12	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3; radical cation forms which deprotonates.	86A110
		4.1×10^9	7.4	p.r.	P.b.k.	79A202
		4×10^9	6.1	p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. 2.5 × 10^{-3} mol L^{-1} NaN_3 and 10^{-3} mol L^{-1} tryptophan, in various dilutions.	771114
97	**Tryptophanamide**					
	$\cdot N_3$ + TrpH → N_3^- + Trp· + H^+	4.8×10^9	7.5, 13	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3; radical cation forms which deprotonates.	86A110
98	**Tryptophan methyl ester**					
	$\cdot N_3$ + TrpH → N_3^- + Trp· + H^+	4.2×10^9	7.5, 13	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3; radical cation forms which deprotonates.	86A110
99	**Tryptophylalanine**					
	$\cdot N_3$ + TrpHAla → N_3^- + ·TrpAla + H^+	4.4×10^9	7.5, 13	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3; radical cation forms which deprotonates.	86A110
100	**Tryptophylleucine**					
	$\cdot N_3$ + TrpHLeu → N_3^- + ·TrpLeu + H^+	$>3 \times 10^9$		p.r.	P.b.k.	79A316
101	**Tryptophyltyrosine**					
	$\cdot N_3$ + TrpHTyrOH →	$>3 \times 10^9$		p.r.	P.b.k. at 510 nm	79A316
102	**Tyrosine**					
	$\cdot N_3$ + TyrOH → N_3^- + TyrO· + H^+	1.0×10^8 3.6×10^9	6.5 11.8	p.r.	P.b.k.	79A202
103	**Tyrosine methyl ester**					
	$\cdot N_3$ + MeTyrOH → N_3^- + MeTyrO· + H^+	1.5×10^8 4×10^9	7.5 13	p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaN_3; radical cation forms which deprotonates.	86A110

TABLE 6. Rate constants for reactions of the azide radical in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
104	**Tyrosyltryptophan**					
	$\cdot N_3$ + TyrOHTrpH →	$>3 \times 10^9$	7.1	p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. $>2 \times 10^{-2}$ mol L^{-1} NaN_3.	79A316
105	**Urate ion**					
	$\cdot N_3 + UrO^- \rightarrow N_3^- + H^+ +$ UrO·	5.4×10^9	7.0	p.r.	P.b.k. in N_2O-satd. soln. contg. 2.5×10^{-2} mol L^{-1} azide ion and 10^{-2} mol L^{-1} phosphate; in 2×10^{-2} mol L^{-1} SDS $k = 5.6 \times 10^9$.	84A388
106	**Valine**					
	$\cdot N_3$ + Val →	$<3 \times 10^5$	7.5	p.r.	D.k. at 280 nm.	79A202
107	**Alcohol dehydrogenase**					
	$\cdot N_3$ + ALDH →	6.0×10^9	6.9	p.r.	P.b.k.; enzyme from yeast.	79A202
108	**α-Chymotrypsinogen**					
	$\cdot N_3$ + Chy →	$\sim 6 \times 10^8$	5.9	p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. NaN_3.	82A183
109	**Concanavalin A**					
	$\cdot N_3$ + Con A →	$\sim 6 \times 10^8$	6.7	p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. NaN_3.	82A183
110	**5-*S*-Cysteinyldopa-melanin**					
	$\cdot N_3 + CysDOPA_{mel} \rightarrow$	2.2×10^8	7.4	p.r.	P.b.k. in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} azide; k based on monomer of mol. wt. 150	86A227
111	**Cytochrome C (ferro)**					
	$\cdot N_3$ + Cyt C (Fe^{2+}) →	1.3×10^9	7	p.r.	D.k. at 450 or 550 (cyt) in N_2O-satd. soln.; 100% e-transfer; similar rate at pH 8.	81A069
112	**Dopa-melanin**					
	$\cdot N_3 + DOPA_{mel} \rightarrow$	1.8×10^8	7.4	p.r.	P.b.k. in N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} azide; k based on monomer of mol. wt. 150, from autoxidation of DL-dihydroxyphenylalanine.	86A227
113	**α-Lactalbumin**					
	$\cdot N_3$ + α-LAB →	$\sim 7 \times 10^8$	7.4	p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. NaN_3.	82A183
114	**β-Lactoglobulin**					
	$\cdot N_3$ + β-LAG →	$\sim 6 \times 10^8$	6.2	p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. NaN_3.	82A183
115	**Lysozyme**					
	$\cdot N_3$ + Lys →	$\sim 2 \times 10^9$		p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. NaN_3.	82A183
116	**Pepsin**					
	$\cdot N_3$ + Pepsin →	2.2×10^9	5.6	p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. NaN_3.	82A183
117	**Phage T4 gene 32 protein**					
	$\cdot N_3$ + gp32 →	3.2×10^9	6.2	p.r.	P.b.k. at 405 nm (TyrO·) in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} NaN_3 (phosphate buffer).	84A059

TABLE 7. Rate constants for reactions of amino radicals in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Amino radical**					
	$\cdot NH_3^+ + \cdot NH_3^+ \rightarrow NH_4^+ + NH_2^+$	$\sim 4 \times 10^8$	1	f.p.	D.k. at 290 nm (ϵ = 500 L mol^{-1} cm^{-1}) in soln. contg. 2-20 $\times$ 10^{-5} mol L^{-1} $Co(NH_3)_6^{3+}$, $HClO_4$, H_2SO_4 or CF_3SO_2OH; pK_a of radical = 2.3.	78A356
	$\cdot NH_2 + \cdot NH_2 \rightarrow H_2NNH_2$	2.2×10^9		p.r.	D.k. at 530 nm in ammonia soln.; ϵ = 81 L mol^{-1} cm^{-1}.	720109
2	**Hydroxyl**					
	$\cdot NH_2 + \cdot OH \rightarrow NH_2OH$	9.5×10^9		p.r.	Estd. from hydroxylamine formn.	720109
3	**Diamminesilver(I) ion**					
	$\cdot NH_2 + Ag(NH_3)_2^+ \rightarrow Ag(NH_3)_2NH_2^+$	4×10^9	11.5	p.r.	P.b.k. at 270 nm in soln. contg. 10^{-4} mol L^{-1} Ag^+ and 1 mol L^{-1} NH_3.	79A304
4	**Bicarbonate ion**					
	$\cdot NH_2 + HCO_3^- \rightarrow NH_3 + CO_2$	$<1 \times 10^4$	7.8	p.r.	suggested by results in ammonia soln. contg. 5 $\times$ 1-$^{-2}$ mol L^{-1} bicarbonate.	86A502
5	**Carbonate radical ion**					
	$\cdot NH_2 + CO_3\cdot^- \rightarrow NH_2O^- + CO_2$	1.5×10^9	7.8	p.r.	D.k. at 600 nm in soln. contg. 5 $\times$ 10^{-2} mol L^{-1} ammonium bicarbonate; radicals from equal reactivity of $\cdot OH$ with NH_3 and HCO_3^-.	86A502
6	**Tris(dimethylglyoximato)nickelate(II) ion**					
	$\cdot NH_2 + Ni(dmg)_3^{4-} \rightarrow Ni(dmg)_3^{3-}$	$\sim 2 \times 10^9$		p.r.	P.b.k. in N_2O-satd. soln. contg. 2 $\times$ 10^{-4} mol L^{-1} dimethylglyoxime and 5 $\times$ 10^{-5} mol L^{-1} $NiSO_4$ in 4 mol L^{-1} NH_4OH; product has λ_{max} = 470 nm.	720584
7	**Hydrogen peroxide**					
	$\cdot NH_2 + H_2O_2 \rightarrow NH_3 + HO_2\cdot$	9×10^7		p.r.	D.k.	720109
8	**Oxygen**					
	$\cdot NH_2 + O_2 \rightarrow NH_2\dot{O}_2$	3×10^8		p.r.	D.k.	720109
		$\sim 1 \times 10^7$	11.5	p.r.	P.b.k. at 300 nm.	78A218
		$>1 \times 10^7$	1	f.p.	Abs. completely quenched.	78A356
9	**Sulfite ion**					
	$\cdot NH_2 + SO_3^{2-} \rightarrow$		11.5	p.r.	No reaction	85A103
10	**4-Aminophenoxide ion**					
	$\cdot NH_2 + NH_2C_6H_4O^- + H^+ \rightarrow NH_3 + H_2NC_6H_4O\cdot$	6.7×10^7	11.3	p.r.	P.b.k. at 440 nm.	78A218
11	**Aniline**					
	$\cdot NH_2 + C_6H_5NH_2 \rightarrow$	$<1 \times 10^5$	11.5	p.r.	P.b.k. at 400 nm	78A218
12	**Ascorbate ion**					
	$\cdot NH_2 + AH^- \rightarrow NH_3 + \cdot A^-$	7.3×10^8	11.3	p.r.	P.b.k.	78A218
13	**Benzoate ion**					
	$\cdot NH_2 + C_6H_5CO_2^- \rightarrow$	$<1 \times 10^5$	11.2	p.r.	P.b.k. at 330 nm	78A218
14	**4-Cyanophenoxide ion**					
	$\cdot NH_2 + NCC_6H_4O^- \rightarrow$	$<1 \times 10^4$	11.2	p.r.	P.b.k. at 400 nm	78A218
15	**2,5-Dihydroxybenzoate ion**					
	$\cdot NH_2 + (HO)_2C_6H_3CO_2^- \rightarrow NH_3 + H^+ + \cdot OC_6H_3(CO_2^-)(O^-)$	1.6×10^7	11.2	p.r.	P.b.k. at 430 nm	78A218

TABLE 7. Rate constants for reactions of amino radicals in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
16	**4-Fluorophenoxide ion**					
	$\cdot NH_2 + FC_6H_4O^- + H^+ \rightarrow NH_3 + FC_6H_4O\cdot$	3×10^5	11.1	p.r.	P.b.k. at 400 nm	78A218
17	**Hydroquinone dianion**					
	$\cdot NH_2 + {}^-OC_6H_4O^- + H^+ \rightarrow NH_3 + {}^-OC_6H_4O\cdot$	1.8×10^8 6.5×10^8	11.3 13.7	p.r.	P.b.k. at 430 nm.	78A218
18	**4-Hydroxybenzoate ion**					
	$\cdot NH_2 + ({}^-O)C_6H_4CO_2{}^- + H^+ \rightarrow NH_3 + \cdot OC_6H_4CO_2{}^-$	$\sim 5 \times 10^4$	11.3	p.r.	P.b.k. at 400 nm	78A218
19	**3-Methoxyphenoxide ion**					
	$\cdot NH_2 + CH_3OC_6H_4O^- + H^+ \rightarrow NH_3 + CH_3OC_6H_4O\cdot$	4.3×10^6	11.2	p.r.	P.b.k. at 430 nm	78A218
20	**4-Methoxyphenoxide ion**					
	$\cdot NH_2 + CH_3OC_6H_4O^- + H^+ \rightarrow NH_3 + CH_3OC_6H_4O\cdot$	9.0×10^6	11.2	p.r.	P.b.k. at 420 nm	78A218
21	**4-Methylphenoxide ion**					
	$\cdot NH_2 + CH_3C_6H_4O^- + H^+ \rightarrow NH_3 + CH_3C_6H_4O\cdot$	4.4×10^6	11.2	p.r.	P.b.k. at 400 nm.	78A218
22	**Phenoxide ion**					
	$\cdot NH_2 + C_6H_5O^- + H^+ \rightarrow NH_3 + C_6H_5O\cdot$	3×10^6	11.3, 12	p.r.	P.b.k. at 400 nm in soln. contg. 1.5 mol L^{-1} ammonia.	78A218
23	***p*-Phenylenediamine**					
	$\cdot NH_2 + C_6H_4(NH_2)_2 \rightarrow NH_3 + H_2NC_6H_4NH$	3.2×10^7	11.4	p.r.	P.b.k. at 490 nm	78A218
24	**2-Propanol**					
	$\cdot NH_3{}^+ + (CH_3)_2CHOH \rightarrow$	$<1 \times 10^4$		f.p.	No change in absorbance or d.k.; $Co(NH_3)_6{}^{3+}$ soln. contg. 0.17 mol L^{-1} 2-PrOH.	78A356
25	**Resorcinol dianion**					
	$\cdot NH_2 + {}^-OC_6H_4O^- + H^+ \rightarrow NH_3 + {}^-OC_6H_4O\cdot$	5.0×10^7	11.2	p.r.	P.b.k. at 450 nm	78A218
26	**2,4,5-Trimethoxybenzoate ion**					
	$\cdot NH_2 + (CH_3O)_3C_6H_2CO_2{}^- \rightarrow$	$<1 \times 10^5$	11.3	p.r.	P.b.k. at 580 nm	78A218

TABLE 8. Rate constants for reactions of nitrogen dioxide in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Nitrogen dioxide**					
	$\cdot NO_2 + \cdot NO_2 \rightarrow N_2O_4$	4.6×10^8		p.r.	D.k. at 410 nm in NO_2^- soln. saturated with N_2O.	761171
		4.5×10^8		p.r.	D.k. at 400 nm ($\epsilon = 201$ L mol^{-1} cm^{-1}) in NO_2^- soln. saturated with N_2O; $K = 1.53 \times 10^{-5}$ mol L^{-1} for $N_2O_4 \rightleftarrows 2NO_2$; K also has been reported as 7.5×10^{-5} (pH 8.8), 1.8×10^{-5} (pH 3) [80A366], and 1.3×10^{-5} (pH 5) [707264].	690439
	$\cdot NO_2 + \cdot NO_2 \rightarrow NO_3^- + NO_2^- + 2\ H^+$	1.0×10^8		flow	Reactive dissolution; $1 \times 10^{-7} \leq p\ (NO_2) \leq 8 \times 10^{-4}$ atm; Henry's law coefficient 7.0×10^{-3} mol L^{-1} atm^{-1}	81A43
		6.5×10^7	7	p.r.	Recalcd. by Schwartz and White [83Z375].	690439
		4.7×10^7		f.p.	Recalcd. by Schwartz and White [83Z375].	707264
		1.5×10^7	7	p.r.	D.k. at 400 nm in $NaNO_3$ (>0.5 M) soln.; $2k/\epsilon = 1.44 \times 10^5$; assumed $\epsilon_{400} \simeq 208$ L mol^{-1} cm^{-1}.	690417
		3.8×10^7		f.p.	C.k. in NO_3^- soln.; obs. effect of intensity on buildup of ferricyanide at 420 nm; assumed $\epsilon_{Fc}/\epsilon_{NO2} \simeq 10$; rel. to $k(NO_2 + Fe(CN)_6^{4-}) = 4.3 \times 10^6$.	687024
2	**Carbon dioxide radical anion**					
	$\cdot NO_2 + \cdot CO_2^- \rightarrow NO_2^- + CO_2$	$>5 \times 10^9$	6.8	γ-r.	Obs. $G(NO_2^-)$ in $NaNO_3$ soln. contg. formate; estd. k by optimizing routine.	84G10
		$>6 \times 10^9$		γ-r.	Obs. $G(NO_2^-)$ (pH 2-7) in deoxygenated $NaNO_3$ soln. (2.5 or 25 $\times 10^{-3}$ mol L^{-1}) contg. Na formate (0.05 mol L^{-1}); estd. from modelling; complex mechanism.	83A15
3	**Carbonate radical**					
	$\cdot NO_2 + CO_3^{\cdot -} \rightarrow CO_2 + NO_3^-$	1.0×10^9	~11	p.r.	Est. from opt. and condy. d.k.	78A25
4	**Copper(I) ion**					
	$\cdot NO_2 + Cu^+ \rightarrow$		6-8	γ-r.	No reaction; Obs. $G(NO_2^-)$ on addn. of 10^{-5} mol L^{-1} Cu^{2+} to 2.5×10^{-3} mol L^{-1} $NaNO_3$ and 0.1 mol L^{-1} *tert*-BuOH; Cu^+ from $\cdot CH_2C(CH_3)_2OH + Cu^{2+}$.	84G10
5	**Tris(3,4,7,8-tetramethyl-1,10-phenanthroline)iron(II) ion**					
	$\cdot NO_2 + Fe(TMP)_3^{2+} \rightarrow NO_2^- + Fe(TMP)_3^{3+}$	1.0×10^7		p.r.	P.b.k. at 370 and 665 nm in N_2O-satd. soln. contg. 5×10^{-3} mol L^{-1} $NaNO_2$; counterion SO_4^{2-}.	85A48
6	**Ferrocyanide ion**					
	$\cdot NO_2 + Fe(CN)_6^{4-} \rightarrow NO_2^- + Fe(CN)_6^{3-}$	3.0×10^6		p.r.	Packer and Willson, unpubl. data	86A02
		4.3×10^6	7	f.p.	P.b.k. at 420 nm in NO_3^- soln.	687024
7	**Iodide ion**					
	$\cdot NO_2 + I^- \rightarrow NO_2^- + I\cdot$	1.1×10^5		p.r.	Packer and Willson, unpubl. data	86A02
		$<1 \times 10^7$		p.r.	Argon saturated soln. contg. 0.2 mol L^{-1} $NaNO_3$, 2-20 $\times 10^{-3}$ mol L^{-1} $NaNO_2$ and 5-30 $\times 10^{-4}$ mol L^{-1} KI.	747554
8	**Nitric oxide**					
	$\cdot NO_2 + NO \rightarrow N_2O_3$	1.1×10^9	7	p.r.	D.k. at 400 nm, as well as p.b.k. at 260 nm, in NO_2^--NO-N_2O soln.; $k_r = 8.0 \times 10^4$ s^{-1}; $K(N_2O_3 \rightleftarrows NO + NO_2) = 2 \times 10^{-5}$ [707264].	700228

TABLE 8. Rate constants for reactions of nitrogen dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
9	**Hydroperoxyl radical**					
	$\cdot NO_2 + HO_2\cdot \rightarrow HO_2NO_2$	4×10^9	1.6-3.6	p.r.	Deduced from complex mechanism; obs. change in nitroform produced in $HO_2 + C(NO_2)_4$ reaction; reverse reaction is interpreted to have $k = 0.014$ s^{-1}; also see [78A177].	750347
10	**Hydroxyl radical**					
	$\cdot NO_2 + \cdot OH \rightarrow HO_2NO$	1.2×10^{10}	≤5	f.p.	Estd. from condy. study in 5×10^{-4} mol L^{-1} HNO_3; $k(HO_2NO \rightarrow HNO_3) = 1.9 \times 10^3$ s^{-1}; rel. to $k(\cdot OH + \cdot OH) = 6 \times 10^9$; may reflect cage effect.	80A366
		1.3×10^9	9	p.r.	Meas. buildup of abs. at 302 nm in NO_3^- soln.; calcn. involves $k(\cdot OH + \cdot OH) = 0.6 \times 10^{10}$ and $k(NO_3^{2-} + H_2O \rightarrow NO_2 + 2OH^-) = 5.5 \times 10^4$ s^{-1}.	700151
11	**Sulfite ion**					
	$\cdot NO_2 + SO_3^{2-} \rightarrow$	$\sim 3.5 \times 10^7$	12.1	p.r.	C.k.; NO_2 from $\cdot OH + NO_2^-$; similar values at pH 10.3 (c.k. with hydroquinone) and pH 9 (c.k. with ferrocyanide); rel. to $k(NO_2 + C_6H_5O^-) = 8.6 \times 10^6$; overall reaction of $2NO_2 + SO_3^{2-} \rightarrow 2NO_2^- + SO_4^{2-}$.	86A059
		$>2 \times 10^6$	6.4, 5.8		Obs. acid production; products are H^+, NO_2^- and SO_4^{2-}; complex mechanism; gas-liquid system	82A469
12	**Arachidonate ion**					
	$\cdot NO_2 + CH_3(CH_2CH{=}CH)_4(CH_2)_4CO_2^- \rightarrow$	$\sim 1 \times 10^6$	9.0	p.r.	D.k. at 400 nm in soln. contg. 8×10^{-4} mol L^{-1} substrate.	85A483
13	**Ascorbate ion**					
	$\cdot NO_2 + AH^- \rightarrow NO_2^- + H^+ + \cdot A^-$	1.8×10^7	6.5	p.r.	C.k. in soln. contg. 0.1 mol L^{-1} $NaNO_3$, 1 mol L^{-1} *tert*-BuOH and 2×10^{-3} mol L^{-1} ABTS; rel. to $k(NO_2 + ABTS) = 2.2 \times 10^7$.	86A022
		6.4×10^7	9.2	p.r.	P.b.k.; NO_2 from $\cdot OH + NO_2^-$.	86A059
14	**2,2'-Azinobis(3-ethylbenzothiazoline-6-sulfonate ion)**					
	$\cdot NO_2 + ABTS \rightarrow NO_2^- + ABTS\cdot^+$	2.2×10^7	6.5-9	p.r.	P.b.k. at 417 nm in N_2-satd. soln. contg. *tert*-BuOH and $NaNO_3$; same result in N_2O-nitrite-nitrate soln.	86A022
15	**Cysteine, negative ion**					
	$\cdot NO_2 + CysS^- \rightarrow NO_2^- + CysS\cdot$	$>5 \times 10^8$	7.9-9.0	p.r.	P.b.k. $[RSSR]\cdot^-$ in N_2-satd. soln. contg. 0.1 mol L^{-1} $NaNO_3$ and hydroquinone.	86A022
		2.4×10^8	9.2	p.r.	P.b.k. at 410 nm ($RSSR^-$)	85A483
16	**Cystinylbisglycine**					
	$\cdot NO_2 + (CysGly)_2 \rightarrow$		6.5	p.r.	No reaction obs. in 4×10^{-3} mol L^{-1} substrate.	85A483
17	**Dihydroxyfumarate ion**					
	$\cdot NO_2 + DHF^{2-} \rightarrow NO_2^- + H^+ + [DHF]\cdot^-$	1.3×10^7	6.5	p.r.	C.k. in soln. contg. 0.1 mol L^{-1} $NaNO_3$, 1 mol L^{-1} *tert*-BuOH and 2×10^{-3} mol L^{-1} ABTS; rel. to $k(NO_2 + ABTS) = 2.2 \times 10^7$.	86A022
18	***N,N*-Dimethylaniline**					
	$\cdot NO_2 + C_6H_5N(CH_3)_2 \rightarrow NO_2^- + [C_6H_5N(CH_3)_2]\cdot^+$	2.6×10^7	9.6	p.r.	P.b.k.; NO_2 from $\cdot OH + NO_2^-$.	86A059

TABLE 8. Rate constants for reactions of nitrogen dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
19	**Dithiothreitol**					
	$\cdot NO_2 + HSCH_2CHOHCHOHCH_2SH \rightarrow NO_2^- + H^+ + \cdot SCH_2CHOHCHOHCH_2SH$	4.6×10^8	9	p.r.	P.b.k. at 400 nm in N_2O-satd. soln. contg. 2×10^{-3} mol L^{-1} $NaNO_2$ and 1-2 $\times 10^{-4}$ mol L^{-1} DTT.	82A17
20	**Glycyltryptophan**					
	$\cdot NO_2$ + GlyTrpH $\rightarrow NO_2^- + H^+$ + GlyTrp$\cdot$	$\sim 1 \times 10^6$	6.5	p.r.		85A48
21	**Glycyltyrosine**					
	$\cdot NO_2$ + GlyTyrOH $\rightarrow NO_2^-$ + GlyTyrO$\cdot$ + H^+	3.2×10^5	7.5	p.r.	P.b.k. at 405 nm in soln. contg. nitrate and nitrite ions; at pH <7 $k < 1 \times 10^5$.	85A48
		2.0×10^7	11.3			
22	**Glycyltyrosyl radical**					
	$\cdot NO_2$ + GlyTyrO$\cdot$ $\rightarrow$ addn.	$\sim 3 \times 10^9$		p.r.	P.b.k. at 450 nmin soln. contg. N_3^-. NO_3^- and GlyTyr; ϵ_{350} = 3000 L mol^{-1} cm^{-1}.	85A48
23	**Hydroquinone**					
	$\cdot NO_2 + HOC_6H_4O^- \rightarrow NO_2^- + {}^-OC_6H_4O\cdot + H^+$	1.6×10^8	10.3	p.r.	P.b.k.; NO_2 from $\cdot OH + NO_2^-$.	86A05
		$>5 \times 10^8$	~12	p.r.	P.b.k. in N_2-satd. soln. contg. 0.1 mol L^{-1} $NaNO_3$ and hydroquinone.	86A02
		1.1×10^9	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. nitrite ion soln.	86A25
24	**2-Hydroxy-2,2-dimethylethyl radical**					
	$\cdot NO_2 + \cdot CH_2C(CH_3)_2OH \rightarrow$	$<5 \times 10^4$	6.8	γ-r.	Obs. $G(NO_2^-)$ in $NaNO_3$ soln. contg. *tert*-BuOH; estd. k by optimizing routine.	84G10
25	**Hydroxymethyl radical**					
	$\cdot NO_2 + \cdot CH_2OH \rightarrow NO_2^- + HCHO + H^+$	1.0×10^9	6.8, 9	γ-r.	Obs. $G(NO_2^-)$ in $NaNO_3$ soln. contg. methanol; estd. k by optimizing routine.	84G10
26	**1-Hydroxy-1-methylethyl radical**					
	$\cdot NO_2 + (CH_3)_2\dot{C}OH \rightarrow NO_2^- + CH_3COCH_3 + H^+$	1.1×10^9	6.8	γ-r.	Obs. $G(NO_2^-)$ in $NaNO_3$ soln. contg. 2-PrOH; estd. k by optimizing routine.	84G10
		6×10^9		γ-r.	Obs. $G(NO_2^-)$ (pH 2-7) in deoxygenated $NaNO_3$ soln. (2.5 or 25 $\times 10^{-3}$ mol L^{-1}) contg. 2-PrOH (0.05 mol L^{-1}); estd. from modelling.	83A15
27	**Linoleate ion**					
	$\cdot NO_2 + LCO_2^- \rightarrow$	$<5 \times 10^4$	6.5	p.r.	C.k. in soln. contg. 0.1 mol L^{-1} $NaNO_3$, 1 mol L^{-1} *tert*-BuOH and 2×10^{-3} mol L^{-1} ABTS; rel. to $k(NO_2$ + ABTS) = 2.2×10^7.	86A02
		$\sim 2 \times 10^5$	9.5	p.r.	D.k. at 400 nm in soln. contg. 3.3×10^{-3} mol L^{-1} substrate.	85A48
28	**Methionylglycine**					
	$\cdot NO_2$ + MetGly $\rightarrow$		6.2	p.r.	No reaction obs. in soln. contg. 5×10^{-1} mol L^{-1} substrate.	85A48
29	**3-Methoxyphenoxide ion**					
	$\cdot NO_2 + CH_3OC_6H_4O^- \rightarrow NO_2^- + CH_3OC_6H_4O\cdot$	1.8×10^7	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. nitrite ion soln.	86A25
30	**4-Methoxyphenoxide ion**					
	$\cdot NO_2 + CH_3OC_6H_4O^- \rightarrow NO_2^- + CH_3OC_6H_4O\cdot$	1.4×10^8	12	p.r.	P.b.k.; NO_2 from $\cdot OH + NO_2^-$.	86A05

TABLE 8. Rate constants for reactions of nitrogen dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
31	**10-Methylphenothiazine**					
	$\cdot NO_2 + MPTH \rightarrow NO_2^- + MPTH\cdot^+$	6.6×10^7	5	f.p.	P.b.k. at 515 nm in 2:1 v/v water-ethanol contg. 0.1 mol L^{-1} $NaNO_3$ and 1.5×10^{-4} mol L^{-1} MPTH; quenching of triplet MPTH gave NO_3^{2-} which hydrolyzed to NO_2.	82A297
32	**3-Methylphenoxide ion**					
	$\cdot NO_2 + CH_3C_6H_4O^- \rightarrow NO_2^- + CH_3C_6H_4O\cdot$	1.3×10^7	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. nitrite ion soln.	86A254
33	**4-Methylphenoxide ion**					
	$\cdot NO_2 + CH_3C_6H_4O^- \rightarrow NO_2^- + CH_3C_6H_4O\cdot$	3.4×10^7	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. nitrite ion soln.	86A254
34	**Metiazinic acid, conjugate base**					
	$\cdot NO_2 + MZ^- \rightarrow NO_2^- + MZ\cdot$	1.2×10^8	6.8-9.3	p.r.	P.b.k. at 530 nm in N_2O-satd. soln. contg. 0.01 mol L^{-1} $NaNO_2$ and (1-7) $\times 10^{-4}$ mol L^{-1} metiazinic acid (pK_a 7.2)	86A022
35	**Phenoxide ion**					
	$\cdot NO_2 + C_6H_5O^- \rightarrow NO_2^- + C_6H_5O\cdot$	8.6×10^6	12.1	p.r.	P.b.k.; NO_2 from $\cdot OH + NO_2^-$.	86A059
36	***p*-Phenylenediamine**					
	$\cdot NO_2 + C_6H_4(NH_2)_2 \rightarrow NO_2^- + H_2NC_6H_4NH + H^+$	4.6×10^7	9.2	p.r.	P.b.k.; NO_2 from $\cdot OH + NO_2^-$.	86A059
37	**Resorcinol**					
	$\cdot NO_2 + {}^-OC_6H_4O^- \rightarrow NO_2^- + {}^-OC_6H_4O\cdot$	3.8×10^8	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. nitrite ion soln.	86A254
38	***N,N,N',N'*-Tetramethylbenzidine**					
	$\cdot NO_2 + TMB \rightarrow NO_2^- + TMB\cdot^+$	2.5×10^8		f.p.	P.b.k. in 2:1 v/v water-ethanol contg. $NaNO_3$; quenching of triplet TMB gave NO_3^{2-} which hydrolyzed to NO_2.	82A297
39	**Tryptophan**					
	$\cdot NO_2 + TrpH \rightarrow$	$<5 \times 10^5$	~12	p.r.	P.b.k. at 520 nm in N_2O-satd. soln. contg. $NaNO_2$ and tryptophan.	87A179
40	**Tyrosine**					
	$\cdot NO_2 + TyrOH \rightarrow NO_2^- + TyrO\cdot + H^+$	2.9×10^7	~12	p.r.	P.b.k. in N_2O-satd. soln. contg. $NaNO_2$ and tyrosine.	87A179
41	**Deoxyribonucleic acid**					
	$\cdot NO_2 + DNA \rightarrow$			p.r.	No reaction obs. at 1 g/L DNA.	85A483

TABLE 9. Rate constants for reactions of nitrogen trioxide in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Nitrogen trioxide**					
	$NO_3\cdot + NO_3\cdot \rightarrow N_2O_6$	7.9×10^5	acid	f.p.	D.k. at 635 nm in 3.5-15 mol L^{-1} HNO_3 and 10$^{-?}$ mol L^{-1} $(NH_4)_2Ce(NO_3)_6$; ϵ(635 nm) = 250 L mol^{-1} cm^{-1}; cor. for major contribution from Ce(III) + NO_3.	70F72[illegible]
2	**Silver(I) ion**					
	$NO_3\cdot + Ag^+ \rightarrow Ag^{2+} + NO_3^-$	1.5×10^9	<0	p.r.	D.k. at 635 nm in 2 mol L^{-1} nitric acid soln. contg. metal ion; k = 2.1 and 2.0 × 10^9 in 4 and 7 mol L^{-1} nitric acid, resp.	86A48[illegible]
		3.1×10^9	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A27[illegible]
3	**Bromide ion**					
	$NO_3\cdot + Br^- \rightarrow NO_3^- + Br\cdot$	4×10^9	nat.	p.r.	D.k. at 640 nm in 5 mol L^{-1} $NaNO_3$.	86A27[illegible]
4	**Cerium(III)**					
	$NO_3\cdot$ + Ce(III) $\rightarrow NO_3^-$ + Ce(IV)	1.1×10^6	<0	p.r.	D.k. at 635 nm in 3 mol L^{-1} nitric acid soln. contg. metal ion; k = 1.3, 1.7 and 4.4 × 10^6 in 1.7, 6 and 12 mol L^{-1} nitric acid, resp.	86A48[illegible]
		1.3×10^6	acid	p.r.	D.k. at 600 nm in 2 mol L^{-1} HNO_3 contg. 10^{-2} mol L^{-1} Ce^{III}; cor. for $NO_3 + NO_3$.	741140
		3.7×10^5	nat	f.p.	D.k. at 600 nm in 2-20 × 10^{-3} mol L^{-1} $K_2Ce(NO_3)_6$.	677274
		1.7×10^6	<0	f.p.	D.k. at 635 nm; 6 mol L^{-1} nitric acid; radical from ceric ammonium nitrate	64A00[illegible]
5	**Chloride ion**					
	$NO_3\cdot + Cl^- \rightarrow NO_3^- + Cl\cdot$	7.1×10^7	nat.	p.r.	P.b.k. (Cl_2^-) at 345 nm, as well as d.k. at 640 nm, in soln. contg. 5 mol L^{-1} $NaNO_3$.	86A27[illegible]
		1.0×10^8	nat.	p.r.	P.b.k. at 345 nm ($Cl_2\cdot^-$) in 2 mol L^{-1} NO_3^- soln.	761141
6	**Cobalt(II) ion**					
	$NO_3\cdot + Co^{2+} \rightarrow$	$<7 \times 10^4$	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A27[illegible]
7	**Iron(II) ion**					
	$NO_3\cdot$ + Fe(II) $\rightarrow NO_3^-$ + Fe(III)	8.0×10^6	acid	p.r.	D.k. at 600 nm in 2 mol L^{-1} HNO_3 contg. 10^{-3} mol L^{-1} Fe^{2+}; cor. for $NO_3 + NO_3$.	741140
8	**Manganese(II) ions**					
	$NO_3\cdot$ + Mn(II) $\rightarrow NO_3^-$ + Mn(III)	1.5×10^6	<0	p.r.	D.k. at 635 nm in 3 mol L^{-1} nitric acid soln. contg. metal ion; k = 1.8 and 2.2 × 10^6 in 6 and 8 mol L^{-1} nitric acid, resp.	86A48[illegible]
		1.1×10^6	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A27[illegible]
9	**Nitrite ion**					
	$NO_3\cdot + NO_2^- \rightarrow NO_3^- + \cdot NO_2$	1.2×10^9	7	p.r.	D.k.	690417
10	**Dioxoneptunium(V) ion**					
	$NO_3\cdot + NpO_2^+ \rightarrow NpO_2^{2+} + NO_3^-$	8.1×10^8	<0	p.r.	D.k. at 640 nm in soln. contg. 1 mol L^{-1} HNO_3 and 0, 3 and 6 mol L^{-1} $LiNO_3$; similar values were detd. in soln. with 2-5 mol L^{-1} HNO_3.	86A37[illegible]
11	**Bisulfite/sulfite ion**					
	$NO_3\cdot + HSO_3^-/SO_3^{2-} \rightarrow NO_3^- + SO_3\cdot^-$ (+ H^+)	2×10^9	~7	p.r.	D.k. at 640 nm in 5 mol L^{-1} $NaNO_3$.	86A27[illegible]
12	**Thallium(I) ion**					
	$NO_3\cdot$ + Tl(I) $\rightarrow NO_3^-$ + Tl(II)	5.0×10^7	<0	p.r.	D.k. at 635 nm in 3 mol L^{-1} nitric acid soln. contg. metal ion; k = 4.0 and 2.2 × 10^7 in 6 and 9 mol L^{-1} nitric acid, resp.	86A48[illegible]

TABLE 9. Rate constants for reactions of nitrogen trioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
12	**Thallium(I) ion**—Continued					
		8.6×10^7	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
		3.5×10^7	0.65	f.p.	D.k. at 600 nm in soln. contg. 0.1 mol L^{-1} $K_2Ce(NO_3)_6$ and 1-8 $\times$ 10^{-5} mol L^{-1} Tl^+	677274
13	**Vanadium(IV) ions**					
	$NO_3\cdot + V(IV) \rightarrow NO_3^- + V(V)$	6.0×10^6	<0	p.r.	D.k. at 635 nm in 3 mol L^{-1} nitric acid soln. contg. metal ion; k = 1.2 and 2.2 $\times$ 10^7 in 6 and 9 mol L^{-1} nitric acid, resp.	86A480
14	**Acetic acid**					
	$NO_3\cdot + CH_3CO_2H \rightarrow$	4.6×10^4	0.65	f.p.	D.k. at 600 nm in soln. contg. 0.1 mol L^{-1} $K_2Ce(NO_3)_6$ and 1-4 $\times$ 10^{-2} mol L^{-1} AcOH.	677274
		2.3×10^2	<0	f.p.	D.k. at 635 nm; 0-10 mol L^{-1} acetic acid added to 6 mol L^{-1} nitric acid; radical from ceric ammonium nitrate	64A001
15	**Acetophenone**					
	$NO_3\cdot + C_6H_5COCH_3 \rightarrow$	1.4×10^7	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
16	**Acrylamide**					
	$NO_3\cdot + H_2C{=}CHCONH_2 \rightarrow$	3.4×10^6	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
17	**Anisole**					
	$NO_3\cdot + C_6H_5OCH_3 \rightarrow$	3.2×10^9	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
18	**Anthrasemiquinone-2,6-disulfonate, radical ion**					
	$NO_3\cdot + [(SO_3)_2AQ]\cdot^{3-} \rightarrow NO_3^- + (SO_3)_2AQ^{2-}$	1.0×10^8	8.0	f.p.	D.k.	737560
19	**Crotonic acid**					
	$NO_3\cdot + CH_3CH{=}CHCO_2H \rightarrow$	5.1×10^7	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
20	**Ethanol**					
	$NO_3\cdot + C_2H_5OH \rightarrow HNO_3 + CH_3\dot{C}HOH$	1.4×10^6	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
		2.2×10^6	acid	p.r.	D.k. at 600 nm in 5 mol L^{-1} HNO_3; cor. for $NO_3 + NO_3$.	741140
		3.9×10^6	0.65	f.p.	D.k. at 600 nm in soln. contg. 0.1 mol L^{-1} $K_2Ce(NO_3)_6$ and 1.3-15 $\times$ 10^{-4} mol L^{-1} EtOH, as well as with 0.1 and 0.01 mol L^{-1} HNO_3 added.	677274
21	**Ethylene glycol**					
	$NO_3\cdot + HOCH_2CH_2OH \rightarrow HNO_3 + HOCH_2\dot{C}HOH$	1.6×10^6	<0	p.r.	D.k. at 600 nm in 5 mol L^{-1} HNO_3; cor. for $NO_3 + NO_3$.	741140
22	**Formic acid**					
	$NO_3\cdot + HCO_2H \rightarrow HNO_3 + \cdot CO_2H$	$<1 \times 10^5$	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
		2.1×10^5	0.65	f.p.	D.k. at 600 nm in soln. contg. 0.1 mol L^{-1} $K_2Ce(NO_3)_6$ and 1-10 $\times$ 10^{-3} mol L^{-1} formic acid.	677274
23	**Fumaric acid**					
	$NO_3\cdot + HO_2CCH{=}CHCO_2H \rightarrow$	$<1 \times 10^6$	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
24	**Glycerol**					
	$NO_3\cdot + HOCH_2CH(OH)CH_2OH \rightarrow$	1.8×10^6	<0	p.r.	D.k. at 600 nm in 5 mol L^{-1} HNO_3; cor. for $NO_3 + NO_3$.	741140

TABLE 9. Rate constants for reactions of nitrogen trioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
25	**Methanol**					
	$NO_3\cdot + CH_3OH \rightarrow HNO_3 + \cdot CH_2OH$	2.1×10^5	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
		1.2×10^6	<0	p.r.	D.k. at 600 nm in 5 mol L^{-1} HNO_3; cor. for $NO_3 + NO_3$.	741140
		1.0×10^6	0.65	f.p.	D.k. at 600 nm in soln. contg. 0.1 mol L^{-1} $K_2Ce(NO_3)_6$ and 2-10 $\times 10^{-3}$ mol L^{-1} MeOH.	677274
26	**Phenylacetic acid**					
	$NO_3\cdot + C_6H_5CH_2CO_2H \rightarrow$	1.8×10^9	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
27	**2-Propanol**					
	$NO_3\cdot + (CH_3)_2CHOH \rightarrow HNO_3 + (CH_3)_2\dot{C}OH$	2.4×10^6	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
		2.3×10^6	<0	p.r.	D.k. at 600 nm in 5 mol L^{-1} HNO_3; cor. for $NO_3 + NO_3$.	741140
		3.6×10^6	0.65	f.p.	D.k. at 600 nm in soln. contg. 0.1 mol L^{-1} $K_2Ce(NO_3)_6$ and 1-6 $\times 10^{-4}$ mol L^{-1} 2-PrOH.	677274
28	**Pyridinium ion**					
	$NO_3\cdot + pyH^+ \rightarrow$	$<1 \times 10^4$	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278
29	**Tetrahydrofuran**					
	$NO_3\cdot + THF \rightarrow$	1.2×10^7	<0	p.r.	D.k. at 640 nm in 6 mol L^{-1} HNO_3.	86A278

TABLE 10. Rate constants for miscellaneous nitrogen-containing radicals

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Hydrazyl radical**					
1.1	$\cdot N_2H_4^+ + \cdot N_2H_4^+ \rightarrow$	3.0×10^8	2.0	p.r.	D.k. in N_2O-satd. soln. contg. 2.0×10^{-2} mol L^{-1} hydrazine; $\epsilon = 1500$ L mol^{-1} cm^{-1} at 225 nm.	720003
1.2	$\cdot NHNH_2 + \cdot NHNH_2 \rightarrow$	1.2×10^9	9.2	p.r.	D.k.; $\epsilon = 3500$ at 230 nm; at pH 13.4 $k = 1.3 \times 10^9$	720003
1.3	$\cdot N_2H_4^+ + Fe(CN)_6^{4-} \rightarrow$	$<3 \times 10^6$	5, 8	p.r.	No reaction detected in N_2O-satd. soln. contg. 10^{-3} mol L^{-1} ferrocyanide, 10^{-2} mol L^{-1} hydrazine and 10^{-2} mol L^{-1} Na_2HPO_4.	84A237
2	**Cyanate-OH adduct**					
2.1	$\cdot NC(OH)O^- + NCO^- \rightarrow (^-O_2CNHNCO^-)\cdot$	4.3×10^6	10	p.r.	P.b.k. at 330 nm ($\epsilon = 970$ L mol^{-1} cm^{-1}).	87A220
		4.6×10^6	5.1	p.r.	P.b.k. as a function of [NCO$^-$].	771035
3	**Cyanate radical ion**					
3.1	$(^-O_2CNHNCO^-)\cdot + C_6H_5NH_2 \rightarrow [C_6H_5NH_2]\cdot^+$	$<5 \times 10^6$	10	p.r	P.b.k. at 420 nm in soln. contg. 5×10^{-5}-1×10^{-3} mol L^{-1} aniline and 0.1-1 mol L^{-1} NCO$^-$.	87A220
3.2	$(^-O_2CNHNCO^-)\cdot + AH^- \rightarrow \cdot A^-$	1.2×10^8	10	p.r	P.b.k. at 430 nm (ascorbate radical) in soln. contg. 5×10^{-5}-1×10^{-3} mol L^{-1} ascorbate ion and 0.1-1 mol L^{-1} NCO$^-$.	87A220
3.3	$(^-O_2CNHNCO^-)\cdot + {}^-OC_6H_4O^- \rightarrow {}^-OC_6H_4O\cdot$	3.2×10^8	13	p.r	P.b.k. at 430 nm (ArO·) in soln. contg. 5×10^{-5}-1×10^{-3} mol L^{-1} hydroquinone and 0.1-1 mol L^{-1} NCO$^-$.	87A220
3.4	$(^-O_2CNHNCO^-)\cdot + CH_3OC_6H_4O^- \rightarrow CH_3OC_6H_4O\cdot$	6.5×10^7	13	p.r	P.b.k. at 420 nm (ArO·) in soln. contg. 5×10^{-5}-1×10^{-3} mol L^{-1} 4-methoxyphenol and 0.1-1 mol L^{-1} NCO$^-$.	87A220
3.5	$(^-O_2CNHNCO^-)\cdot + C_6H_4(NH_2)_2 \rightarrow [H_2NC_6H_4NH_2]\cdot^+$	6.4×10^7	10	p.r	P.b.k. at 480 nm in soln. contg. 5×10^{-5}-1×10^{-3} mol L^{-1} *p*-phenylenediamine and 0.1-1 mol L^{-1} NCO$^-$.	87A220
3.6	$(^-O_2CNHNCO^-)\cdot + C_6H_5O^- \rightarrow C_6H_5O\cdot$	$<1 \times 10^6$	12.5	p.r	P.b.k. at 400 nm (ArO·) in soln. contg. 5×10^{-5}-1×10^{-3} mol L^{-1} phenol and 0.1-1 mol L^{-1} NCO$^-$.	87A220
3.7	$(^-O_2CNHNCO^-)\cdot$ + TMPD $\rightarrow$ TMPD$\cdot^+$	1.5×10^8	10	p.r	P.b.k. at 560 nm in soln. contg. 5×10^{-5}-1×10^{-3} mol L^{-1} *N,N,N',N'*-tetramethyl-*p*-phenylenediamine and 0.1-1 mol L^{-1} NCO$^-$.	87A220
3.8	$(^-O_2CNHNCO^-)\cdot$ + UrO$^-$ $\rightarrow$ UrO·	8.3×10^7	13	p.r	P.b.k. at 360 nm in soln. contg. 5×10^{-5}-1×10^{-3} mol L^{-1} urate ion and 0.1-1 mol L^{-1} NCO$^-$.	87A220
4	**Cyanide-OH adduct**					
4.1	HOCH=N· + HOCH=N· $\rightarrow$	1.4×10^9	2.85, 3.5	p.r.	D.k. in N_2O-satd. 0.01-0.1 mol L^{-1} HCN.	761079
		7.5×10^8	3.7-7	p.r.	D.k. in HCN soln.	741132
5	**Cyanide-H adduct**					
5.1	$\cdot N{=}CH_2 + \cdot N{=}CH_2 \rightarrow$	1.3×10^9	1.9	p.r.	D.k. in 0.1 mol L^{-1} HCN soln.	761079
6	**Carbamoyl radicals**					
6.1	$\cdot CONH^- + \cdot CONH^- \rightarrow$	1.1×10^9	13.8	p.r.	D.k. in CN$^-$ soln.	741132
6.2	$\cdot CONH_2 + \cdot CONH_2 \rightarrow$	3.1×10^9	9.85-11.5	p.r.	D.k. in CN$^-$ soln.	761079
		3.1×10^9	10-11	p.r.	D.k. in CN$^-$ soln.; $\epsilon(245) = 2200$ L mol^{-1} cm^{-1}; $2k = 5.5 \times 10^9$ for same radical from formamide.	741132
		6.5×10^8	7	p.r.	D.k. at 320 nm; radical from formamide.	700098

TABLE 10. Rate constants for miscellaneous nitrogen-containing radicals—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
6	**Carbamoyl radicals**—Continued					
6.3	$\cdot CONH_2 + Co(NH_3)_6^{3+} \rightarrow$	$<4 \times 10^7$	6.2	p.r.	D.k. in N_2O-satd. soln. contg. 0.01 mol L^{-1} formamide.	72A018
6.4	$\cdot CONH_2 + Cr(H_2O)_6^{2+} \rightarrow (H_2O)_5Cr^{III}CONH_2$	6.5×10^8	~ 5	p.r.	P.b.k. in Ar- or N_2O-satd. soln. contg. formamide.	741146
6.5	$\cdot CONH_2 + Ru(NH_3)_6^{3+} \rightarrow$	$<7 \times 10^7$	6.2	p.r.	D.k. n N_2O-satd. 10^{-2} mol L^{-1} formamide soln.; *e*-transfer.	72A018
7	**Nitrite radical ion**					
7.1	$\dot{N}O_2^{2-} + H_2O \rightarrow NO + OH^-$	7.7×10^2		p.r.	D.k. at 270 nm.	761171
		1.0×10^3	9.0	p.r.	D.k. at 270 nm; soln. contains 0.25 mol L^{-1} *tert*-BuOH; pK = 7.7, 5.7 for (H^+ +) $NO_2^{2-} \rightleftharpoons HNO_2^-$ (+ H^+) $\rightleftharpoons H_2NO_2$. (See also [707264])	690439
8	**Nitrate radical ion**					
8.1	$\dot{N}O_3^{2-} + H_2O \rightarrow \cdot NO_2 + OH^-$	1.6×10^3		p.r.	D.k. at 260 nm in soln. contg. 10^{-2} mol L^{-1} $NaNO_3$; reported $k = 9 \times 10^4$ s^{-1}.	761171
		1.0×10^3	alk.	p.r.	D.k. at 290 nm; also condy. change; 400 nm absorption obs. for $\cdot NO_2$; half-life = 12.5 μs; pK = 7.5, 4.8 for (H^+ +) $NO_3^{2-} \rightleftharpoons HNO_3^-$ (+ H^+) $\rightleftharpoons H_2NO_3$. Half-life for $HNO_3^- \rightarrow OH^- + \cdot NO_2$ = 3 μs.	700151
		1.3×10^3		p.r.	Conductivity change in $>2 \times 10^{-5}$ mol L^{-1} NO_3^- soln.; same k with up to 0.05 mol L^{-1} MeOH added; reported lifetime 9.5 μs, $k = 10^5$ s^{-1}	700254
8.2	$\dot{N}O_3^{2-} + O_2 \rightarrow NO_3^- + O_2\cdot^-$	$\sim 2 \times 10^6$	10.6	p.r.	Estd. in O_2-satd. soln. contg. 1 mol L^{-1} *tert*-BuOH, 0.5 mol L^{-1} nitrate ion and 5×10^{-4} mol L^{-1} ABTS and half-life of NO_3^{2-} 12.5 μs.	86A022
		2.4×10^8	12		Estd. from dependence of $G(NO_2^-)$ on $[O_2]$; rel. to $k(NO_3^{2-} + H_2O)$.	670032
8.3	$\dot{N}O_3^{2-} + Q \rightarrow NO_3^- + Q\cdot^-$	7.6×10^8	7	p.r.	P.b.k. in N_2-satd. soln. contg. 10% *tert*-BuOH, 0.2 mol L^{-1} nitrate ion and (0.2-1) $\times 10^{-3}$ mol L^{-1} benzoquinone.	86A022
8.4	$\dot{N}O_3^{2-} + MV^{2+} \rightarrow NO_3^- + MV\cdot^+$	3.3×10^9	11	p.r.	P.b.k. in N_2-satd. soln. contg. 1 mol L^{-1} *tert*-BuOH, 0.1 mol L^{-1} nitrate ion and 10^{-3} mol L^{-1} methyl viologen.	86A022
8.5	$\dot{N}O_3^{2-} + DQ \rightarrow NO_3^- + DQ\cdot^-$	$<1 \times 10^7$	6	p.r.	No abs. detected in N_2-satd. soln. contg. 10% *tert*-BuOH, 0.2 mol L^{-1} nitrate ion and (0.2-1) $\times 10^{-3}$ mol L^{-1} duroquinone; some semiquinone formn. at pH 11.	86A022

TABLE 11. Rate constants for reactions of phosphite radicals in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Phosphite radical ion**						
	$\dot{P}O_3^{2-} + \dot{P}O_3^{2-} \rightarrow$	3.2×10^6		$\rightarrow 0$	p.r.	D.k. in N_2O-satd. soln. of Na phosphite; $2k_{obs} = 9.6 \times 10^6$.	82A085
2	**Oxygen**						
	$H\dot{P}O_3^- + O_2 \rightarrow HPO_5\cdot^-$	1.9×10^9	2.5		p.r.	D.k. in N_2O-satd. soln. contg. 10^{-1} mol L^{-1} phosphite, product identified by opt. and condy. studies.	80A226
	$\dot{P}O_3^{2-} + O_2 \rightarrow PO_5^{2-}$	1.1×10^9	9				
3	**Diethyl disulfide**						
	$H\dot{P}O_3^- + C_2H_5SSC_2H_5 \rightarrow C_2H_5SPO_3H^- + C_2H_5S\cdot$	1.3×10^8	~4		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} phosphite ion, product anal. showed [RSSR]$\cdot^-$ or [RSSR]$\cdot^+$ not formed.	80A226
	$\dot{P}O_3^{2-} + C_2H_5SSC_2H_5 \rightarrow C_2H_5SPO_3^{2-} + C_2H_5S\cdot$	1.1×10^8	~12				
4	**Dimethyl disulfide**						
	$\dot{P}O_3^{2-} + CH_3SSCH_3 \rightarrow CH_3S\cdot + CH_3SPO_3^{2-}$	2.3×10^8	~12		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} phosphite ion, [RSSR]$\cdot^-$ or [RSSR]$\cdot^+$ not formed.	80A226
5	**Di(1-methylethyl) disulfide**						
	$H\dot{P}O_3^- + [(CH_3)_2CH]_2S_2 \rightarrow (CH_3)_2CHS\cdot + (CH_3)_2CHSPO_3H^-$	2.1×10^7	~4		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} phosphite ion, product anal. showed [RSSR]$\cdot^-$ or [RSSR]$\cdot^+$ not formed.	80A226
	$\dot{P}O_3^{2-} + [(CH_3)_2CH]_2S_2 \rightarrow (CH_3)_2CHS\cdot + (CH_3)_2CHSPO_3^{2-}$	1.2×10^7	7				
6	**Ethanethiol**						
	$\dot{P}O_3^{2-} + C_2H_5SH \rightarrow HPO_3^{2-} + C_2H_5S\cdot$	3.0×10^8	7		p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} phosphite ion.	80A226
	$\dot{P}O_3^{2-} + C_2H_5S^- \rightarrow PO_3^{3-} + C_2H_5S\cdot$	1.0×10^8	~12				
7	**Lipoate ion**						
	$\dot{P}O_3^{2-} + RSSR \rightarrow PO_3^{3-} + RSSR\cdot^-$	4.0×10^8	basic		p.r.	P.b.k. at 425 nm in basic and 390 nm in acidic N_2O-satd. soln. contg. phosphite ion, product yields indicate this reaction accounts for half of radical decay, addn. reaction assumed to occur at rate similar to electron transfer.	80A226
	$H\dot{P}O_3^- + RSSR \rightarrow HPO_3^{2-} + RSSR\cdot^-$	1.4×10^9	acid				
8	**Penicillamine**						
	$H\dot{P}O_3^- + PenSH \rightarrow H_2PO_3^- + PenS\cdot$	2.8×10^8	4		p.r.	P.b.k. at 330 nm ([PenS]$_2\cdot^-$)in N_2O-satd. soln. contg. 0.1 mol L^{-1} phosphite ion.	80A226
	$\dot{P}O_3^{2-} + PenSH \rightarrow HPO_3^{2-} + PenS\cdot$	2.0×10^8	7				
	$\dot{P}O_3^{2-} + PenS^- \rightarrow PO_3^{3-} + PenS\cdot$	3.0×10^8	~12				
9	**2-Propanethiol**						
	$\dot{P}O_3^{2-} + (CH_3)_2CHSH \rightarrow HPO_3^{2-} + (CH_3)_2CHS\cdot$	2.0×10^8	7		p.r.	P.b.k. (RSSR$\cdot$ from RS$\cdot$ + R$^-$) in N_2O-satd. soln. contg. 0.1 mol L^{-1} phosphite ion.	80A226
10	**Tetranitromethane**						
	$\dot{P}O_3^{2-} + C(NO_2)_4 \rightarrow PO_3^{3-} + NO_2\cdot + C(NO_2)_3^-$	1.6×10^9	8.7		p.r.	P.b.k. (nitroform anion) at 350 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} phosphite ion.	80A226
	$H\dot{P}O_3^- + C(NO_2)_4 \rightarrow HPO_3^{2-} + NO_2\cdot + C(NO_2)_3^-$	2.6×10^9	3.5				

TABLE 12. Rate constants for reactions of phosphate radicals in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Dihydrogen phosphate radical**						
	$H_2PO_4\cdot + H_2PO_4\cdot \rightarrow H_2P_2O_8^{2-} + 2\ H^+$	$\sim1 \times 10^9$	3.8		p.r.	D.k. at 500 nm in 1-3 mol L^{-1} phosphate satd. with N_2O; interpreted from $2k/\epsilon = 1.1 \times 10^6$ cm s^{-1} and $\epsilon = 1800$ L mol^{-1} cm^{-1} [78A075].	73105C
		$\sim2 \times 10^9$	3.5, 4.1	~1	p.r.	D.k. at 500 nm in 1 mol L^{-1} $H_2PO_4^-$ contg. N_2O; calcd. from $2k/\epsilon = 2.5 \times 10^6$, $\epsilon = 1800$ L mol^{-1} cm^{-1} [78A075].	700302
2	**Hydrogen phosphate radical ion**						
	$HPO_4\cdot^- + HPO_4\cdot^- \rightarrow P_2O_8^{4-} + 2\ H^+$	$\sim1.5 \times 10^8$	~9	$\rightarrow0$	p.r.	D.k. at 500 nm in N_2O-satd. 0.3 mol L^{-1} phosphate; interpreted from $2k/\epsilon \simeq 3\text{-}7 \times 10^5$ cm s^{-1} and $\epsilon = 1550$ L mol^{-1} cm^{-1} [78A075].	73105C
		$\sim4 \times 10^8$	7-8		p.r.	D.k. at 500 nm in 1 mol L^{-1} HPO_4^{2-} contg. N_2O; calcd. from $2k/\epsilon = 5.5 \times 10^5$ - 6.1×10^5, $\epsilon \simeq 1550$ L mol^{-1} cm^{-1} [78A075].	700302
3	**Phosphate radical ion**						
	$PO_4\cdot^{2-} + PO_4\cdot^{2-} \rightarrow P_2O_8^{4-}$	3.9×10^7	~12	$\rightarrow0$	p.r.	D.k. at 500 nm in N_2O-satd. 0.3 mol L^{-1} phosphate; interpreted from $2k/\epsilon \simeq 10^5$ cm s^{-1} and $\epsilon = 2100$ L mol^{-1} cm^{-1} [78A075].	73105C
		$\sim2 \times 10^8$	11-12	~6	p.r.	D.k. at 500 nm in 1 mol L^{-1} PO_4^{3-} contg. N_2O; calcd. from $2k/\epsilon = 1.9 \times 10^5$ - 2.4×10^5, $\epsilon = 2100$ L mol^{-1} cm^{-1} [78A075].	700302
4	**Bromide ion**						
	$H_2PO_4\cdot + Br^- \rightarrow H_2PO_4^- + Br\cdot$	8×10^8	4	~0.06	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A07
	$HPO_4\cdot^- + Br^- \rightarrow HPO_4^{2-} + Br\cdot$	6.5×10^6	9	~0.2			
5	**Chloride ion**						
	$H_2PO_4\cdot + Cl^- \rightarrow H_2PO_4^- + Cl\cdot$	2.2×10^6	4	~0.06	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A07
	$HPO_4\cdot^- + Cl^- \rightarrow$	$\leq1 \times 10^4$	7	~0.12			
6	**Iodide ion**						
	$PO_4\cdot^{2-} + I^- \rightarrow PO_4^{3-} + I\cdot$	3×10^8	12	~0.2	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A07
7	**Azide ion**						
	$HPO_4\cdot^- + N_3^- \rightarrow HPO_4^{2-} + \cdot N_3$	1.1×10^8	7	~0.1	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A07
8	**Ammonia**						
	$PO_4\cdot^{2-} + NH_3 \rightarrow \cdot NH_2 + HPO_4^{2-}$	2.2×10^6	11.0		p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	78A21
9	**Ammonium ion/Ammonia**						
	$HPO_4\cdot^- + NH_4^+/NH_3 \rightarrow$	4×10^4	7.1		p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	78A21
10	**Hydrazine**						
	$HPO_4\cdot^- + H_2NNH_2 \rightarrow \cdot NHNH_2 + H_2PO_4^-$	4.9×10^8	9.4	~0.2	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A07
11	**Hydrazinium ion**						
	$H_2PO_4\cdot + H_2NNH_3^+ \rightarrow \cdot N_2H_4^+ + H_3PO_4$	1.9×10^8	4	~0.06	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A07
	$HPO_4\cdot^- + H_2NNH_3^+ \rightarrow \cdot N_2H_4^+ + H_2PO_4^-$	1.4×10^8	7	~0.1			

TABLE 12. Rate constants for reactions of phosphate radicals in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
12	**Hydroxylamine**						
	$HPO_4{\cdot}^- + NH_2OH \rightarrow NHOH + H_2PO_4^-$	4.9×10^8	9	~0.2	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
13	**Hydroxylammonium ion**						
	$H_2PO_4{\cdot} + NH_3OH^+ \rightarrow H_3PO_4 + {\cdot}NH_2{}^+OH$	1.2×10^7	4	~0.06	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
14	**Nitrite ion**						
	$HPO_4{\cdot}^- + NO_2^- \rightarrow HPO_4^{2-} + NO_2$	1.4×10^7	7	~0.1	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
15	**Hydroxide ion**						
	$PO_4{\cdot}^{2-} + OH^- \rightarrow PO_4^{3-} + {\cdot}OH$	5×10^5	>12	~0.2	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
		2×10^5	>12	~1	p.r.	D.k. at 500 nm in 0.3 mol L^{-1} HPO_4^{2-} soln.; first order decay rate 9.15×10^3 at pH 12.65.	731050
16	**Hydrogen peroxide**						
	$H_2PO_4{\cdot} + H_2O_2 \rightarrow H_2PO_4^- + HO_2{\cdot} + H^+$	5.5×10^7	4.5	0.1	f.p.	D.k. at 500 nm in 0.1 mol L^{-1} NaH_2PO_4 soln.	700326
	$HPO_4{\cdot}^- + H_2O_2 \rightarrow HPO_4^{2-} + 2\ H^+ + O_2{\cdot}^-$	2.7×10^7	9.0	0.1			
17	**Phosphinic acid, ion(1-)**						
	$H_2PO_4{\cdot} + H_2PO_2^- \rightarrow H_2PO_4^- + H^+ + H\dot{P}O_2^-$	3.9×10^8	4	~0.06	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
	$HPO_4{\cdot}^- + H_2PO_2^- \rightarrow HPO_4^{2-} + H^+ + H\dot{P}O_2^-$	5.9×10^7	7	~0.1			
	$PO_4{\cdot}^{2-} + H_2PO_2^- \rightarrow PO_4^{3-} + H^+ + H\dot{P}O_2^-$	7.9×10^7	12	~0.2			
18	**Hydrogen phosphite ion**						
	$PO_4{\cdot}^{2-} + HPO_3^{2-} \rightarrow PO_4^{3-} + H^+ + \dot{P}O_3^{2-}$	5.5×10^6	12	~0.2	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
	$HPO_4{\cdot}^- + HPO_3^{2-} \rightarrow H_2PO_4^- + \dot{P}O_3^{2-}$	5.9×10^6	9	~0.2			
19	**Dihydrogen phosphite ion**						
	$H_2PO_4{\cdot} + H_2PO_3^- \rightarrow H_2PO_4^- + H\dot{P}O_3^- + H^+$	4×10^7	4	~0.06	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
20	**Hydrogen peroxomonophosphate ion**						
	$HPO_4{\cdot}^- + HPO_5^{2-} \rightarrow$	$<1 \times 10^5$			p.r.	D.k. at 520 nm.	771047
21	**Sulfite ion**						
	$HPO_4{\cdot}^- + SO_3^{2-} \rightarrow HPO_4^{2-} + \dot{S}O_3^-$	2.7×10^7	9	~0.2	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
	$PO_4{\cdot}^{2-} + SO_3^{2-} \rightarrow PO_4^{3-} + \dot{S}O_3$	4.1×10^7	12	~0.2			
22	**Hydrogen sulfite ion**						
	$H_2PO_4{\cdot} + HSO_3^- \rightarrow H_2PO_4^- + \dot{S}O_3^- + H^+$	2.7×10^8	4	~0.06	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075
23	**Sulfate ion**						
	$HPO_4{\cdot}^- + SO_4^{2-} \rightarrow$	$\leq 1 \times 10^4$			p.r.	immeasurably slow	78A075
24	**Thiosulfate ion**						
	$HPO_4{\cdot}^- + S_2O_3^{2-} \rightarrow HPO_4^{2-} + S_2O_3{\cdot}^-$	1.0×10^8	7	~0.1	p.r.	D.k. at 520 nm in 0.02 mol L^{-1} $Li_4P_2O_8$ soln.	78A075

TABLE 12. Rate constants for reactions of phosphate radicals in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
25	**Acetate ion**						
	$HPO_4\cdot^- + CH_3CO_2^- \rightarrow$	8.5×10^4	7.1	~0.1	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
26	**Acetic acid**						
	$H_2PO_4\cdot + CH_3CO_2H \rightarrow H_2PO_4^- + \cdot CH_2CO_2H + CO_2 + \cdot CH_3 + H^+$	3.4×10^5	3.6	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.; acetate and methyl radical formed in ratio of ~ 2:1 from CO_2 yields by γ-r. [78G168]	771106
27	**Acetone**						
	$H_2PO_4\cdot + CH_3COCH_3 \rightarrow H_2PO_4^- + \cdot CH_2COCH_3 + H^+$	3.3×10^5	3.2-4.6	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
28	**Acrylamide**						
	$H_2PO_4\cdot/HPO_4\cdot^- + H_2C{=}CHCONH_2 \rightarrow$	2.2×10^8 $\leq 1 \times 10^6$	3.8-4 7-7.5	~0.06 ~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
29	**Acrylate ion**						
	$HPO_4\cdot^- + CH_2{=}CHCO_2^- \rightarrow {}^-HO_3POCH_2CHCO_2^-$	6.2×10^6	7-7.5	~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$; product radical obs. by esr [775209].	80A240
30	**Acrylic acid**						
	$H_2PO_4\cdot + H_2C{=}CHCO_2H \rightarrow H_2O_3POCH_2CHCO_2H$	1.6×10^8	3.8-4	~0.06	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
31	**Acrylonitrile**						
	$H_2PO_4\cdot/HPO_4\cdot^- + H_2C{=}CHCN \rightarrow$	5.9×10^7 4.4×10^7	3.8-4 7-7.5	~0.06 ~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
32	**Alanine**						
	$PO_4\cdot^{2-} + Ala \rightarrow$	1.6×10^7	12	~0.2	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
33	**Allyl alcohol**						
	$H_2PO_4\cdot/HPO_4\cdot^- + H_2C{=}CHCH_2OH \rightarrow$	1.4×10^9 2.1×10^8	3.8-4 7-7.5	~0.06 ~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
34	**Allyl cyanide**						
	$H_2PO_4\cdot/HPO_4\cdot^- + H_2C{=}CHCH_2CN \rightarrow$	8.8×10^4 3.4×10^7	3.8-4 7-7.5	~0.06 ~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
35	**4-Aminobenzoate ion**						
	$H_2PO_4\cdot + H_3N^+C_6H_4CO_2^- \rightarrow H_2PO_4^- + H_2\dot{N}^+C_6H_4CO_2^- + H^+$	1.5×10^9	3.3	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.; $pK_a = 2.38, 4.89$.	771106
36	**Benzoate ion**						
	$HPO_4\cdot^- + C_6H_5CO_2^- \rightarrow$	$\leq 1 \times 10^7$	7.1	~0.1	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
37	**Benzoic acid**						
	$H_2PO_4\cdot + C_6H_5CO_2H \rightarrow H_2PO_4^- + [C_6H_5CO_2H]\cdot^+$	2.4×10^8	3.2	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.; approx. equal formn. of phenyl and OH adduct detd. from CO_2 yield by γ-r. [78G168]	771106
38	**4-Chlorobenzoate ion**						
	$H_2PO_4\cdot + ClC_6H_4CO_2^- \rightarrow$	4.8×10^7	5.0	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
39	**4-Chlorobenzoic acid**						
	$H_2PO_4\cdot + ClC_6H_4CO_2H \rightarrow$	1.0×10^8	3.3	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
40	**Crotonate ion**						
	$HPO_4\cdot^- + CH_3CH{=}CHCO_2^- \rightarrow$	3.5×10^6	7-7.5	~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240

TABLE 12. Rate constants for reactions of phosphate radicals in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
41	**Crotonic acid**						
	$H_2PO_4\cdot + CH_3CH{=}CHCO_2H \rightarrow$	4.5×10^8	3.8-4	~0.06	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
42	**4-Cyanobenzoate ion**						
	$H_2PO_4\cdot + NCC_6H_4CO_2^- \rightarrow$	1.0×10^7	4.6	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
43	**4-Cyanophenoxide ion**						
	$PO_4\cdot^{2-} + NCC_6H_4O^- \rightarrow PO_4^{3-} + NCC_6H_4O\cdot$	1.9×10^8	11.2	~0.2	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771503
44	**2-Deoxy-D-ribose**						
	$HPO_4\cdot^- + C_5H_{10}O_4 \rightarrow H_2PO_4^- + \cdot C_5H_9O_4$	7.5×10^7	9.0		f.p.	D.k. at 500 nm in 0.03 mol L^{-1} HPO_4^{2-}.	700326
45	**5,6-Dihydrouracil**						
	$H_2PO_4\cdot$ + DHU $\rightarrow$	$\leq 3 \times 10^7$	9.0		f.p.	D.k. at 500 nm in 0.03 mol L^{-1} HPO_4^{2-}.	700326
46	**Ethanol**						
	$H_2PO_4\cdot + C_2H_5OH \rightarrow H_2PO_4^- + CH_3\dot{C}HOH + H^+$	7.7×10^7	4	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
	$PO_4\cdot^{2-} + C_2H_5OH \rightarrow HPO_4^{2-} + CH_3\dot{C}HOH$	1.9×10^7	12.0	~0.2			
	$HPO_4\cdot^- + C_2H_5OH \rightarrow H_2PO_4^- + CH_3\dot{C}HOH$	2.0×10^7	7	~0.1			
		4.0×10^7	9.0		f.p.	D.k. at 500 nm in 0.03 mol L^{-1} HPO_4^{2-}.	700326
47	**Formate ion**						
	$PO_4\cdot^{2-} + HCO_2^- \rightarrow HPO_4^{2-} + \cdot CO_2^-$	2.2×10^7	12	~0.2	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
	$H_2PO_4\cdot + HCO_2^- \rightarrow H_2PO_4^- + \cdot CO_2^- + H^+$	1.5×10^8	4.5	~0.06			
	$HPO_4\cdot^- + HCO_2^- \rightarrow H_2PO_4^- + \cdot CO_2^-$	2.5×10^7	7	~0.1			
		2.9×10^7	9.0		f.p.	D.k. at 500 nm in 0.03 mol L^{-1} HPO_4^{2-} soln.	700326
48	**Fumaric acid**						
	$H_2PO_4\cdot + HO_2CCH{=}CHCO_2H \rightarrow HO_2CCHCH(CO_2H)OPO_3H_2$	1.5×10^7	3.2-4.6	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.; product radical obs. by esr [775209]	771106
49	**Glucose**						
	$HPO_4\cdot^- + C_6H_{12}O_6 \rightarrow HPO_4^{2-} + \cdot C_6H_{11}O_6 + H^+$	8.0×10^7	9.0		f.p.	D.k. at 500 nm in 0.03 mol L^{-1} phosphate soln.	700326
	$H_2PO_4\cdot + C_6H_{12}O_6 \rightarrow H_2PO_4^- + \cdot C_6H_{11}O_6 + H^+$	1.1×10^8	4.5				
50	**Glycine**						
	$H_2PO_4\cdot$ + Gly $\rightarrow$	$\leq 1 \times 10^5$	4.5	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
51	**Glycine, negative ion**						
	$PO_4\cdot^{2-} + H_2NCH_2CO_2^- \rightarrow HPO_4^{2-} + H_2N\dot{C}HCO_2^-$	2.6×10^7	12	~0.2	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
52	**4-Hydroxybenzoate ion**						
	$HPO_4\cdot^- + HOC_6H_4CO_2^- \rightarrow H_2PO_4^- + {}^-O_2CC_6H_4O\cdot$	1.7×10^8	7.2	~0.1	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
	$PO_4\cdot^{2-} + HOC_6H_4CO_2^- \rightarrow HPO_4^{2-} + {}^-O_2CC_6H_4O\cdot$	5×10^7	11.4	~0.2	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771503

TABLE 12. Rate constants for reactions of phosphate radicals in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
53	**4-Hydroxybenzoic acid**						
	$H_2PO_4\cdot + HOC_6H_4CO_2H \rightarrow H_2PO_4^- + \cdot OC_6H_4CO_2H + H^+$	1.3×10^9	3.3	~0.06	p.r.	D.k. at 520 nm in Li_4P_2O soln.	771106
54	**Maleic acid**						
	$H_2PO_4\cdot + HO_2CCH{=}CHCO_2H \rightarrow HO_2CCHCH(CO_2H)OPO_3H_2$	3.1×10^7	3.2-4.6	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln. Product radical obs. by esr [775209].	771106
55	**Malonic acid**						
	$H_2PO_4\cdot + HO_2CCH_2CO_2H \rightarrow H_2PO_4^- + \cdot CH(CO_2H)_2 + \cdot CH_2CO_2H + CO_2 + H^+$	1.8×10^5	3.2-4.6	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln. Product radical obs. by esr [775209]; approx. equal formn. of malonate radical and acetate radical detd. from CO_2 yield by γ-r. [78G168].	771106
56	**Methacrylate ion**						
	$HPO_4\cdot^- + CH_2{=}C(CH_3)CO_2^- \rightarrow$	2.3×10^7	7-7.5	~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
57	**Methacrylic acid**						
	$H_2PO_4\cdot + H_2C{=}C(CH_3)CO_2H \rightarrow$	7.3×10^8	3.8-4	~0.06	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
58	**Methacrylonitrile**						
	$H_2PO_4\cdot/HPO_4\cdot^- + H_2C{=}C(CH_3)CN \rightarrow$	3.9×10^8 2.8×10^7	3.8-4 7-7.5	~0.06 ~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
59	**Methanol**						
	$H_2PO_4\cdot + CH_3OH \rightarrow H_2PO_4^- + \cdot CH_2OH + H^+$	4.1×10^7	4	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
	$HPO_4\cdot^- + CH_3OH \rightarrow H_2PO_4^- + \cdot CH_2OH$	1.0×10^7	7	~0.1			
	$PO_4\cdot^{2-} + CH_3OH \rightarrow HPO_4^{2-} + \cdot CH_2OH$	1.0×10^7	12	~0.2			
60	**4-Methoxyphenoxide ion**						
	$PO_4\cdot^{2-} + CH_3OC_6H_4O^- \rightarrow PO_4^{3-} + CH_3OC_6H_4O\cdot$	8.2×10^8	11.3	~0.2	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771503
61	**Methyl methacrylate**						
	$H_2PO_4\cdot/HPO_4\cdot^- + H_2C{=}C(CH_3)CO_2CH_3 \rightarrow$	6.2×10^8 3.9×10^7	3.8-4 7-7.5	~0.06 ~0.1	p.r.	D.k. at 520 nm in soln. contg. $Li_4P_2O_8$.	80A240
62	**2-Methyl-2-propanol**						
	$H_2PO_4\cdot + (CH_3)_3COH \rightarrow H^+ + H_2PO_4^- + \cdot CH_2C(CH_3)_2OH$	3.9×10^6	4	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
	$HPO_4\cdot^- + (CH_3)_3COH \rightarrow H_2PO_4^- + \cdot CH_2C(CH_3)_2OH$	4.5×10^5	7	~0.1			
	$PO_4\cdot^{2-} + (CH_3)_3COH \rightarrow HPO_4^{2-} + \cdot CH_2C(CH_3)_2OH$	4.2×10^5	12	~0.2			
63	**Phenoxide ion**						
	$PO_4\cdot^{2-} + C_6H_5O^- \rightarrow PO_4^{3-} + C_6H_5O\cdot$	5.9×10^8	11.6	~0.2	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771503
64	***p*-Phthalate ion**						
	$H_2PO_4\cdot + C_6H_4(CO_2^-)_2 \rightarrow$	~6×10^7 3.5×10^7	3.4 5.2	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
65	**2-Propanol**						
	$H_2PO_4\cdot + (CH_3)_2CHOH \rightarrow H_2PO_4^- + (CH_3)_2\dot{C}OH + H^+$	1.4×10^8	4	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
		1.6×10^8	4.5		f.p.	D.k. at 500 nm in 0.1 mol L^{-1} $H_2PO_4^-$ soln.	700326

TABLE 12. Rate constants for reactions of phosphate radicals in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
65	**2-Propanol**—Continued						
	$HPO_4\cdot^- + (CH_3)_2\dot{C}HOH \rightarrow H_2PO_4^- + (CH_3)_2\dot{C}OH$	2.5×10^7	7	~0.1	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
		4.0×10^7	9.0		f.p.	D.k. at 500 nm in 0.03 mol L^{-1} HPO_4^{2-} soln.	700326
	$PO_4\cdot^{2-} + (CH_3)_2\dot{C}HOH \rightarrow HPO_4^{2-} + (CH_3)_2\dot{C}OH$	1.8×10^7	12	~0.2	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
66	**Propionic acid**						
	$H_2PO_4\cdot + C_2H_5CO_2H \rightarrow H_2PO_4^- + CH_3\dot{C}HCO_2H + H^+$	4.2×10^6	3.2-4.6	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.; H abstraction and decarboxylation was determined to be in ratio ~ 1:4 from CO_2 yield by γ-r. [78G168]	771106
67	**Ribose**						
	$HPO_4\cdot^- + C_5H_{10}O_5 \rightarrow H_2PO_4^- + \cdot C_5H_9O_5 + H^+$	9.0×10^7	9.0		f.p.	D.k. at 500 nm in 0.03 mol L^{-1} HPO_4^{2-} soln.	700326
68	**Succinic acid**						
	$H_2PO_4\cdot + HO_2CCH_2CH_2CO_2H \rightarrow H_2PO_4^- + HO_2C\dot{C}HCH_2CO_2H + H^+$	1.6×10^6	3.2-4.6	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
69	**Tetrabutylammonium ion**						
	$HPO_4\cdot^- + [CH_3(CH_2)_3]_4N^+ \rightarrow$	2.3×10^7			p.r.	D.k. at 510 nm in soln. contg. $H_2PO_2O_8^{2-}$.	80A346
70	**Tetraethylammonium ion**						
	$HPO_4\cdot^- + (C_2H_5)_4N^+ \rightarrow$	6.2×10^5			p.r.	D.k. at 510 nm in soln. contg. $H_2P_2O_8^{2-}$.	80A346
71	**Tetramethylammonium ion**						
	$HPO_4\cdot^- + (CH_3)_4N^+ \rightarrow$	6×10^4			p.r.	D.k. at 510 nm in soln. contg. $H_2P_2O_8^{2-}$.	80A346
72	**Tetrapropylammonium ion**						
	$HPO_4\cdot^- + (CH_3CH_2CH_2)_4N^+ \rightarrow$	1.1×10^7			p.r.	D.k. at 510 nm in soln. contg. $H_2P_2O_8^{2-}$.	80A346
73	**Thymine**						
	$HPO_4\cdot^- +$ 5-MeU $\rightarrow$	9.6×10^7	9.0	~0.2	f.p.	D.k. at 500 nm in 0.03 mol L^{-1} HPO_4^{2-} soln.	700326
74	***p*-Toluic acid**						
	$H_2PO_4\cdot + CH_3C_6H_4CO_2H \rightarrow$	5.4×10^8	3.3	~0.06	p.r.	D.k. at 520 nm in $Li_4P_2O_8$ soln.	771106
75	**Uracil**						
	$H_2PO_4\cdot/HPO_4\cdot^- +$ U $\rightarrow$	6.0×10^8 9.7×10^7	4.5 9.0		f.p.	D.k. at 500 nm in 0.03 mol L^{-1} phosphate soln.	700326

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Sulfur dioxide radical anion**						
	$SO_2^{\cdot -} + SO_2^{\cdot -} \rightarrow S_2O_4^{2-}$	1.1×10^9	2-6	~1	p.r.	P.b.k. at 320 nm in 10^{-3} mol L^{-1} HSO_3^-/SO_2 soln. contg. 1 mol L^{-1} HCO_2^-/HCO_2H; $\epsilon(320) = 8500$ L mol^{-1} cm^{-1}.	751118
		6.5×10^8	acid		p.r.	D.k. at 360 nm ($\epsilon = 600$ L mol^{-1} cm^{-1}) as well as p.b.k. at 320 nm in $SO_2 + HSO_3^-$ soln.	741033
		1.7×10^9	6.5	0.15	s.f.	Estd. from d.k. in solns. contg. oxygen and excess dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	74A001
		1.3×10^9	8.0	0.4	s.f.	D.k. in soln. contg. pyrophosphate buffer and dithionite; k recalcd. using $k_r = 1.7$ s^{-1} and $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	733185
2	**Hexaamminecobalt(III) ion**						
	$SO_2^{\cdot -} + Co(NH_3)_6^{3+} \rightarrow$	2.8×10^2		0.15	s.f.	D.k. in buffered soln. (Tris) contg. 0.95 mol L^{-1} $NaClO_4$; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	79M361
3	**Pentaammine(pyridine)cobalt(III) ion**						
	$SO_2^{\cdot -} + Co(NH_3)_5py^{3+} \rightarrow$	6.0×10^3		1	s.f.	D.k. in buffered soln. (Tris) contg. 0.95 mol L^{-1} $NaClO_4$; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	79M361
4	**Pentaammine(azido)cobalt(III) ion**						
	$SO_2^{\cdot -} + Co(NH_3)_5N_3^{2+} \rightarrow$	7.7×10^3		1	s.f.	D.k. in buffered soln. (Tris) contg. 0.95 mol L^{-1} $NaClO_4$; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	79M361
5	**Pentaammine(chloro)cobalt(III) ion**						
	$SO_2^{\cdot -} + Co(NH_3)_5Cl^{2+} \rightarrow$	3.0×10^5		1	s.f.	D.k. in buffered soln. (Tris) contg. 0.95 mol L^{-1} $NaClO_4$; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	79M361
6	**Pentaammine(sulfato)cobalt(III) ion**						
	$SO_2^{\cdot -} + Co(NH_3)_5OSO_3^+ \rightarrow$	8.4×10^2		1	s.f.	D.k. in buffered soln. (Tris) contg. 0.95 mol L^{-1} $NaClO_4$; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	79M361
7	**Pentaammine(trichloroacetato-*O*)cobalt(III) ion**						
	$SO_2^{\cdot -} + Co(NH_3)_5O_2CCCl_3^{2+} \rightarrow$	$<3 \times 10^2$		1	s.f.	D.k. in buffered soln. (Tris) contg. 0.95 mol L^{-1} $NaClO_4$; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	79M361
8	**Pentaammine(benzoato)cobalt(III) ion**						
	$SO_2^{\cdot -} + Co(NH_3)_5O_2CC_6H_5^{2+} \rightarrow$	$<7 \times 10^1$		1	s.f.	D.k. in buffered soln. (Tris) contg. 0.95 mol L^{-1} $NaClO_4$; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	79M361
9	***cis*-Bis(iminodiacetato)cobaltate(III) ion**						
	$SO_2^{\cdot -}$ + *cis*-$Co(IDA)_2^- \rightarrow SO_2$ + *cis*-$Co(IDA)_2^{2-}$	$\leq 10^3$	7.0	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-20 $\times 10^{-4}$ mol L^{-1} complex and 2-16 $\times 10^{-3}$ mol L^{-1} dithionite; k calcd. using k_{obs} and $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$.	80A449

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
10	***trans*-Bis(iminodiacetato)cobaltate(III) ion**						
	$SO_2\cdot^- + trans\text{-}Co(IDA)_2^- \rightarrow SO_2 + trans\text{-}Co(IDA)_2^{2-}$	$\leq 10^3$	7.0	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-20 $\times 10^{-4}$ mol L^{-1} complex and 2-40 $\times 10^{-3}$ mol L^{-1} dithionite; k calcd. using k_{obs} and $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$.	80A449
11	**Bis[nitrilotriacetato]-di-μ-hydroxydicobaltate(III) ion**						
	$SO_2\cdot^- + [Co(NTA)OH]_2^{2-} \rightarrow SO_2 + [Co(NTA)OH]_2^{3-}$	5.2×10^3	7.0	0.4	s.f.	D.k. at 530-600 soln. contg. 1-20 $\times 10^{-4}$ mol L^{-1} complex and 5-80 $\times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	80A449
12	**Ethylenediaminetetraacetatocobaltate(III) ion**						
	$SO_2\cdot^- + CoEDTA^- \rightarrow SO_2 + CoEDTA^{2-}$	1.1×10^3	7.0, 10	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-10 $\times 10^{-4}$ mol L^{-1} complex and 2-20 $\times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1. no change in k from I = 0.2-1.4 at pH 10; over T = 13-32.5°C, $\Delta H\ddagger - ½\Delta H$(diss) = 72.8 kJ mol^{-1} and $\Delta S\ddagger - ½\Delta S$(diss) = −16 J K^{-1} mol^{-1}.	80A449
13	**Chloro(ethylenediaminotetraacetato)cobaltate(III) ion**						
	$SO_2\cdot^- + Co(EDTA)Cl^{2-} \rightarrow SO_2 + Co(EDTA)Cl^{3-}$	2.4×10^5	7.0	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-20 $\times 10^{-4}$ mol L^{-1} complex and 1-13 $\times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1. over T = 15-32°C, $\Delta H\ddagger - ½\Delta H$(diss) = 64.8 kJ mol^{-1} and $\Delta S\ddagger - ½\Delta S$(diss) = −13 J K^{-1} mol^{-1}.	80A449
14	**Aqua(*N*-methylethylenediaminetriacetato)cobalt(III)**						
	$SO_2\cdot^- + Co(MEDTA)OH_2 \rightarrow SO_2 + Co(MEDTA)OH_2^-$	1.7×10^4	7.0	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-20 $\times 10^{-4}$ mol L^{-1} complex and 1-40 $\times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	80A449
15	**Bromo(*N*-methylethylenediaminetriacetato)cobaltate(III) ion**						
	$SO_2\cdot^- + Co(MEDTA)Br^- \rightarrow SO_2 + Co(MEDTA)Br^{2-}$	7.3×10^6	7.0	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-20 $\times 10^{-4}$ mol L^{-1} complex and 1-13 $\times 10^{-3}$ mol L^{-1} dithionite; fast reacting component; slow reacting component k 1.3×10^4; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1. over T = 15-32°C, $\Delta H\ddagger - ½\Delta H$(diss) = 54.4 kJ mol^{-1} and $\Delta S\ddagger - ½\Delta S$(diss) = 17 cal K^{-1} mol^{-1}.	80A449
16	***trans*-1,2-Cyclohexanediamine-*N,N,N',N'*-tetraacetatocobaltate(III) ion**						
	$SO_2\cdot^- + CoCyDTA^- \rightarrow SO_2 + CoCyDTA^{2-}$	2.6×10^3	7.0	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-20 $\times 10^{-4}$ mol L^{-1} complex and 3.6-42 $\times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	80A449

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
17	**Trioxalatocobaltate(III) ion**						
	$SO_2^{\cdot -} + Co(C_2O_4)_3^{3-} \rightarrow SO_2 + Co(C_2O_4)_3^{4-}$	2.0×10^4 1.1×10^4	7.0 10	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-20 $\times 10^{-4}$ mol L^{-1} complex and 1-33 $\times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1. over T = 18.5-43°C, $\Delta H\ddagger - ½\Delta H(\text{diss})$ = 62.3 kJ mol^{-1} and $\Delta S\ddagger - ½\Delta S(\text{diss})$ = −37 J K^{-1} mol^{-1}.	80A44
18	**Bis(oxalato)dihydroxydicobaltate(III) ion**						
	$SO_2^{\cdot -} + [Co(C_2O_4)_2OH]_2^{4-} \rightarrow SO_2 + [Co(C_2O_4)_2OH]_2^{5-}$	1.8×10^4	7.0	0.4	s.f.	D.k. at 530-600 in soln. contg. 1-10 $\times 10^{-4}$ mol L^{-1} complex and 1-30 $\times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1. over T = 11-25°C, $\Delta H\ddagger - ½\Delta H(\text{diss})$ = 77 kJ mol^{-1} and $\Delta S\ddagger - ½\Delta S(\text{diss})$ = 8 J K^{-1} mol^{-1}.	80A44
19	**1,8-Dinitro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosanecobalt(III) ion**						
	$SO_2^{\cdot -}$ + Co(dinosar)$^{3+} \rightarrow SO_2$ + Co(dinosar)$^{2+}$	4.1×10^5	6.3	0.5	s.f.	D.k. at 474 nm in soln. contg. MES buffer, 2.4-124 $\times 10^{-3}$ mol L^{-1} dithionite and 0.26-1.7 $\times 10^{-3}$ mol L^{-1} Co complex; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	83A40
20	**1,8-Dinitro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosanecobalt(II) ion**						
	$SO_2^{\cdot -}$ + Co(dinosar)$^{2+} \rightarrow$	1.9×10^4	6.3	0.5	s.f.	Second stage of reduction of Co(dinosar)$^{3+}$; d.k. at 474 nm in soln. contg. MES buffer, 2.4-124 $\times$ 10^{-3} mol L^{-1} dithionite and 0.26-1.7 $\times 10^{-3}$ mol L^{-1} Co complex; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	83A40
21	**Bis(2,2',6',2"-terpyridine)cobalt(III) ion**						
	$SO_2^{\cdot -}$ + Co(terpy)$_2^{3+} \rightarrow$	$\leq 10^7$	7.0	0.4	s.f.	D.k. at 450 nm in soln. contg. 1-10 $\times 10^{-4}$ mol L^{-1} complex and 0.3-1 $\times 10^{-3}$ mol L^{-1} dithionite; k calcd. from k_{obs} and $K(S_2O_4^{2-} \rightleftharpoons 2SO_2^-)$.	80A44
22	**5,10,15,20-Tetrakis-4-(*N*,*N*,*N*-trimethylammonio)phenylporphinatocobalt(III) ion**						
	$SO_2^{\cdot -}$ + CoTAPP$^{5+} \rightarrow SO_2$ + CoTAPP^{4+}	1.9×10^8	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08
23	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatocobalt(III) ion**						
	$SO_2^{\cdot -}$ + CoTMpyP$^{5+} \rightarrow SO_2$ + CoTMpyP^{4+}	2×10^8	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08
		2.4×10^8	5.5	0.05	s.f.	D.k., as well as p.b.k., in soln. contg. Na dithionite and 5 $\times 10^{-6}$ mol L^{-1} Mn porphyrin; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	80R10
		2.4×10^8 4.3×10^6	4 8	0.5	s.f.	D.k.; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	75A24
24	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatocobalt(III) ion bispyridine complex**						
	$SO_2^{\cdot -}$ + CoTMpyP(py)$_2^{5+} \rightarrow SO_2$ + CoTMpyP(py)$_2^{4+}$	2.3×10^6	8	0.5	s.f.	D.k. ; 2.5 $\times 10^{-3}$ mol L^{-1} borate buffer; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	75A24
25	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatocobaltate(III) ion**						
	$SO_2^{\cdot -}$ + CoTPPS$^{3-} \rightarrow SO_2$ + CoTPPS^{4-}	4×10^7	1		p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
26	**Cobalt(III) deuteroporphyrin dimethyl ester, dipyridine complex**						
	$SO_2\cdot^- + CoDPDME(py)_2^+ \rightarrow SO_2 + CoDPDME(py)_2$	7.2×10^3	7.8	0.1	s.f.	D.k. in soln. contg. 1.22×10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; outer-sphere reaction; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	74M403
27	**Cobalt(III) mesoporphyrin dimethyl ester, dipyridine complex**						
	$SO_2\cdot^- + CoMPDME(py)_2^+ \rightarrow SO_2 + CoMPDME(py)_2$	3.3×10^3	7.8	0.1	s.f.	D.k. in soln. contg. 1.22×10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; outer-sphere reaction; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	74M403
28	**Ferricyanide ion**						
	$SO_2\cdot^- + Fe(CN)_6^{3-} \rightarrow SO_2 + Fe(CN)_6^{4-}$	1.8×10^8	6.8	0.1	s.f.	D.k. at 418 nm; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1; K used not clear, assumed 1.4×10^{-9}; studied reaction at 25, 15 and 8°C to obtain $\Delta H\ddagger = 17$ kJ mol^{-1} and $\Delta S\ddagger = -33$ J K^{-1} mol^{-1}.	80A451
29	**Ethylenediaminetetraacetatoferrate(III) ion**						
	$SO_2\cdot^- + FeEDTA^- \rightarrow SO_2 + FeEDTA^{2-}$	$\leq 2 \times 10^6$	7.0	0.4	s.f.	D.k. at 400 nm in soln. contg. 1-10 $\times 10^{-4}$ mol L^{-1} complex and 5-40 $\times 10^{-3}$ mol L^{-1} dithionite; k calcd. from k_{obs} and $K(S_2O_4^{2-} \rightleftarrows 2SO_2^-)$.	80A449
30	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatoiron(III) ion**						
	$SO_2\cdot^- + FeTMpyP^{5+} \rightarrow SO_2 + FeTMpyP^{4+}$	3.4×10^9	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A083
		2.2×10^7	7.0	0.05	s.f.	D.k., as well as p.b.k., in soln. contg. Na dithionite and 5×10^{-6} mol L^{-1} Mn porphyrin; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1;	80R105
31	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatoferrate(III) ion**						
	$SO_2\cdot^- + FeTPPS^{3-} \rightarrow SO_2 + FeTPPS^{4-}$	1.2×10^8	1		p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A083
	$SO_2\cdot^- + FeTPPS(OH)^{4-} \rightarrow$	5.9×10^6	9	0.1	s.f.	D.k. in soln. contg. dithionite and 0.01 mol L^{-1} Tris buffer; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	85A489
33	**Iron(III) protoporphyrin dicyano complex**						
	$SO_2\cdot^- + Fe^{III}P(CN)_2 \rightarrow SO_2 + Fe^{II}P(CN)_2$	1.8×10^8	12.0	0.5	s.f.	D.k. in soln. contg. ~4×10^{-6} mol L^{-1} porphyrin, 10^{-2} OH^-, 0.1 mol L^{-1} CN^-, and 0.1-1 10^{-3} mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80A450
34	**Iron(III) deuteroporphyrin dicyano complex**						
	$SO_2\cdot^- + Fe^{III}DP(CN)_2 \rightarrow SO_2 + Fe^{II}DP(CN)_2$	1.1×10^5	12.0	0.5	s.f.	D.k. in soln. contg. ~4×10^{-6} mol L^{-1} porphyrin, 10^{-2} OH^-, 0.1 mol L^{-1} CN^-, and 0.1-1 10^{-3} mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80A450

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
35	**Iron(III) 2,4-dibromodeuteroporphyrin dicyano complex**						
	$SO_2\cdot^- + Fe^{III}DPBr_2(CN)_2 \rightarrow SO_2 + Fe^{II}DPBr_2(CN)_2$	2.1×10^8	12.0	0.5	s.f.	D.k. in soln. contg. ~4 × 10^{-6} mol L^{-1} porphyrin, 10^{-2} OH^-, 0.1 mol L^{-1} CN^-, and 0.1-1 10^{-3} mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80A45
36	**Iron(III) 2,4-diacetyldeuteroporphyrin dicyano complex**						
	$SO_2\cdot^- + Fe^{III}DP(Ac)_2(CN)_2 \rightarrow SO_2 + Fe^{II}DP(Ac)_2(CN)_2$	3.1×10^8	12.0	0.5	s.f.	D.k. in soln. contg. ~4 × 10^{-6} mol L^{-1} porphyrin, 10^{-2} OH^-, 0.1 mol L^{-1} CN^-, and 0.1-1 10^{-3} mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80A45
37	**Iron(III) mesoporphyrin dicyano complex**						
	$SO_2\cdot^- + Fe^{III}MP(CN)_2 \rightarrow SO_2 + Fe^{II}MP(CN)_2$	9.4×10^7	12.0	0.5	s.f.	D.k. in soln. contg. ~4 × 10^{-6} mol L^{-1} porphyrin, 10^{-2} OH^-, 0.1 mol L^{-1} CN^-, and 0.1-1 10^{-3} mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80A45
38	**Hemin, protonated**						
	$SO_2\cdot^- + Fe^{3+}$ heme $\rightarrow SO_2 + Fe^{2+}$ heme	5.5×10^6		0.1	s.f.	D.k. at 570 nm in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1; pK_a = 5.89; calcd. from k_{obs} at pH 7-9.	77A27
39	**Hemin, deprotonated**						
	$SO_2\cdot^- + Fe^{3+}heme(OH) \rightarrow SO_2 + Fe^{2+}heme(OH)$	5×10^3		0.1	s.f.	D.k. at 570 nm in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1. pK_a = 5.89; calcd. from k_{obs} at pH 7-9.	77A27
40	**Hemin bis(pyridine)**						
	$SO_2\cdot^- + Fe^{3+}heme(py)_2 \rightarrow SO_2 + Fe^{2+}heme(py)_2$	7.8×10^7	7	0.1	s.f.	D.k. at 570 nm in soln. contg. dithionite and pyridine (0.05-0.20 mol L^{-1}); k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	77A27
41	**Hexachloroiridate(IV) ion**						
	$SO_2\cdot^- + IrCl_6^{2-} \rightarrow SO_2 + IrCl_6^{3-}$	1.1×10^9	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08
42	**1,2-Cyclohexanediaminetetraacetatomanganate(III) ion**						
	$SO_2\cdot^- + MnCyDTA^- \rightarrow SO_2 + MnCyDTA^{2-}$	$\leq 10^8$	7.0	0.4	s.f.	D.k. at 510 nm in soln. contg. 4-25 × 10^{-5} mol L^{-1} complex and 5-40 × 10^{-3} mol L^{-1} dithionite; k calcd. from k_{obs} and $K(S_2O_4^{2-} \rightleftarrows 2SO_2^-)$.	80A44
43	**5,10,15,20-Tetrakis(4-pyridyl)porphinatomanganese(III) ion**						
	$SO_2\cdot^- + MnTpyP^+ \rightarrow SO_2 + MnTpyP$	1.3×10^7 1.2×10^7 1.1×10^7	6.8 7.5-10 11.5	0.05	s.f.	D.k., as well as p.b.k., in soln. contg. Na dithionite and 5 × 10^{-6} mol L^{-1} Mn porphyrin; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80R10
44	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatomanganese(III) ion**						
	$SO_2\cdot^- + MnTMpyP^{5+} \rightarrow SO_2 + MnTMpyP^{4+}$	4.6×10^8	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08
		1.3×10^7	7.5, 8.0	0.05	s.f.	D.k., as well as p.b.k., in soln. contg. Na dithionite and 5 × 10^{-6} mol L^{-1} Mn porphyrin; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80R10

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
45	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatomanganese(III) ion bispyridine complex**						
	$SO_2^{\cdot-}$ + $MnTMpyP(py)_2^{5+}$ → SO_2 + $MnTMpyP(py)_2^{4+}$	>3 × 10^7	7.8	0.1	s.f.	D.k. in soln. contg. 1.22 × 10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; outer-sphere reaction.	74M403
46	**5,10,15,20-Tetrakis(4-carboxyphenyl)porphinatomanganese(III) ion**						
	$SO_2^{\cdot-}$ + $MnTCPP^{3-}$ → SO_2 + $MnTCPP^{4-}$	2.3 × 10^6	7.5	0.05	s.f.	D.k., as well as p.b.k., in soln. contg. Na dithionite and 5 × 10^{-6} mol L^{-1} Mn porphyrin; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80R105
47	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatomanganate(III) ion**						
	$SO_2^{\cdot-}$ + $MnTPPS^{3-}$ → SO_2 + $MnTPPS^{4-}$	<1 × 10^7	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A083
		3.7 × 10^6	7.5	0.05	s.f.	D.k., as well as p.b.k., in soln. contg. Na dithionite and 5 × 10^{-6} mol L^{-1} Mn porphyrin; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	80R105
48	**Manganese(III) protoporphyrin dimethyl ester, dipyridine complex**						
	$SO_2^{\cdot-}$ + $Mn^{III}PDME(py)_2$ → SO_2 + $Mn^{II}PDME(py)_2$	3.1 × 10^6	7.8	0.1	s.f.	D.k. in soln. contg. 1.22 × 10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1. outer-sphere reaction.	74M403
49	**Manganese(III) deuteroporphyrin dimethyl ester, dipyridine complex**						
	$SO_2^{\cdot-}$ + $Mn^{III}DPDME(py)_2$ → SO_2 + $Mn^{II}DPDME(py)_2$	7.3 × 10^5	7.8	0.1	s.f.	D.k. in soln. contg. 1.22 × 10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1. outer-sphere reaction.	74M403
50	**Manganese(III) diacetyldeuteroporphyrin dimethyl ester, dipyridine complex**						
	$SO_2^{\cdot-}$ + $Mn^{III}DPDME(py)_2(Ac)_2$ → SO_2 + $Mn^{II}DPDME(py)_2(Ac)_2$	>2 × 10^7	7.8	0.1	s.f.	D.k. in soln. contg. 1.22 × 10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1. some ring reduction obs.	74M403
51	**Manganese(III) etioporphyrin III dipyridine complex**						
	$SO_2^{\cdot-}$ + $Mn^{III}EP(py)_2$ → SO_2 + $Mn^{II}EP(py)_2$	3.1 × 10^5	7.8	0.1	s.f.	D.k. in soln. contg. 1.22 × 10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	74M403
52	**Manganese(III) mesoporphyrin dimethyl ester, dipyridine complex**						
	$SO_2^{\cdot-}$ + $Mn^{III}MPDME(py)_2$ → SO_2 + $Mn^{II}MPDME(py)_2$	6.8 × 10^5	7.8	0.1	s.f.	D.k. in soln. contg. 1.22 × 10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	74M403

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
53	**Manganese(III) hematoporphyrin dimethyl ester, dipyridine complex**						
	$SO_2\cdot^- + Mn^{III}HPDME(py)_2 \rightarrow SO_2 + Mn^{II}HPDME(py)_2$	4.6×10^6	7.8	0.1	s.f.	D.k. in soln. contg. 1.22×10^{-2} mol L^{-1} dithionite, 0.05 mol L^{-1} porphyrin, 0.1 mol L^{-1} NaCl and 4 mol L^{-1} pyridine; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	74M40
54	**Oxygen**						
	$SO_2\cdot^- + O_2 \rightarrow SO_2 + O_2\cdot^-$	$\geq 1 \times 10^8$	6.5	0.15	s.f.	Estd. from d.k. in solns. contg. excess dithionite or excess oxygen (solubility in 0.15 mol L^{-1} NaCl at 25°C taken to be 1.3×10^{-3} mol L^{-1}) using $K(S_2O_4^{2-} \rightleftharpoons 2\ SO_2^-)$.	74A00
55	**Hydrogen peroxide**						
	$SO_2\cdot^- + H_2O_2 \rightarrow$	2.4×10^2	6.5	0.15	s.f.	D.k. in solns. contg. dithionite and excess hydrogen peroxide; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	74A00
56	**Hydroperoxide ion**						
	$SO_2\cdot^- + HO_2^- \rightarrow$	5.4×10^0	13	0.10	s.f.	D.k. in solns. contg. dithionite and excess hydrogen peroxide; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	74A00
57	**5,10,15,20-Tetrakis(3-pyridyl)porphinatoantimony(V) ion**						
	$SO_2\cdot^- + SbTpyP^{7+} \rightarrow SO_2 + [SbTpyP]\cdot^{6+}$	2.7×10^9	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08
58	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatotin(IV) ion**						
	$SO_2\cdot^- + SnTMpyP^{6+} \rightarrow SO_2 + [SnTMpyP]\cdot^{5+}$	1.6×10^9	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08
59	**9,10-Anthraquinone-2-sulfonate ion**						
	$SO_2\cdot^- + SO_3AQ^- \rightarrow SO_2 + [SO_3AQ]\cdot^{2-}$	1.3×10^8	1		p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08
60	**1,1''-Butanediylbis(1'-methyl-4,4'-bipyridinium) ion**						
	$SO_2\cdot^- + BTQ^{4+} \rightarrow SO_2 + BTQ\cdot^{3+}$	6.0×10^7	8.2	0.50	s.f.	Obs. radical formation in soln. contg. 1-2 $\times 10^{-5}$ mol L^{-1} viologen and 2-20 $\times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	86A26
61	**1,1'-Dibenzyl-4,4'-bipyridinium ion**						
	$SO_2\cdot^- + BV^{2+} \rightarrow SO_2 + BV\cdot^+$	1.1×10^8	8.1, 9.2	0.5	s.f	P.b.k.; air-free soln. contg. Na dithionite (0.5-60 $\times 10^{-3}$ mol L^{-1}) and 0.1 mol L^{-1} Tris/H_2SO_4 buffer and Na_2SO_4 and 5-10 $\times 10^{-6}$ mol L^{-1} viologen; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	85A09
62	**2,6-Dichloroindophenolate ion**						
	$SO_2\cdot^- + DCIP \rightarrow$	2.8×10^8	9.2	~0.03	s.f.	D.k. in soln. contg. dithionite and 1.5×10^{-2} mol L^{-1} Na borate; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	84A10

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
63	**1,1'-Dimethyl-4,4'-bipyridinium ion**						
	$SO_2{\cdot}^- + MV^{2+} \rightarrow SO_2 + MV{\cdot}^+$	1.1×10^7	7.2-9.2	0.5	s.f	P.b.k.; air-free soln. contg. Na dithionite ($0.5\text{-}60 \times 10^{-3}$ mol L^{-1}) and 0.1 mol L^{-1} Tris/H_2SO_4 buffer and Na_2SO_4 and $5\text{-}10 \times 10^{-6}$ mol L^{-1} viologen; k recalcd. using $K(S_2O_4{}^{2-} \rightleftarrows SO_2{}^-)$ from Fig. 1; at pH 1 the reverse reaction has $k = 1.2 \times 10^9$ L mol^{-1} s^{-1} [87A083].	85A095
64	**Duroquinone**						
	$SO_2{\cdot}^- + DQ \rightarrow SO_2 + DQ{\cdot}^-$	1.4×10^9	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A083
65	**1,1''-Ethanediylbis(1'-methyl-4,4'-bipyridinium) ion**						
	$SO_2{\cdot}^- + ETQ^{4+} \rightarrow SO_2 + ETQ{\cdot}^{3+}$	1.6×10^8	8.2	0.50	s.f.	Obs. radical formation in soln. contg. $1\text{-}2 \times 10^{-6}$ mol L^{-1} viologen and $2\text{-}20 \times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4{}^{2-} \rightleftarrows SO_2{}^-)$ from Fig. 1.	86A266
66	**1,1'-Ethylene-2,2'-bipyridinium ion**						
	$SO_2{\cdot}^- + BP^{2+} \rightarrow SO_2 + BP{\cdot}^+$	7.5×10^7	8.1	0.5	s.f	P.b.k.; air-free soln. contg. Na dithionite ($0.5\text{-}60 \times 10^{-3}$ mol L^{-1}) and 0.1 mol L^{-1} Tris/H_2SO_4 buffer and Na_2SO_4 and $5\text{-}10 \times 10^{-6}$ mol L^{-1} viologen; k recalcd. using $K(S_2O_4{}^{2-} \rightleftarrows SO_2{}^-)$ from Fig. 1.	85A095
67	**1,1'-Ethylene-4,4'-dimethyl-2,2'-bipyridinium ion**						
	$SO_2{\cdot}^- + MDQ^{2+} \rightarrow SO_2 + MDQ{\cdot}^+$	2.1×10^6	8.1	0.5	s.f	P.b.k.; air-free soln. contg. Na dithionite ($0.5\text{-}60 \times 10^{-3}$ mol L^{-1}) and 0.1 mol L^{-1} Tris/H_2SO_4 buffer and Na_2SO_4 and $5\text{-}10 \times 10^{-6}$ mol L^{-1} viologen; k recalcd. using $K(S_2O_4{}^{2-} \rightleftarrows SO_2{}^-)$ from Fig. 1.	85A095
68	**Lumiflavin-3-acetate ion**						
	$SO_2{\cdot}^- + Fl_{ox}CH_2CO_2{}^- \rightarrow SO_2 + Fl{\cdot}CH_2CO_2{}^-$	2.9×10^7	8.0	0.41	s.f.	D.k. in soln. contg. dithionite; k recalcd. using k_{obs} and $K(S_2O_4{}^{2-} \rightleftarrows SO_2{}^-)$ from Fig. 1.	733185
69	**4-Nitroacetophenone**						
	$SO_2{\cdot}^- + PNAP \rightarrow SO_2 + PNAP^-$	2.6×10^7	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A083
70	**Nitro Blue Tetrazolium**						
	$SO_2{\cdot}^- + NBT^{2+} \rightarrow SO_2 + NBT{\cdot}^+$	1.2×10^8	9.2	~0.03	s.f.	D.k. in soln. contg. dithionite and 1.5×10^{-2} mol L^{-1} Na borate; k recalcd. using $K(S_2O_4{}^{2-} \rightleftarrows SO_2{}^-)$ from Fig. 1.	84A100
71	**Phenanthrolino[4,5-*a*:6,7-*c*]diazepinedium ion**						
	$SO_2{\cdot}^- + PPQ^{2+} \rightarrow SO_2 + PPQ{\cdot}^+$	$>6 \times 10^8$	8.1	0.5	s.f	P.b.k.; air-free soln. contg. Na dithionite ($0.5\text{-}60 \times 10^{-3}$ mol L^{-1}) and 0.1 mol L^{-1} Tris/H_2SO_4 buffer and Na_2SO_4 and $5\text{-}10 \times 10^{-6}$ mol L^{-1} viologen; k recalcd. using $K(S_2O_4{}^{2-} \rightleftarrows SO_2{}^-)$ from Fig. 1.	85A095

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
72	**Phenanthrolino[4,5-*a*:6,7-*c*]pyrazinedlium ion**						
	$SO_2\cdot^- + EPQ^{2+} \rightarrow SO_2 + EPQ\cdot^+$	1.6×10^8	8.1	0.5	s.f	P.b.k.; air-free soln. contg. Na dithionite ($0.5\text{-}60 \times 10^{-3}$ mol L^{-1}) and 0.1 mol L^{-1} Tris/H_2SO_4 buffer and Na_2SO_4 and $5\text{-}10 \times 10^{-6}$ mol L^{-1} viologen; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	85A09[illegible]
73	**1,1''-Propanediylbis(1'-methyl-4,4'-bipyridinium) ion**						
	$SO_2\cdot^- + PTQ^{4+} \rightarrow SO_2 + PTQ\cdot^{3+}$	7.4×10^7 8.2×10^7	7.2 8.2	0.50	s.f.	Obs. radical formation in soln. contg. $1\text{-}2 \times 10^{-5}$ mol L^{-1} viologen perchlorate and $2\text{-}20 \times 10^{-3}$ mol L^{-1} dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	86A26[illegible]
74	**Riboflavine**						
	$SO_2\cdot^- + RF \rightarrow SO_2 + RF\cdot^-$	4.0×10^8	1	~0.1	p.r.	P.b.k. in soln. contg. SO_2 and 2-PrOH in 0.1 mol L^{-1} $HClO_4$.	87A08[illegible]
75	**1,1'-Tetramethylene-2,2'-bipyridinium ion**						
	$SO_2\cdot^- + BP^{2+} \rightarrow SO_2 + BP\cdot^+$	1.0×10^4	9.2	0.5	s.f	P.b.k.; air-free soln. contg. Na dithionite ($0.5\text{-}60 \times 10^{-3}$ mol L^{-1}) and 0.1 mol L^{-1} Tris/H_2SO_4 buffer and Na_2SO_4 and $5\text{-}10 \times 10^{-6}$ mol L^{-1} viologen; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	85A09[illegible]
76	**1,1'-Trimethylene-2,2'-bipyridinium ion**						
	$SO_2\cdot^- + TQ^{2+} \rightarrow SO_2 + TQ\cdot^+$	3.5×10^5	8.1	0.5	s.f	P.b.k.; air-free soln. contg. Na dithionite ($0.5\text{-}60 \times 10^{-3}$ mol L^{-1}) and 0.1 mol L^{-1} Tris/H_2SO_4 buffer and Na_2SO_4 and $5\text{-}10 \times 10^{-6}$ mol L^{-1} viologen; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	85A09[illegible]
77	**Azurin**						
	$SO_2\cdot^- + Cu^{2+}P \rightarrow$	3.8×10^6	9.2	~0.03	s.f.	D.k. in soln. contg. dithionite and 1.5×10^{-2} mol L^{-1} Na borate; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	84A10[illegible]
		2.8×10^6	7.0	~1	s.f.	D.k. at 625 nm in 0.1 mol L^{-1} phosphate, 0.8 mol L^{-1} NaCl buffer; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	83A41[illegible]
78	**Cobalticytochrome C**						
	$SO_2\cdot^- + Co^{3+}cyt\ C \rightarrow$	5.4×10^3	8-9.3	~0.2	s.f.	D.k. at 426 nm in soln. contg. dithionite using $K(S_2O_4^{2-} \rightleftarrows 2\ SO_2^-)$; E_a determined from 20-35°C; effects of pH (6-11) and ionic strength were also studied.	78A488
79	**Cytochrome C**						
	$SO_2\cdot^- + Cyt\ C\ (Fe^{3+}) \rightarrow SO_2 + Cyt\ C\ (Fe^{2+})$	2×10^7	7.0	0.09	s.f.	D.k.; 4×10^{-6} mol L^{-1} horse heart cyt C and 1.8×10^{-4} mol L^{-1} dithionite ion in 0.1 mol L^{-1} Tris buffer; $k = 5 \times 10^6$ for tuna heart cyt C; k calcd. using K from [78A488].	87A127
		8.1×10^7	7.0	~1	s.f.	D.k. at 550 nm in 0.1 mol L^{-1} phosphate, 0.8 mol L^{-1} NaCl buffer; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	83A413

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
79	**Cytochrome C**—Continued						
		3.7×10^7	6.3	0.15	s.f.	D.k. at 530 nm; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	83R189
		1.2×10^8	7.0	→0	therm. (s.f.)	D.k. at 417 nm in deoxygenated soln. contg. $Na_2S_2O_4$; pH effect; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	759421
		4.4×10^7	8.0	0.41	s.f.	D.k. in soln. contg. dithionite and horse ferricytochrome C; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	733185
		2.7×10^7	6.5	1.0	s.f.	D.k. at 550 nm in soln. contg. dithionite and horse ferricytochrome C; authors prefer non-radical mechanism; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	733186
80	**Cytochrome C, 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide (EDC) modified**						
	$SO_2^{\cdot -} + Fe^{3+}$ cyt C-EDC → SO_2 + Fe^{2+} cyt C-EDC	1.8×10^8	7.0		s.f.	D.k.; 4×10^{-6} mol L^{-1} EDC-modified horse heart cyt C and 1.8×10^{-4} mol L^{-1} dithionite ion in 0.1 mol L^{-1} Tris buffer; $k = 7.4 \times 10^7$ for tuna heart cyt C; K from [78A488].	87A127
81	**Cytochrome C cyanide adduct**						
	$SO_2^{\cdot -} + Fe^{3+}$ cyt C-CN → SO_2 + Fe^{2+} cyt C-CN	9.8×10^5	6.4	1.00	s.f.	D.k. at 560 nm in solns. contg. 0.6-40 $\times 10^{-3}$ mol L^{-1} dithionite, 2.5×10^{-2} mol L^{-1} HCN and 0.2 mol L^{-1} phosphate buffer ~8×10^{-5} mol L^{-1} horse heart cyt C; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1; k for horse heart protein; $k = 3.5 \times 10^5$ for C. krusei protein.	74A002
82	**Cytochrome C oxidase**						
	$SO_2^{\cdot -} + Cu^{2+}$haem →	1.2×10^5 1.9×10^5	7.0	~0.2 ~1	s.f.	D.k. at 605 nm in 0.1 mol L^{-1} phosphate buffer; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1; k varied with enzyme preparation.	83A413
83	**Cytochrome P-450**						
	$SO_2^{\cdot -}$ + cyt P-450 →	6.4×10^4	7.9	2.0	chem.	Stopped-flow, d.k. at 475 and 643 nm in camphor-free soln. contg. $Na_2S_2O_4$. Camphor-bound substrate gave $k = 1.6 \times 10^4$ and $\Delta E - \frac{1}{2}\Delta H$(diss) = 50.6 kJ mol^{-1}. Metyrapone-bound substrate gave $k = 1.4 \times 10^4$ and $\Delta E - \frac{1}{2}\Delta H$(diss) = 59 kJ mol^{-1} at 442 nm; K from [78A488]	80A207
84	**Cytochrome b 558**						
	$SO_2^{\cdot -}$ + cyt b 558 → cyt b 558_{red}	6×10^6	7.4	0.15	s.f.	P.b.k. at 428-412 nm in soln. contg. dithionite and cytochrome b 558 from human neutrophils solubilized in Lubrol PX (nonionic detergent); k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1. Over T = 17-39°C E_a = −0.69 kJ mol^{-1}.	86A448

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
85	**Cytochrome b_5 (III)**						
	$SO_2{\cdot}^-$ + Cytochrome b_5 (III) → SO_2 + Cytochrome b_5 (II)	3.0×10^6 1.3×10^6	7.9-9.3	0.055 0.005	s.f.	D.k. at 424 nm in buffered soln. (Tris) contg. 0.5-4 × 10^{-6} mol L^{-1} cytochrome; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1; similar rates for membrane-bound cytochrome.	86N155
86	**Cytochrome C_3**						
	$SO_2{\cdot}^-$ + cyt C_3 →	6.0×10^6 1.9×10^6	9.1	~0.05 0.1	chem.	Stopped-flow, radical from $Na_2S_2O_4$; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1; different rates from different heme groups.	78A232
87	**Ferredoxin (spinach)**						
	$SO_2{\cdot}^-$ + Ferredoxin (spinach) → redn.	2.6×10^5	8.0	0.41	s.f.	D.k. in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	733185
88	**Ferriperoxidase cyanide adduct**						
	$SO_2{\cdot}^-$ + Fe^{III} HRP-CN → SO_2 + Fe^{II} HRP-CN	2.8×10^5	6.3	0.15	s.f.	P.b.k. at 432 nm (Fe(II) production), as well as d.k. at 404 nm; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	83R189
89	**Ferriperoxidase (horseradish)**						
	$SO_2{\cdot}^-$ + Fe^{III} HRP → SO_2 + Fe^{II} HRP	4.8×10^5	6.3	0.15	s.f.	P.b.k. at 432 nm (Fe(II) production), as well as d.k. at 404 nm; horseradish peroxidase; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	83R189
90	**High-potential iron-sulfur protein (Chromatium vinosum D), oxidized**						
	$SO_2{\cdot}^-$ + Hipip$_o$ →	2.1×10^6	7.3	0.01-0.11	s.f.	D.k. at 480 nm in buffered soln. (10^{-2} mol L$^-$ Tris) contg. 0.15-5 × 10^{-3} mol L^{-1} dithionite; calcd. from k_{obs} using $K(S_2O_4^{2-} \rightleftarrows 2SO_2^-)$; no I dependence.	76R191
91	**Manganese(III) myoglobin, protonated**						
	$SO_2{\cdot}^-$ + $Mn^{III}MbH^+$ → SO_2 + $Mn^{II}MbH^+$	6.0×10^6	5.3-8.6	0.45	s.f.	P.b.k. at 438 nm (or d.k. at 471 nm) in buffered soln. contg. Na_2SO_4 and dithionite; pK_a = 4.6; calcd. from k_{obs} over pH range, using pK_a = 4.6; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	86A228
	$SO_2{\cdot}^-$ + $Mn^{III}Mb$ → SO_2 + $Mn^{II}Mb$	1.5×10^4	5.3-8.6	0.45	s.f.	P.b.k. at 438 nm (or d.k. at 471 nm) in buffered soln. contg. Na_2SO_4 and dithionite; calcd. from k_{obs} over pH range, using pK_a = 4.6; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	86A228
92	**Methemerythrin**						
	$SO_2{\cdot}^-$ + Fe^{3+}methem → SO_2 + Fe^{2+}methem	1.4×10^5 1.2×10^5 7×10^4	6.3 8.2 9	0.1	s.f.	D.k. at 420-450 nm in soln. contg. 0.07-0.2 × 10^{-3} mol L^{-1} protein (octamer from P. gouldii) and 1-50 × 10^{-3} mol L^{-1} dithionite, 0.03 mol L^{-1} Tris at pH 8.2 and 0.03 mol L^{-1} Mes at pH 6.3 and Na_2SO_4; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1. data limited at pH 9.	78R211

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
92	**Methemerythrin**—Continued						
		1.9×10^5	6.3	0.47	s.f.	D.k. at 350-450 in soln. contg. 2-5 × 10^{-5} mol L^{-1} protein and 2-50 × 10^{-3} mol L^{-1} dithionite, 0.03 mol L^{-1} Mes and Na_2SO_4; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	79R196
93	**Metmyoglobin**						
	$SO_2\cdot^- + Fe^{3+}Mb \rightarrow SO_2 + Fe^{2+}Mb$	2.5×10^6	6.4	0.3	s.f.	D.k. at 476 nm, as well as p.b.k. at 555 nm, in soln. contg. 0.15 mol L^{-1} NaH_2PO_4, 0.05 mol L^{-1} Na_2HPO_4; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	77A276
		5.3×10^6	8.2	0.47	s.f.	P.b.k. at 565 nm in soln. contg. dithionite; k determined over pH 7-10.3; pK_a = 8.9; also, $k = 3.5 \times 10^6$ for pH 8.2 was determined from reactions of several Mb complexes; k for Metmyoglobin$^+$OH$^-$ $<3 \times 10^4$.	77A278
		3.0×10^6	8.0	0.41	s.f.	D.k. in soln. contg. dithionite and horse metmyoglobin; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	733185
94	**Metmyoglobin azide**						
	$SO_2\cdot^- + Fe^{3+}Mb\text{-}N_3 \rightarrow SO_2 + Fe^{2+}Mb\text{-}N_3$	1.3×10^4	6.4	0.5	s.f.	D.k. at 476 nm, as well as p.b.k. at 555 nm, in soln. contg. 0.15 mol L^{-1} NaH_2PO_4, 0.05 mol L^{-1} Na_2HPO_4 and 0.2 mol L^{-1} N_3^{-1} using $K(S_2O_4^{2-} \rightleftarrows 2\ SO_2^-)$.	77A276
		$<1 \times 10^4$	8.2	0.47	s.f.	P.b.k. at 565 nm in soln. contg. dithionite using $K(S_2O_4^{2-} \rightleftarrows 2\ SO_2^-)$; observed reaction due to dissociated Mb.	77A278
95	**Metmyoglobin cyanate**						
	$SO_2\cdot^- + Fe^{3+}Mb\text{-}CNO \rightarrow$	$<1 \times 10^4$	8.2	0.47	s.f.	P.b.k. at 565 nm in soln. contg. dithionite using $K(S_2O_4^{2-} \rightleftarrows 2\ SO_2^-)$; observed reaction due to dissociated Mb.	77A278
96	**Metmyoglobin cyanide**						
	$SO_2\cdot^- + Fe^{3+}Mb\text{-}CN \rightarrow SO_2 + Fe^{2+}Mb\text{-}CN$	1.2×10^6	6.4	0.3	s.f.	D.k. at 476 nm, as well as p.b.k. at 555 nm, in soln. contg. 0.15 mol L^{-1} NaH_2PO_4, 0.05 mol L^{-1} Na_2HPO_4, 0.01 mol L^{-1} KCN; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	77A276
		2.2×10^6	8.2	0.5	s.f.	P.b.k. at 565 nm in soln. contg. dithionite and 0.1 and 1.0 mol L^{-1} KCN; k quoted in [78A487].	77A278
97	**Metmyoglobin fluoride**						
	$SO_2\cdot^- + Fe^{3+}Mb\text{-}F \rightarrow SO_2 + Fe^{2+}Mb\text{-}F$	$<2 \times 10^2$	6.4	0.3	s.f.	D.k. at 476 nm, as well as p.b.k. at 555 nm, in soln. contg. 0.15 mol L^{-1} NaH_2PO_4, 0.05 mol L^{-1} Na_2HPO_4 and KF using $K(S_2O_4^{2-} \rightleftarrows 2\ SO_2^-)$.	77A276
98	**Metmyoglobin formate**						
	$SO_2\cdot^- + Fe^{3+}Mb\text{-}HCO_2 \rightarrow$	$<1 \times 10^6$	6.6	0.47	s.f.	P.b.k. at 565 nm in soln. contg. dithionite using $K(S_2O_4^{2-} \rightleftarrows 2\ SO_2^-)$; observed reaction due to dissociated Mb.	77A278

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
99	**Metmyoglobin imidazole, negative ion**						
	$SO_2\cdot^- + Fe^{3+}$Mb-Im $\rightarrow SO_2 + Fe^{2+}$Mb-Im	1.8×10^9		0.5	s.f.	P.b.k. at 555 nm in soln. contg. dithionite; calcd. from dependence of k on pH (8.2-12.6); pK = 10.4.	78A487
		6×10^7	6.4	0.3	s.f.	D.k. at 476 nm, as well as p.b.k. at 555 nm, in soln. contg. 0.15 mol L^{-1} NaH_2PO_4, 0.05 mol L^{-1} Na_2HPO_4 and imidazole using $K(S_2O_4^{2-} \rightleftharpoons 2\ SO_2^-)$.	77A276
100	**Metmyoglobin 1-methylimidazole complex**						
	$SO_2\cdot^- + Fe^{3+}$Mb-1-CH_3Im $\rightarrow$ $SO_2 + Fe^{2+}$Mb-1-CH_3Im	$\geq 2 \times 10^8$	8.2	0.50	s.f.	P.b.k. at 555 nm in soln. contg. dithionite using $K(S_2O_4^{2-} \rightleftharpoons 2\ SO_2^-)$.	78A487
101	**Metmyoglobin 2-methylimidazole complex**						
	$SO_2\cdot^- + Fe^{3+}$Mb-2-CH_3Im $\rightarrow$ $SO_2 + Fe^{2+}$Mb-2-CH_3Im	2.4×10^6	8.2	0.50	s.f.	P.b.k. at 520 nm in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	78A487
102	**Metmyoglobin 2-methyl-5-nitroimidazole complex**						
	$SO_2\cdot^- + Fe^{3+}$Mb-2-$CH_3$5-NO_2Im $\rightarrow SO_2 + Fe^{2+}$Mb-2-$CH_3$5-$NO_2$Im	1.0×10^7	10.2	0.50	s.f.	P.b.k. at 555 nm in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	78A487
103	**Metmyoglobin nitrite**						
	$SO_2\cdot^- + Fe^{3+}$Mb-NO_2 $\rightarrow$	$<1 \times 10^4$	8.2	0.47	s.f.	P.b.k. at 565 nm in soln. contg. dithionite using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$; obs. reaction due to dissociated Mb.	77A278
104	**Metmyoglobin 4-nitroimidazole complex**						
	$SO_2\cdot^- + Fe^{3+}$Mb-4-NO_2Im $\rightarrow$ $SO_2 + Fe^{2+}$Mb-4-NO_2Im	9.4×10^6	9.4	0.50	s.f.	P.b.k. at 560 and 535 nm in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	78A487
105	**Metmyoglobin 2-picoline complex**						
	$SO_2\cdot^- + Fe^{3+}$Mb-2-CH_3py $\rightarrow$ $SO_2 + Fe^{2+}$Mb-2-CH_3py	3.7×10^7	8.2	0.50	s.f.	P.b.k. at 530 nm in soln. contg. dithionite: k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	78A487
106	**Metmyoglobin 3-picoline complex**						
	$SO_2\cdot^- + Fe^{3+}$Mb-3-CH_3py $\rightarrow$ $SO_2 + Fe^{2+}$Mb-3-CH_3py	3.1×10^8	8.2	0.50	s.f.	P.b.k. at 530 nm in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	78A487
107	**Metmyoglobin 4-picoline complex**						
	$SO_2\cdot^- + Fe^{3+}$Mb-4-CH_3py $\rightarrow$ $SO_2 + Fe^{2+}$Mb-4-CH_3py	3.3×10^8	8.2	0.50	s.f.	P.b.k. at 530 nm in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	78A487
108	**Metmyoglobin pyridine complex**						
	$SO_2\cdot^- + Fe^{3+}$Mb-py $\rightarrow SO_2 + Fe^{2+}$Mb-py	3.4×10^8	8.2	0.50	s.f.	P.b.k. at 530 nm in soln. contg. dithionite; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	78A487
109	**Metmyoglobin thiocyanate**						
	$SO_2\cdot^- + Fe^{3+}$Mb-SCN $\rightarrow SO_2 + Fe^{2+}$Mb-SCN	2.7×10^5	6.4	0.7	s.f.	D.k. at 476 nm, as well as p.b.k. at 555 nm, in soln. contg. 0.15 mol L^{-1} NaH_2PO_4, 0.05 mol L^{-1} Na_2HPO_4, 0.2 mol L^{-1} KSCN; k recalcd. using $K(S_2O_4^{2-} \rightleftharpoons SO_2^-)$ from Fig. 1.	77A276

TABLE 13. Rate constants for reactions of the sulfur dioxide radical anion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
109	**Metmyoglobin thiocyanate**—Continued						
		$<1 \times 10^3$	8.2	0.47	s.f.	P.b.k. at 565 nm in soln. contg. dithionite using $K(S_2O_4^{2-} \rightleftarrows 2\ SO_2^-)$; observed reaction due to dissociated Mb.	77A278
110	**Metmyohemerythrin**						
	$SO_2^{\cdot -} + Fe^{3+}$myohem $\rightarrow SO_2 + Fe^{2+}Fe^{3+}$myohem	1.1×10^6	8.2	0.15	s.f.	D.k.; monomeric protein from T. zostericola (same as T. pyroides).	81A438
111	**Myoglobin**						
	$SO_2^{\cdot -} + Fe^{2+}Mb \rightarrow$	4.5×10^6	8.2	0.47	s.f.	D.k. at 552 nm in soln. contg. dithionite and MES buffer; k is dependent on pH and ionic strength; calcd. from k_{obs} using $K(S_2O_4^{2-} \rightleftarrows 2SO_2^-) = 1.4 \times 10^{-9}$	83R189
112	**Myoglobin cyanide adduct**						
	$SO_2^{\cdot -} + Fe^{2+}Mb\text{-}CN \rightarrow$	1.9×10^6	8.2	0.47	s.f.	D.k. at 552 nm in soln. contg. dithionite and MES buffer; k is dependent on pH and ionic strength; calcd. from k_{obs} using $K(S_2O_4^{2-} \rightleftarrows 2SO_2^-) = 1.4 \times 10^{-9}$	83R189
113	**Myoglobin imidazole adduct**						
	$SO_2^{\cdot -} + Fe^{2+}Mb\text{-}Im \rightarrow$	8.8×10^7	8.2	0.47	s.f.	D.k. at 552 nm in soln. contg. dithionite and MES buffer; k is dependent on pH and ionic strength; calcd. from k_{obs} using $K(S_2O_4^{2-} \rightleftarrows 2SO_2^-) = 1.4 \times 10^{-9}$	83R189
114	**Plastocyanin**						
	$SO_2^{\cdot -} + Cu^{2+}P \rightarrow$ redn.	3.3×10^7	8.0	0.41	s.f.	D.k. in soln. contg. dithionite and spinach plastocyanin; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	733185
115	**Semimethemerythrin**						
	$SO_2^{\cdot -} + Fe^{2+}Fe^{3+}$methem $\rightarrow SO_2 + Fe^{2+}$deoxyhem	4×10^5	8.2			D.k. in soln. contg. 0.05 mol L^{-1} Tris; semimethemerythrin from one-electron oxidation of deoxyhemethyrin with ferricyanide; protein from T. zostericola.	81R202
		7×10^5	8.2	0.15		Semimethemerythrin from one-electron oxidation of deoxyhemethyrin with ferricyanide.	80A195
116	**Stellacyanin**						
	$SO_2^{\cdot -} + Cu^{2+}P \rightarrow$	5.9×10^7	7.0	~1	s.f.	D.k. at 604 nm in 0.1 mol L^{-1} phosphate, 0.8 mol L^{-1} NaCl buffer; k recalcd. using $K(S_2O_4^{2-} \rightleftarrows SO_2^-)$ from Fig. 1.	83A413

TABLE 14. Rate constants for reactions of sulfite radical ion in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Sulfite radical ion**						
	$\dot{S}O_3^- + \dot{S}O_3^- \rightarrow S_2O_6^{2-}$ $(+ SO_3^{2-} + SO_3)$	5.3×10^8	14	~2.5	p.r.	D.k. in soln. contg. 0.5 mol L^{-1} Na_2SO_3 and 1.0 mol L^{-1} NaOH assuming $\epsilon_{300} = 390$ and $\epsilon_{325} = 300$ L mol^{-1} cm^{-1}.	87D064
		3.6×10^8	10.7		p.r.	D.k. at 270 nm in 5×10^{-3} mol L^{-1} Na_2SO_3 soln.	82A328
		3.4×10^8	9.8		p.r.	D.k. at 260 nm in N_2O-satd. soln contg. 3×10^{-3} mol L^{-1} sulfite ion and 10^{-2} mol L^{-1} borate buffer; $\epsilon = 1300$ L mol^{-1}cm^{-1} [710461].	81G067
		7.6×10^8			f.p.	D.k. at 290 nm; $2k/\epsilon = 2.5 \times 10^6$; k calcd. using $\epsilon = 610$ L mol^{-1} cm^{-1}.	78B076
		4.3×10^8 7×10^8	5 10		p.r.	D.k. at 255 nm ($\epsilon = 1200 \pm 50$ L mol^{-1} cm^{-1}) in SO_2/HSO_3^- soln.; $k = 7 \times 10^8$ by pulse conductivity at pH 9.5; sulfate is formed by hydrolysis of SO_3; rel. amounts of sulfate and dithionate formed depend on pH.	741033
		2.7×10^8			phot.	C.k. in soln. contg. 1.6×10^{-3} mol L^{-1} SO_3^{2-}, 0.68 mol L^{-1} acetone and 10^{-3} mol L^{-1} $Na_4B_2O_7$; rel. to $k = 7 \times 10^8$ for second-order decay of $(CH_3)_2\dot{C}OH$, assuming no cross reaction.	735022
		9.5×10^8	11.8	0.03	e-r.	Obs. steady-state $\dot{S}O_3^-$ concn. by esr in N_2O-satd. SO_3^{2-} soln.; rel. to $2k(\cdot CH_2CO_2^- + \cdot CH_2CO_2^-) = 1.0 \times 10^9$.	725049
		5.5×10^8	3.7-9.8	→0	f.p.	D.k. at 255-320 nm in SO_3^{2-}/HSO_3^- soln.; $2k/\epsilon = 8.3 \times 10^5$ - 3.6×10^6; $\epsilon = 1000$ L mol^{-1} cm^{-1} at 260 nm; same in $S_2O_6^{2-}$ soln.	727008
		4.3×10^8	5.4, 10.2	→0	p.r.	D.k. in SO_3^{2-}/HSO_3^- soln.	727008
2	**Carbonate radical ion**						
	$\dot{S}O_3^- + CO_3^{\cdot -} \rightarrow CO_2 + SO_4^{2-}$	5.5×10^8	9.6		p.r.	D.k. at 260 nm; also condy. study.	78A256
3	**Ferrocyanide ion**						
	$\dot{S}O_3^- + Fe(CN)_6^{4-} \rightarrow SO_3^{2-} + Fe(CN)_6^{3-}$	$<1 \times 10^6$			p.r.	Unpublished data, Huie and Neta.	86A059
4	**Nitrous oxide**						
	$\dot{S}O_3^- + N_2O \rightarrow$	$\leq 10^6$			p.r.	Estd. from measurement of electron spin relaxation time, $T_1 = 2.0$ μs in Ar-satd. as well as N_2O-satd. soln. assuming $[N_2O] = 0.02$ mol L^{-1}.	85D178
5	**Oxygen**						
	$\dot{S}O_3^- + O_2 \rightarrow SO_5^{\cdot -}$	1.5×10^9	6.8	0.5	p.r.	Derived from p.b.k. at 360 nm in soln. contg. 5×10^{-3} mol L^{-1} ascorbate and 5×10^{-2} mol L^{-1} Na_2SO_3 at several N_2O/O_2 ratios.	84A327
		$>1 \times 10^9$			f.p.		727008
6	***N*-Acetyltryptophan**						
	$\dot{S}O_3^- + AcTrpH \rightarrow$	$<5 \times 10^5$	3.0		p.r.	P.b.k. at 525 nm.	86A110

TABLE 14. Rate constants for reactions of sulfite radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
7	**Adenine**						
	$\dot{S}O_3^- + A \rightarrow$	$\leq 1 \times 10^6$	7.0		p.r.	C.k. with crocin ($k = 1 \times 10^9$) in N_2O-satd. soln. contg. 0.05-0.1 mol L^{-1} Na_2SO_3; same result for cytosine, thymine, uracil, adenosine, guanosine, cytidine, thymidine and uridine.	87A332
8	**Aniline**						
	$\dot{S}O_3^- + C_6H_5NH_2 \rightarrow$	$<1 \times 10^6$	13		p.r.		85A103
9	**Arachidonate ion**						
	$\dot{S}O_3^- + CH_3(CH_2CH{-}CH)_4(CH_2)_4CO_2^- \rightarrow$	3.9×10^6	11.5		p.r.	C.k. with quercetin ($k = 2.5 \times 10^8$) in N_2O-satd. soln. contg. 0.05 mol L^{-1} NaN_3 and 10^{-3} mol L^{-1} Na_2SO_3.	87A332
10	**Ascorbic acid**						
	$\dot{S}O_3^- + AH_2 \rightarrow$	$<1 \times 10^6$	<3	0.1	p.r.	Derived from p.b.k. at 360 nm in N_2O-satd. soln. contg. Na sulfite; pK_a(AH_2) = 4.2, 11.5.	85A288
11	**Ascorbate ion**						
	$\dot{S}O_3^- + AH^- \rightarrow SO_3^{2-} + \cdot A^- + H^+$	9×10^6	5-10	0.1-0.5	p.r.	Derived from p.b.k. at 360 nm in N_2O-satd. soln. contg. Na sulfite; k slightly higher at $I = 0.5$.	85A288
	$\dot{S}O_3^- + A^{2-} \rightarrow SO_3^{2-} + \cdot A^- +$	3×10^8	>12	0.1			
12	**Catechol**						
	$\dot{S}O_3^- + 2\text{-}HOC_6H_4O^- \rightarrow SO_3^{2-} + 2\text{-}^-OC_6H_4O\cdot + H^+$	3×10^7	9.2		p.r.	P.b.k. at 300 nm; pK_a = 9.4, 13.0.	85A255
		5×10^7	11				
		3×10^8	13.2				
13	**Chlorpromazine**						
	$\dot{S}O_3^- + CZ \rightarrow SO_3^{2-} + CZ\cdot^+$	$\sim 5 \times 10^6$	3.6		p.r.	P.b.k.	84A327
14	**Crocin**						
	$\dot{S}O_3^- + C_{44}H_{64}O_{24} \rightarrow$	1.0×10^9	7.0		p.r.	D.k. at 490 nm	87A332
15	**Crocetin**						
	$\dot{S}O_3^- + C_{20}H_{24}O_4 \rightarrow$	1.5×10^9	10.0		p.r.	D.k. at 465 nm	87A332
		8×10^8			p.r.	D.k. at 420 nm.	86A191
16	**2,5-Dihydroxyphenylacetate ion**						
	$\dot{S}O_3^- + (HO)_2C_6H_3CH_2CO_2^- \rightarrow$	7×10^7	11.0		p.r.	P.b.k. at 435 nm	87A332
17	**Diphenylamine**						
	$\dot{S}O_3^- + (C_6H_5)_2NH \rightarrow$	$<1 \times 10^7$	3-7		p.r.	P.b.k.	85A103
18	**Ethanol**						
	$\dot{S}O_3^- + C_2H_5OH \rightarrow$	$\leq 2 \times 10^3$		0.1	f.p.	D.k. at 270 nm in N_2-satd. 0.1 mol L^{-1} $S_2O_6^{2-}$ soln.	727008
19	**Glutathione**						
	$\dot{S}O_3^- + GSH \rightarrow$	9.6×10^6	7.0		p.r.	C.k. with crocin ($k = 1 \times 10^9$) in N_2O-satd. soln. contg. 0.05-0.1 mol L^{-1} Na_2SO_3.	87A332
20	**Hydroquinone**						
	$\dot{S}O_3^- + HOC_6H_4O^- \rightarrow SO_3^{2-} + ^-OC_6H_4O\cdot + H^+$	1×10^7	9		p.r.	P.b.k. at 430 nm; pK_a = 9.9, 11.5.	85A255
		1.2×10^8	11.2				
		3.2×10^8	13				
		5.4×10^7	10.5		p.r.		86A059

TABLE 14. Rate constants for reactions of sulfite radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
21	**Hydroquinone-2,5-disulfonate ion**						
	$\dot{S}O_3^- + C_6H_2(OH)(O^-)(SO_3^-)_2 \rightarrow SO_3^{2-} + \cdot OC_6H_2(O^-)(SO_3^-)_2 + H^+$	$<10^7$ 3×10^7 8×10^7	9 12.1 13.1		p.r.	P.b.k. at 450 nm.	85A255
22	**Hydroquinone-2-sulfonate ion**						
	$\dot{S}O_3^- + C_6H_3(OH)(O^-)(SO_3^-) \rightarrow SO_3^{2-} + \cdot OC_6H_3(O^-)(SO_3^-) + H^+$	1×10^7 8×10^7 1.7×10^8	9.5 12 13		p.r.	P.b.k. at 430 nm.	85A255
23	**6-Hydroxy-2,5,7,8-tetramethylchroman-2-carboxylate ion (Trolox C)**						
	$\dot{S}O_3^- + HTC\text{-}CO_2^- \rightarrow SO_3^{2-} + [HTC\text{-}CO_2]\cdot^-$	$\sim 1 \times 10^6$ 8×10^7 1.1×10^8 1.5×10^8 1.9×10^8	9 11.1 11.4 11.6 12	0.1	p.r.	Derived from p.b.k. at 360 nm in N_2O-satd. soln. contg. Na sulfite.	85A288
24	**Kaempferol [3,5,7-Trihydroxy-2-(4-hydroxyphenyl)-2-benzopyran-4-one]**						
	$\dot{S}O_3^- + KfOH \rightarrow$	4×10^8	11.5		p.r.	P.b.k. at 545 nm.	87A332
25	**Linoleate ion**						
	$\dot{S}O_3^- + LCO_2^- \rightarrow$	1.8×10^6	11.5		p.r.	C.k. with quercetin ($k = 2.5 \times 10^8$) in N_2O-satd. soln. contg. 0.05 mol L^{-1} NaN_3 and 10^{-3} mol L^{-1} Na_2SO_3.	87A332
26	**Linolenate ion**						
	$\dot{S}O_3^- + CH_3(CH_2CH{=}CH)_3(CH_2)_7CO_2^- \rightarrow$	2.8×10^6	11.5		p.r.	C.k. with quercetin ($k = 2.5 \times 10^8$) in N_2O-satd. soln. contg. 0.05 mol L^{-1} NaN_3 and 10^{-3} mol L^{-1} Na_2SO_3.	87A332
27	**3-Methoxyphenoxide ion**						
	$\dot{S}O_3^- + CH_3OC_6H_4O^- \rightarrow SO_3^{2-} + CH_3OC_6H_4O\cdot$	1.1×10^6	12.3		p.r.	P.b.k. at 400-430 nm in N_2O-satd. sulfite ion soln.	86A254
28	**4-Methoxyphenoxide ion**						
	$\dot{S}O_3^- + CH_3OC_6H_4O^- \rightarrow SO_3^{2-} + CH_3OC_6H_4O\cdot$	4×10^7 1.0×10^8 1.2×10^8	9.2 11.7 12.4		p.r.	P.b.k.; [sulfite] $\geq 10^{-3}$ mol L^{-1}.	84A327
29	**3-Methylphenoxide ion**						
	$\dot{S}O_3^- + CH_3C_6H_4O^- \rightarrow$	$\leq 10^4$	12.3		p.r.	P.b.k. at 400-430 nm in N_2O-satd. sulfite ion soln.	86A254
30	**4-Methylphenoxide ion**						
	$\dot{S}O_3^- + CH_3C_6H_4O^- \not\rightleftharpoons SO_3^{2-} + CH_3C_6H_4O\cdot$		12.3		p.r.	P.b.k. at 400-430 nm in N_2O-satd. sulfite ion soln.; no reaction obs.; reverse reaction expected to occur.	86A254
31	**Phenoxide ion**						
	$\dot{S}O_3^- + C_6H_5O^- \rightleftharpoons SO_3^{2-} + C_6H_5O\cdot$	6×10^5	11.1		p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Na_2SO_3 and 0.05 mol L^{-1} phenol; $k_r = 1.0 \times 10^7$.	84A327
32	***p*-Phenylenediamine**						
	$\dot{S}O_3^- + C_6H_4(NH_2)_2 \rightarrow SO_3^{2-} + [H_2NC_6H_4NH_2]\cdot^+$	5.0×10^7 4.2×10^6 $<5 \times 10^5$	9.3 5.25 3		p.r.	P.b.k.; pK = 3.3, 6.1.	85A103
33	**2-Propanol**						
	$\dot{S}O_3^- + (CH_3)_2CHOH \rightarrow$	$\leq 10^3$		0.1	f.p.	D.k. in N_2-satd. 0.1 mol L^{-1} $S_2O_6^{2-}$ soln.	727008

TABLE 14. Rate constants for reactions of sulfite radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
34	**Pyrogallol**						
	$\dot{S}O_3^- + C_6H_3(OH)_3 \rightarrow SO_3^{2-} +$ $(HO)(O^-)C_6H_3O\cdot + 2\ H^+$	6×10^7 1.7×10^8 2.7×10^8	9 11.5 13		p.r.	P.b.k. at 320 nm; pK_a = 9.1, 11.3.	85A255
35	**Quercetin [2-(3,4-Dihyroxyphenyl)-3,5,7-trihydroxy-1-benzopyran-4-one]**						
	$\dot{S}O_3^- + QOH \rightarrow$	2.5×10^8	11.5		p.r.	P.b.k. at 525 nm.	87A332
36	**Resorcinol**						
	$\dot{S}O_3^- + {}^-OC_6H_4O^- \rightarrow SO_3^{2-} +$ ${}^-OC_6H_4O\cdot$	2×10^7 9×10^7 1.7×10^8	9 11 12.5		p.r.	P.b.k. at 450 nm; pK_a = 9.3; 11.2.	85A255
37	***N,N,N',N'*-Tetramethyl-*p*-phenylenediamine**						
	$\dot{S}O_3^- + TMPD \rightarrow SO_3^{2-} +$ $TMPD\cdot^+$	5.2×10^8 8.2×10^6	9.5 4.5		p.r.	P.b.k.; at low pH competing process forming abs. at 455 nm may be radical-radical reaction; pK = 2.2, 6.5.	85A103
38	**2',4',5'-Trihydroxybutyrophenone**						
	$\dot{S}O_3^- +$ $(HO)_3C_6H_2COCH_2CH_2CH_3 \rightarrow$	6×10^7	10		p.r.	D.k. at 350 nm	87A332
39	**Tryptamine**						
	$\dot{S}O_3^- + TrpH \rightarrow HSO_3^- + Trp\cdot$	5.1×10^4	3.0		p.r.	P.b.k.	86A110
40	**Tryptophan**						
	$\dot{S}O_3^- + TrpH \rightarrow HSO_3^- + Trp\cdot$	8×10^4	3.0		p.r.	P.b.k.	86A110
41	**Tryptophanamide**						
	$\dot{S}O_3^- + TrpH \rightarrow HSO_3^- + Trp\cdot$	4×10^5	3.0		p.r.	P.b.k.	86A110
42	**Urate ion**						
	$\dot{S}O_3^- + UrO^- \rightarrow SO_3^{2-} + UrO\cdot$	1.2×10^8	13		p.r	P.b.k. at 360 nm.	87A220

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Sulfate radical ion**						
	$SO_4{\cdot}^- + SO_4{\cdot}^- \rightarrow S_2O_8^{2-}$	8.1×10^8	5.8		f.p.	D.k. at 435 nm (recalcd. for $\epsilon = 920$ L mol^{-1} cm^{-1}, rel. to $\epsilon_{210}(O_2{\cdot}^-) = 1798$ L mol^{-1} cm^{-1}).	78B07
		5.0×10^8	5.5	0.06	f.p.	D.k. at 455 nm in aerated sulfate soln.; recalcd. for $\epsilon_{455} = 1100$ L mol^{-1} cm^{-1}.	677012
		4.4×10^8 3.8×10^8 4.8×10^8	0.1 1.0 4.8	 0.03	f.p.	D.k. at 455 nm in aerated $S_2O_8^{2-}$ soln.; recalcd. for $\epsilon_{455} = 1100$ L mol^{-1} cm^{-1}.	677058
		1.8×10^9	<0	>1	p.r.	D.k.; 4 mol L^{-1} H_2SO_4; used $\epsilon_{450} \approx 1000$ L mol^{-1} cm^{-1} [660019].	731030
2	**Silver(I) ions**						
	$SO_4{\cdot}^- + Ag(I) \rightarrow SO_4^{2-} + Ag(II)$	3.6×10^9	<0		p.r.	D.k. at 450 nm in 2 mol L^{-1} sulfuric acid soln. contg. metal ion; $k = 2.9$, 3.0 and 2.0×10^9 in 4, 7 and 10 mol L^{-1} sulfuric acid, resp.	86A48
		1.8×10^9	<0	>1	p.r.	D.k. at 450 nm in 6 mol L^{-1} H_2SO_4.	86A27
		6.2×10^9 3.5×10^9	~5 ~5	0.01 0.1,1	p.r.	D.k. at 450 nm soln. contg. 0.01 mol L^{-1} $K_2S_2O_8$ and ~10^{-4} mol L^{-1} silver ion.	86A48
		4×10^9	~5		p.r.	D.k. in soln. contg. Ag^+ and $S_2O_8^{2-}$.	80A30
3	**Arsenite(III) ion**						
	$SO_4{\cdot}^- + AsO_2^- \rightarrow SO_4^{2-} + AsO_2$	8.0×10^8	7-8		phot.	C.k. with fumarate ion in $S_2O_8^{2-}$ soln.; effect of solute on fumarate-SO_4^- adduct obs. by esr; rel. to $k(SO_4{\cdot}^- + OH^-) = 7.3 \times 10^7$.	73D40
4	**Bromide ion**						
	$SO_4{\cdot}^- + Br^- \rightarrow SO_4^{2-} + Br{\cdot}$	3.5×10^9	7	0.03	p.r.	D.k. at 450 nm in air-satd. $S_2O_8^{2-}$ soln. contg. 0.05 mol L^{-1} *tert*-BuOH.	751069
5	**Cyanide ion**						
	$SO_4{\cdot}^- + CN^- \rightarrow$	~8×10^7	7-8		phot.	C.k. with fumarate in $S_2O_8^{2-}$ soln.; effect of solute on fumarate-SO_4^- adduct obs. by esr; rel. to $k(SO_4{\cdot}^- + OH^-) = 7.3 \times 10^7$.	73D40
6	**Cyanate ion**						
	$SO_4{\cdot}^- + OCN^- \rightarrow$	~5×10^8	7-8		phot.	C.k. with fumarate in $S_2O_8^{2-}$ soln.; effect of solute on fumarate-SO_4^- adduct obs. by esr; rel. to $k(SO_4{\cdot}^- + OH^-) = 7.3 \times 10^7$.	73D40
7	**Thiocyanate ion**						
	$SO_4{\cdot}^- + SCN^- \rightarrow SO_4^{2-} + SCN{\cdot}$	5.2×10^9	7	0.03	p.r.	D.k. at 450 nm in air-satd. $S_2O_8^{2-}$ soln. contg. 0.05 mol L^{-1} *tert*-BuOH.	751069
8	**Bicarbonate ion**						
	$SO_4{\cdot}^- + HCO_3^- \rightarrow SO_4^{2-} + H^+ + CO_3{\cdot}^-$	9.1×10^6	7.5-8.5	0.03	f.p.	D.k. at 330 nm ($SO_4{\cdot}^-$) as well as p.b.k. at 600 nm ($CO_3{\cdot}^-$) in aerated 10^{-2} mol L^{-1} $S_2O_8^{2-}$ soln.	677058
9	**Cerium(III) ions**						
	$SO_4{\cdot}^- + Ce(III) \rightarrow SO_4^{2-} + Ce(IV)$	1.3×10^8	<0		p.r.	D.k. at 450 nm in 2 mol L^{-1} sulfuric acid soln. contg. metal ion; $k = 1.8$, 1.7 and 1.5×10^8 in 5, 7 and 10 mol L^{-1} sulfuric acid, resp.	86A480
		1.6×10^8	−0.4		phot.	Ce(IV) in 0.4 mol L^{-1} H_2SO_4	84F565

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
9	**Cerium(III) ions**—Continued						
		5×10^7	<0	>1	γ-r.	Air-satd. soln. contains Ce^{IV}, Ce^{III}, 4 mol L^{-1} H_2SO_4 and formic acid; ratios calcd. from assumed mechanism	720094
		1.4×10^8	~0	>1	f.p.	D.k. at 455 nm; 1 mol L^{-1} H_2SO_4; Ce^{III} produced from ceric sulfate.	677274
10	**Chloride ion**						
	$SO_4{\cdot}^- + Cl^- \rightarrow SO_4^{2-} + Cl{\cdot}$	2.0×10^8	1.4	0.2	p.r.	D.k. at 480 nm; $[Ir(Hbpy\text{-}C^3,N')(bpy)_2]^{4+}$-$S_2O_8^{2-}$-$Cl^-$ soln.	86A057
		1.3×10^8			p.r.	P.b.k. ($Cl_2{\cdot}^-$) in 0.002 mol L^{-1} $S_2O_8^{2-}$; $k = 4.1 \times 10^8$ in 2 mol L^{-1} SO_4^{2-} soln.	761141
		3.1×10^8	6.8		p.r.	D.k. at 480 nm; soln. contains $S_2O_8^{2-}$, *tert*-BuOH and phosphate buffer.	755244
11	**Cobalt(II) ion**						
	$SO_4{\cdot}^- + Co^{2+} \rightarrow SO_4^{2-} + Co^{3+}$	2.0×10^6	<0	>1	p.r.	D.k. at 450 nm in 6 mol L^{-1} sulfuric acid.	86A278
12	**Chromium(II) ion**						
	$SO_4{\cdot}^- + Cr^{2+} \rightarrow SO_4^{2-} + Cr^{3+}$	$>1 \times 10^9$	1.0	1.0	therm.	Estimated from competition of Br^- for $SO_4{\cdot}^-$ in peroxodisulfate oxidation of Cr(II) by two one-electron steps; fast flow.	68M084
13	**Iron(II) ion**						
	$SO_4{\cdot}^- + Fe^{2+} \rightarrow SO_4^{2-} + Fe^{3+}$	9.9×10^8		1	p.r.	D.k. at 450 nm in soln. contg. 1 mol L^{-1} $KHSO_4$.	660019
14	**Manganese(II) ions**						
	$SO_4{\cdot}^- + Mn(II) \rightarrow SO_4^{2-} + Mn(III)$	2.0×10^7	<0		p.r.	D.k. at 450 nm in 2 mol L^{-1} sulfuric acid soln. contg. metal ion; k = 1.3 and 1.5×10^7 in 5 and 10 mol L^{-1} sulfuric acid, resp.	86A480
		2.0×10^7	<0	>1	p.r.	D.k. at 450 nm in 6 mol L^{-1} sulfuric acid.	86A278
15	**Azide ion**						
	$SO_4{\cdot}^- + N_3^- \rightarrow SO_4^{2-} + {\cdot}N_3$	$\sim 3 \times 10^9$	7		p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$.	78A075
16	**Ammonia**						
	$SO_4{\cdot}^- + NH_3 \rightarrow SO_4^{2-} + {\cdot}NH_2 + H^+$	1.4×10^7	9.2		p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$.	78A218
17	**Ammonium ion/Ammonia**						
	$SO_4{\cdot}^- + NH_4^+/NH_3 \rightarrow$	3×10^5	7.0		p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$.	78A218
18	**Hydrazine**						
	$SO_4{\cdot}^- + H_2NNH_2 \rightarrow$	8.1×10^8	9.5		p.r.	D.k. at 450 nm in $S_2O_8^{2-}$ soln.	78A075
	$SO_4{\cdot}^- + H_2NNH_3^+ \rightarrow$	2.1×10^8	4				
19	**Hydroxylamine**						
	$SO_4{\cdot}^- + NH_2OH \rightarrow$	8.5×10^8	8.2		p.r.	D.k. at 450 nm in $S_2O_8^{2-}$ soln.	78A075
	$SO_4{\cdot}^- + NH_3OH^+ \rightarrow$	1.5×10^7	4.1				
20	**Nitrite ion**						
	$SO_4{\cdot}^- + NO_2^- \rightarrow SO_4^{2-} + {\cdot}NO_2$	8.8×10^8	7		p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$.	78A075

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
21	**Nitric acid**						
	$SO_4{\cdot}^- + HNO_3 \rightarrow SO_4^{2-} + NO_3{\cdot} + H^+$	5.5×10^5	<0	>1	p.r.	P.b.k. in 6 mol L^{-1} sulfuric acid.	86A27
22	**Nitrate ion**						
	$SO_4{\cdot}^- + NO_3^- \rightarrow SO_4^{2-} + NO_3{\cdot}$	2.1×10^6	7-8		phot.	C.k. with fumarate in $S_2O_8^-$ soln.; effect of solute on fumarate-SO_4^- adduct obs. by esr; rel. to $k(SO_4{\cdot}^- + OH^-) = 7.3 \times 10^7$.	73D4(
		3.6×10^5	9		phot.	C.k. with RNO in air-satd. $S_2O_8^{2-}$ soln.	70723
23	**Nickel(II) ion**						
	$SO_4{\cdot}^- + Ni^{2+} \rightarrow$	$<5 \times 10^4$	<0	>1	p.r.	D.k. at 450 nm in 6 mol L^{-1} sulfuric acid.	86A27
24	**Dioxoneptunium(V) ion**						
	$SO_4{\cdot}^- + NpO_2^+ \rightarrow SO_4^{2-} + NpO_2^{2+}$	7×10^8	~0		p.r.	D.k. at 450 nm in soln. contg. 2 mol L^{-1} H_2SO_4.	86A37
25	**Hydroxide ion**						
	$SO_4{\cdot}^- + OH^- \rightarrow SO_4^{2-} + {\cdot}OH$	8.3×10^7	>11	0.06-0.08	p.r.	C.k.; effect of pH on formn. of tyrosine transient at 410 nm; rel. to $k(SO_4{\cdot}^- + TyrOH) = 3.2 \times 10^9$.	75106
		7.3×10^7	alk.		p.r.	D.k. at 450 nm; soln. contains $S_2O_8^{2-}$ and *tert*-BuOH	75524
		6.5×10^7	alk.		p.r.	D.k. vs. OH^- concn. in O_2-free $S_2O_8^{2-}$ soln.	72700
		4.6×10^7	>11		p.r.	D.k. at 460 nm; soln. contains $S_2O_8^{2-}$.	69015
26	**Water**						
	$SO_4{\cdot}^- + H_2O \rightarrow SO_4^{2-} + {\cdot}OH + H^+$	$<6 \times 10^1$	7		p.r.	Extrapolated from d.k. vs. OH^- concn.	72700
27	**Hydrogen peroxide**						
	$SO_4{\cdot}^- + H_2O_2 \rightarrow SO_4^{2-} + HO_2{\cdot} + H^+$	1.2×10^7	7		p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$.	78A07
28	**Phosphinic acid, ion(1-)**						
	$SO_4{\cdot}^- + H_2PO_2^- \rightarrow SO_4^{2-} + H^+ + HPO_2^-$	1.8×10^8	7		p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$.	78A07
29	**Hydrogen phosphite ion**						
	$SO_4{\cdot}^- + HPO_3^{2-} \rightarrow SO_4^{2-} + H^+ + \dot{P}O_3^{2-}$	6.2×10^7	8.3		p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$.	78A07
30	**Dihydrogen phosphite ion**						
	$SO_4{\cdot}^- + H_2PO_3^- \rightarrow SO_4^{2-} + H_2\dot{P}O_3$	1.6×10^7	4		p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$ and $H_2PO_3^-$.	78A07
31	**Hydrogen phosphate ion**						
	$SO_4{\cdot}^- + HPO_4^{2-} \rightarrow SO_4^{2-} + HPO_4{\cdot}^-$	1.2×10^6	9		p.r.	P.b.k. at 560 nm in soln. contg. $S_2O_8^{2-}$ and HPO_4^{2-}.	78A07
32	**Dihydrogen phosphate ion**						
	$SO_4{\cdot}^- + H_2PO_4^- \rightarrow$	$<7 \times 10^4$	7		p.r.	No reaction obs.	78A07
33	**Bisulfite/sulfite ion**						
	$SO_4{\cdot}^- + HSO_3^-/SO_3^{2-} \rightarrow SO_4^{2-} + \dot{S}O_3^- (+ H^+)$	$>2 \times 10^9$			p.r.	Suggested by comparison to $NO_3{\cdot}$ and ${\cdot}OH$ rate constants.	86A27

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
33	**Bisulfite/sulfite ion**—Continued						
		$>5 \times 10^8$			f.p.	D.k. in $S_2O_8^{2-}$ soln.; suggested that reaction with HSO_3^- is higher than SO_3^{2-} by a factor of 2.5.	727008
34	**Peroxodisulfate ion**						
	$SO_4^{\cdot-} + S_2O_8^{2-} \rightarrow SO_4^{2-} + S_2O_8^{-}$	1.2×10^6			p.r.	P.b.k. in Ar-satd. soln. contg. 0.1 mol L^{-1} $K_2S_2O_8$.	87A134
35	**Hydrogen peroxomonosulfate ion**						
	$SO_4^{\cdot-} + HSO_5^- \rightarrow$	$<1 \times 10^5$			p.r.	D.k. at 450 nm in $S_2O_8^{2-}$ soln.	771047
36	**Antimony(III) ions**						
	$SO_4^{\cdot-}$ + Sb(III) $\rightarrow SO_4^{2-}$ + Sb(IV)	8.0×10^8	<0		p.r.	D.k. at 450 nm in 3 or 5 mol L^{-1} sulfuric acid soln. contg. metal ion.	86A480
37	**Silicate ion**						
	$SO_4^{\cdot-} + SiO_3^{2-} \rightarrow SO_4^{2-} + SiO_3^{\cdot-}$	2×10^7			f.p.	P.b.k. at 625 nm.	707262
38	**Thallium(I) ion**						
	$SO_4^{\cdot-} + Tl^+ \rightarrow SO_4^{2-} + Tl^{2+}$	1.7×10^9		>1	f.p.	D.k. at 455 nm; soln. contains ceric sulfate and 1 mol L^{-1} H_2SO_4.	677274
39	**Uranium(IV) ions**						
	$SO_4^{\cdot-}$ + U(IV) $\rightarrow SO_4^{2-}$ + U(V)	8.0×10^7	<0		p.r.	D.k. at 450 nm in 2 mol L^{-1} sulfuric acid soln. contg. metal ion; k = 7.0 and 8.0×10^7 in 3.5 and 5 mol L^{-1} sulfuric acid, resp.	86A480
40	**Vanadium(III) ions**						
	$SO_4^{\cdot-}$ + V(III) $\rightarrow SO_4^{2-}$ + V(IV)	1.3×10^8	<0		p.r.	D.k. at 450 nm in 2 mol L^{-1} sulfuric acid soln. contg. metal ion; k = 1.6 and 1.9×10^8 in 5 and 10 mol L^{-1} sulfuric acid, resp.	86A480
		4.5×10^7	<0	>1	p.r.	D.k. at 450 nm in 6 mol L^{-1} sulfuric acid.	86A278
41	**Vanadium(IV) ions**						
	$SO_4^{\cdot-}$ + V(IV) $\rightarrow SO_4^{2-}$ + V(V)	3.3×10^7	<0		p.r.	D.k. at 450 nm in 2 mol L^{-1} sulfuric acid soln. contg. metal ion; k = 6.6, 9.0 and 36×10^7 in 3, 5 and 7 mol L^{-1} sulfuric acid, resp.	86A480
42	**Acetanilide**						
	$SO_4^{\cdot-} + C_6H_5NHCOCH_3 \rightarrow SO_4^{2-} + [C_6H_5NHCOCH_3]^{\cdot+}$	3.6×10^9	7		p.r.	D.k. at 450 nm; soln. contains 0.01-0.05 mol L^{-1} $S_2O_8^{2-}$.	771001
43	**Acetate ion**						
	$SO_4^{\cdot-} + CH_3CO_2^- \rightarrow SO_4^{2-} + {\cdot}CH_3 + CO_2$ (+ ${\cdot}CH_2CO_2^-$)	5.0×10^6	6.8		p.r.	D.k. at 450 nm; soln. contains $S_2O_8^{2-}$, *tert*-BuOH, and phosphate buffer; predominantly methyl radical formn; CO_2 yield meas. by γ-r.[78G168]	755244
44	**Acetic acid**						
	$SO_4^{\cdot-} + CH_3CO_2H \rightarrow HSO_4^- + {\cdot}CH_3 + CO_2$ (+ ${\cdot}CH_2CO_2H$)	8.8×10^4	~0	>1	p.r.	D.k. at 455 nm; soln. contains ceric sulfate and 1 mol L^{-1} H_2SO_4.	677274
45	**Acetophenone**						
	$SO_4^{\cdot-} + C_6H_5COCH_3 \rightarrow SO_4^{2-} + [C_6H_5COCH_3]^{\cdot+}$	3.1×10^8	7	0.03	p.r.	D.k. at 450 nm in ~ 10^{-2} mol L^{-1} $S_2O_8^{2-}$ soln.	771001

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
46	**4-Acetylbenzoate ion**						
	$SO_4{\cdot}^- + CH_3COC_6H_4CO_2^- \rightarrow SO_4^{2-} + [CH_3COC_6H_4CO_2]\cdot$	2.0×10^8	7	0.03	p.r.	D.k. at 450 nm in $\sim 10^{-2}$ mol L^{-1} $S_2O_8^{2-}$ soln.	77100
47	**Acrylamide**						
	$SO_4{\cdot}^- + H_2C{=}CHCONH_2 \rightarrow$	1.6×10^8	7.3		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A24
		$\sim 2 \times 10^8$			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3{\cdot}^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A23
48	**Acrylate ion**						
	$SO_4{\cdot}^- + CH_2{=}CHCO_2^- \rightarrow$	1.1×10^8	6.5		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A24
		$\sim 2 \times 10^8$			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3{\cdot}^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A23
49	**Acrylonitrile**						
	$SO_4{\cdot}^- + H_2C{=}CHCN \rightarrow SO_4^{2-} + HOCH_2\dot{C}HCN + H^+$	8.1×10^7	7.4		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A24
		4.6×10^7			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3{\cdot}^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A23
		1.7×10^8	~ 7		p.r.	Soln. contains $S_2O_8^{2-}$; product obs. by absorption spectrum.	690158
49a	**Adenine**						
	$SO_4{\cdot}^- + A \rightarrow SO_4^{2-} + [A]{\cdot}^+$	4.6×10^9	6-7		p.r.	P.b.k. at 350 nm	87A36
49b	**Adenosine**						
	$SO_4{\cdot}^- + A \rightarrow SO_4^{2-} + [A]{\cdot}^+$	2.7×10^9	6-7		p.r.	P.b.k. at 350 nm	87A36
50	**Alanine**						
	$SO_4{\cdot}^- + Ala \rightarrow$	1.0×10^7	7	0.03	p.r.	D.k. at 450 nm in $S_2O_8^{2-}$ soln.	751061
51	**Allyl alcohol**						
	$SO_4{\cdot}^- + H_2C{=}CHCH_2OH \rightarrow$	1.5×10^9	6.8		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A24
52	**Allyl cyanide**						
	$SO_4{\cdot}^- + H_2C{=}CHCH_2CN \rightarrow$	1.1×10^9	7.0		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A24
53	**Anisole**						
	$SO_4{\cdot}^- + C_6H_5OCH_3 \rightarrow SO_4^{2-} + [C_6H_5OCH_3]{\cdot}^+$	4.9×10^9			p.r.	P.b.k.; product ident. by esr.	751171
54	**Benzamide**						
	$SO_4{\cdot}^- + C_6H_5CONH_2 \rightarrow SO_4^{2-} + [C_6H_5CONH_2]{\cdot}^+$	1.9×10^8	7	0.03	p.r.	D.k. at 450 nm in $\sim 10^{-2}$ mol L^{-1} $S_2O_8^{2-}$ soln.	771001
55	**Benzene**						
	$SO_4{\cdot}^- + C_6H_6 \rightarrow SO_4^{2-} + [C_6H_6]{\cdot}^+$	$\sim 3 \times 10^9$	7	0.03	p.r.	D.k. at 450 nm in $S_2O_8^{2-}$ soln. contg. 0.1 mol L^{-1} *tert*-BuOH; also p.b.k. at 315 nm [761187].	771001
		8×10^8	~7		p.r.	D.k. at 460 nm in soln. contg. $S_2O_8^{2-}$.	690158
56	**1,2,4,5-Benzenetetracarboxylate ion**						
	$SO_4{\cdot}^- + C_6H_2(CO_2)_4^{4-} \rightarrow SO_4^{2-} + [C_6H_2(CO_2)_4]{\cdot}^{3-}$	1.7×10^7	9		p.r.	D.k. at 450 nm; $S_2O_8^{2-}$ soln.	761187
57	**1,3,5-Benzenetricarboxylate ion**						
	$SO_4{\cdot}^- + C_6H_3(CO_2)_3^{3-} \rightarrow SO_4^{2-} + [C_6H_3(CO_2)_3]{\cdot}^{2-}$	8.3×10^7	9		p.r.	D.k. at 450 nm.	761187

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
58	**Benzoate ion**						
	$SO_4^{\cdot-} + C_6H_5CO_2^- \rightarrow SO_4^{2-} + [C_6H_5CO_2]^{\cdot}$	1.2×10^9	7	0.03	p.r.	D.k. at 450 nm in ~ 10^{-2} mol L^{-1} $S_2O_8^{2-}$ soln.; CO_2 yield in γ-r. suggests 56% phenyl radical formn. [78G168] Absorption of OH adduct in p.r. suggests 20% OH adduct formn. [78B101].	771001
59	**Benzonitrile**						
	$SO_4^{\cdot-} + C_6H_5CN \rightarrow SO_4^{2-} + [C_6H_5CN]^{\cdot+}$	1.2×10^8	7	0.03	p.r.	D.k. at 450 nm in ~ 10^{-2} mol L^{-1} $S_2O_8^{2-}$ soln.	771001
60	**1,4-Benzoquinone**						
	$SO_4^{\cdot-} + Q\ (+ H_2O) \rightarrow HSO_4^- + Q(OH)^{\cdot}$	1×10^8			γ-r.	C.k.; obs. product yields in 1 mol L^{-1} H_2SO_4 soln. contg. 1.5×10^{-4} mol L^{-1} benzoquinone and 2-PrOH.	86G031
61	**Benzyl methyl ether**						
	$SO_4^{\cdot-} + C_6H_5CH_2OCH_3 \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8^{2-}$-alcohol soln.; obs. C_6H_5CHO yield; $k/k(SO_4^{\cdot-} + \text{2-PrOH}) = 18$.	749006
62	**2-Bromobenzoate ion**						
	$SO_4^{\cdot-} + BrC_6H_4CO_2^- \rightarrow SO_4^{2-} + [BrC_6H_4CO_2]^{\cdot}$	8.7×10^8	7	0.03	p.r.	D.k. at 450 nm in ~ 10^{-2} mol L^{-1} $S_2O_8^{2-}$ soln.; Br^- and CO_2 yields meas. on γ-r. indicate ~ 16% phenoxyl radical formn. and ~ 10% phenyl radical formn [78G168]	771001
63	**4-Bromobenzoate ion**						
	$SO_4^{\cdot-} + BrC_6H_4CO_2^- \rightarrow SO_4^{2-} + [BrC_6H_4CO_2]^{\cdot}$	1.0×10^9	7	0.03	p.r.	D.k. at 450 nm in ~ 10^{-2} mol L^{-1} $S_2O_8^{2-}$ soln.; Br^- and CO_2 yields meas. on γ-r. indicate ~ 30% debromination and ~ 40% decarboxylation; see [78G168]	771001
64	**Butyl acrylate**						
	$SO_4^{\cdot-} + CH_2{=}CHCOO(CH_2)_3CH_3 \rightarrow$	$\sim 2 \times 10^8$			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3^{\cdot-}$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
65	**4-Chlorobenzoate ion**						
	$SO_4^{\cdot-} + ClC_6H_4CO_2^- \rightarrow SO_4^{2-} + [ClC_6H_4CO_2]^{\cdot}$	3.6×10^8	7	0.03	p.r.	D.k. at 450 nm in ~ 10^{-2} mol L^{-1} $S_2O_8^{2-}$ soln.; CO_2 yield meas. on γ-r. indicates ~ 40% decarboxylation [78G168].	771001
66	**Crotonic acid**						
	$SO_4^{\cdot-} + CH_3CH{=}CHCO_2H \rightarrow$	7.7×10^8	4.8		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A240
67	**4-Cyanobenzoate ion**						
	$SO_4^{\cdot-} + NCC_6H_4CO_2^- \rightarrow SO_4^{2-} + [NCC_6H_4CO_2]^{\cdot}$	3.3×10^7	4.8	0.03	p.r.	D.k. at 450 nm in ~ 10^{-2} mol L^{-1} $S_2O_8^{2-}$ soln.; CO_2 yield meas. on γ-r. indicates ~ 30% decarboxylation [78G168].	771001
68	**Cycloheptanol**						
	$SO_4^{\cdot-} + \text{-}(CH_2)_5CHOHCH_2\text{-} \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8^{2-}$-alcohol soln.; obs. ketone formn.; for 1-d-cycloheptanol ratio = 1.5.	749006
69	**Cycloheptanol-d_1**						
	$SO_4^{\cdot-} + \text{-}(CH_2)_5CDOHCH_2\text{-} \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8^{2-}$-alcohol soln.; obs. ketone formn.;	749006

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
70	**Cyclohexene**						
	$SO_4^{\cdot-}$ + c-C_6H_{10} → SO_4^{2-} + $\underline{C}HCHOH(CH_2)\underline{C}H_2$ + H^+	4×10^8	~ 7		p.r.	Soln. contains $S_2O_8^{2-}$; product obs. by absorption spectrum.	690158
71	**Cytosine**						
	$SO_4^{\cdot-}$ + Cy^- → SO_4^{2-} + Cy·	7.5×10^8	11		p.r.	D.k.	83A132
71a	**2'-Deoxyadenosine**						
	$SO_4^{\cdot-}$ + dA → SO_4^{2-} + $dA^{\cdot+}$	3.7×10^8	7.0		p.r.	C.k. in soln. contg. 0.1-0.2 mol L^{-1} *tert*-BuOH and 1-2 × 10^{-2} mol L^{-1} $K_2S_2O_8$; rel. to $k(SO_4^{\cdot-}$ + TMB) = 2.4×10^9	87A337
71b	**2'-Deoxycytosine**						
	$SO_4^{\cdot-}$ + dC → SO_4^{2-} + $dC^{\cdot+}$	2.5×10^8	7.0		p.r.	C.k. in soln. contg. 0.1-0.2 mol L^{-1} *tert*-BuOH and 1-2 × 10^{-2} mol L^{-1} $K_2S_2O_8$; rel. to $k(SO_4^{\cdot-}$ + TMB) = 2.4×10^9	87A337
71c	**2'-Deoxyguanosine**						
	$SO_4^{\cdot-}$ + dG → SO_4^{2-} + $dG^{\cdot+}$	2.3×10^9	7.0		p.r.	C.k. in soln. contg. 0.1-0.2 mol L^{-1} *tert*-BuOH and 1-2 × 10^{-2} mol L^{-1} $K_2S_2O_8$; rel. to $k(SO_4^{\cdot-}$ + TMB) = 2.4×10^9	87A337
71d	**2-Deoxy-D-ribose**						
	$SO_4^{\cdot-}$ + deoxyribose →	3.8×10^7	7.0		p.r.	C.k. in soln. contg. 0.1-0.2 mol L^{-1} *tert*-BuOH and 1-2 × 10^{-2} mol L^{-1} $K_2S_2O_8$; rel. to $k(SO_4^{\cdot-}$ + TMB) = 2.4×10^9	87A337
72	**Diethyl disulfide**						
	$SO_4^{\cdot-}$ + $C_2H_5SSC_2H_5$ → SO_4^{2-} + $[C_2H_5SSC_2H_5]^{\cdot+}$	3×10^8	~ 4.5	0.3	p.r.	D.k. at 300 nm in Ar-satd. 0.1 mol L^{-1} $S_2O_8^{2-}$ soln.	761143
73	**1,2-Dimethoxybenzene**						
	$SO_4^{\cdot-}$ + $C_6H_4(OCH_3)_2$ → SO_4^{2-} + $[C_6H_4(OCH_3)_2]^{\cdot+}$	5.0×10^9		0.003	p.r.	P.b.k.; product ident. by esr and absorption spectra.	751171
74	**1,3-Dimethoxybenzene**						
	$SO_4^{\cdot-}$ + $C_6H_4(OCH_3)_2$ → SO_4^{2-} + $[C_6H_4(OCH_3)_2]^{\cdot+}$	7.0×10^9		0.003	p.r.	P.b.k.; product ident. by esr and absorption spectra.	751171
75	**1,4-Dimethoxybenzene**						
	$SO_4^{\cdot-}$ + $C_6H_4(OCH_3)_2$ → SO_4^{2-} + $[C_6H_4(OCH_3)_2]^{\cdot+}$	7.2×10^9		0.003	p.r.	P.b.k.; product ident. by esr and absorption spectra.	751171
76	**2,3-Dimethoxybenzoate ion**						
	$SO_4^{\cdot-}$ + $(CH_3O)_2C_6H_3CO_2^-$ → SO_4^{2-} + $[(CH_3O)_2C_6H_3CO_2]^{\cdot}$	8.5×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
77	**2,4-Dimethoxybenzoate ion**						
	$SO_4^{\cdot-}$ + $(CH_3O)_2C_6H_3CO_2^-$ → SO_4^{2-} + $[(CH_3O)_2C_6H_3CO_2]^{\cdot}$	3.8×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
78	**2,6-Dimethoxybenzoate ion**						
	$SO_4^{\cdot-}$ + $(CH_3O)_2C_6H_3CO_2^-$ → SO_4^{2-} + $[(CH_3O)_2C_6H_3CO_2]^{\cdot}$	2.5×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
79	**3,4-Dimethoxybenzoate ion**						
	$SO_4^{\cdot-}$ + $(CH_3O)_2C_6H_3CO_2^-$ → SO_4^{2-} + $[(CH_3O)_2C_6H_3CO_2]^{\cdot}$	4.5×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
80	**3,5-Dimethoxybenzoate ion**						
	$SO_4{\cdot}^- + (CH_3O)_2C_6H_3CO_2^- \rightarrow SO_4^{2-} + [(CH_3O)_2C_6H_3CO_2]{\cdot}$	4.4×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
80a	**N^6,N^6-Dimethyladenosine**						
	$SO_4{\cdot}^- + DMA \rightarrow SO_4^{2-} + [DMA]{\cdot}^+$	3.9×10^9	6-7		p.r.	P.b.k. at 350 nm	87A362
81	**Dimethyl disulfide**						
	$SO_4{\cdot}^- + CH_3SSCH_3 \rightarrow SO_4^{2-} + [CH_3SSCH_3]{\cdot}^+$	5×10^8	~ 4.5	0.3	p.r.	D.k. at 300 nm in Ar-satd. 0.1 mol L^{-1} $S_2O_8^{2-}$ soln.	761143
82	**N,N-Dimethyl-4-nitrosoaniline (RNO)**						
	$SO_4{\cdot}^- + Me_2NC_6H_4NO \rightarrow SO_4^{2-} + [Me_2NC_6H_4NO]{\cdot}^+$	5.9×10^8	7		phot.	C.k.; air-satd. $S_2O_8^{2-}$ soln.	707234
83	**1,3-Dimethyluracil**						
	$SO_4{\cdot}^- + DMU \rightarrow SO_4^{2-} + [DMU]{\cdot}^+$	5.5×10^9			p.r.	D.k. at 500 nm in soln. contg. $S_2O_8^{2-}$ and 2.7-25 × 10^{-5} mol L^{-1} 1,3-dimethyluracil.	87A134
84	**1,4-Dioxane**						
	$SO_4{\cdot}^- + O(CH_2)_2OCH_2CH_2 \rightarrow SO_4^{2-} + O\dot{C}HCH_2OCH_2CH_2 + H^+$	1.6×10^7	7-8	0.003	p.r.	C.k.; obs. buildup of $[TMB]{\cdot}^+$; $k_H/k_D = 1.7$; rel. to $k(SO_4{\cdot}^- + TMB) = 2.6 \times 10^9$.	78A076
85	**Ethanol**						
	$SO_4{\cdot}^- + C_2H_5OH \rightarrow SO_4^{2-} + CH_3\dot{C}HOH + H^+$	1.6×10^7	7-8	0.003	p.r.	C.k., obs. buildup of $[TMB]{\cdot}^+$; $k_H/k_D = 2.4$; rel. to $k(SO_4{\cdot}^- + TMB) = 2.6 \times 10^9$.	78A076
		7.7×10^7	4.8	0.03	f.p.	D.k. in aerated 10^{-2} mol L^{-1} $K_2S_2O_8$ soln.; at pH 1.0 $k = 6.2 \times 10^7$.	677058
		3.4×10^7		>1	f.p.	D.k. at 455 nm in ceric sulfate and 1 mol L^{-1} H_2SO_4 soln.	677274
		3×10^7		1	p.r.	D.k. at 450 nm; HSO_4^- soln.	660019
86	**Ethyl acrylate**						
	$SO_4{\cdot}^- + H_2C{=}CHCO_2C_2H_5 \rightarrow$	~2×10^8			f.p.	C.k.; obs. quenching of 600 nm abs. $(CO_3{\cdot}^-)$ in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
87	**1-(p-Ethylphenyl)ethanol**						
	$SO_4{\cdot}^- + C_2H_5C_6H_4CHOHCH_3 \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8^{2-}$-alcohol soln.; obs. ketone formation.	749006
88	**Formate ion**						
	$SO_4{\cdot}^- + HCO_2^- \rightarrow SO_4^{2-} + {\cdot}CO_2^- + H^+$	1.7×10^8	7	0.03	p.r.	D.k.; $S_2O_8^{2-}$ soln.	751069
89	**Formic acid**						
	$SO_4{\cdot}^- + HCO_2H \rightarrow SO_4^{2-} + {\cdot}CO_2H + H^+$	1.4×10^6	~0	>1	f.p.	D.k. at 455 nm in ceric sulfate and 1 mol L^{-1} H_2SO_4 soln.	677274
90	**Fumarate ion**						
	$SO_4{\cdot}^- + {}^-O_2CCH{=}CHCO_2^- \rightarrow CO_2 + {\cdot}CH{=}CHCO_2^- + {}^-O_2C\dot{C}HCH(OSO_3^-)CO_2^-SO_4^-$	1.6×10^7	7		p.r.	D.k. at 450 nm; 50% decarboxylation was determined from $G(CO_2)$ by γ-r. [78G168]; adduct obs. by esr [755244].	771106
91	**Glycine**						
	$SO_4{\cdot}^- + Gly \rightarrow$	9×10^6	7		p.r.	D.k. in $S_2O_8^{2-}$ soln.	751069

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
92	**Histidine**						
	$SO_4{\cdot}^- + His \rightarrow$	$\sim 2.5 \times 10^9$	7	0.03	p.r.	D.k. in $S_2O_8^{2-}$ soln.	751069
93	**Homophthalate ion**						
	$SO_4{\cdot}^- + (^-O_2C)C_6H_4CH_2CO_2^- \rightarrow SO_4^{2-} + CO_2 + \dot{C}H_2C_6H_4CO_2^-$	1.1×10^9	7		p.r.	D.k. at 450 nm as well as p.b.k. at 328 nm ($ArCH_2\cdot$) in $S_2O_8^{2-}$ soln.; CO_2 yield meas. by γ-r. [78G168] and absorption of $ArCH_2$ radical by p.r. [78B101] indicate predominant decarboxylation from side chain.	761187
94	**Hydrocinnamic acid**						
	$SO_4{\cdot}^- + C_6H_5CH_2CH_2CO_2H \rightarrow SO_4^{2-} + C_6H_5CH_2\dot{C}H_2 + CO_2 + H^+$	1.6×10^9	5-7		p.r.	D.k. at 450 nm in soln. contg. 0.1 mol L^{-1} *tert*-BuOH and 5×10^{-2} mol L^{-1} $S_2O_8^{2-}$.	81A236
95	**4-Hydroxybenzoate ion**						
	$SO_4{\cdot}^- + HOC_6H_4CO_2^- \rightarrow SO_4^{2-} + {}^-O_2CC_6H_4O\cdot + H^+$	2.5×10^9	7		p.r.	D.k. in $S_2O_8^{2-}$ soln.	771001
96	**Isobutyl methacrylate**						
	$SO_4{\cdot}^- + CH_2{=}C(CH_3)COOCH_2CH(CH_3)_2 \rightarrow$	$\sim 1 \times 10^9$			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3{\cdot}^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
97	**Isopropenyl acetate**						
	$SO_4{\cdot}^- + CH_3CO_2C(CH_3){=}CH_2 \rightarrow$	1.5×10^9			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3{\cdot}^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
98	**Lumiflavine**						
	$SO_4{\cdot}^- + LF \rightarrow$	7×10^9	7		p.r.	D.k. at 450 nm and/or p.b.k. at 640 nm; N_2-satd. soln. contg. 0.005 mol L^{-1} $K_2S_2O_8$, 0.005 mol L^{-1} *tert*-BuOH and 3×10^{-5} mol L^{-1} lumiflavin.	86A457
99	**Maleic hydrazide**						
	$SO_4{\cdot}^- + MH_2 \rightarrow$		2		p.r.	No reaction	83A165
100	**Malonate ion**						
	$SO_4{\cdot}^- + CH_2(CO_2^-)_2 \rightarrow SO_4^{2-} + CO_2 + \cdot CH_2CO_2^-$	5.5×10^6	7		p.r.	D.k. at 450 nm; radical obs. by esr; CO_2 yield meas. by γ-r. [78G168].	771106
101	**Methacrylate ion**						
	$SO_4{\cdot}^- + CH_2{=}C(CH_3)CO_2^- \rightarrow$	7.0×10^8	6.9		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A240
		$\sim 6 \times 10^8$			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3{\cdot}^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
102	**Methacrylic acid**						
	$SO_4{\cdot}^- + H_2C{=}C(CH_3)CO_2H \rightarrow$	1.1×10^9	2.9		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A240
103	**Methacrylonitrile**						
	$SO_4{\cdot}^- + H_2C{=}C(CH_3)CN \rightarrow$	3.8×10^8	7		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A240
		$\sim 4 \times 10^8$			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3{\cdot}^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
104	**Methanol**						
	$SO_4{\cdot}^- + CH_3OH \rightarrow SO_4^{2-} + \cdot CH_2OH + H^+$	3.2×10^6	7-8	0.003	p.r.	C.k.; obs. buildup of $[TMB]{\cdot}^+$; $k_H/k_D = 2.7$; rel. to $k(SO_4{\cdot}^- + TMB) = 2.6 \times 10^9$.	78A076
		1.1×10^7	7	0.03	p.r.	D.k. in $S_2O_8^{2-}$ soln.	751069

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
104	**Methanol**—Continued						
		2.0×10^6	9		phot.	C.k. with RNO in air-satd. $S_2O_8^{2-}$ soln.	707234
		2.5×10^7	1, 4.8	0.03	f.p.	D.k. in aerated 10^{-2} mol L^{-1} $K_2S_2O_8$ soln..	677058
		1.1×10^7		>1	f.p.	D.k. at 455 nm in ceric sulfate and 1 mol L^{-1} H_2SO_4 soln.	677274
		2×10^7		1	p.r.	D.k. at 450 nm.	660019
105	**Methionine**						
	$SO_4\cdot^- + Met \rightarrow SO_4^{2-} + Met\cdot^+$	1.1×10^9	7	0.03	p.r.	D.k. in $S_2O_8^{2-}$ soln.	751069
106	**2-Methoxybenzoate ion**						
	$SO_4\cdot^- + CH_3OC_6H_4CO_2^- \rightarrow SO_4^{2-} + [CH_3OC_6H_4CO_2]\cdot$	7.0×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
107	**3-Methoxybenzoate ion**						
	$SO_4\cdot^- + CH_3OC_6H_4CO_2^- \rightarrow SO_4^{2-} + [CH_3OC_6H_4CO_2]\cdot$	7.6×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
108	**4-Methoxybenzoate ion**						
	$SO_4\cdot^- + CH_3OC_6H_4CO_2^- \rightarrow SO_4^{2-} + [CH_3OC_6H_4CO_2]\cdot$	3.5×10^9	7		p.r.	P.b.k. at 560 nm (cation radical) in $S_2O_8^{2-}$ soln.	771001
		7.6×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
109	**1-Methoxy-2-methyl-1-phenylpropane**						
	$SO_4\cdot^- + C_6H_5CH(OCH_3)CH(CH_3)_2 \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8^{2-}$-alcohol soln.; obs. benzaldehyde and isopropyl phenyl ketone formn.	749006
110	**Methyl acrylate**						
	$SO_4\cdot^- + H_2C{=}CHCO_2CH_3 \rightarrow$	5.7×10^7			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3\cdot^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
110a	**9-Methyladenine**						
	$SO_4\cdot^- + MA \rightarrow SO_4^{2-} + [MA]\cdot^+$	4.1×10^9	6-7		p.r.	P.b.k. at 350 nm	87A362
111	**3-Methyllumiflavine**						
	$SO_4\cdot^- + F \rightarrow$	8×10^9	3.8, 7.7		p.r.	D.k. at 450 nm and/or p.b.k. at 690 nm; N_2-satd. soln. contg. 0.005 mol L^{-1} $K_2S_2O_8$, 0.005 mol L^{-1} *tert*-BuOH and 3×10^{-5} mol L^{-1} lumiflavin.	86A457
112	**Methyl methacrylate**						
	$SO_4\cdot^- + H_2C{=}C(CH_3)CO_2CH_3 \rightarrow$	1.0×10^9	7.3		p.r.	D.k. at 460 nm in soln. contg. $K_2S_2O_8$.	80A240
		$\sim 1 \times 10^9$			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3\cdot^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
113	***N*-Methylolacrylamide**						
	$SO_4\cdot^- + H_2CC{=}CHCONHCH_2OH \rightarrow$	$\sim 2 \times 10^8$			f.p.	C.k.; obs. quenching of 600 nm abs. ($CO_3\cdot^-$) in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
114	**2-Methyl-2-propanol**						
	$SO_4\cdot^- + (CH_3)_3COH \rightarrow SO_4^{2-} + \cdot CH_2C(CH_3)_2OH + H^+$	4.0×10^5	7-8	0.003	p.r.	C.k.; obs. buildup of $[TMB]\cdot^+$ rel. to $k(SO_4\cdot^- + TMB) = 2.6 \times 10^9$.	78A076
		8.0×10^5	7	0.03	p.r.	D.k. in $S_2O_8^{2-}$ soln.	751069
			1.8		therm.	$T = 75°$ C; c.k. in $S_2O_8^{2-}$-alcohol soln.; obs. acetone formn.	749006
		9.1×10^5			p.r.	D.k. in $S_2O_8^{2-}$ soln.	727008

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
115	**3-Pentanol**						
	$SO_4{\cdot}^- + C_2H_5CH(OH)C_2H_5 \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8{}^{2-}$-alcohol soln.; obs. ketone formn.	749006
116	**1-Phenyl-3-butanol**						
	$SO_4{\cdot}^- + C_6H_5CH_2CH_2CH(OH)CH_3 \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8{}^{2-}$-alcohol soln.; obs. ketone and acetaldehyde formn.	749006
117	**1-Phenylethanol**						
	$SO_4{\cdot}^- + C_6H_5CHOHCH_3 \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8{}^{2-}$-alcohol soln.; obs. ketone formn.	749006
118	**1-Phenyl-2-propanol**						
	$SO_4{\cdot}^- + C_6H_5CH_2CH(OH)CH_3 \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8{}^{2-}$-alcohol soln.; obs. acetaldehyde formn.	749006
119	**2-Phenyl-2-propanol**						
	$SO_4{\cdot}^- + C_6H_5COH(CH_3)_2 \rightarrow$		1.8		therm.	$T = 75°C$; c.k. in $S_2O_8{}^{2-}$-alcohol soln.; obs. ketone formn.	749006
120	***p*-Phthalate ion**						
	$SO_4{\cdot}^- + C_6H_4(CO_2{}^-)_2 \rightarrow SO_4{}^{2-} + {\cdot}C_6H_4CO_2{}^- + CO_2$ (+ $HOC_6H_4(CO_2{}^-)_2$)	1.7×10^8	9		p.r.	D.k. at 450 nm; ~ 60% phenyl radical and ~ 40% OH adduct based on CO_2 yields by γ-r. [78G168].	771001
121	**1-Propanol**						
	$SO_4{\cdot}^- + CH_3CH_2CH_2OH \rightarrow$	5.8×10^7	7-8		phot.	C.k. with fumarate in $S_2O_8{}^{2-}$ soln.; effect of solute on fumarate-$SO_4{}^-$ adduct obs. by esr; rel. to $k(SO_4{\cdot}^- + OH^-) = 7.3 \times 10^7$.	73D403
		1.2×10^7	9		phot.	C.k. with RNO in air-satd. $S_2O_8{}^{2-}$ soln.	707234
122	**2-Propanol**						
	$SO_4{\cdot}^- + (CH_3)_2CHOH \rightarrow SO_4{}^{2-} + (CH_3)_2\dot{C}OH + H^+$	3.2×10^7	7-8	0.003	p.r.	C.k.; obs. buildup of $[TMB]{\cdot}^+$; $k_H/k_D = 2.7$; rel. to $k(SO_4{\cdot}^- + TMB) = 2.6 \times 10^9$.	78A070
		8.0×10^7	7	0.03	p.r.	D.k. at 450 nm; $S_2O_8{}^{2-}$-*tert*-BuOH soln.	751069
		2.2×10^7	9		phot.	C.k. with RNO in air-satd. $S_2O_8{}^{2-}$ soln.	707234
		8.5×10^7	4.4		f.p.	D.k. in aerated 10^{-2} mol L^{-1} $K_2S_2O_8$ soln.; at pH 1.0 $k = 9.1 \times 10^7$.	677058
		4.6×10^7	~0	>1	f.p.	D.k. at 455 nm in ceric sulfate and 1 mol L^{-1} H_2SO_4 soln.	677274
123	**Propionate ion**						
	$SO_4{\cdot}^- + CH_3CH_2CO_2{}^- \rightarrow SO_4{}^{2-} + CO_2 + {\cdot}CH_2CH_3 + CH_3\dot{C}HCO_2{}^-$	4.6×10^6	7		p.r.	D.k. at 450 nm; CO_2 yield obs. by γ-r. [78G168].	771106
124	**Pyridine**						
	$SO_4{\cdot}^- + py \rightarrow$	2.2×10^8	7		p.r.	D.k. at 450 nm; $S_2O_8{}^{2-}$ soln.	761187
125	**Pyridinium ion**						
	$SO_4{\cdot}^- + pyH^+ \rightarrow$	$\sim 2 \times 10^7$	3.9		p.r.	D.k. at 450 nm; $S_2O_8{}^{2-}$ soln.	761187
126	**Serine**						
	$SO_4{\cdot}^- + Ser \rightarrow$	2.3×10^7	7	0.03	p.r.	D.k. at 450 nm; $S_2O_8{}^{2-}$-*tert*-BuOH soln.	751069

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
127	**Styrene**						
	$SO_4{\cdot}^- + C_6H_5CH{=}CH_2 \rightarrow$	2×10^9			p.r.	D.k. at 450 nm in soln. contg. 0.1 mol L^{-1} *tert*-BuOH and $K_2S_2O_8$.	79B138
128	**Succinate ion**						
	$SO_4{\cdot}^- + {}^-O_2CCH_2CH_2CO_2^- \rightarrow SO_4^{2-} + CO_2 + {\cdot}CH_2CH_2CO_2^-$	7.1×10^6	7		p.r.	D.k. at 450 nm; CO_2 yield obs. by γ-r. [78G168].	771106
129	**Tetrabutylammonium ion**						
	$SO_4{\cdot}^- + [CH_3(CH_2)_3]_4N^+ \rightarrow$	5.3×10^7			p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$, also c.k. with 1,3,5-trimethoxybenzene assuming $k(SO_4{\cdot}^- + TMB) = 2.6 \times 10^9$.	80A346
130	**Tetraethylammonium ion**						
	$SO_4{\cdot}^- + (C_2H_5)_4N^+ \rightarrow$	2.3×10^5			p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^-$, also c.k. with 1,3,5-trimethoxybenzene assuming $k(SO_4{\cdot}^- + TMB) = 2.6 \times 10^9$.	80A346
131	**Tetrahydrofuran**						
	$SO_4{\cdot}^- + \overline{OCH_2CH_2CH_2CH_2} \rightarrow SO_4^{2-} + \underline{O\dot{C}HCH_2CH_2CH_2} + H^+$	1.0×10^8	7-8	0.003	p.r.	C.k.; obs. buildup of $[TMB]{\cdot}^+$; $k_H/k_D = 2.0$; rel. to $k(SO_4{\cdot}^- + TMB) = 2.6 \times 10^9$.	78A076
132	**Tetramethylammonium ion**						
	$SO_4{\cdot}^- + (CH_3)_4N^+ \rightarrow$	9×10^4			p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$, also c.k. with 1,3,5-trimethoxybenzene assuming $k(OH + TMB) = 2.6 \times 10^9$.	80A346
133	**Tetrapropylammonium ion**						
	$SO_4{\cdot}^- + (CH_3CH_2CH_2)_4N^+ \rightarrow$	2.7×10^7			p.r.	D.k. at 450 nm in soln. contg. $S_2O_8^{2-}$, also c.k. with 1,3,5-trimethoxybenzene assuming $k(SO_4{\cdot}^- + TMB) = 2.6 \times 10^9$.	80A346
133a	**Thymidine**						
	$SO_4{\cdot}^- + T \rightarrow SO_4^{2-} + [T]{\cdot}^+$	$\leq 2.0 \times 10^8$	7.0		p.r.	C.k. in soln. contg. 0.1-0.2 mol L^{-1} *tert*-BuOH and $1\text{-}2 \times 10^{-2}$ mol L^{-1} $K_2S_2O_8$; rel. to $k(SO_4{\cdot}^- + TMB) = 2.4 \times 10^9$	87A337
134	***m*-Toluate ion**						
	$SO_4{\cdot}^- + CH_3C_6H_4CO_2^- \rightarrow$	2.0×10^9	7		p.r.	D.k. at 450 nm.; abs. spectrum by p.r. indicates predominant formation of OH adducts [78B101].	771001
135	***o*-Toluate ion**						
	$SO_4{\cdot}^- + CH_3C_6H_4CO_2^- \rightarrow SO_4^{2-} + \dot{C}H_2C_6H_4CO_2^- + H^+$	1.4×10^9	7		p.r.	D.k. at 450 nm; product ident. by abs. spectrum by p.r. [78B101]; CO_2 yield by γ-r. < 10% [78G168]	771001
136	***p*-Toluate ion**						
	$SO_4{\cdot}^- + CH_3C_6H_4CO_2^- \rightarrow SO_4^{2-} + CH_3\dot{C}_6H_4 + CO_2 + \dot{C}H_2C_6H_4CO_2^-$ (+ $CH_3C_6H_4(OH)CO_2^-$)	1.8×10^9	7		p.r.	D.k. at 450 nm; ~ 30% phenyl radical; 30% benzyl radical and 40% OH adduct based on CO_2 yields by γ-r. [78G168] and abs. spectra by p.r. [78B101]	771001
137	**1,2,3-Trimethoxybenzene**						
	$SO_4{\cdot}^- + C_6H_3(OCH_3)_3 \rightarrow SO_4^{2-} + [C_6H_3(OCH_3)_3]{\cdot}^+$	$\sim 7 \times 10^9$		0.003	p.r.	P.b.k.; product ident. by optical absorption and esr spectra.	751171

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
138	**1,2,4-Trimethoxybenzene**						
	$SO_4{\cdot}^- + C_6H_3(OCH_3)_3 \rightarrow SO_4^{2-} + [C_6H_3(OCH_3)_3]{\cdot}^+$	7.8×10^8		0.003	p.r.	P.b.k.; product ident. by optical absorption and esr spectra.	751171
139	**1,3,5-Trimethoxybenzene (TMB)**						
	$SO_4{\cdot}^- + C_6H_3(OCH_3)_3 \rightarrow SO_4^{2-} + [C_6H_3(OCH_3)_3]{\cdot}^+$	2.6×10^9	6.9		p.r.	P.b.k. at 580 nm in N_2-satd. soln. contg. 10^{-3} mol L^{-1} $Na_2S_2O_8$.	80A346
		2.4×10^9	7-8	0.003	p.r.	P.b.k. at 580 nm.	78A076
		1.8×10^9		0.003	p.r.	P.b.k.; product ident. by optical absorption and esr spectra.	751171
140	**2,3,4-Trimethoxybenzoate ion**						
	$SO_4{\cdot}^- + (CH_3O)_3C_6H_2CO_2^- \rightarrow SO_4^{2-} + [(CH_3O)_3C_6H_2CO_2]{\cdot}$	2.5×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
141	**2,4,5-Trimethoxybenzoate ion**						
	$SO_4{\cdot}^- + (CH_3O)_3C_6H_2CO_2^- \rightarrow SO_4^{2-} + [(CH_3O)_3C_6H_2CO_2]{\cdot}$	4.4×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
142	**2,4,6-Trimethoxybenzoate ion**						
	$SO_4{\cdot}^- + (CH_3O)_3C_6H_2CO_2^- \rightarrow SO_4^{2-} + [(CH_3O)_3C_6H_2CO_2]{\cdot}$	2.6×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
143	**3,4,5-Trimethoxybenzoate ion**						
	$SO_4{\cdot}^- + (CH_3O)_3C_6H_2CO_2^- \rightarrow SO_4^{2-} + [(CH_3O)_3C_6H_2CO_2]{\cdot}$	5.0×10^9	>3	0.03	p.r.	P.b.k. in Ar-satd. $S_2O_8^{2-}$ soln.	771006
144	**Trimethylanilinium ion**						
	$SO_4{\cdot}^- + C_6H_5N(CH_3)_3^+ \rightarrow SO_4^{2-} + [C_6H_5N(CH_3)_3]{\cdot}^{2+}$	1.5×10^8	7		p.r.	D.k. at 450 nm; $S_2O_8^{2-}$ soln.	771001
145	**Tryptophan**						
	$SO_4{\cdot}^- + TrpH \rightarrow SO_4^{2-} + Trp{\cdot} + H^+$	$\sim 2 \times 10^9$	7	0.03	p.r.	D.k. at 450 nm; $S_2O_8^{2-}$-*tert*-BuOH soln.	751069
146	**Tyrosine**						
	$SO_4{\cdot}^- + TyrOH \rightarrow SO_4^{2-} + TyrO{\cdot} + H^+$	3.0×10^9	6.8		p.r.	D.k. at 450 nm as well as p.b.k. at 407 nm (aryloxy radical).	761112
		3.2×10^9	7	0.03	p.r.	D.k. at 450 nm; $S_2O_8^{2-}$-*tert*-BuOH soln.	751069
147	**Uracil**						
	$SO_4{\cdot}^- + U \rightarrow SO_4^{2-} + U{\cdot}^+$	$\sim 1 \times 10^9$			p.r.	P.b.k. at 580 nm	78A257
148	**Vinyl acetate**						
	$SO_4{\cdot}^- + CH_3CO_2CH{=}CH_2 \rightarrow$	$\sim 2 \times 10^9$			f.p.	C.k.; obs. quenching of 600 nm abs. $(CO_3{\cdot}^-)$ in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
		1×10^9	~7		p.r.	Soln. contains $S_2O_8^{2-}$; product obs. by absorption spectrum.	690158
149	**Vinyl isobutyl ether**						
	$SO_4{\cdot}^- + (CH_3)_2CHCH_2OCH{=}CH_2 \rightarrow$	1.5×10^9			f.p.	C.k.; obs. quenching of 600 nm abs. $(CO_3{\cdot}^-)$ in $K_2S_2O_8$-$NaHCO_3$ soln.	77A230
150	**Lysozyme**						
	$SO_4{\cdot}^- + Lys \rightarrow$	1.8×10^{10}	7	0.03	p.r.	D.k. in $S_2O_8^{2-}$-*tert*-BuOH soln.	751069
151	**Peroxidase (horseradish)**						
	$SO_4{\cdot}^- + Fe^{III}\ HRP \rightarrow SO_4^{2-} +$ HRP Compound II	$\sim 3 \times 10^6$	6.3		phot.	C.k.; obs. Compound II formn. in soln. contg. $S_2O_8^{2-}$; rel. to $2k(SO_4{\cdot}^- + SO_4{\cdot}^-) = 9 \times 10^8$.	80R177

TABLE 15. Rate constants for reactions of sulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
152	**Ribonuclease**						
	$SO_4{\cdot}^-$ + RNase →	1.2×10^{10}	7	0.03	p.r.	D.k. at 450 nm; $S_2O_8^{2-}$-*tert*-BuOH soln.	751069

TABLE 16. Rate constants for reactions of peroxomonosulfate radical ion in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Peroxomonosulfate radical ion**						
	$SO_5^{\cdot-} + SO_5^{\cdot-} \rightarrow$			1	p.r.	D.k. in N_2O-satd. HSO_5^- soln.; ϵ(265 nm) > 560 L mol^{-1} cm^{-1}; not simple order; k uncertain, estd. to be 2×10^8, $t_{1/2} \sim 3$ ms.	727008
2	**Sulfite ion**						
	$SO_5^{\cdot-} + HSO_3^- \rightarrow HSO_5^- + \dot{S}O_3^-$	$<3 \times 10^5$	4.9	0.5	p.r.	C.k. in N_2O:O_2 (1:1) satd. soln. contg. 2.05×10^{-3} mol L^{-1} ascorbate, 1.9-14.6 $\times 10^{-3}$ mol L^{-1} sulfite and 0.5 mol L^{-1} $NaClO_4$; rel. to $k(SO_5^{\cdot-} + AH^-) = 1.4 \times 10^8$.	87A319
	$SO_5^{\cdot-} + SO_3^{2-}$ (+ H^+) $\rightarrow HSO_5^- + \dot{S}O_3^-$	1.3×10^7	8.7	0.5	p.r.	C.k. in N_2O:O_2 (1:1) satd. soln. contg. 2.05×10^{-3} mol L^{-1} ascorbate, 1.9-14.6 $\times 10^{-3}$ mol L^{-1} sulfite and 0.5 mol L^{-1} $NaClO_4$; rel. to $k(SO_5^{\cdot-} + AH^-) = 1.4 \times 10^8$.	87A319, 85A288
3	**Aniline**						
	$SO_5^{\cdot-} + C_6H_5NH_2 \rightarrow HSO_5^- + C_6H_5\dot{N}H$	$\sim 3 \times 10^6$	13	0.3-0.6	p.r.	0.1-0.2 mol L^{-1} sulfite and 1-4 $\times 10^{-2}$ mol L^{-1} aniline in pres. of N_2O-O_2 (1:1).	85A103
4	**Ascorbic acid/Ascorbate ion**						
	$SO_5^{\cdot-} + AH^- \rightarrow HSO_5^- + A^{\cdot-}$	2×10^6 1.3×10^7 7.8×10^7 1.4×10^8	2 3.6 6.7 6.7	0.1 0.3 0.05 0.5	p.r.	Derived from p.b.k. at 360 nm in N_2O-O_2-satd. soln. contg. Na sulfite; pK_a = 4.1.	85A288
5	**Catechol**						
	$SO_5^{\cdot-} + C_6H_4(OH)_2 \rightarrow HSO_5^- + {}^-OC_6H_4O\cdot + H^+$	2.7×10^6	6.7		p.r.	P.b.k. at 300 nm in N_2O/O_2 (1:1) satd. soln. contg. Na sulfite.	85A255
6	***N,N*-Dimethylanilinium ion**						
	$SO_5^{\cdot-} + C_6H_5NH(CH_3)_2^+ \rightarrow HSO_5^- + C_6H_5\dot{N}(CH_3)_2^+$	1×10^7	3.6		p.r.	P.b.k.	85A103
7	**Diphenylamine**						
	$SO_5^{\cdot-} + (C_6H_5)_2NH \rightarrow HSO_5^- + (C_6H_5)_2\dot{N}$	5×10^7 $<1 \times 10^7$	3 7		p.r.	P.b.k.	85A103
8	**Ethanol**						
	$SO_5^{\cdot-} + C_2H_5OH \rightarrow$	$\leq 10^3$	9		f.p.	D.k. in air-contg. $S_2O_8^{2-}$ soln.	727008
9	**Hydroquinone**						
	$SO_5^{\cdot-} + C_6H_4(OH)_2 \rightarrow HSO_5^- + {}^-OC_6H_4O^- + H^+$	2.7×10^6 2.0×10^7	6.6 9.5		p.r.	P.b.k. at 430 nm in N_2O/O_2 (1:1) soln. contg. Na bisulfite.	85A255
10	**Hydroquinone-2,5-disulfonate ion**						
	$SO_5^{\cdot-} + C_6H_2(OH)_2(SO_3^-)_2 \rightarrow HSO_5^- + (O^-)C_6H_2(SO_3^-)_2O\cdot + H^+$	8.2×10^5 4.7×10^6	6.6 9.1		p.r.	P.b.k. at 450 nm in N_2O/O_2 (1:1) soln. contg. Na bisulfite.	85A255
11	**Hydroquinone-2-sulfonate ion**						
	$SO_5^{\cdot-} + C_6H_3(OH)_2SO_3^- \rightarrow HSO_5^- + (O^-)C_6H_3(SO_3^-)O\cdot + H^+$	1.5×10^6	6.8		p.r.	P.b.k. at 430 nm in N_2O/O_2 (1:1) soln. contg. Na bisulfite.	85A255
12	**6-Hydroxy-2,5,7,8-tetramethylchroman-2-carboxylate anion**						
	$SO_5^{\cdot-} + ArOH \rightarrow HSO_5^- + ArO\cdot$	1.2×10^7	9	0.1	p.r.	Derived from p.b.k. at 360 nm in O_2-N_2O-satd. soln. contg. Na sulfite.	85A288

TABLE 16. Rate constants for reactions of peroxomonosulfate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
13	**4-Methoxyphenoxide ion**						
	$SO_5\cdot^- + CH_3OC_6H_4O^-$ (+ H^+) → $HSO_5^- + CH_3OC_6H_4O\cdot$	~5 × 10^5 5.5 × 10^7 1.3 × 10^8	6.7 9.2 11.7		p.r.	P.b.k. in N_2O-O_2 (1:1) satd. soln. contg. 4-methoxyphenol and sulfite ion.	84A327
14	**Phenoxide ion**						
	$SO_5\cdot^- + C_6H_5O^-$ (+ H^+) → $HSO_5^- + C_6H_5O\cdot$	~8 × 10^4	11.1		p.r.	P.b.k. in N_2O-O_2 (1:1) satd. soln. contg. phenol and sulfite ion.	84A327
15	**Pyrogallol**						
	$SO_5\cdot^- + C_6H_3(OH)_3 \rightarrow HSO_5^- + \cdot OC_6H_3(O^-)(OH) + H^+$	4.1 × 10^6	6.7		p.r.	P.b.k. at 430 nm in N_2O/O_2 (1:1) soln. contg. Na bisulfite.	85A255
16	**Resorcinol**						
	$SO_5\cdot^- + C_6H_4(OH)_2 \rightarrow$	<1 × 10^6	6.7		p.r.	P.b.k. at 450 nm in N_2O/O_2 (1:1) soln. contg. Na bisulfite.	85A255

TABLE 17. Rate constants for miscellaneous sulfur-containing radicals

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Sulfhydryl radical**					
1.1	$S\cdot^- + S\cdot^- \rightarrow$	1×10^9	11	p.r.	P.b.k. at 280 nm, S_2^{2-}.	670273
	$HS\cdot + HS\cdot \rightarrow H_2S_2$	6.5×10^9	7.0	p.r.	D.k. at 380 nm, computer simulation.	87A082
1.2	$H_2S_2\cdot^- + HS\cdot \rightarrow H_2S_2 + HS^-$	9.0×10^9	7.0	p.r.	D.k. at 380 nm, computer simulation.	87A082
1.3	$O_2 + HS\cdot \rightarrow SO_2\cdot^- + H^+$	7.5×10^9	7.0	p.r.	D.k. at 380 nm at low H_2S concn., dependence on both $[O_2]$ and $[H_2S]$.	87A082
1.4	$HS^- + HS\cdot \rightarrow H_2S_2\cdot^-$	5.4×10^9	7.0	p.r.	D.k. at 380 nm, computer simulation; $k_r = 5.3 \times 10^5$ s^{-1}	87A082
2	**Sulfhydryl dimer radical anion**					
2.1	$H_2S_2\cdot^- + H_2S_2\cdot^- \rightarrow H_2S_2 + HS^-$	9.5×10^8	7.0	p.r.	D.k. at 380 nm, computer simulation.	87A082
2.2	$O_2 + H_2S_2\cdot^- \rightarrow O_2\cdot^- + H_2S_2$	4.0×10^8	7.0	p.r.	D.k. at 380 nm at high H_2S concn., dependence on both $[O_2]$ and $[H_2S]$.	87A082
3	**Thiocyanogen**					
3.1	$SCN\cdot + SCN^- \rightarrow (SCN)_2\cdot^-$	9×10^9		f.p.	$(SCN)_2\cdot^-$ from $SCN^- + SO_4\cdot^-$ (by photolysis of $S_2O_8^{2-}$ at 248 nm); photolysis at 523 nm caused bleaching; recovery of abs. at 500 nm corresponded to recombination process.	85A132
		7.0×10^9		p.r.	$K = 2 \times 10^5$ mol L^{-1}; detd. by effect of $[SCN^-]$ on $[(SCN)_2\cdot^-]$.	680375
4	**Carbon disulfide OH adduct**					
4.1	$SC(O^-)S\cdot + SC(O^-)S\cdot \rightarrow$	8×10^8	6	p.r.	D.k. at 280 nm ($\epsilon = 11{,}000$ L mol^{-1} cm^{-1}) in N_2O-satd. soln. contg. 10^{-4} mol L^{-1} carbon disulfide; pK_a = 4.4.	731015
5	**Carbon disulfide electron adduct**					
5.1	$CS_2\cdot^- + CS_2\cdot^- \rightarrow$	3.2×10^9	6.0	p.r.	D.k. at 270 nm ($\epsilon = 20{,}000$ L mol^{-1} cm^{-1}) in Ar-satd. soln. contg. 0.1 mol L^{-1} *tert*-BuOH and 10^{-4} mol L^{-1} carbon disulfide; pK_a ($S\dot{C}SH$) ~1.6.	731015
5.2	$CS_2\cdot^- + H^+ \rightarrow SC(H)S\cdot$	5.1×10^7		p.r.	D.k.	731015
	$CS_2\cdot^- + H^+ \rightarrow S\dot{C}SH$	1.3×10^9	3.8	p.r.	D.k. at 275 nm ($\epsilon = 2000$ L mol^{-1} cm^{-1}) as well as p.b.k. at 320 nm in N_2-satd. soln. contg. 25% *tert*-BuOH; k lower by a factor of 2 by addn. of 1 mol L^{-1} $NaClO_4$.	83A204
5.3	$CS_2\cdot^- + O_2 \rightarrow$	1.9×10^9		p.r.	D.k. at 275 nm in soln. contg. 25% *tert*-BuOH, 10^{-2} mol L^{-1} CS_2, containing oxygen.	83A204
6	**Protonated carbon disulfide electron adduct**					
6.1	$SC(H)S\cdot + SC(H)S\cdot \rightarrow$	3.7×10^9		p.r.	D.k.	731015
7	**Thiosulfate radical ion**					
7.1	$S_2O_3\cdot^- + S_2O_3\cdot^- \rightarrow S_4O_6^{2-}$	8.6×10^8		p.r.	D.k. at 380 nm ($\epsilon = 1720$ L mol^{-1} cm^{-1}).	84A096
		2.9×10^9	4.5	f.p.	D.k. in soln. contg. 5×10^{-3} mol L^{-1} $S_2O_3^{2-}$ using $\epsilon(380) = 1720$ L mol^{-1} cm^{-1}; $2k/\epsilon = 3.3 \times 10^6$.	78A427
		3.5×10^9	7	f.p.	D.k. at 380 nm in N_2-satd. $S_2O_3^{2-}$ soln.; $2k/\epsilon = 4.1 \times 10^6$; same at pH 10.9; addn. of ethanol, carbonate ion or allyl alcohol did not affect the decay rate.	687072
7.2	$S_2O_3\cdot^- + S_2O_3^{2-} \rightarrow S_4O_6^{3-}$	8×10^8	4.5, 9.6	p.r.	P.b.k. at 370 nm or d.k. at 320 nm in $S_2O_3^{2-}$ soln.; $k = 1.8 \times 10^9$ at $I = 0.1$.	731027

TABLE 17. Rate constants for miscellaneous sulfur-containing radicals—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
8	**Thiosulfate ion-OH adduct**					
8.1	$S_2O_3OH^{2-} + S_2O_3^{2-} \rightarrow S_4O_6^{3-} + OH^-$	6×10^8		p.r.	Calcd. from abs.-time depencence at 450 and 320 nm. ϵ OH adduct = 0.8×10^3 L mol^{-1} cm^{-1} at 320 nm; ϵ ($S_4O_6^{3-}$) = 3.5×10^3 L mol^{-1} cm^{-1} at 450 and 0.8×10^2 at 320 nm.	84A096
9	**Tetrathionate radical ion**					
9.1	$S_4O_6^{3-} \rightarrow S_2O_3^{\cdot-} + S_2O_3^{2-}$	2.5×10^6 s^{-1}		p.r.	Calcd. from d.k. in 0.01 mol L^{-1} $S_2O_3^{2-}$ soln.	84A096
10	**Pentafluorosulfur radical**					
10.1	$\cdot SF_5 + H_2O \rightarrow \cdot OH + H^+$	1.1×10^5 s^{-1}	6.8	p.r.	C.k.; obs. formn. of benzosemiquinone from hydroquinone in SF_6-satd. soln. contg. *tert*-BuOH.	761099
10.2	$\cdot SF_5 + SO_4^{2-} \rightarrow$			p.r.	No reaction.	761099
10.3	$\cdot SF_5 + (CH_3)_3COH \rightarrow$	$<2 \times 10^5$	6.8	p.r.	C.k.; no effect on hydroquinone reaction in SF_6-satd. soln. with change in *tert*-BuOH concentration.	761099
10.4	$\cdot SF_5 + 1,4\text{-}C_6H_4(OH)_2 \rightarrow 4\text{-}^-OC_6H_4O\cdot + H^+$	1.7×10^9	6.8	p.r.	P.b.k. at 430 nm in SF_6-sat. soln. contg. 0.2 mol L^{-1} *tert*-BuOH and 3-10 $\times 10^{-5}$ mol L^{-1} hydroquinone.	761099

TABLE 18. Rate constants for reactions of selenite radical ions in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Selenite radical, protonated**						
	$H_2SeO_3\cdot^+ + H_2SeO_3\cdot^+ \rightarrow$	9.8×10^8	1		p.r.	D.k. in soln. of $HSeO_3^-$ contg. $HClO_4$; $\lambda_{max} = 430$ nm; $\epsilon = 930$ L mol^{-1} cm^{-1}; p$K_a(H_2SeO_3\cdot^+) = 3.9$, 7.4 [85A226].	771173
2	**Selenite radical**						
	$HSeO_3\cdot + HSeO_3\cdot \rightarrow$	2.3×10^8	5-6		p.r.	D.k. in soln. of $HSeO_3^-$ contg. N_2O; $\lambda_{max} = 430$ nm; $\epsilon_{max} = 600$ L mol^{-1} cm^{-1}.	771173
3	**Selenite radical anion**						
	$SeO_3\cdot^- + SeO_3\cdot^- \rightarrow$	2.7×10^8	12.5		f.p.	D.k. at 430 nm ($\epsilon = 1.4 \times 10^3$ L mol^{-1} cm^{-1}) in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} SeO_3^{2-}; $2k/\epsilon = 3.8 \times 10^5$.	78A451
		2.7×10^8	9-11		p.r.	D.k. in soln. of $HSeO_3^-$ contg. N_2O; $\lambda_{max} = 430$ nm; $\epsilon_{max} = 1350$ L mol^{-1} cm^{-1}.	771173
		2.6×10^8	<11	0.33	p.r.	D.k. at 402 nm; $\epsilon = 1470$ L mol^{-1} cm^{-1}; k cor. for I.	86A331
	$SeO_3\cdot^- + SeO_3\cdot^- \rightarrow$ $SeO_3\cdot^- + HSeO_4\cdot^{2-} \rightarrow$ $HSeO_4\cdot^{2-} + HSeO_4\cdot^{2-} \rightarrow$	k_A k_B k_C			p.r.	$k_A \approx 0.5k_B \approx k_C$; Rate of decay at isosbestic point did not vary with pH.	86A331
4	**Carbonate ion**						
	$SeO_3\cdot^- + CO_3^{2-} \rightarrow SeO_3^{2-} + CO_3\cdot^-$	6.2×10^6	~10		p.r.	D.k. at 420 nm, as well as p.b.k., in soln. contg. $5 \times 10^{-3} < [CO_3^{2-}] < 2 \times 10^{-2}$ mol L^{-1}.	86A331
5	**Alanine**						
	$HSeO_3\cdot/SeO_3\cdot^- + Ala \rightarrow$	$<1 \times 10^6$	~7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
6	**Arginine**						
	$HSeO_3\cdot/SeO_3\cdot^- + Arg \rightarrow$	7.7×10^6	~7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
7	**Cystine**						
	$HSeO_3\cdot/SeO_3\cdot^- + S_2[CH_2CH(NH_3^+)CO_2^-]_2 \rightarrow$	3.5×10^7	~7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
8	**Glycine**						
	$HSeO_3\cdot/SeO_3\cdot^- + Gly \rightarrow$	$<1 \times 10^6$	~7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
9	**Histidine**						
	$SeO_3\cdot^- + His \rightarrow$ $HSeO_3\cdot/SeO_3\cdot^- + His \rightarrow$	1.6×10^8 4.3×10^7	11.2 ~7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. SeO_3^{2-}.	85A226
10	**Methionine**						
	$HSeO_3\cdot/SeO_3\cdot^- + Met \rightarrow$	1.2×10^8	~7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$.	85A226
11	***O*-Methyltyrosine**						
	$SeO_3\cdot^- + CH_3OC_6H_4CH_2CH(NH_2)CO_2^- \rightarrow$	3.5×10^8	11.2		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. SeO_3^{2-}.	85A226
	$HSeO_3\cdot + CH_3OC_6H_4CH_2CH(NH_3^+)CO_2^- \rightarrow$	3.2×10^7	~6		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
12	**Tryptophan**						
	$HSeO_3\cdot + TrpH \rightarrow$	3.3×10^9	3.5		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$,	85A226

TABLE 18. Rate constants for reactions of selenite radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
12	**Tryptophan**—Continued						
	$HSeO_3\cdot/SeO_3\cdot^- + TrpH \rightarrow$	3.4×10^9	7.4	0.006	p.r.	D.k. in N_2O-satd. $HSeO_3^-$ soln.	761151
	$SeO_3\cdot^- + TrpH \rightarrow$	2.5×10^9	11.2		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. SeO_3^{2-}.	85A226
13	**Tyrosine**						
	$SeO_3\cdot^- + TyrOH \rightarrow$	9.5×10^8	9.2 11.2		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. SeO_3^{2-}.	85A226
	$HSeO_3\cdot + TyrOH \rightarrow$	1.1×10^9	~6		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$; same rate at pH ~7	85A226
14	**Alcohol dehydrogenase**						
	$SeO_3\cdot^- + ALDH \rightarrow$	1.2×10^{10}	10.7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. SeO_3^{2-}; enzyme from yeast.	85A226
	$HSeO_3\cdot + ALDH \rightarrow$	3.4×10^9	~6		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$; enzyme from yeast.	85A226
15	**α-Chymotrypsin**						
	$HSeO_3\cdot$ + α-Chymotrypsin →	3.5×10^9	~6		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
16	**Lactate dehydrogenase**						
	$HSeO_3\cdot + LADH \rightarrow$	$<1 \times 10^7$	~6		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
	$SeO_3\cdot^- + LADH \rightarrow$	2.6×10^9	10.7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. SeO_3^{2-}	85A226
17	**Lysozyme**						
	$HSeO_3\cdot + Lys \rightarrow$	3.2×10^9	~6		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
18	**Ribonuclease**						
	$HSeO_3\cdot + RNase \rightarrow$	$<1 \times 10^7$	~6		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. $HSeO_3^-$	85A226
	$SeO_3\cdot^- + RNase \rightarrow$	1.4×10^9	10.7		p.r.	D.k. at 430 nm in N_2O-satd. soln. contg. SeO_3^{2-}	85A226

TABLE 19. Rate constants for miscellaneous selenium-containing radicals

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Di(selenocyanate) radical anion**					
1.1	$(SeCN)_2^{\cdot -}$ + Cys →	6.7×10^7		p.r.	D.k. at 430 nm in soln. contg. 10^{-3} mol L^{-1} $SeCN^-$ and 8×10^{-4} mol L^{-1} cysteine.	79A035
1.2	$(SeCN)_2^{\cdot -}$ + RNase →	$<1 \times 10^7$	~7	p.r.	N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} KCNSe and ribonuclease.	77R182
2	**Selenium dioxide radical anion**					
2.1	$SeO_2^{\cdot -} + SeO_2^{\cdot -} \rightarrow Se_2O_4^{2-}$	6.4×10^8	6.2	p.r.	D.k. in soln. of $HSeO_3^-$ contg. 2-methyl-2-propanol; $\lambda_{max} = 330$ nm; $\epsilon_{max} = 1450$ L mol^{-1} cm^{-1}.	771173
3	**Selenate(VII) radical ion**					
3.1	$SeO_4^{\cdot -} + SeO_4^{\cdot -} \rightarrow$	5.5×10^8	nat.	p.r.	D.k. at 525 nm ($\epsilon = 610$) in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} SeO_4^{2-}; $2k/\epsilon = 1.9 \times 10^6$.	78A259

TABLE 20. Rate constants for reactions of the dithiocyanate radical ion in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Di(thiocyanate) radical ion**						
	$(SCN)_2^{\cdot -} + (SCN)_2^{\cdot -} \rightarrow (SCN)_2 + 2\ SCN^-$	1.3×10^9	7	0.1	p.r.	D.k. at 475 nm in N_2O-satd. soln. k detd. at 19-81 °C at [KSCN] (10^{-4}-10^{-1} mol L^{-1}); $\epsilon = 7600$ L mol^{-1} cm^{-1}; $E_a = 13$ kJ mol^{-1}.	84A281
		1.2×10^9	3	0.1	p.r.	D.k. at 312 ($\epsilon = 230$), 475 ($\epsilon = 7600$) and 630 nm ($\epsilon = 440$ L mol^{-1} cm^{-1}); at pH 7 and 11 d.k. *not* pure second order.	82A115
		1.3×10^9		0.005	p.r.	Addn. of Cl^- increases k to 3.3×10^9 at 5 mol L^{-1} LiCl.	751119
		1.2×10^9	~5.7	→0	p.r.	D.k. in O_2-satd. soln. of ≤ 0.5 mol L^{-1} SCN^-; ϵ not given.	720475
		$\sim 1.5 \times 10^9$		→0	p.r.	Second order decay in N_2O-satd. SCN^- soln.; value from graph; $\epsilon_{475} = 7600$ L mol^{-1} cm^{-1}.	680375
		1.5×10^9	7	0.01	p.r.	D.k. in presence or absence of O_2; ϵ(500 nm) = 7100 L mol^{-1} cm^{-1}.	650386
2	**Nitrilotriacetatocobaltate(II) ion**						
	$(SCN)_2^{\cdot -} + CoNTA^- \rightarrow SCN^- + [CoNTA(NCS)]^-$	4.6×10^7 5.5×10^7	5.0 7.5		p.r.	D.k.; inner-sphere mechanism; $k =$ 23-150 s^{-1} for decomposition of intermediate, pH 5-7.5.	78A436
3	**Ethylenediaminetetraacetatocobaltate(II) ion**						
	$(SCN)_2^{\cdot -} + CoEDTA^{2-} \rightarrow$	$<1 \times 10^7$	5.0		p.r.	D.k.; $k > 6 \times 10^4$ estimated from yields in γ-r. of N_2O-satd. soln. contg. 0.1 mol L^{-1} SCN^-.	78A436
4	**Nitrilotriacetatocuprate(II) ion**						
	$(SCN)_2^{\cdot -} + CuNTA^- \rightarrow$	$<5 \times 10^6$			p.r.	unreactive	78A436
5	**Ethylenediaminetetraacetatocuprate(II) ion**						
	$(SCN)_2^{\cdot -} + CuEDTA^{2-} \rightarrow$	$<5 \times 10^6$			p.r.	unreactive	78A436
6	**Nitrilotriacetatoferrate(II) ion**						
	$(SCN)_2^{\cdot -} + FeNTA^- \rightarrow$	1.1×10^8	4.8		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} SCN^-.	78A436
7	**Ethylenediaminetetraacetatoferrate(II) ion**						
	$(SCN)_2^{\cdot -} + FeEDTA^{2-} \rightarrow$	1.0×10^8	4.8		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} SCN^-.	78A436
8	**Carboxyferrocene ion(1-)**						
	$(SCN)_2^{\cdot -} + FcCO_2^- \rightarrow 2\ SCN^- + Fc^+CO_2^-$	3.5×10^8			p.r.		84A460
9	**Carboxymethylferrocene ion(1-)**						
	$(SCN)_2^{\cdot -} + FcCH_2CO_2^- \rightarrow 2\ SCN^- + Fc^+CH_2CO_2^-$	1.5×10^9			p.r.	D.k.	83A274
10	**2-Carboxyethylferrocene ion(1-)**						
	$(SCN)_2^{\cdot -} + Fc(CH_2)_2CO_2^- \rightarrow 2\ SCN^- + Fc^+(CH_2)_2CO_2^-$	1.8×10^9			p.r.	D.k.	83A274
11	**Iodide ion**						
	$(SCN)_2^{\cdot -} + I^- \rightarrow SCN^- + ISCN^{\cdot -}$	1.6×10^9		0.005	p.r.	D.k. in N_2O-satd. SCN^- soln.	700164
12	**Nitrilotriacetatomanganate(II) ion**						
	$(SCN)_2^{\cdot -} + MnNTA^- \rightarrow SCN^- + [MnNTA(NCS)]^-$	1.3×10^7 4.0×10^7	4.5 5.0		p.r.	D.k.; inner-sphere mechanism; $k = 2 \times 10^2$ s^{-1} for decomposition of intermediate complex.	78A436

TABLE 20. Rate constants for reactions of the dithiocyanate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
13	**Ethylenediaminetetraacetatomanganate(II) ion**						
	$(SCN)_2{\cdot}^- + MnEDTA^{2-} \rightarrow$	$<7 \times 10^6$	5.0		p.r.	D.k.; $k > 5 \times 10^4$ estd. from γ-r. yields in N_2O-satd. soln. contg. 0.1 mol L^{-1} SCN^-.	78A436
14	**Nitrite ion**						
	$(SCN)_2{\cdot}^- + NO_2^- \rightarrow 2\ SCN^- + {\cdot}NO_2$	2.2×10^6	6.6		p.r.	D.k. at 480 nm in 0.1 mol L^{-1} KSCN soln.	86A059
15	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion**						
	$(SCN)_2{\cdot}^- + Ni(aneN_4)^{2+} \rightarrow SCN^- + Ni(aneN_4)SCN^{2+}$	1.0×10^9	2	~0.02	p.r.	D.k. in 0.005-0.01 mol L^{-1} SCN^- soln.	78A299
16	**α-2,12-Dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]heptadeca-1(17),13,15-trienenickel(II) ion**						
	$(SCN)_2{\cdot}^- + Ni(CR{+}4H)^{2+} \rightarrow SCN^- + Ni(CR{+}4H)SCN^{2+}$	6.3×10^9	4		p.r.	D.k. at 540 nm in N_2O-satd. soln. contg. SCN^-.	82A106
17	**Bisaqua-α-2,12-dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]heptadeca-1(17),2,11,13,15-pentaenenickel(II) ion**						
	$(SCN)_2{\cdot}^- + Ni(CR)^{2+} \rightarrow SCN^- + Ni(CR)SCN^{2+}$	1.4×10^9	4		p.r.	D.k. at 540 nm in N_2O-satd. soln. contg. SCN^-.	82A106
18	**α-2,12-Dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]heptadeca-1(17),2,6,11,13,15-hexaenenickel(II) ion**						
	$(SCN)_2{\cdot}^- + Ni(CR{-}2H)^{2+} \rightarrow SCN^- + Ni(CR{-}2H)SCN^{2+}$	1.0×10^{10}	4		p.r.	D.k. at 540 nm in N_2O-satd. soln. contg. SCN^-.	82A106
19	**Nitrilotriacetatonickelate(II) ion**						
	$(SCN)_2{\cdot}^- + NiNTA^- \rightarrow$				p.r.	unreactive	78A436
20	**Tris(2,2'-bipyridine)osmium(II) ion**						
	$(SCN)_2{\cdot}^- + Os(bpy)_3^{2+} \rightarrow 2\ SCN^- + Os(bpy)_3^{3+}$	2.8×10^9	3	0.1	p.r.	D.k. at 475 nm in soln. contg. 0.1 mol L^{-1} SCN^- and 10^{-5} mol L^{-1} complex; k for reverse reaction = 25 L^2 mol^{-2} s^{-1}.	82A115
21	**Tris(2,2'-bipyridine)osmium(III) ion**						
	$(SCN)_2{\cdot}^- + Os(bpy)_3^{3+} \rightarrow (SCN)_2 + Os(bpy)_3^{2+}$	1.0×10^{10}	3	0.1	p.r.	D.k. at 475 nm in soln. contg. 0.1 mol L^{-1} SCN^- and 10^{-5} mol L^{-1} complex.	82A115
22	**Bisulfide ion**						
	$(SCN)_2{\cdot}^- + HS^- \rightarrow 2\ SCN^- + HS{\cdot}$	9.8×10^8			p.r.	D.k. at 500 nm.	670273
23	**Sulfite ion**						
	$(SCN)_2{\cdot}^- + SO_3^{2-} \rightarrow 2\ SCN^- + SO_3^-$	1.1×10^8			p.r.	D.k.	86A191
23a	**Uranium(III) ion**						
	$(SCN)_2{\cdot}^- + U^{3+} \rightarrow USCN^{3+} + SCN^-$	1.4×10^9	~1		p.r.	D.k. in He-satd. soln. contg. 0.5 mol L^{-1} $HClO_4$ contg. 0.1 mol L^{-1} NaSCN; inner-sphere mechanism.	85A122
24	**Uranyl(V) ion**						
	$(SCN)_2{\cdot}^- + UO_2^+ \rightarrow 2\ SCN^- + UO_2^{2+}$	1.5×10^9	1.0		f.p.	D.k. in SCN^- - U(VI) soln.; reaction probably reoxid. of U(V) to U(VI); assume $[(SCN)_2{\cdot}^-] = [UO_2^+]$.	767279
25	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatozinc(II) ion**						
	$(SCN)_2{\cdot}^- + ZnTMpyP^{4+} \rightarrow 2\ SCN^- + [ZnTMpyP]{\cdot}^{5+}$	5.1×10^9	7.0	0.01	p.r.	P.b.k. at 690-700 nm in N_2O-satd. buffered soln. contg. KSCN and (1-4) $\times 10^{-4}$ mol L^{-1} porphyrin; the π-radical cation complexes with SCN^- (ϵ_{700nm} = 14,610 L mol^{-1} cm^{-1}).	85A038

TABLE 20. Rate constants for reactions of the dithiocyanate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
26	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatozinc(II) ion**						
	$(SCN)_2^{\cdot-}$ + $ZnTPPS^{4-}$ → 2 SCN^- + $[ZnTPPS]^{\cdot 3-}$	9.6×10^8	7.0	0.01	p.r.	P.b.k. at 690-700 nm in N_2O-satd. buffered soln. contg. KSCN and (1-4) $\times 10^{-4}$ mol L^{-1} porphyrin; SCN^- complexes with π-radical (ϵ_{700nm} = 10,880 L mol^{-1} cm^{-1}).	85A038
27	**4-[[(4-(Acetylamino)phenyl]amino]-1-amino-9,10-anthraquinone-2-sulfonate ion**						
	$(SCN)_2^{\cdot-}$ + AB-40 →	5.4×10^8			γ-r.	C.k.; obs. G(-dye); rel. to $k((SCN)_2^{\cdot-}$ + TrpH) = 2.7×10^8.	79G141
28	**2-Amino-(4-hydroxy-6-benzothiazolyl)propionate ion**						
	$(SCN)_2^{\cdot-}$ + $AHBP^-$ → 2 SCN^- + AHBP·	5.1×10^8	<12		p.r.	D.k. in alk. N_2O-satd. soln. contg. 5 $\times 10^{-2}$ mol L^{-1} KSCN.	84A024
29	**2-Amino-(4-methoxy-6-benzothiazolyl)propionate ion**						
	$(SCN)_2^{\cdot-}$ + $AMBP^-$ → 2 SCN^- + AMBP·	1×10^8	<12		p.r.	D.k. in alk. N_2O-satd. soln. contg. 5 $\times 10^{-2}$ mol L^{-1} KSCN.	84A024
30	**Aniline**						
	$(SCN)_2^{\cdot-}$ + $C_6H_5NH_2$ → 2 SCN^- + $C_6H_5\dot{N}H$ + H^+	1.0×10^8	10		p.r	D.k. at 480 nm.	87A220
31	**Ascorbate ion**						
	$(SCN)_2^{\cdot-}$ + AH^- → 2 SCN^- + H^+ + $A^{\cdot-}$	3.5×10^8	11	→0	p.r.	P.b.k. at 360 nm in N_2O satd. soln. contn. 10^{-3} mol L^{-1} SCN^-	771036
		4.8×10^8	6.7	0.01	p.r.	D.k. in N_2O-satd. 10^{-2} mol L^{-1} SCN^- soln.	733006
		6.0×10^8	7	0.1	p.r.	D.k. at 500 nm in SCN^- soln., as well as p.b.k. at 360 nm.	720266
32	**Ascorbic acid**						
	$(SCN)_2^{\cdot-}$ + AH_2 → 2 SCN^- + 2 H^+ + $A^{\cdot-}$	$<1 \times 10^7$			p.r.	D.k. in N_2O-satd. 10^{-2} mol L^{-1} SCN^- soln.	733006
		1.0×10^7	1.8		p.r.	P.b.k. at 380 nm in 0.1 mol L^{-1} SCN^- soln.	720266
33	**2,2'-Azinobis(3-ethylbenzothiazoline-6-sulfonate ion)**						
	$(SCN)_2^{\cdot-}$ + ABTS → 2 SCN^- + $ABTS^{\cdot+}$	1.5×10^9			p.r.	D.k. at 480 nm (as well as p.b.k. at 415 nm) in N_2O-satd. soln. contg. 0.1 mol L^{-1} KSCN.	82A196
34	**Bacteriochlorophyll a**						
	$(SCN)_2^{\cdot-}$ + BChl a → 2 SCN^- + $[BChl\ a]^{\cdot+}$	1.3×10^9			p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5 $\times 10^{-2}$ mol L^{-1} SCN^-; rate for aqueous phase, k in micellar phase = 2.4×10^9.	81N146
35	**4-Bromophenoxide ion**						
	$(SCN)_2^{\cdot-}$ + $BrC_6H_4O^-$ → 2 SCN^- + $BrC_6H_4O\cdot$	3.1×10^8	12.5		p.r.	P.b.k.	743052
36	**Camphor**						
	$(SCN)_2^{\cdot-}$ + $C_{10}H_{16}O$ →	$<1 \times 10^6$			p.r.	D.k. at 500 nm	79A191
37	**β-Carotene**						
	$(SCN)_2^{\cdot-}$ + car → 2 SCN^- + $car^{\cdot+}$	$\sim 3 \times 10^8$			p.r.	P.b.k. in N_2O-satd. micellar (2% Triton X-100) contg. 0.3 mol L^{-1} KSCN and 10^{-4} mol L^{-1} carotene.	83N014
38	**4-Chlorophenoxide ion**						
	$(SCN)_2^{\cdot-}$ + $ClC_6H_4O^-$ → 2 SCN^- + $ClC_6H_4O\cdot$	3.4×10^8	12.5		p.r.	P.b.k.	743052

TABLE 20. Rate constants for reactions of the dithiocyanate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
39	**Chlorophyll *a***						
	$(SCN)_2{\cdot}^- + \text{Chl a} \rightarrow 2\ SCN^- + [\text{Chl a}]{\cdot}^+$	1.1×10^9			p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} SCN^-; rate for aqueous phase, k in micellar phase = 1.2×10^9.	81N14
40	**Chlorophyll *b***						
	$(SCN)_2{\cdot}^- + \text{Chl b} \rightarrow 2\ SCN^- + [\text{Chl b}]{\cdot}^+$	9.0×10^8			p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} SCN^-; rate for aqueous phase, k in micellar phase = 1.2×10^9.	81N14
41	**Chlorpromazine**						
	$(SCN)_2{\cdot}^- + CZH^+ \rightarrow 2\ SCN^- + CZH{\cdot}^{2+}$	3.6×10^9	3.5		p.r.	P.b.k. at 505 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KSCN; overall rate constant, 97% electron transfer.	83A27
42	**Crocin**						
	$(SCN)_2{\cdot}^- + C_{44}H_{64}O_{24} \rightarrow$	4×10^8			p.r.	D.k.	82R02
43	**4-Cyanophenoxide ion**						
	$(SCN)_2{\cdot}^- + NCC_6H_4O^- \rightarrow 2\ SCN^- + CNC_6H_4O{\cdot}$	6.3×10^7	12.5		p.r.	P.b.k.	74305[illegible]
44	**Cysteamine**						
	$(SCN)_2{\cdot}^- + H_3N^+CH_2CH_2S^- \rightarrow$	8×10^7			p.r.		741168
45	**Cysteine**						
	$(SCN)_2{\cdot}^- + \text{CysSH} \rightarrow$	5×10^7 $\sim 9 \times 10^8$	6.6 12	0.1	p.r.	D.k. in N_2O-satd. SCN^- soln.	720036
46	**1,6-Diazabicyclo[4.4.4]tetradecane radical cation**						
	$(SCN)_2{\cdot}^- + DABCT{\cdot}^+ \rightarrow 2\ SCN^- + DABCT$	4.2×10^7		$\rightarrow 0$	p.r.	D.k. at 480 nm in N_2O-satd. soln. contg. 0.02-2.0 $\times 10^{-3}$ mol L^{-1} radical cation and 0.1 mol L^{-1} KSCN; $k_{obs} = 2.0 \times 10^7$	86A27[illegible]
47	**3,4-Dihydroxyacetophenone**						
	$(SCN)_2{\cdot}^- + (HO)_2C_6H_3COCH_3 \rightarrow 2\ SCN^- + {\cdot}O(O^-)C_6H_3COCH_3 + 2\ H^+$	7.6×10^8 9.5×10^8	5-7 ~9		p.r.	D.k. in N_2O-satd. soln. contg. SCN^-.	85A49[illegible]
48	**3-(3,4-Dihydroxyphenyl)alanine**						
	$(SCN)_2{\cdot}^- + (HO)_2C_6H_3CH_2CH(NH_3^+)CO_2^- \rightarrow 2\ SCN^- + 2\ H^+ + {\cdot}O(O^-)C_6H_3CH_2CH(NH_3^+)CO_2^-$	3×10^7			p.r.		741168
49	**2,3-Dihydroxy-2-propenal**						
	$(SCN)_2{\cdot}^- + TRH_2 \rightarrow 2\ SCN^- + TR{\cdot}^- + 2\ H^+$	2.7×10^7			p.r.	D.k. at 472 nm; pK_a = 5.0, 13.0; pK_a (radical) = 1.4.	85A39[illegible]
	$(SCN)_2{\cdot}^- + TRH^- \rightarrow 2\ SCN^- + TR{\cdot}^- + H^+$	9.0×10^8					
50	***N,N*-Dimethylaniline**						
	$(SCN)_2{\cdot}^- + C_6H_5N(CH_3)_2 \rightarrow 2\ SCN^- + [C_6H_5N(CH_3)_2]{\cdot}^+$	1.3×10^8	13-14		p.r.	D.k. at 500 nm in N_2O-satd. soln. contg. KSCN; $k = 1.4 \times 10^8$ in neutral soln.	82A43[illegible]
51	**1,1'-Dimethyl-4,4'-bipyridinium radical ion (1+)**						
	$(SCN)_2{\cdot}^- + MV{\cdot}^+ \rightarrow MV^{2+}(SCN^-)_2$	$\sim 6 \times 10^{10}$	1-8		f.p.	D.k.; reencounter after photolysis of methyl viologen dithiocyanate.	84A33[illegible]

TABLE 20. Rate constants for reactions of the dithiocyanate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
52	**Dimethyl disulfide**						
	$(SCN)_2^{\cdot-} + CH_3SSCH_3 \rightarrow 2\ SCN^- + [CH_3SSCH_3]^{\cdot+}$	6.2×10^7	~4	0.01	p.r.	D.k. at 500 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KSCN and 0.3-2 $\times 10^{-3}$ mol L^{-1} disulfide; $k_r = 5.0 \times 10^8$ ($k_r = 6.3 \times 10^8$ L^2 mol^{-2} s^{-1}, cor. for I).	86A403
53	**Dithiothreitol**						
	$(SCN)_2^{\cdot-}$ + DTT $\rightarrow$	2.1×10^7	7	0.1	p.r.	D.k. in SCN^- soln.	731020
54	**Ephedrine**						
	$(SCN)_2^{\cdot-} + PhCHOHCH(CH_3)NH_2^+CH_3 \rightarrow$		7		p.r.	No reaction.	83A176
55	**Formate ion**						
	$(SCN)_2^{\cdot-} + HCO_2^- \rightarrow$	$<2 \times 10^3$	7	~1	p.r.	D.k. in N_2O-satd. 1 mol L^{-1} SCN^- soln.	78A093
56	**Histidine**						
	$(SCN)_2^{\cdot-}$ + His $\rightarrow$	$<1 \times 10^6$	7-13	0.1	p.r.	D.k. in N_2O-satd. SCN^- soln.	720036
57	**Hydroquinone**						
	$(SCN)_2^{\cdot-} + C_6H_4(OH)_2 \rightarrow 2\ SCN^- + {\cdot}OC_6H_4O^- + 2\ H^+$	6×10^7			p.r.	No details	741168
58	***p*-Hydroxyacetophenone**						
	$(SCN)_2^{\cdot-} + HOC_6H_4COCH_3 \rightarrow 2\ SCN^- + {\cdot}OC_6H_4COCH_3 + H^+$	1.1×10^9 1.2×10^9	5-7 ~9		p.r.	D.k. in N_2O-satd. soln. contg. SCN^-.	85A492
59	**4-Hydroxybenzoate ion**						
	$(SCN)_2^{\cdot-} + (^-O)C_6H_4CO_2^- \rightarrow 2\ SCN^- + {}^-O_2CC_6H_4O{\cdot}$	2.7×10^8	12.5		p.r.	P.b.k.	743052
60	**4-Hydroxybenzothiazole**						
	$(SCN)_2^{\cdot-} + BTO^- \rightarrow 2\ SCN^- + BTO{\cdot}$	9.0×10^8	<12	0.05	p.r.	D.k. in alk. N_2O-satd. soln. contg. 5 $\times 10^{-2}$ mol L^{-1} KSCN.	84A024
		3.5×10^9	>12	0.1	p.r.	D.k. in soln. contg. 0.01 mol L^{-1} KCNS and 0.1 mol L^{-1} NaOH.	80B093
61	**4-Hydroxy-3-[(2-methylphenyl)azo]-5-[(4-methylphenyl)sulfonyl]amino-2,7-naphthalenedisulfonate ion**						
	$(SCN)_2^{\cdot-}$ + AR-265 $\rightarrow$	3.8×10^8			γ-r.	C.k.; obs. G(-dye); rel. to $k((SCN)_2^{\cdot-}$ + TrpH) = 2.7×10^8.	79G141
62	**Linolenate ion**						
	$(SCN)_2^{\cdot-} + CH_3(CH_2CH{=}CH)_3(CH_2)_7CO_2^- \rightarrow$	$<1 \times 10^6$	11		p.r.	D.k.	86A191
63	**Lipoic acid**						
	$(SCN)_2^{\cdot-}$ + RSSR $\rightarrow 2\ SCN^-$ + RSSR$^{\cdot+}$	1.9×10^9	3.6		p.r.	D.k. at 500 nm in N_2O-satd. soln. contg. KSCN and various concns. disulfide; $k_r = 5.0 \times 10^5$ L^2 mol^{-2} s^{-1} (1.1×10^6 cor. for I).	86A403
64	**Maleic hydrazide**						
	$(SCN)_2^{\cdot-} + MH_2 \rightarrow$		2		p.r.	No reaction	83A165
65	**Methionine**						
	$(SCN)_2^{\cdot-}$ + Met $\rightarrow$	2×10^6 $\sim 3 \times 10^8$	7.0 >9	0.1	p.r.	D.k. in N_2O-satd. 0.1 mol L^{-1} SCN^- soln.	720036
		$<10^6$ 3.6×10^8	<7 ≥9		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} SCN^- and $<10^{-3}$ mol L^{-1} methionine.	81A339

TABLE 20. Rate constants for reactions of the dithiocyanate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
66	**S-Methylcysteine, negative ion**						
	$(SCN)_2^{\cdot -}$ + $CH_3SCH_2CH(NH_2)CO_2^-$ →	5×10^6			p.r.	D.k.	81A33
67	**4-Methylphenoxide ion**						
	$(SCN)_2^{\cdot -} + CH_3C_6H_4O^- \rightarrow$ 2 $SCN^- + CH_3C_6H_4O\cdot$	5.5×10^8	12.5		p.r.	P.b.k.; at pH 7 $k \approx 10^7$.	743052
68	**Metiazinic acid**						
	$(SCN)_2^{\cdot -} + MZ^- \rightarrow$ 2 SCN^- + $MZ\cdot$	2.6×10^9	10		p.r.	D.k. at 460 nm as well as p.b.k. at 270 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KSCN.	81A16
69	**Nicotinamide adenine dinucleotide, reduced**						
	$(SCN)_2^{\cdot -}$ + NADH → 2 SCN^- + $NAD^+ + H^+$	4.7×10^8		0.1	p.r.	D.k. in N_2O-satd. SCN^- soln.	710158
70	**4-Nitrophenoxide ion**						
	$(SCN)_2^{\cdot -} + NO_2C_6H_4O^- \rightarrow$ 2 $SCN^- + NO_2C_6H_4O\cdot$	3.9×10^7	12.5		p.r.	P.b.k.	743052
71	**Phenol**						
	$(SCN)_2^{\cdot -} + C_6H_5OH \rightarrow$ 2 SCN^- + $H^+ + C_6H_5O\cdot$	$\sim 1 \times 10^7$	8		p.r.	Value from graph.	741168
72	**Phenoxide ion**						
	$(SCN)_2^{\cdot -} + C_6H_5O^- \rightarrow$ 2 SCN^- + $C_6H_5O\cdot$	$\sim 3 \times 10^8$	12		p.r.	Value from graph	741168
		3.4×10^8	12.5		p.r.	P.b.k.	743052
73	**Phenylalanine**						
	$(SCN)_2^{\cdot -}$ + Phe →	$\leq 1 \times 10^6$	7.0	0.1	p.r.	D.k. in N_2O-satd. SCN^- soln.	720036
74	**Pheophytin *a***						
	$(SCN)_2^{\cdot -}$ + Ph a → 2 SCN^- + $[\text{Ph a}]^{\cdot +}$	$<1 \times 10^6$			p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} SCN^-.	81N14
75	**Promethazine**						
	$(SCN)_2^{\cdot -} + PZH^+ \rightarrow$ 2 SCN^- + $PZH^{\cdot 2+}$	1.9×10^9	3.5		p.r.	P.b.k. at 505 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KSCN; overall rate constant, 64% electron transfer.	83A27
76	**Propyl gallate**						
	$(SCN)_2^{\cdot -} + (HO)_3C_6H_2CO_2C_3H_7$ → 2 SCN^- + 2 H^+ + $\cdot O(O^-)(OH)C_6H_2CO_2C_3H_7$	1.2×10^9	~9		p.r.	D.k. in N_2O-satd. soln. contg. SCN^-.	85A49
77	**6,7,8,9-Tetrahydro-4-hydroxythiazolo[4,5-*h*]isoquinoline-7-carboxylate ion**						
	$(SCN)_2^{\cdot -} + THIC^{2-} \rightarrow$ 2 SCN^- + $THIC^{\cdot -}$	6.8×10^8	<12		p.r.	D.k. in alk. N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} KSCN.	84A024
78	**6,7,8,9-Tetrahydro-4-methoxythiazolo[4,5-*h*]isoquinoline-7-carboxylate ion**						
	$(SCN)_2^{\cdot -} + TMIC^- \rightarrow$ 2 SCN^- + $TMIC\cdot$	1×10^8	<12		p.r.	D.k. in alk. N_2O-satd. soln. contg. 5×10^{-2} mol L^{-1} KSCN.	84A024
79	***N,N,N',N'*-Tetramethyl-*p*-phenylenediamine**						
	$(SCN)_2^{\cdot -}$ + TMPD → 2 SCN^- + $TMPD^{\cdot +}$	3.1×10^9	7.5		p.r.	P.b.k. in N_2O-satd. soln. contg. 10^{2-} mol L^{-1} KCNS and 2×10^{-4} mol L^{-1} TMPD.	81A122
80	**2,2,6,6-Tetramethyl-4-piperidone *N*-oxyl**						
	$(SCN)_2^{\cdot -}$ + TAN →	1.0×10^9	5-6	0.1	p.r.	D.k. in 0.1 mol L^{-1} SCN^- soln.; at pH 2 and 12 $k = 1.1 \times 10^9$.	710618

TABLE 20. Rate constants for reactions of the dithiocyanate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
81	**Tetraphenylborate ion**						
	$(SCN)_2^{\cdot-} + Ph_4B^- \rightarrow 2\ SCN^- + Ph_4B\cdot$	2×10^6			p.r.	P.b.k.	86A469
82	**Thymine**						
	$(SCN)_2^{\cdot-}$ + 5-MeU $\rightarrow$	$\sim 1 \times 10^6$ $\sim 3 \times 10^7$	6-8 12		p.r.	Values from graph.	741168
83	**2',4',5'-Trihydroxybutyrophenone**						
	$(SCN)_2^{\cdot-} + (HO)_3C_6H_2COCH_2CH_2CH_3 \rightarrow$	5.2×10^8 1.3×10^9	5-7 ~9		p.r.	D.k. in N_2O-satd. soln. contg. SCN^-.	85A492
84	**2',4',6'-Trihydroxy-β-(4-hydroxyphenyl)-propiophenone**						
	$(SCN)_2^{\cdot-} + (HO)_3C_6H_2CO(CH_2)_2C_6H_4OH \rightarrow$	1.6×10^9	~9		p.r.	D.k. in N_2O-satd. soln. contg. SCN^-.	85A492
85	**2',4',5'-Trihydroxy-α-(4-methoxyphenyl)-acetophenone**						
	$(SCN)_2^{\cdot-} + (HO)_3C_6H_2COCH_2C_6H_4OCH_3 \rightarrow$	1.4×10^9	~9		p.r.	D.k. in N_2O-satd. soln. contg. SCN^-.	85A492
86	**Tryptophan**						
	$(SCN)_2^{\cdot-}$ + TrpH $\rightarrow 2\ SCN^-$ + Trp· + H^+	3.0×10^8	7		p.r.	D.k. at 500 nm in N_2O-satd. soln. contg.5 $\times 10^{-3}$ mol L^{-1} KSCN and 4-50 $\times 10^{-5}$ mol L^{-1} TrpH.	78A315
		2.7×10^8 4.6×10^8	7.0 11.2	0.1	p.r.	D.k. in N_2O-satd. SCN^- soln.; k increases with pH.	720036 731147
87	**Tyrosine**						
	$(SCN)_2^{\cdot-}$ + TyrOH $\rightarrow 2\ SCN^-$ + TyrO· + H^+	5×10^6 3.2×10^8	7.0 11.2	0.1	p.r.	D.k. in N_2O-satd. SCN^- soln.; k increases with pH.	720036 731147
88	**Albumin**						
	$(SCN)_2^{\cdot-}$ + Albumin $\rightarrow$	1×10^9	6.0	0.01	p.r.	D.k. in 10^{-2} mol L^{-1} SCN^- soln.; also detd. reactivity with alkyl sulfate complexes; bovine serum albumin; $k = 5 \times 10^8$ at pH 6.5 for human serum albumin; k increased at pH > 10.	761185
89	**Alcohol dehydrogenase**						
	$(SCN)_2^{\cdot-}$ + ALDH $\rightarrow$	9.6×10^8	7		p.r.	D.k.; enzyme from yeast; $k = 5.6 \times 10^8$ for horse liver enzyme.	78R007 741125
90	**Aldolase**						
	$(SCN)_2^{\cdot-}$ + ALD $\rightarrow$	$\sim 5 \times 10^9$ $\sim 3 \times 10^{10}$	7 ~11	0.1	p.r.	D.k. in SCN^- soln.; value from graph; k increases with pH.	753058
91	**D-Amino acid oxidase**						
	$(SCN)_2^{\cdot-}$ + DAAO $\rightarrow$	6.6×10^8	7		p.r.	D.k. in N_2O-satd. 0.05 mol L^{-1} SCN^- soln.; mol. wt. 50,000.	77A198
92	**Apocarbonic anhydrase**						
	$(SCN)_2^{\cdot-}$ + apo-CAHD $\rightarrow$	1.3×10^8 3.2×10^8	7.0 11.1		p.r.	D.k. in N_2O-satd. soln. contg. 5 $\times$ 10^{-5} mol L^{-1} EDTA and 10^{-4} mol L^{-1} KSCN, and 2.5 mg mL^{-1} enzyme.	81A300, 81A299
93	**Carbonic anhydrase**						
	$(SCN)_2^{\cdot-}$ + CAHD $\rightarrow$	2.9×10^8 9.5×10^7	7.0 11.1		p.r.	D.k. at 480 nm in N_2O-satd. soln. contg. 1 $\times 10^{-4}$ mol L^{-1} KSCN and 2.5 mg mL^{-1} enzyme (from beef blood); cor. for SCN^- binding of enzyme,	81A300, 81A299

TABLE 20. Rate constants for reactions of the dithiocyanate radical ion in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
93	**Carbonic anhydrase**—Continued						
		2.4×10^8			p.r.	D.k. in 0.1×10^{-3} mol L^{-1} SCN$^-$; Zn^{2+} enzyme	79A37
		$\sim 1.5 \times 10^8$ $\sim 7 \times 10^8$	7 11			N_2O-satd. soln. contg. 0.05 mol L^{-1} SCN$^-$ and Zn^{2+} (bovine) enzyme.	75309
94	**Carboxypeptidase A**						
	$(SCN)_2{\cdot}^- $ + CPD-A →	4×10^8 5×10^8 9×10^8 1×10^9	8 9 10 11		p.r.	D.k.; values from graph.	73106
95	**α-Chymotrypsin**						
	$(SCN)_2{\cdot}^-$ + α-Chymotrypsin →	9×10^8	6.7	0.04	p.r.	D.k. in N_2O-satd. 4×10^{-2} mol L^{-1} SCN$^-$ soln.; mol. wt. 20,000.	74109
96	**Cytochrome C (ferro)**						
	$(SCN)_2{\cdot}^-$ + Cyt C (Fe^{2+}) → 2 SCN$^-$ + Cyt C (Fe^{3+})	7.9×10^8	7-8	0.073	p.r.	D.k. at 504 $(SCN)_2{\cdot}^-$ or 450 or 550 nm (cyt) in N_2O-satd. soln.; 100% e-transfer.	81A06
97	**Glucoamylase I**						
	$(SCN)_2{\cdot}^-$ + Glu-I →				p.r.	D.k. at 500 nm; no reaction at pH 4,7,11	78A31
98	**Isocitrate dehydrogenase**						
	$(SCN)_2{\cdot}^-$ + ICDH →	3.4×10^8			p.r.	D.k. at 480 nm; enzyme from pig heart.	82A31
99	**Lactate dehydrogenase**						
	$(SCN)_2{\cdot}^-$ + LADH →	1.5×10^9	7.2	0.005	p.r.	[illegible]-satd. soln. contg. 5×10^{-3} mol [illegible] and 1.2×10^{-5} mol L^{-1} enzym[illegible] heart.	771132
100	**Lysozyme**						
	$(SCN)_2{\cdot}^-$ + Lys →	6.6×10^8	7	0.1	p.r.	D.k. in N_2O-satd. SCN$^-$ soln.; $k = 3.0 \times 10^8$ for lysozyme oxidized at Trp-108 (β-oxoindolylalanine).	693039
101	**Papain**						
	$(SCN)_2{\cdot}^-$ + Papain →	9.5×10^8 1.8×10^9	7 11.5		p.r.	D.k. in N_2O-satd. soln. contg. SCN$^-$ and activated enzyme.	741026
102	**Pepsin**						
	$(SCN)_2{\cdot}^-$ + Pepsin →	2.5×10^8	5.9		p.r.	D.k.	79A18
103	**Ribonuclease**						
	$(SCN)_2{\cdot}^-$ + RNase →	3.4×10^7	7	0.05	p.r.	D.k. in N_2O-satd. SCN$^-$ soln.; k increases at pH > 9.5.	720037
104	**Subtilisin**						
	$(SCN)_2{\cdot}^-$ + Subtilisin →	1×10^8	7		p.r.	D.k. in N_2O-satd. 0.04 mol L^{-1} SCN$^-$ soln.; k increases with pH in alk. soln.	731147 741119
105	**Trypsin**						
	$(SCN)_2{\cdot}^-$ + Tryp →	5.1×10^8 3.1×10^9	7-8 11.5	0.04	p.r.	D.k. in N_2O-satd. SCN$^-$ soln.	731067
106	**Trypsinogen**						
	$(SCN)_2{\cdot}^-$ + Trypsinogen →	2.6×10^8 3.6×10^9	7-8 12.1		p.r.	D.k. in N_2O-satd. SCN$^-$ soln.	731067

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Dichlorine radical ion**						
	$Cl_2{\cdot}^- + Cl_2{\cdot}^- \rightarrow Cl^- + Cl_3^-$	2.2×10^9	3		p.r.	D.k. at 340 nm in N_2O-satd. soln. contg. 1 mol L^{-1} NaCl; ϵ = 8100 L mol^{-1} cm^{-1}.	87A301
		1.9×10^9	0	1	p.r.	D.k. at 360 nm in 1 mol L^{-1} HCl soln. satd. with Cl_2; ϵ(360) = 8000 L mol^{-1} cm^{-1}; at 12 mol L^{-1} HCl k = 1.0×10^9.	84A462
		2.0×10^9	~1	0.2	p.r.	Calcd. fit to d.k. at 340 nm in O_2-satd. soln. contg. 0.05 mol L^{-1} Cl^- and 0.15 mol L^{-1} $HClO_4$; ϵ = 8800 L mol^{-1} cm^{-1}; assumed k($Cl_2{\cdot}^-$ + $HO_2{\cdot}$) = 1×10^9 [731039].	80A378
		8.5×10^9	7	0.2	p.r.	D.k. in Cl^- soln.; ϵ(340 nm) = 12,500 L mol^{-1} cm^{-1}; obs. change in [$Cl_2{\cdot}^-$] with dose.	771097
		6.5×10^9			p.r.	D.k. in Cl^- soln.; ϵ(340 nm) = 12,400 L mol^{-1} cm^{-1}.	761048
		3.3×10^9 2.2×10^9	7	1.5-8 12.5-14	p.r.	D.k. in 1.5-14 mol L^{-1} LiCl soln. at 340 nm; calcd. from obs. $2k/\epsilon$ = (5 to 8) $\times 10^5$ and ϵ = 8700 L mol^{-1} cm^{-1}.	751154
		9.0×10^9		~1	p.r.	D.k. in NaCl or HCl soln. assuming ϵ = 12,500 L mol^{-1} cm^{-1}.	741087
		~2×10^9 ~4.5×10^9	~7 ~7	~10 ~1	p.r.	D.k. in LiCl soln.; values from graph; k increased as concn. decreased.	741140
		2.6×10^9	1	0.2	f.p.	D.k. in $FeCl^{2+}$ soln. (10^{-3} mol L^{-1} Fe^{3+}, 0.1 mol L^{-1} H^+, 0.1 mol L^{-1} Cl^-); ϵ(366 nm) = 10,000 L mol^{-1} cm^{-1}.	737159
		6.0×10^9	1.9	0.1	p.r.	D.k.	723107
		7.0×10^9	3.1		p.r.	D.k. in N_2O-satd. Cl^- soln. assuming ϵ(360 nm) = 10,000 L mol^{-1} cm^{-1}; independent of pH 0.9 - 3.2.	680313
		7.0×10^9	1.1, 6	0.5	f.p.	D.k. in NaCl-$HClO_4$ soln.; assumed ϵ(350 nm) = 12,500 L mol^{-1} cm^{-1}.	677171
1a	**Americium(III) ion**						
	$Cl_2{\cdot}^- + Am^{3+} \rightarrow 2\ Cl^- +$ Am(IV)	3.2×10^5			p.r.	D.k. at 340 nm in N_2O-satd. soln. contg. 1 mol L^{-1} NaCl.	87A301
2	**Hexachlorobismuthate(III) ion**						
	$Cl_2{\cdot}^- + BiCl_6^{3-} \rightarrow 2\ Cl^- + BiCl_6^{2-}$	9×10^9	~0		p.r.	D.k. at 340 nm in 2×10^{-4} - 0.1 mol L^{-1} Bi(III) and hydrochloric acid (Cl^- 0.5-5 mol L^{-1}); Bi(III) complex ~60% hexachloro.	86A035
3	**Cerium(III) ion**						
	$Cl_2{\cdot}^- + Ce^{3+} \rightarrow 2\ Cl^- + Ce^{4+}$	~1×10^4				Estd. from G(Ce^{3+}) in Ce^{4+} soln. contg. 10 mol L^{-1} LiCl assuming k($Cl_2{\cdot}^-$ + $Cl_2{\cdot}^-$) = 2×10^9.	750440
4	**Chlorine dioxide**						
	$Cl_2{\cdot}^- + ClO_2{\cdot} \rightarrow$	1.0×10^9	5		f.p.	D.k. in ClO_2-Cl^- soln.	737043
5	**Cobalt(II) ion**						
	$Cl_2{\cdot}^- + Co^{2+} \rightarrow Cl^- + CoCl^{2+}$	2.3×10^6	~1		p.r.	D.k. as well as p.b.k. in soln. contg. 0.1 mol L^{-1} HCl; added 1.6 and 11 mol L^{-1} $HClO_4$ gave k = 2.1 and 4.3×10^6, resp.	84A438

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
5	**Cobalt(II) ion**—Continued						
		1.4×10^6	~1	0.3	f.p.	D.k. in Cl_3^- soln. (0.1 mol L^{-1} Cl^-, 0.005 mol L^{-1} Cl_2, 0.1 mol L^{-1} H^+) contg. 0.1-0.5 mol L^{-1} Co(II); $\Delta H\ddagger = 29$ kJ mol^{-1} and $\Delta S\ddagger = -31$ J K^{-1} mol^{-1} detd. at 13.5 to 41.5 °C; inner-sphere substitution.	737316
6	**Pentaaquachlorocobalt(II) ion**						
	$Cl_2^{\cdot -} + Co(H_2O)_5Cl^+ \rightarrow 2\ Cl^- + Co(H_2O)_5Cl^{2+}$	1.4×10^7	<1		p.r.	Calcd. from d.k. as well as p.b.k. in soln. contg. 0.1-12.9 mol L^{-1} HCl	84A438
7	**Tetraaqua(dichloro)cobalt(II)**						
	$Cl_2^{\cdot -} + Co(H_2O)_4Cl_2 \rightarrow 2\ Cl^- + Co(H_2O)_4Cl_2^+$	1.2×10^8	<1		p.r.	Calcd. from d.k. as well as p.b.k. in soln. contg. 0.1-12.9 mol L^{-1} HCl	84A438
8	**Tetrachlorocobaltate(II) ion**						
	$Cl_2^{\cdot -} + CoCl_4^{2-} \rightarrow 2\ Cl^- + CoCl_4^-$	2.2×10^9	<1		p.r.	D.k. as well as p.b.k. in soln. contg. 12.9 mol L^{-1} HCl	84A438
9	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecobalt(II) ion**						
	$Cl_2^{\cdot -} + Co(4,11\text{-dieneN}_4)^{2+} \rightarrow 2\ Cl^- + Co(4,11\text{-dieneN}_4)^{3+}$	1.0×10^9	1	1.1	f.p.	D.k.	727506
10	**Chromium(II) ion**						
	$Cl_2^{\cdot -} + Cr^{2+} \rightarrow 2\ Cl^- + Cr^{3+}$	2.4×10^9	1	0.2	p.r.	D.k. in deaerated Cl^- soln.; reaction 50% inner-sphere and 50% outer-sphere.	741104
11	**Copper(II) ion**						
	$Cl_2^{\cdot -} + Cu^{2+} \rightarrow$	$\leq 1.5 \times 10^8$			p.r.		751188
12	**1,4,8,11-Tetraazacyclotetradecanecopper(II) ion**						
	$Cl_2^{\cdot -} + Cu(cyclam)^{2+} \rightarrow Cl^- + ClCu(cyclam)^{2+}$	1.4×10^9	~0	~1	f.p.	P.b.k.; oxidant radical ion generated by photolysis of $Co(NH_3)_5Cl^{2+}$ in 1.0 mol L^{-1} $HClO_4$; [Cl^-] dependent.	83A271
13	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanecopper(II) ion**						
	$Cl_2^{\cdot -} + Cu(aneN_4)^{2+} \rightarrow Cl^- + ClCu(aneN_4)^{2+}$	1.4×10^9	~0	~1	f.p.	P.b.k.; oxidant radical ion generated by photolysis of $Co(NH_3)_5Cl^{2+}$ in 1.0 mol L^{-1} $HClO_4$; [Cl^-] dependent.	83A271
14	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecopper(II) ion**						
	$Cl_2^{\cdot -} + Cu(4,11\text{-dieneN}_4)^{2+} \rightarrow Cl^- + ClCu(4,11\text{-dieneN}_4)^{2+}$	1.5×10^8	~0	~1	f.p.	P.b.k.; *meso*-complex; oxidant radical ion generated by photolysis of $Co(NH_3)_5Cl^{2+}$ in 1.0 mol L^{-1} $HClO_4$.	83A271
15	**2,3,9,10-Tetramethyl-1,4,8,11-tetraazacyclotetradeca-1,3,8,10-tetraenecopper(II) ion**						
	$Cl_2^{\cdot -} + Cu(Me_4tetraeneN_4)^{2+} \rightarrow Cl^- + ClCu(Me_4tetraeneN_4)^{2+}$	1.9×10^7	~0	~1	f.p.	P.b.k.; oxidant radical ion generated by photolysis of $Co(NH_3)_5Cl^{2+}$ in 1.0 mol L^{-1} $HClO_4$; [Cl^-] dependent.	83A271
16	**Tetrakis(4-*N*-methylpyridyl)porphinatocopper(II) ion**						
	$Cl_2^{\cdot -} + CuTMpyP^{4+} \rightarrow 2\ Cl^- + [CuTMpyP]^{\cdot 5+}$	6.0×10^9	3.0		p.r.	D.k.	83C026
17	**Iron(II) ion**						
	$Cl_2^{\cdot -} + Fe^{2+} \rightarrow Cl^- + FeCl^{2+}$	1.4×10^7	1	0.1	p.r.	D.k. in soln. contg. 0.01 mol L^{-1} NaCl and 0.1 mol L^{-1} perchloric acid.	731039

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
17	**Iron(II) ion**—Continued						
		1.4×10^7	1	0.2	f.p.	D.k. in $FeCl^{2+}$ soln. (10^{-3} mol L^{-1} Fe^{3+}, 0.1 mol L^{-1} H^+, 0.1 mol L^{-1} Cl^-) in presence of Fe^{2+}; overall rate, inner-sphere = 4.0×10^6 ($\Delta H\ddagger$ = 31.5 kJ mol^{-1}, $\Delta S\ddagger = -21$ J K^{-1} mol^{-1}), outer-sphere = 1.0×10^7 ($\Delta H\ddagger$ = 22.7 kJ mol^{-1}, $\Delta S\ddagger$ = -42 J K^{-1} mol^{-1}).	737159
		3.8×10^7	2.1	0.04	p.r.	D.k.	680313
18	**Tetrachloroferrate(II) ion**						
	$Cl_2\cdot^- + FeCl_4^{2-} \rightarrow 2\ Cl^- + FeCl_4^-$	4×10^9	<1		p.r.	D.k. as well as p.b.k. in soln. contg. 11 mol L^{-1} HCl	84A438
		1.6×10^8	<1		p.r.	D.k. at 360 nm in 6 mol L^{-1} HCl; Fe-chloro complex	84A462
19	**Tris(1,10-phenanthroline)iron(III) ion**						
	$Cl_2\cdot^- + Fe(phen)_3^{3+} \rightarrow$	$<1 \times 10^7$			p.r.	No reaction	85A284
20	**Hydrogen atom**						
	$Cl_2\cdot^- + H\cdot \rightarrow 2\ Cl^- + H^+$	8.0×10^9	3		p.r.	D.k. at 340 nm in He-satd. soln. contg. 1 mol L^{-1} NaCl; ϵ = 8100 L mol^{-1} cm^{-1}; by kinetic modeling.	87A301
		$\sim 7 \times 10^9$	~1	0.2	p.r.	Calcd. fit to d.k. at 340 nm in Ar-satd. soln. contg. 0.05 mol L^{-1} Cl^- and 0.15 mol L^{-1} $HClO_4$; assumed $G(Cl_2\cdot^-) = 2.9$, $G(H\cdot) = 3.7$, $2k(Cl_2\cdot^- + Cl_2\cdot^-) = 4 \times 10^9$, $2k(H\cdot + H\cdot) = 2.2 \times 10^{10}$.	80A378
21	**Manganese(II) ion**						
	$Cl_2\cdot^- + Mn^{2+} \rightarrow 2\ Cl^- + Mn^{3+}$	8.5×10^6	1	0.25	f.p.	D.k. in Cl_3^- soln. (0.1 mol L^{-1} Cl^-, 0.005 mol L^{-1} Cl_2, 0.1 mol L^{-1} H^+) contg. 0.001-0.02 mol L^{-1} Mn^{2+}; E_a = 34 kJ mol^{-1} (16 to 40°C); inner-sphere electron transfer ($\Delta H\ddagger$ = 32 kJ mol^{-1}, $\Delta S\ddagger = -4$ J K^{-1} mol^{-1}),	737317
22	**Tetrachloromanganate(II) ion**						
	$Cl_2\cdot^- + MnCl_4^{2-} \rightarrow 2\ Cl^- + MnCl_4^-$	9×10^8			p.r.	D.k. as well as p.b.k. in soln. contg. 11 mol L^{-1} HCl	84A438
23	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatomanganese(II) ion**						
	$Cl_2\cdot^- + MnTMpyP^{4+} \rightarrow Cl^- + [ClMnTMpyP]\cdot^{4+}$	1.5×10^{10}	4.0		p.r.	D.k. as well as p.b.k.	84A120
24	**5,10,15,20-Tetrakis(4-pyridyl)porphinatomanganese(III) ion**						
	$Cl_2\cdot^- + MnTpyP^+ \rightarrow 2\ Cl^- + [MnTpyP]\cdot^{2+}$	1.0×10^{10}	3.0		p.r.	D.k. as well as p.b.k.	84A120
25	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatomanganese(III) ion**						
	$Cl_2\cdot^- + MnTMpyP^{5+} \rightarrow 2\ Cl^- + [MnTMpyP]\cdot^{6+}$	1.5×10^9	3.0		p.r.	D.k. as well as p.b.k.	84A120
26	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatomanganate(III) ion**						
	$Cl_2\cdot^- + MnTPPS^{3-} \rightarrow 2\ Cl^- + [MnTPPS]\cdot^{2-}$	2.1×10^9	3.0		p.r.	D.k. as well as p.b.k.	84A120
27	**Azide ion**						
	$Cl_2\cdot^- + N_3^- \rightarrow 2\ Cl^- + \cdot N_3$	1.2×10^9	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
28	**Hydrazinium ion**						
	$Cl_2^{\cdot-} + H_2NNH_3^+ \rightarrow$	8.0×10^6	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
		1.4×10^7	6.8				
29	**Hydroxylamine**						
	$Cl_2^{\cdot-} + NH_2OH \rightarrow$	9.3×10^6	6.7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
30	**Hydroxylammonium ion**						
	$Cl_2^{\cdot-} + NH_3OH^+ \rightarrow$	$<1 \times 10^5$	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
31	**Nitrite ion**						
	$Cl_2^{\cdot-} + NO_2^- \rightarrow 2\ Cl^- + NO_2^{\cdot}$	2.5×10^8	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
32	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion**						
	$Cl_2^{\cdot-}$ + Ni(aneN$_4$)$^{2+}$ $\rightarrow$ 2 Cl^- + Ni(aneN$_4$)$^{3+}$	2.0×10^9	2	~0.02	p.r.	D.k. in 0.005 - 0.01 mol L^{-1} Cl^- soln.	78A299
33	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienenickel(II) ion**						
	$Cl_2^{\cdot-}$ + Ni(4,11-dieneN$_4$)$^{2+}$ $\rightarrow$ 2 Cl^- + Ni(4,11-dieneN$_4$)$^{3+}$	9.6×10^9	2	~0.02	p.r.	D.k. in 0.005 - 0.01 mol L^{-1} Cl^- soln.	78A299
34	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-1,4,8,11-tetraenenickel(II) ion**						
	$Cl_2^{\cdot-}$ + Ni(tetraeneN$_4$)$^{2+}$ $\rightarrow$ 2 Cl^- + Ni(tetraeneN$_4$)$^{3+}$	8.7×10^9	2	~0.02	p.r.	D.k. in 0.005 - 0.01 mol L^{-1} Cl^- soln.	78A299
35	**Dioxoneptunium(V) ion**						
	$Cl_2^{\cdot-} + NpO_2^+ \rightarrow 2\ Cl^- + NpO_2^{2+}$	2.4×10^6	3		p.r.	D.k. at 340 nm in N_2O-satd. soln. contg. 1 mol L^{-1} NaCl.	87A301
		3.1×10^6	~0		p.r.	D.k. at 420 nm in soln. contg. 1 mol L^{-1} HCl; values were determined in solutions with 0.5-3 mol L^{-1} HCl and added salts.	86A370
37	**Hydrogen peroxide**						
	$Cl_2^{\cdot-} + H_2O_2 \rightarrow$	1.4×10^5	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
38	**Perhydroxyl radical**						
	$Cl_2^{\cdot-} + HO_2^{\cdot} \rightarrow 2\ Cl^- + H^+ + O_2$	$\sim 3 \times 10^9$			p.r.	D.k. in concd. HCl soln. contg. oxygen assuming $[Cl_2^{\cdot-}] = [HO_2^{\cdot}]$	84A462
		1.0×10^9	~1	0.2	p.r.	Calcd. fit to d.k. at 340 nm in O_2-satd. soln. contg. 0.05 mol L^{-1} Cl^- and 0.15 mol L^{-1} $HClO_4$; $G(Cl_2^{\cdot-})$ = 2.9, $G(HO_2^{\cdot})$ = 3.7; assumed $2k(Cl_2^{\cdot-} + Cl_2^{\cdot-}) = 4 \times 10^9$.	80A378 81A227
		4.5×10^9	~0.4	0.5	p.r.	Calcd. from effect of Cl^- on $G(Fe^{3+})$ in air-satd. Fe^{2+} soln.	771170
39	**Superoxide radical ion**						
	$Cl_2^{\cdot-} + O_2^{\cdot-} \rightarrow 2\ Cl^- + O_2$	$\leq 2 \times 10^9$			p.r.	D.k. in O_2-satd. 1.3 and 5 mol L^{-1} LiCl soln. compared with deaerated soln.	741149
40	**(Aqua)pentachloroosmate(IV) ion**						
	$Cl_2^{\cdot-} + OsCl_5(H_2O)^- \rightarrow 2\ Cl^- + OsCl_5(H_2O)$	4.3×10^7	1	0.1	p.r.	P.b.k. at 500 nm in soln. contg. 0.1 mol L^{-1} HCl; in 1 mol L^{-1} HCl k = 2.0×10^8 for Os^{IV}.	77A219
41	**Hexachloroosmate(IV) ion**						
	$Cl_2^{\cdot-} + OsCl_6^{2-} \rightarrow 2\ Cl^- + OsCl_6^-$	3.2×10^8	<0	~5	p.r.	P.b.k. at 450 nm in 5 mol L^{-1} HCl.	77A219

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
42	**Lead(II)**						
	$Cl_2\cdot^- + Pb(II) \rightarrow 2\ Cl^- + Pb(III)$	1.4×10^9 $\sim 1 \times 10^9$	<0 ~ 0	~ 11 ~ 1	p.r.	P.b.k. at 450 nm in 11 (or 1) mol L^{-1} HCl; lead ions exist as chloro complexes.	84A446
43	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatopalladium(II) ion**						
	$Cl_2\cdot^- + PdTMpyP^{4+} \rightarrow 2\ Cl^- + [PdTMpyP]\cdot^{5+}$	3.2×10^9	3.0		p.r.	D.k.	83C026
44	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatopalladate(II) ion**						
	$Cl_2\cdot^- + PdTPPS^{4-} \rightarrow 2\ Cl^- + [PdTPPS]\cdot^{3-}$	5.0×10^8	2.0		p.r.	D.k.	83C026
45	**Tetraammineplatinum(II) ion**						
	$Cl_2\cdot^- + Pt(NH_3)_4{}^{2+} \rightarrow 2\ Cl^- + Pt(NH_3)_4{}^{3+}$	9×10^9	~ 0.3	~ 0.5	p.r.	D.k. at 340-380 nm, as well as p.b.k. at 260-305 nm in He-satd. 0.5 mol L^{-1} HCl soln.; product may be Pt(III) chloro species	86A017 86A082
46	**Bis(ethylenediamine)platinum(II) ion**						
	$Cl_2\cdot^- + Pt(en)_2{}^{2+} \rightarrow 2\ Cl^- + Pt(en)_2{}^{3+}$	8.9×10^9	~ 0.3	~ 0.5	p.r.	D.k. in 0.5 mol L^{-1} HCl; transient with ϵ(280 nm) = 15,900 L mol^{-1} cm^{-1} was formed.	751188
47	**Chloro(diethylenetriamine)platinum(II) ion**						
	$Cl_2\cdot^- + Pt(dien)Cl^+ \rightarrow 2\ Cl^- + Pt(dien)Cl^{2+}$	6.4×10^9	~ 0.3	~ 0.5	p.r.	D.k. in 0.5 mol L^{-1} HCl; transient with ϵ(280 nm) = 17,000 L mol^{-1} cm^{-1} was formed.	751188
48	**Chloro(tetraethyldiethylenetriamine)platinum(II) ion**						
	$Cl_2\cdot^- + Pt(Et_4dien)Cl^+ \rightarrow 2\ Cl^- + Pt(Et_4dien)Cl^{2+}$	4.2×10^8	~ 0.3	~ 0.5	p.r.	D.k. in 0.5 mol L^{-1} HCl; transient with ϵ(290 nm) = 7240 L mol^{-1} cm^{-1} was formed.	751188
49	**Tetrachloroplatinate(II) ion**						
	$Cl_2\cdot^- + PtCl_4{}^{2-} \rightarrow 2\ Cl^- + PtCl_4{}^-$	1.6×10^9	~ 1		p.r.	D.k. in 0.1 mol L^{-1} HCl soln.; 1.0 mol L^{-1} NaCl soln. gave $k = 1.25 \times 10^9$.	761055
		1.1×10^9	~ 0.3	~ 0.5	p.r.	D.k. in 0.5 mol L^{-1} HCl; transient with ϵ(260 nm) $\approx$ 13,000 L mol^{-1} cm^{-1} was formed (Pt^{III}).	751188
49a	**Plutonium(III) ion**						
	$Cl_2\cdot^- + Pu^{3+} \rightarrow 2\ Cl^- + Pu(IV)$	4.8×10^7			p.r.	D.k. at 340 nm in N_2O-satd. soln. contg. 1 mol L^{-1} NaCl.	87A301
50	**Tris(2,2'-bipyridine)ruthenium(II) ion**						
	$Cl_2\cdot^- + Ru(bpy)_3{}^{2+} \rightarrow 2\ Cl^- + Ru(bpy)_3{}^{3+}$	1.6×10^9	3		p.r.	D.k. at 340 nm (as well as d.k. at 450 nm) in soln. contg. 10^{-3} mol L^{-1} HCl and 8.0 mol L^{-1} LiCl.	86A044
51	**Hexachlororuthenate(III) ion**						
	$Cl_2\cdot^- + RuCl_6{}^{3-} \rightarrow 2\ Cl^- + RuCl_6{}^{2-}$	3.1×10^9			p.r.	D.k. at 360 nm as well as p.b.k. at 485 nm in soln. contg. 10 mol L^{-1} HCl.	80A114
52	**Thiocyanate ion**						
	$Cl_2\cdot^- + SCN^- \rightarrow 2\ Cl^- + SCN\cdot$	2.9×10^9	2.6		p.r.	D.k. in N_2O-satd. 6×10^{-3} mol L^{-1} Cl^- soln.; addn. of 0.1 mol L^{-1} $NaClO_4$ gave $k = 3.7 \times 10^9$; product is $(SCN)_2\cdot^-$ detd. by absorption spectrum; $K(ClSCN^- + SCN^-) \rightleftharpoons Cl^- + (SCN)_2\cdot^-) = 3.0 \times 10^4$.	690565

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
53	**Hydrogen sulfite ion**						
	$Cl_2^{\cdot -} + HSO_3^- \rightarrow 2\ Cl^- + SO_3^- + H^+$	3.4×10^8	3	0.1	p.r.	D.k. in soln. contg. 0.1 mol L^{-1} Cl^-.	87A319
54	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatostannate(IV) ion**						
	$Cl_2^{\cdot -} + SnTPPS^{2-} \rightarrow 2\ Cl^- + [SnTPPS]^{\cdot -}$	4.4×10^8	2.0		p.r.	D.k.	83C026
55	**Titanium(III) ions**						
	$Cl_2^{\cdot -} + Ti(III) \rightarrow 2\ Cl^- + Ti(IV)$	$\sim 4 \times 10^8$	~1.7		p.r.	D.k. at 380 nm in 0.02 mol L^{-1} HCl contg. formic acid.	731057
56	**Thallium(I) ion**						
	$Cl_2^{\cdot -} + Tl^+ \rightarrow 2\ Cl^- + Tl^{2+}$	5×10^9	0	1	p.r.	P.b.k. at 260 nm in 1 mol L^{-1} HCl soln.	741038
56a	**Uranium(III) ion**						
	$Cl_2^{\cdot -} + U^{3+} \rightarrow UCl^{3+} + Cl^-$	4.2×10^9	<1		p.r.	D.k. in He-satd. soln. contg. 0.5 mol L^{-1} $HClO_4$ contg.	85A122
56b	**Uranyl(V) ion**						
	$Cl_2^{\cdot -} + UO_2^+ \rightarrow 2\ Cl^- + UO_2^{2+}$	6.5×10^8	3		p.r.	D.k. at 340 nm in He-satd. soln. contg. 1 mol L^{-1} NaCl; by kinetic modeling; U(V) from reduction of U(VI) by hydrated electrons.	87A301
57	**Vanadium(II) ion**						
	$Cl_2^{\cdot -} + V^{2+} \rightarrow 2\ Cl^- + V^{3+}$	2.0×10^9	1	0.2	p.r.	D.k. in deaerated Cl^- soln.; outer-sphere electron transfer.	741104
58	**Vanadyl(IV) ion**						
	$Cl_2^{\cdot -} + HVO^{3+} \rightarrow 2\ Cl^- + H^+ + VO^{3+}$	1×10^6	<0	2	p.r.	2 mol L^{-1} H^+ ($HClO_4$ + HCl); see Fig. 1 for increase of k to 2×10^8 as $[H^+]$ increases to 12 mol L^{-1}	85A338
59	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatozinc(II) ion**						
	$Cl_2^{\cdot -} + ZnTMpyP^{4+} \rightarrow 2\ Cl^- + [ZnTMpyP]^{\cdot 5+}$	$\sim 1 \times 10^{10}$	3.2	0.10	p.r.	P.b.k. at 690-700 nm in N_2O-satd. buffered soln. contg. NaCl and (1-4) $\times 10^{-4}$ mol L^{-1} porphyrin; the π-radical cation complexes with Cl^-.	85A038
60	**Acetanilide**						
	$Cl_2^{\cdot -} + C_6H_5NHCOCH_3 \rightarrow$	$\sim 2.0 \times 10^7$	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
61	**Acetic acid**						
	$Cl_2^{\cdot -} + CH_3CO_2H \rightarrow$	$<1 \times 10^4$	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
62	**Acetone**						
	$Cl_2^{\cdot -} + CH_3COCH_3 \rightarrow$	1.4×10^3	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
63	**Acriflavine (3,6-Diamino-10-methylacridinium)**						
	$Cl_2^{\cdot -} + ACFl^+ \rightarrow$	$\sim 4 \times 10^9$		1	p.r.	D.k. at 450 nm (dye) in N_2O-satd. 1 mol L^{-1} KCl soln.	700241
64	**Acrylate ion**						
	$Cl_2^{\cdot -} + CH_2{=}CHCO_2^- \rightarrow$	1.9×10^7	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
65	**Acrylic acid**						
	$Cl_2^{\cdot -} + H_2C{=}CHCO_2H \rightarrow$	5.4×10^6	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
66	**Acrylonitrile**						
	$Cl_2\cdot^- + H_2C{=}CHCN \rightarrow$	2.2×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
67	**Adenine**						
	$Cl_2\cdot^- + A \rightarrow$	$<5 \times 10^6$	2.7		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
68	**Alanine**						
	$Cl_2\cdot^- + Ala \rightarrow$	1.3×10^5	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
69	**Allyl alcohol**						
	$Cl_2\cdot^- + H_2C{=}CHCH_2OH \rightarrow$	5.9×10^8	1,7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.; at pH 7 $Cl_2\cdot^-$ was generated by SO_4^- from $S_2O_8^{2-}$.	78A093
70	**4-Aminobenzoate ion**						
	$Cl_2\cdot^- + H_2NC_6H_4CO_2^- \rightarrow 2\ Cl^- + H\dot{N}C_6H_4CO_2^- + H^+$	1.1×10^9	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
71	**4-Aminobenzoic acid**						
	$Cl_2\cdot^- + H_3N^+C_6H_4CO_2H \rightarrow$	2.2×10^7	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
72	**Anilinium ion**						
	$Cl_2\cdot^- + C_6H_5NH_3^+ \rightarrow 2\ Cl^- + H^+ + C_6H_5\dot{N}H_2^+$	1.2×10^7	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
73	**Anthraquinone-2,6-disulfonate radical ion**						
	$Cl_2\cdot^- + [(SO_3)_2AQ]\cdot^{3-} \rightarrow 2\ Cl^- + (SO_3)_2AQ^{2-}$	6.5×10^8	8.0		f.p.	D.k.	737569
74	**Ascorbic acid**						
	$Cl_2\cdot^- + AH_2 \rightarrow 2\ Cl^- + 2\ H^+ + A\cdot^-$	6.0×10^8	2		p.r.	D.k. in N_2O-satd. 0.5 mol L^{-1} Cl$^-$ soln.	733006
		6.8×10^8	2		p.r.		720266
75	**Benzenesulfonate ion**						
	$Cl_2\cdot^- + C_6H_5SO_3^- \rightarrow$	$<1 \times 10^5$	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
76	**Benzoate ion**						
	$Cl_2\cdot^- + C_6H_5CO_2^- \rightarrow$	2×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
77	**Benzonitrile**						
	$Cl_2\cdot^- + C_6H_5CN \rightarrow$	$<1 \times 10^5$	1,7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.; at pH 7 $Cl_2\cdot^-$ was generated by SO_4^- from $S_2O_8^{2-}$.	78A093
78	**4-Bromobenzoate ion**						
	$Cl_2\cdot^- + BrC_6H_4CO_2^- \rightarrow$	7×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
79	**4-Chlorobenzoate ion**						
	$Cl_2\cdot^- + ClC_6H_4CO_2^- \rightarrow$	3×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
80	**5-Chlorouracil**						
	$Cl_2\cdot^- + 5\text{-}ClU \rightarrow$	1.0×10^7	2.0		p.r.	D.k. in 0.01 mol L^{-1} NaCl soln.	723107
81	**Chlorpromazine**						
	$Cl_2\cdot^- + CZ \rightarrow 2\ Cl^- + CZ\cdot^+$	5×10^9	1-2		p.r.	D.k. in N_2O-satd. soln. contg. Cl$^-$.	73A150
82	**4-Cyanobenzoate ion**						
	$Cl_2\cdot^- + NCC_6H_4CO_2^- \rightarrow$	5×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
83	**4-Cyanophenol**						
	$Cl_2\cdot^- + NCC_6H_4OH \rightarrow 2\ Cl^- + H^+ + NCC_6H_4O\cdot$	4.0×10^7	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
84	**Cysteamine**						
	$Cl_2\cdot^- + H_3N^+CH_2CH_2S^- \rightarrow$	2×10^9	1-2		p.r.	D.k. in N$_2$O-satd. soln. contg. Cl$^-$.	73A150
85	**Cysteine**						
	$Cl_2\cdot^- + CysSH \rightarrow$	8.5×10^8	1.8		p.r.	D.k. in 0.1 mol L^{-1} Cl$^-$ soln.	720036
86	**Cytidine**						
	$Cl_2\cdot^- + C_9H_{13}N_3O_5 \rightarrow$	4×10^6	2.0		p.r.	D.k. in 0.01 mol L^{-1} NaCl soln.	723107
87	**Cytosine**						
	$Cl_2\cdot^- + Cy \rightarrow$	1.0×10^7	2.0		p.r.	D.k. in 0.01 mol L^{-1} NaCl soln.	723107
		9.1×10^7	2.7		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
88	**2'-Deoxyadenosine 5'-monophosphate**						
	$Cl_2\cdot^- + dAMP \rightarrow$	$<5 \times 10^6$	2.7		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
89	**2'-Deoxycytidine-5'-monophosphate**						
	$Cl_2\cdot^- + dCMP \rightarrow$	$<5 \times 10^6$	2.7		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
90	**Deoxyguanosine 5'-monophosphate**						
	$Cl_2\cdot^- + dGMP \rightarrow$	1.2×10^8	2.7		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
91	**Diethyl sulfide**						
	$Cl_2\cdot^- + (C_2H_5)_2S \rightarrow Cl^- + (C_2H_5)_2SCl$	4.7×10^9	<3		p.r.	D.k. as well as p.b.k. at 390 nm in N$_2$O-satd. soln. contg. 0.1 mol L^{-1} Cl$^-$.	80A377
92	**2,3-Dihydroxy-2-propenal**						
	$Cl_2\cdot^- + TRH_2 \rightarrow 2\ Cl^- + 2\ H^+ + TR\cdot^-$	1.1×10^9			p.r.	D.k. at 340 nm; pK_a = 5.0, 13.0; pK_a (radical) = 1.4.	85A392
93	**1,1'-Dimethyl-4,4'-bipyridinium radical ion (1+)**						
	$Cl_2\cdot^- + MV\cdot^+ \rightarrow 2\ Cl^- + MV^{2+}$	$>1 \times 10^{10}$	7		f.p.	D.k.; reencounter after photolysis of methyl viologen dichloride	84A338
94	**Dimethyl sulfide**						
	$Cl_2\cdot^- + (CH_3)_2S \rightarrow Cl^- + (CH_3)_2SCl$	3.0×10^9	<3		p.r.	D.k. as well as p.b.k. at 390 nm in N$_2$O-satd. soln. contg. 0.1 mol L^{-1} Cl$^-$.	80A377
95	**Dithiothreitol**						
	$Cl_2\cdot^- + DTT \rightarrow$	3.0×10^9	2		p.r.	D.k.	731020
96	**Dodecylsulfate ion**						
	$Cl_2\cdot^- + CH_3(CH_2)_{11}OSO_3^- \rightarrow$	3.9×10^6	2.0		p.r.	D.k. in 0.5 mol L^{-1} NaCl soln.	723107
97	**Ethanol**						
	$Cl_2\cdot^- + C_2H_5OH \rightarrow$	4.5×10^4	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
98	**Formate ion**						
	$Cl_2\cdot^- + HCO_2^- \rightarrow H^+ + 2\ Cl^- + \cdot CO_2^-$	1.9×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. S$_2$O$_8^{2-}$.	78A093
99	**Formic acid**						
	$Cl_2\cdot^- + HCO_2H \rightarrow$	6.7×10^3	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.; obs. k contains substantial contribution from formate ion.	78A093

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
100	**Fumarate ion**						
	$Cl_2^{\cdot -}$ + *trans*-$^{-}O_2CCH{=}CHCO_2^{-}$ →	4×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$; adduct radical obs. by esr [755244].	78A093
101	**Fumarate ion, hydrogen**						
	$Cl_2^{\cdot -}$ + *trans*-$HO_2CCH{=}CHCO_2^{-}$ →	2.4×10^6	3.7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
102	**Fumaric acid**						
	$Cl_2^{\cdot -}$ + $HO_2CCH{=}CHCO_2H$ →	$\sim 2 \times 10^5$	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
103	**Glutamic acid**						
	$Cl_2^{\cdot -}$ + Glu →	2.3×10^5	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
104	**Glycine**						
	$Cl_2^{\cdot -}$ + Gly →	$\sim 5 \times 10^6$ $<10^4$	9.8 1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.; at pH 9.8 $Cl_2^{\cdot -}$ generated by SO_4^{-} from $S_2O_8^{2-}$.	78A093
105	**Guanine**						
	$Cl_2^{\cdot -}$ + G →	8.1×10^7	2.3		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
106	**Hexadecyltrimethylammonium chloride**						
	$Cl_2^{\cdot -}$ + $CH_3(CH_2)_{15}N(Cl)(CH_3)_3$ →	1.2×10^7	2.0		p.r.	D.k. in 0.01 mol L^{-1} HCl soln.	723107
107	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene**						
	$Cl_2^{\cdot -}$ + 4,11-diene →	3×10^7	3		p.r.	D.k.	79A038
108	**3-Hexene-1,6-dioate ion**						
	$Cl_2^{\cdot -}$ + $^{-}O_2CCH_2CH{=}CHCH_2CO_2^{-}$ →	1.6×10^8	7	~1	p.r.	D.k. in mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
109	**Histidine**						
	$Cl_2^{\cdot -}$ + His →	1.4×10^7	1.8		p.r.	D.k. in 0.1 mol L^{-1} Cl^- soln.	720036
110	**Hydroquinone**						
	$Cl_2^{\cdot -}$ + $C_6H_4(OH)_2$ → 2 Cl^- + H^+ + $HOC_6H_4O\cdot$	1.4×10^9	1	~1	p.r.	D.k. in 0.1 mol L^{-1} Cl^- soln.	78A093
		1×10^9	1-2		p.r.	D.k. in N_2O-satd. soln. contg. Cl^-.	73A150
		1.5×10^9	9.5	~1	p.r.	D.k. in 0.1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
111	**4-Hydroxybenzoate ion**						
	$Cl_2^{\cdot -}$ + $HOC_6H_4CO_2^{-}$ → 2 Cl^- + H^+ + $^{-}O_2CC_6H_4O\cdot$	2.8×10^8	7	~1	p.r.	D.k. in 0.1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$; product radical obs. by esr.	78A093
112	**4-Hydroxybenzoic acid**						
	$Cl_2^{\cdot -}$ + $HOC_6H_4CO_2H$ → 2 Cl^- + H^+ + $\cdot OC_6H_4CO_2H$	1.3×10^8	3.1	~1	p.r.	D.k. in 0.1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
		1.1×10^8	1	~1	p.r.	D.k. in 0.1 mol L^{-1} Cl^- soln.	78A093
113	**4-Hydroxycinnamic acid**						
	$Cl_2^{\cdot -}$ + $HOC_6H_4CH{=}CHCO_2H$ → 2 Cl^- + H^+ + $\cdot OC_6H_4CH{=}CHCO_2H$	2.9×10^8	2.9		p.r.	P.b.k. at 595 nm in N_2O-satd. soln. contg. 1 mol L^{-1} Cl^-.	84A206
114	**Inosine**						
	$Cl_2^{\cdot -}$ + Ino →	$<1 \times 10^7$	1-2		p.r.	D.k. in N_2O-satd. soln. contg. Cl^-.	73A150

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
115	**Maleate ion**						
	$Cl_2^{\cdot-} + {}^-O_2CCH{=}CHCO_2^- \rightarrow$	3×10^6	6.5	~1	p.r.	D.k. in 0.1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
116	**Methanol**						
	$Cl_2^{\cdot-} + CH_3OH \rightarrow$	3.5×10^3	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
117	**Methionine, conjugate acid**						
	$Cl_2^{\cdot-} + MetH^+ \rightarrow Cl^- + CH_3\dot{S}(Cl)CH_2CH_2CH(NH_3^+)CO_2H$	3.9×10^9	1		p.r.	D.k. in soln. contg. 0.1 mol L^{-1} Cl$^-$ and 10^{-4}-10^{-3} mol L^{-1} methionine.	81A339
118	**4-Methoxybenzoate ion**						
	$Cl_2^{\cdot-} + CH_3OC_6H_4CO_2^- \rightarrow 2\ Cl^- + [CH_3OC_6H_4CO_2]\cdot$	2.0×10^8	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$; product radical identified by optical p.r.	78A093
119	**4-Methoxyphenol**						
	$Cl_2^{\cdot-} + CH_3OC_6H_4OH \rightarrow 2\ Cl^- + H^+ + CH_3OC_6H_4O\cdot$	1.1×10^9	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
120	**2-Methyl-2-propanol**						
	$Cl_2^{\cdot-} + (CH_3)_3COH \rightarrow$	$\sim 7 \times 10^2$	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
121	**Muconate ion**						
	$Cl_2^{\cdot-} + {}^-O_2CCH{=}CHCH{=}CHCO_2^- \rightarrow$	2.1×10^8	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
122	**Phenol**						
	$Cl_2^{\cdot-} + C_6H_5OH \rightarrow 2\ Cl^- + H^+ + C_6H_5O\cdot$	2.5×10^8	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
		5×10^8	1-2		p.r.	D.k. in N_2O-satd. soln. contg. Cl$^-$.	73A150
123	**4-Phenoxybenzoate ion**						
	$Cl_2^{\cdot-} + C_6H_5OC_6H_4CO_2^- \rightarrow 2\ Cl^- + [C_6H_5OC_6H_4CO_2]\cdot$	1.5×10^8	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
124	**Phenylalanine**						
	$Cl_2^{\cdot-}$ + Phe $\rightarrow$	6×10^6	1.8		p.r.	D.k. in 0.1 mol L^{-1} Cl$^-$ soln.	720036
125	***p*-Phthalate ion**						
	$Cl_2^{\cdot-} + C_6H_4(CO_2^-)_2 \rightarrow$	6×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln. contg. $S_2O_8^{2-}$.	78A093
126	**Polyoxyethylene(15) *p*-nonylphenyl ether**						
	$Cl_2^{\cdot-} + C_9H_{19}C_6H_4(OCH_2CH_2)_{15}OH \rightarrow$	2.1×10^8	2.0		p.r.	D.k. in 0.01 mol L^{-1} NaCl soln.	723107
127	**Promethazine (10-(2-Methyl-2-dimethylaminoethyl)phenothiazine)**						
	$Cl_2^{\cdot-}$ + PZ $\rightarrow$ 2 Cl$^-$ + PZ$\cdot^+$	5×10^9	1-2		p.r.	D.k. in N_2O-satd. soln. contg. Cl$^-$.	73A150
128	**2-Propanol**						
	$Cl_2^{\cdot-} + (CH_3)_2CHOH \rightarrow 2\ Cl^- + H^+ + (CH_3)_2\dot{C}OH$	1.5×10^5	1		f.p.	D.k. at 365 nm in soln. contg. 0.008 mol L^{-1} TiO_2 and 0.1 mol L^{-1} HCl with 2.5-20% 2-PrOH.	82N025
		1.2×10^5	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093
		1.9×10^5	~0.3	~0.5	p.r.	D.k. in 0.5 mol L^{-1} HCl.	751188
129	**Propionic acid**						
	$Cl_2^{\cdot-} + C_2H_5CO_2H \rightarrow$	2.2×10^3	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl$^-$ soln.	78A093

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
130	**Propyl gallate**						
	$Cl_2^{\cdot-} + (HO)_3C_6H_2CO_2C_3H_7 \rightarrow$ 2 $Cl^- + H^+ + \cdot O(HO)_2C_6H_2CO_2C_3H_7$	2×10^9	1-2		p.r.	D.k. in N_2O-satd. soln. contg. Cl^-.	73A150
131	**Salicylic acid**						
	$Cl_2^{\cdot-} + HOC_6H_4CO_2H \rightarrow 2\ Cl^- + H^+ + \cdot OC_6H_4CO_2H$	1.1×10^8	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
132	**Serine**						
	$Cl_2^{\cdot-}$ + Ser $\rightarrow$	1.2×10^5	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
133	**Sorbate ion**						
	$Cl_2^{\cdot-} + CH_3CH{=}CHCH{=}CHCO_2^- \rightarrow$	6.8×10^8	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
134	**Succinic acid**						
	$Cl_2^{\cdot-} + HO_2CCH_2CH_2CO_2H \rightarrow$	$\sim 8 \times 10^2$	1	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln.	78A093
135	**Tetrabutylammonium ion**						
	$Cl_2^{\cdot-} + [CH_3(CH_2)_3]_4N^+ \rightarrow$	3×10^4	1		p.r.	D.k. at 340 nm in soln. contg. 1 mol L^{-1} Cl^- and $\leq$0.1 mol L^{-1} ammonium ion.	80A346
136	**Tetraethylammonium ion**						
	$Cl_2^{\cdot-} + (C_2H_5)_4N^+ \rightarrow$	6×10^3	1		p.r.	D.k. at 340 nm in soln. contg. 1 mol L^{-1} Cl^- and $\leq$1 mol L^{-1} ammonium ion.	80A346
137	**Tetramethylammonium ion**						
	$Cl_2^{\cdot-} + (CH_3)_4N^+ \rightarrow$	$<1 \times 10^3$	1		p.r.	D.k. at 340 nm in soln. contg. 1 mol L^{-1} Cl^- and $\leq$1 mol L^{-1} ammonium ion.	80A346
138	**2,2,6,6-Tetramethyl-4-piperidone *N*-oxyl**						
	$Cl_2^{\cdot-}$ + TAN $\rightarrow$	1.4×10^9	2		p.r.	D.k. at 350 nm.	710618
139	**Tetrapropylammonium ion**						
	$Cl_2^{\cdot-} + (CH_3CH_2CH_2)_4N^+ \rightarrow$	8×10^4	1		p.r.	D.k. at 340 nm in soln. contg. 1 mol L^{-1} Cl^- and $\leq$0.1 mol L^{-1} ammonium ion.	80A346
140	**Thymidine 5'-monophosphate**						
	$Cl_2^{\cdot-}$ + TMP $\rightarrow$	4.4×10^7	2.7		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
141	**Thymine**						
	$Cl_2^{\cdot-}$ + 5-MeU $\rightarrow$	7.0×10^7	2.0		p.r.	D.k. in 0.01 mol L^{-1} NaCl soln.	723107
		1.2×10^8	2.7		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
142	***p*-Toluate ion**						
	$Cl_2^{\cdot-} + CH_3C_6H_4CO_2^- \rightarrow$	5×10^6	7	~1	p.r.	D.k. in 1 mol L^{-1} Cl^- soln. contg. $S_2O_8^{2-}$.	78A093
143	**Tryptophan**						
	$Cl_2^{\cdot-}$ + TrpH $\rightarrow$ 2 Cl^- + H^+ + Trp$\cdot$	2.6×10^9	1.8		p.r.	D.k. in 0.1 mol L^{-1} Cl^- soln.	720036
144	**Tyrosine**						
	$Cl_2^{\cdot-}$ + TyrOH $\rightarrow$ 2 Cl^- + TyrO$\cdot$ + H^+	2.7×10^8	1.8		p.r.	D.k. in 0.1 mol L^{-1} Cl^- soln.	720036
145	**Uracil**						
	$Cl_2^{\cdot-}$ + U $\rightarrow$	3.7×10^7	6		p.r.		755244
		3.5×10^7	2.0		p.r.	D.k. in 0.01 mol L^{-1} NaCl soln.	723107

TABLE 21. Rate constants for reactions of dichlorine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
145	**Uracil**—Continued						
		4.1×10^7	2.7		p.r.	D.k. in 0.1 mol L^{-1} NaCl soln.	680313
146	**Peroxidase (horseradish)**						
	$Cl_2^{\cdot -} + Fe^{III}$ HRP → HRP Compound II	$\geq 10^8$	6.3		phot.	C.k.; obs. Compound II formn. in soln. contg. $S_2O_8^{2-}$ and NaCl; rel. to $2k(Cl_2^{\cdot -} + Cl_2^{\cdot -}) = (0.3\text{-}1.7) \times 10^{10}$.	80R177
147	**Zinc(II) insulin**						
	$Cl_2^{\cdot -}$ + Zn(II)Insulin →	2.3×10^9	2		p.r.	D.k. in Ar-satd. soln. contg. 10^{-2} mol L^{-1} KCl	80A204

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Dibromine radical ion**						
	$Br_2\cdot^- + Br_2\cdot^- \rightarrow Br_3^- + Br^-$	2.2×10^9	3.2		p.r.	D.k. at 360 nm in soln. contg. 10^{-3} or 10^{-2} mol L^{-1} Br^-; $\epsilon = 9500$ L mol^{-1} cm^{-1}.	82A087
		1.6×10^9			p.r.	D.k. in Br^- soln.; ϵ(360 nm) = 8560 L mol^{-1} cm^{-1}.	761048
		2.4×10^9		0.02	p.r.	D.k. in N_2O-satd. Br^- soln.; ϵ(360 nm) = 9600 L mol^{-1} cm^{-1}; rates in micellar systems also detd.	761058
		1.6×10^9			f.p.	Calcd. from assumed mechanism for d.k. at 350 nm in Br^- soln. 10^{-5} to 10^{-1} mol L^{-1}.	757346
		2.7×10^9	1	0.2	f.p.	D.k. in $FeBr^{2+}$ soln. (10^{-3} mol L^{-1} Fe^{3+}, 0.1 mol L^{-1} H^+, 0.1 mol L^{-1} Br^-); ϵ(366 nm) = 7800 L mol^{-1} cm^{-1}.	737159
		1.6×10^9	6-7		f.p.	D.k. (10^{-3} mol L^{-1} NaBr and 5×10^{-3} mol L^{-1} N_2O).	707726
		2.8×10^9	12	0.02	p.r.	D.k. in N_2O-satd. 10^{-2} mol L^{-1} Br^- soln.; ϵ(360 nm) = 8200 L mol^{-1} cm^{-1}.	680153
		1.7×10^9	7	<0.01	p.r.	D.k. in 10^{-4} - 10^{-2} mol L^{-1} Br^- soln.; ϵ(365 nm) = 7800 L mol^{-1} cm^{-1}.	660425
		1.8×10^9	2	0.03	p.r.	D.k. in aerated 10^{-4} mol L^{-1} Br^- and 10^{-3} mol L^{-1} Br_2; $k/\epsilon = 2.2 \times 10^5$ cm s^{-1}; ϵ(360 nm) = 8200 L mol^{-1} cm^{-1}.	650382
		1.8×10^9	7	0.01	p.r.	D.k. in N_2O-satd. 10^{-2} mol L^{-1} Br^-; ϵ(360 nm) = 9600 L mol^{-1} cm^{-1}.	650383
2	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatosilver(II) ion**						
	$Br_2\cdot^- + AgTMpyP^{4+} \rightarrow 2\ Br^- + [AgTMpyP]\cdot^{5+}$	3.5×10^8	6.8		p.r.	D.k. at 350 nm in soln. contg. 0.1 mol L^{-1} Br^-.	83C026
3	**Hypobromite ion**						
	$Br_2\cdot^- + BrO^- \rightarrow 2\ Br^- + BrO$	6.2×10^7		$\rightarrow 0$	f.p.	D.k. at 360 nm in aq. alcohol mixt. contg. Br^- and BrO^-.	80A314
		8.0×10^7	12	0.02	p.r.	D.k. in Br^- - BrO^- soln.	680153
4	**Bromite ion**						
	$Br_2\cdot^- + BrO_2^- \rightarrow 2\ Br^- + BrO_2$	8.0×10^7	12	1	p.r.	D.k. in Br^- - BrO_2^- soln.	680153
5	**Bromate ion**						
	$Br_2\cdot^- + BrO_3^- \rightarrow$				p.r.	D.k. of $Br_2\cdot^-$ unaffected by BrO_3^-; no reaction.	680153
6	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatocadmium(II) ion**						
	$Br_2\cdot^- + CdTMpyP^{4+} \rightarrow 2\ Br^- + [CdTMpyP]\cdot^{5+}$	6.8×10^9	6.8		p.r.	D.k. at 350 nm in soln. contg. 0.1 mol L^{-1} Br^-.	83C026
7	**Chlorine dioxide**						
	$Br_2\cdot^- + ClO_2\cdot \rightarrow$	1.2×10^9			f.p.	D.k. in Br^- - ClO_2 soln.	737043
8	**Chlorite ion**						
	$Br_2\cdot^- + ClO_2^- \rightarrow 2\ Br^- + ClO_2\cdot$	2.0×10^7	6.7		p.r.	D.k. at 360 nm in 0.1 mol L^{-1} KBr soln.	86A059
9	**Cobalt(I) ion**						
	$Br_2\cdot^- + Co^+ \rightarrow 2\ Br^- + Co^{2+}$	1.0×10^{10}			f.p.	D.k. in Br^- soln. contg. Co^{2+}; $e_{aq}^- + Co^{2+} \rightarrow Co^+$.	707726

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
10	**Cobalt(II) ion**						
	$Br_2\cdot^- + Co^{2+} \rightarrow$				f.p.	No reaction in soln. contg. 3×10^{-5} mol L^{-1} Br_3^- (0.1 mol L^{-1} Br^-, 5×10^{-5} mol L^{-1} Br_2 and 0.1 mol L^{-1} H^+) and 0.1 mol L^{-1} Co^{2+}.	737316
11	**Iminodiacetatocobalt(II)**						
	$Br_2\cdot^- + CoIDA \rightarrow Br^- + CoIDABr$	8.9×10^7	7		p.r.	P.b.k. at 270 nm, as well as d.k. at 360 nm, in soln. contg. 0.1 mol L^{-1} NaBr buffered with phosphate.	84A284
12	**Nitrilotriacetatocobaltate(II) ion**						
	$Br_2\cdot^- + CoNTA^- \rightarrow Br^- + [CoNTABr]^-$	7.5×10^7	7.0		p.r.	D.k.; inner-sphere mechanism; k = 870 s^{-1} for decomposition of product.	78A436
13	**Ethylenediaminetetraacetatocobaltate(II) ion**						
	$Br_2\cdot^- + CoEDTA^{2-} \rightarrow$	$<7 \times 10^6$	7.0		p.r.	$k > 5 \times 10^4$ estimated from yields in γ-r. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-.	78A436
14	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecobalt(II) ion**						
	$Br_2\cdot^- + Co(4,11\text{-dieneN}_4)^{2+} \rightarrow$	2.0×10^9	9.2	0.1	p.r.	D.k. in N_2O-satd. Br^- soln.	761203
		1.4×10^9	1	0.2	f.p.	D.k. in Br^- soln.; radical from $Co(4,11\text{-dieneN}_4)Br_2^+$ or $Co(NH_3)_5Br^{2+}$.	727506
15	**1,3,6,8,10,13,16,19-Octaazabicyclo[6.6.6]eicosanecobalt(II) ion**						
	$Br_2\cdot^- + Co(sepulchrate)^{2+} \rightarrow 2\ Br^- + Co(sepulchrate)^{3+}$	1.4×10^{10}			p.r.	D.k. at 360 nm in soln. contg. 0.1 mol L^{-1} KBr and 1×10^{-4} mol L^{-1} Co(sepulchrate)$^{3+}$.	86A342
16	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatocobaltate(II) ion**						
	$Br_2\cdot^- + CoTPPS^{4-} \rightarrow 2\ Br^- + CoTPPS^{3-}$	1.0×10^9	7		p.r.	D.k. at 360 nm ($Br_2\cdot^-$) as well as p.b.k. in N_2O-satd. soln. contg. Br^-; initial product may involve addn.	81A317
17	**3,10,17,24-Tetrasulfophthalocyaninecobaltate(II) ion**						
	$Br_2\cdot^- + Co(tspc)^{4-} \rightarrow 2\ Br^- + Co(tspc)^{3-}$	1×10^8	3-10		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaBr; substrate present predominantly as dimer but k calcd. assuming all monomer.	83A238
18	**Cobal(II)amin**						
	$Br_2\cdot^- + B12r \rightarrow 2\ Br^- + B12$	3.4×10^9	4.5		p.r.	D.k. at 365 nm in N_2O-satd. soln. contg. NaBr.	79A046
19	**Chromium(II) ion**						
	$Br_2\cdot^- + Cr^{2+} \rightarrow Br^- + CrBr^{2+}$	1.9×10^9	1	0.2	p.r.	D.k. in deaerated Br^- soln.; inner-sphere electron transfer.	741104
20	**Nitrilotriacetatocuprate(II) ion**						
	$Br_2\cdot^- + CuNTA^- \rightarrow$	$<5 \times 10^6$			p.r.	unreactive	78A436
21	**Ethylenediaminetetraacetatocuprate(II) ion**						
	$Br_2\cdot^- + CuEDTA^{2-} \rightarrow$	$<5 \times 10^6$			p.r.	unreactive	78A436
22	**Copper(II) tetraglycine**						
	$Br_2\cdot^- + Cu(Gly_4)^{2-} \rightarrow Br^- + Cu(Gly_4)Br^{2-}$	2.6×10^8	8.2		p.r.	P.b.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaBr.	80A304

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
23	**Iron(II) ion**						
	$Br_2^{\cdot-} + Fe^{2+} \rightarrow Br^- + FeBr^{2+}$	3.6×10^6	1	0.2	f.p.	D.k. at 366 nm ($Br_2^{\cdot-}$) or p.b.k. at 405 nm ($FeBr^{2+}$); $\Delta H\ddagger = 25.2$ kJ mol^{-1}; $\Delta S\ddagger = -42$ J k^{-1} mol^{-}; inner-sphere substitution controlled mechanism	737159
24	**Ferrocyanide ion**						
	$Br_2^{\cdot-} + Fe(CN)_6^{4-} \rightarrow 2\ Br^- + Fe(CN)_6^{3-}$	2.8×10^7			p.r.	P.b.k. at 410 nm in soln. contg. 5×10^{-2} mol L^{-1} bromide ion and 10^{-4} mol L^{-1} $K_4Fe(CN)_6$; ionic strength effect studied.	84A013
25	**Nitrilotriacetatoferrate(II) ion**						
	$Br_2^{\cdot-} + FeNTA^- \rightarrow$	2.0×10^8	4.8		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-.	78A436
26	**Ethylenediaminetetraacetatoferrate(II) ion**						
	$Br_2^{\cdot-} + FeEDTA^{2-} \rightarrow$	2.0×10^8	4.8		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-.	78A436
27	**Histidineiron(II) complex**						
	$Br_2^{\cdot-} + Fe^{II}HisH \rightarrow 2\ Br^- + Fe^{III}HisH$	1.8×10^8	7-9.4		p.r.	D.k. at 360 nm in N_2O-satd. 0.1 mol L^{-1} KBr soln.	86A187
28	**Dihistidineiron(II) complex**						
	$Br_2^{\cdot-} + Fe^{II}(HisH)_2 \rightarrow 2\ Br^- + Fe^{III}(HisH)_2$	8.6×10^8	7-9.4		p.r.	D.k. at 360 nm in N_2O-satd. 0.1 mol L^{-1} KBr soln.	86A187
29	**Tryptophaniron(II) complex**						
	$Br_2^{\cdot-} + Fe^{II}TrpH \rightarrow 2\ Br^- + Fe^{III}TrpH$	7.0×10^8	7-10		p.r.	D.k. at 360 nm in N_2O-satd. 0.1 mol L^{-1} KBr soln.	86A187
30	**Tris(2,2'-bipyridine)iron(II) ion**						
	$Br_2^{\cdot-} + Fe(bpy)_3^{2+} \rightarrow 2\ Br^- + Fe(bpy)_3^{3+}$	1×10^8	7		p.r.		82A343
31	**Ferrocenylacetate ion**						
	$Br_2^{\cdot-} + FcCH_2CO_2^- \rightarrow 2\ Br^- + Fc^+CH_2CO_2^-$	1.9×10^9			p.r.	D.k. at 360 nm as well as p.b.k. at 285 nm (product zwitterion).	83A274
32	**Hydrogen atom**						
	$Br_2^{\cdot-} + H\cdot \rightarrow 2\ Br^- + H^+$	7×10^9	2		f.p.	D.k.	707726
33	**[(*N*H)-2,2'-Bipyrid-3-ylium-C^3,*N*']bis(2,2'-bipyridine-*N*,*N*')iridium(II) ion**						
	$Br_2^{\cdot-} + [Ir(Hbpy\text{-}C^3,N')(bpy)_2]^{2+} \rightarrow 2\ Br^- + [Ir(Hbpy\text{-}C^3,N')(bpy)_2]^{3+}$	2.5×10^{10}	1.0		p.r.	D.k. at 380 nm in Ar-satd. soln. contg. 0.1 mol L^{-1} NaBr, 0.9 mol L^{-1} 2-PrOH and 2×10^{-4} mol L^{-1} complex.	85A160
34	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatomagnesium(II) ion**						
	$Br_2^{\cdot-} + MgTMpyP^{4+} \rightarrow 2\ Br^- + [MgTMpyP]^{\cdot 5+}$	4.0×10^9	7	~0.01	p.r.	P.b.k. at 700 nm in N_2O-satd. buffered soln. contg. 10^{-2} mol L^{-1} KBr, ~ 2×10^{-4} mol L^{-1} metalloporphyrin.	86A207
35	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatomagnesiate(II) ion**						
	$Br_2^{\cdot-} + MgTPPS^{4-} \rightarrow 2\ Br^- + [MgTPPS]^{\cdot 3-}$	7.5×10^8	7	~0.01	p.r.	P.b.k. at 700 nm in N_2O-satd. buffered soln. contg. 10^{-2} mol L^{-1} KBr, ~ 2×10^{-4} mol L^{-1} metalloporphyrin.	86A207

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
36	**Manganese(II) ion**						
	$Br_2{\cdot}^- + Mn^{2+} \rightarrow 2\ Br^- + Mn^{3+}$	6.3×10^6	1	0.25	f.p.	D.k. in Br_3^- soln. (0.1 mol L^{-1} Br^-, 5×10^{-5} mol L^{-1} Br_2 and 0.1 mol L^{-1} H^+); $E_a = 36$ kJ mol^{-1}; $\Delta H\ddagger = 33.6$ kJ mol^{-1}; $\Delta S\ddagger = -3$ kJ mol^{-1}; inner-sphere electron transfer.	737317
37	**Nitrilotriacetatomanganate(II) ion**						
	$Br_2{\cdot}^- + MnNTA^- \rightarrow Br^- + [MnNTABr]^-$	7.0×10^6 2.0×10^7	3.6 4.5, 5.5		p.r.	D.k.; inner-sphere mechanism; $k = 200$ s^{-1} for decomposition of intermediate complex.	78A436
38	**Ethylenediaminetetraacetatomanganate(II) ion**						
	$Br_2{\cdot}^- + MnEDTA^{2-} \rightarrow$	$<9 \times 10^5$	5.5		p.r.	D.k.; $k > 5 \times 10^4$ estd. from yields on γ-r. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-.	78A436
39	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatomanganese(II) ion**						
	$Br_2{\cdot}^- + (H_2O)MnTMpyP^{4+} \rightarrow Br^- + [BrMnTMpyP]^{4+}$	8.5×10^9	6.8		p.r.	D.k. at 360 nm, as well as p.b.k.	84A120
	$Br_2{\cdot}^- + (OH)MnTMpyP^{3+} \rightarrow Br^- + [BrMnTMpyP]^{4+} + OH^-$	1.4×10^{10}	12.9		p.r.	D.k. at 360 nm, as well as p.b.k.; ~10% of radicals are in the form of $BrOH^-$.	84A120
40	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatomanganate(II) ion**						
	$Br_2{\cdot}^- + (H_2O)MnTPPS^{4-} \rightarrow Br^- + [BrMnTPPS]^{4-}$	1.8×10^9	6.8		p.r.	D.k. at 360 nm, as well as p.b.k.	84A120
	$Br_2{\cdot}^- + (OH)MnTPPS^{5-} \rightarrow Br^- + [BrMnTPPS]^{4-} + OH^-$	2.5×10^9	12.9		p.r.	D.k. at 360 nm, as well as p.b.k.; ~10% of radicals are in form of $BrOH^-$.	84A120
41	**5,10,15,20-Tetrakis(4-pyridyl)porphinatomanganese(III) ion**						
	$Br_2{\cdot}^- + (H_2O)_2MnTpyP^+ \rightarrow Br^- + [Br(H_2O)MnTpyP]^+$	1×10^8	6.8		p.r.	D.k. at 360 nm, as well as p.b.k.	84A120
42	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatomanganese(III) ion**						
	$Br_2{\cdot}^- + (H_2O)_2MnTMpyP^{5+} \rightarrow Br^- + [Br(H_2O)MnTMpyP]^{5+}$	6.8×10^8	6.8		p.r.	D.k. at 360 nm, as well as p.b.k.	84A120
	$Br_2{\cdot}^- + (OH)_2MnTMpyP^{3+} \rightarrow Br^- + [Br(OH)MnTMpyP]^{4+} + OH^-$	4.6×10^9	12.9		p.r.	D.k. at 360 nm, as well as p.b.k.; ~10% of the radicals are in the form of $BrOH^-$.	84A120
43	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatomanganate(III) ion**						
	$Br_2{\cdot}^- + (H_2O)_2MnTPPS^{3-} \rightarrow Br^- + [Br(H_2O)MnTPPS]^{3-}$	6.7×10^7	6.8, 8.9		p.r.	D.k. at 360 nm, as well as p.b.k.	84A120
	$Br_2{\cdot}^- + (OH)_2MnTPPS^{5-} \rightarrow Br^- + [Br(OH)MnTPPS]^{4-} + OH^-$	9.2×10^8	12.9		p.r.	D.k. at 360 nm, as well as p.b.k.; ~10% of the radicals are in the form of $BrOH^-$.	84A120
44	**Azide ion**						
	$Br_2{\cdot}^- + N_3^- \rightarrow 2\ Br^- + {\cdot}N_3$	4.0×10^8			p.r.	D.k. at 360 nm (Br^-) in N_2O-satd. soln. contg. 0.2 mol L^{-1} NaN_3; equilibrium; $k_r = 7.3 \times 10^3$ L^2 mol^{-2} s^{-1}.	87C002
45	**Nitrite ion**						
	$Br_2{\cdot}^- + NO_2^- \rightarrow 2\ Br^- + {\cdot}NO_2$	2×10^7	6.7		p.r.	D.k. at 360 nm in 0.1 mol L^{-1} KBr soln.	86A059
46	**Glycinatonickelate(II) ion**						
	$Br_2{\cdot}^- + Ni(Gly)^+ \rightarrow$	$<1 \times 10^5$			p.r.	No reaction obs.	81A128

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
47	**Iminodiacetatonickel(II)**						
	$Br_2^{\cdot -}$ + NiIDA → Br^- + [BrNiIDA]	1.7×10^0	7		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. Br^-.	81A023
48	**Bis(iminodiacetato)nickelate(II) ion**						
	$Br_2^{\cdot -}$ + $Ni(IDA)_2^{2-}$ → Br^- + $[BrNi(IDA)_2]^{2-}$	1.6×10^7	7		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. Br^-.	81A023
49	**Nitrilotriacetatonickelate(II) ion**						
	$Br_2^{\cdot -}$ + $NiNTA^-$ →				p.r.	unreactive	78A436
50	**11-Methyl-13-(trifluoromethyl)-1,4,7,10-tetraazacyclotrideca-10,13-dienenickel(II) ion**						
	$Br_2^{\cdot -}$ + NiL_2^{2+} → Br^- + NiL_2Br^{2+}	5.0×10^9	3-12		p.r.	D.k. at 380 nm, as well as p.b.k. at 580 nm ($(NiL_2(H_2O)_2)^{3+}$ was obtained from hydrolysis of Br adduct at pH > 9.0)	84A277
51	**11,13-Dimethyl-1,4,7,10-tetraazacyclotetradeca-10,13-dienenickel(II) ion**						
	$Br_2^{\cdot -}$ + $Ni(10,13\text{-diene}N_4)^{2+}$ → Br^- + $[BrNi(10,13\text{-diene}N_4]^{2+}$	6.0×10^9 1.0×10^{10}	3.6 10.6		p.r.	P.b.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} NaBr.	82A060
52	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion**						
	$Br_2^{\cdot -}$ + $Ni(aneN_4)^{2+}$ → Br^- + $[BrNi(aneN_4)]^{2+}$	3.6×10^9	1		p.r.	C.k.; obs. rel. yields of Ni^{III} complex and Br_3^-.	79A038
		3.4×10^9	2		p.r.	D.k. in 0.005 - 0.01 mol L^{-1} Br^- soln.	78A299
53	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienenickel(II) ion**						
	$Br_2^{\cdot -}$ + $Ni(4,11\text{-diene}N_4)^{2+}$ → Br^- + $[BrNi(4,11\text{-diene}N_4]^{2+}$	9.0×10^9	7		p.r.	N_2O-satd. soln. contg. 1-10 × 10^{-2} mol L^{-1} NaBr and 1-10 × 10^{-5} mol L^{-1} complex.	79A002
		2.0×10^9	1		p.r.	C.k.; obs. rel. yields of Ni^{III} complex and Br_3^-.	79A038
		9.8×10^9	2		p.r.	D.k. in 0.005 - 0.01 mol L^{-1} Cl^- soln.	78A299
54	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-1,4,8,11-tetraenenickel(II) ion**						
	$Br_2^{\cdot -}$ + $Ni(tetraeneN_4)^{2+}$ → Br^- + $[BrNi(tetraeneN_4]^{2+}$	2.3×10^9	1		p.r.	C.k.; obs. rel. yields of Ni^{III} complex and Br_3^-.	79A038
		9.5×10^9	2		p.r.	D.k. in 0.005 - 0.01 mol L^{-1} Cl^- soln.	78A299
55	**1,4,7,10,13-Pentaazacyclohexadecanenickel(II) ion**						
	$Br_2^{\cdot -}$ + $Ni[1,4,7,10,13\text{-ane}N_5]^{2+}$ → Br^- + $[BrNi(1,4,7,10,13\text{-ane}N_5]^{2+}$	$\leq 5 \times 10^7$			p.r.	P.b.k. in N_2O-satd. soln. contg. 0.01 mol L^{-1} NaBr.	83A322
56	**α-2,12-Dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]heptadeca-1(17),13,15-trienenickel(II) ion**						
	$Br_2^{\cdot -}$ + $Ni(CR+4H)^{2+}$ → Br^- + $Ni(CR+4H)Br^{2+}$	8×10^9	3-9		p.r.	D.k. at 360 nm as well as p.b.k. at 300 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} Br^-.	81A144 82A106
57	**α-2,12-Dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]heptadeca-1(17),2,11,13,15-pentaenenickel(II) ion**						
	$Br_2^{\cdot -}$ + $Ni(CR)(H_2O)_2^{2+}$ → Br^- + $Ni(CR)Br^{2+}$	1.6×10^9	4		p.r.	D.k. in N_2O-satd. soln. contg. Br^-.	82A106
58	**α-2,12-Dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]heptadeca-1(17),2,6,11,13,15-hexaenenickel(II) ion**						
	$Br_2^{\cdot -}$ + $Ni(CR\text{-}2H)^{2+}$ → Br^- + $Ni(CR\text{-}2H)Br^{2+}$	1.1×10^{10}	4		p.r.	D.k. in N_2O-satd. soln. contg. Br^-.	82A106

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
59	**Bromo-α-2,12-dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]heptadeca-1(17),2,6,11,13,15-hexaenenickel(III) ion**						
	$Br_2\cdot^- + Ni(CR\text{-}2H)Br^{2+} \rightarrow Br^- + Ni(CR\text{-}2H)^{2+} + Br_2$	1.0×10^{10}	3.2			Calcd. from d.k. at 360 nm in soln. contg. 4.6×10^{-6} mol L^{-1} Ni^{II} complex and 10^{-3} mol L^{-1} Br$^-$ assuming $2k(Br_2\cdot^- + Br_2\cdot^-) = 4.5 \times 10^9$, $k(Br_2\cdot^- + Ni(CR\text{-}2H)^{2+}) = 1.1 \times 10^{10}$ and $\epsilon(Ni(CR\text{-}2H)^{2+}) = 900$, $\epsilon(Ni(CR\text{-}2H)Br^{2+}) = 4500$ and $\epsilon(Br_2\cdot^-) = 9500$ L mol^{-1} cm^{-1}.	82A087
60	**Dioxoneptunium(V) ion**						
	$Br_2\cdot^- + NpO_2^+ \rightarrow 2\ Br^- + NpO_2^{2+}$	$<1 \times 10^6$	~0		p.r.	D.k. at 450 nm in soln. contg. 1 mol L^{-1} HBr and up to 0.05 mol L^{-1} NpO_2^+.	86A370
61	**Perhydroxyl radical**						
	$Br_2\cdot^- + HO_2\cdot \rightarrow 2\ Br^- + H^+ + O_2$	6×10^9	2		γ-r.	C.k. in soln. contg. 10^{-4}-1 mol L^{-1} KBr; *rel. to* $k(HO_2\cdot + Br_2)$ and $k(Br_2\cdot^- + Br_2\cdot^-)$.	650055
		4.6×10^9	2		p.r.	D.k.; $k/\epsilon = 4.6 \times 10^5$ cm s^{-1}; more than one rate constant involved in calculation; k cor. using $\epsilon(360) = 9900$ L mol^{-1} cm^{-1} [81Z050]	650382
		1.6×10^9	2		p.r.	D.k. at 360 nm in air-satd. 0.1 mol L^{-1} Br$^-$ soln. using $2k(Br_2\cdot^- + Br_2\cdot^-) = 3.6 \times 10^9$ and $\epsilon(360) = 9600$ L mol^{-1} cm^{-1}.	650383
62	**Hydrogen peroxide**						
	$Br_2\cdot^- + H_2O_2 \rightarrow 2\ Br^- + H^+ + HO_2\cdot$	$<1 \times 10^3$	7		p.r.	D.k. in N_2O-satd. 1 mol L^{-1} NaBr soln.	78A093
63	**Lead(II)**						
	$Br_2\cdot^- + Pb(II) \rightarrow$				p.r.	Pb(II) up to 0.01 mol L^{-1} has no effect on d.k. in 8 mol L^{-1} HBr.	84A446
64	**5,10,15,20-Tetrakis(3-*N*-methylpyridyl)porphinatolead(II) ion**						
	$Br_2\cdot^- + Pb(3\text{-}TMpyP)^{4+} \rightarrow 2\ Br^- + [Pb(3\text{-}TMpyP)]\cdot^{5+}$	$\sim 1 \times 10^{10}$	9		p.r.	P.b.k. at 750 nm in N_2O-satd. soln. contg. 10^{-3} mol L^{-1} borate buffer, 10^{-2} mol L^{-1} KBr and $1\text{-}12 \times 10^{-5}$ mol L^{-1} metalloporphyrin.	86A241
65	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatolead(II) ion**						
	$Br_2\cdot^- + PbTMpyP^{4+} \rightarrow 2\ Br^- + [PbTMpyP]\cdot^{5+}$	$\sim 1 \times 10^{10}$	9		p.r.	P.b.k. at 750 nm in N_2O-satd. soln. contg. 10^{-3} mol L^{-1} borate buffer, 10^{-2} mol L^{-1} KBr and $1\text{-}12 \times 10^{-5}$ mol L^{-1} metalloporphyrin.	86A241
66	**Tetrachloroplatinate(II) ion**						
	$Br_2\cdot^- + PtCl_4^{2-} \rightarrow 2\ Br^- + PtCl_4^-$	2.8×10^8		→0	p.r.	D.k. in N_2O-satd. 0.1 or 0.01 mol L^{-1} Br$^-$ soln. contg. $PtCl_4^{2-}$; product ($\epsilon_{310} = 8400$ L mol^{-1} cm^{-1}) may be $PtBr_nCl_{4-n}$.	761055
67	**Pentaammine(pyridine)ruthenium(II) ion**						
	$Br_2\cdot^- + Ru(NH_3)_5py^{2+} \rightarrow 2\ Br^- + Ru(NH_3)_5py^{3+}$	$\sim 5 \times 10^{10}$			f.p.	Fast relaxation of transients to starting materials was obs. in Ru(III)/Br$^-$ solution.	84A035
68	**Tris(2,2'-bipyridine)ruthenium(II) ion**						
	$Br_2\cdot^- + Ru(bpy)_3^{2+} \rightarrow Br^- + [Ru(bpy)_3^{3+}Br^-]$	3.1×10^9	~0	>1	f.p.	D.k. in 10^{-3} mol L^{-1} Br$^-$ soln. and 1 mol L^{-1} H_2SO_4 and 1×10^{-5} mol L^{-1} $Co(NH_3)_5Br^{2+}$.	737066

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
69	**Thiocyanate ion**						
	$Br_2^{\cdot-} + SCN^- \rightarrow Br^- + BrSCN^{\cdot-}$	1.9×10^9			p.r.	D.k. in N_2O-satd. 5×10^{-3} mol L^{-1} Br^- soln. contg. 10^{-5} - 2×10^{-4} mol L^{-1} SCN^- as well as p.b.k. at 500 nm $(SCN)_2^{\cdot-}$; $K(BrSCN^{\cdot-} + SCN^- \rightleftharpoons Br^- + (SCN)_2^{\cdot-}) = 1.1 \times 10^2$.	690180
70	**Hydrogen sulfite ion**						
	$Br_2^{\cdot-} + HSO_3^- \rightarrow 2\ Br^- + \dot{S}O_3^- + H^+$	6.9×10^7	4.2		p.r.	D.k. at 360 nm.	85A103
71	**Sulfite ion**						
	$Br_2^{\cdot-} + SO_3^{2-} \rightarrow 2\ Br^- + \dot{S}O_3^-$	2.0×10^8			p.r.	D.k.	86A191
		2.6×10^8	10		p.r.	D.k.	85A103
72	**Thallium(I) ion**						
	$Br_2^{\cdot-} + Tl^+ \rightarrow$	$<1 \times 10^6$	1	0.01	f.p.		747625
72a	**Uranium(III) ion**						
	$Br_2^{\cdot-} + U^{3+} \rightarrow UBr^{3+} + Br^-$	3.4×10^9	<1		p.r.	D.k. in He-satd. soln. contg. 0.5 mol L^{-1} $HClO_4$ contg. 0.1 mol L^{-1} NaBr; inner-sphere mechanism.	85A122
73	**Vanadium(II) ion**						
	$Br_2^{\cdot-} + V^{2+} \rightarrow 2\ Br^- + V^{3+}$	1.5×10^9	1	0.2	p.r.	D.k. in Br^- soln.; outer sphere electron transfer.	741104
74	**Vanadyl(IV) ion**						
	$Br_2^{\cdot-} + HVO^{3+} \rightarrow 2\ Br^- + H^+ + VO^{3+}$	1×10^6	<0	~4	p.r.	Soln. contg. 4 mol L^{-1} H^+ ($HClO_4$ + HBr); k increases to 3×10^7 as $[H^+]$ increases to 9 mol L^{-1}	85A338
75	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinato(oxo)vanadium(IV) ion**						
	$Br_2^{\cdot-} + VOTMpyP^{4+} \rightarrow 2\ Br^- + VOTMpyP^{5+}$	$<1 \times 10^7$	7		p.r.	N_2O-satd. buffered soln. contg. 10^{-4} mol L^{-1} metalloporphyrin and 10^{-2} mol L^{-1} KBr	87A097
76	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinato(oxo)vanadium(IV) ion**						
	$Br_2^{\cdot-} + VOTPPS^{4-} \rightarrow 2\ Br^- + VOTPPS^{3-}$	2×10^8	7		p.r.	N_2O-satd. buffered soln. contg. 10^{-4} mol L^{-1} metalloporphyrin and 10^{-2} mol L^{-1} KBr	87A097
77	**Nitrilotriacetatozincate(II) ion**						
	$Br_2^{\cdot-} + ZnNTA^- \rightarrow$	$<1 \times 10^7$			p.r.	D.k. of $Br_2^{\cdot-}$ in N_2O-satd. 0.1 mol L^{-1} KBr.	78A436
78	**Ethylenediaminetetraacetatozincate(II) ion**						
	$Br_2^{\cdot-} + ZnEDTA^{2-} \rightarrow$	$<1 \times 10^7$			p.r.	D.k. of $Br_2^{\cdot-}$ in N_2O-satd. 0.1 mol L^{-1} KBr.	78A436
79	**5,10,15,20-Tetraphenylporphinatozinc(II)**						
	$Br_2^{\cdot-} + ZnTPP \rightarrow 2\ Br^- + [ZnTPP]^{\cdot+}$	7×10^8	7		p.r.	Micellar soln. of 2% Triton X-100 contg. 0.1 mol L^{-1} NaBr, 10^{-3} mol L^{-1} phosphate buffer, satd. N_2O.	82N150
80	**5,10,15,20-Tetraphenylporphinatozinc(II), triplet state**						
	$Br_2^{\cdot-} + {}^3(ZnTPP)^* \rightarrow 2\ Br^- + [ZnTPP]^{\cdot+}$	1×10^{10}	7		p.r.	Micellar soln. of 2% Triton X-100 contg. 1.3 mol L^{-1} 2-PrOH, 10^{-3} mol L^{-1} phosphate buffer, satd. with N_2O; 15% triplet produced by photolysis at 532 nm.	82N150

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
81	**5,10,15,20-Tetrakis(2-*N*-methylpyridyl)porphinatozinc(II) ion**						
	$Br_2^{\cdot-}$ + $Zn(TMpyP)^{4+}$ → 2 Br^- + $[Zn(TMpyP)]^{\cdot 5+}$	4.1×10^9	7	0.01	p.r.	P.b.k. at 700 nm.	86S115
82	**5,10,15,20-Tetrakis(3-*N*-methylpyridyl)porphinatozinc(II) ion**						
	$Br_2^{\cdot-}$ + $Zn(TMpyP)^{4+}$ → 2 Br^- + $[Zn(TMpyP)]^{\cdot 5+}$	4.3×10^9	9	10^{-2}	p.r.	P.b.k. at 700 nm in N_2O-satd. soln. contg. 10^{-3} mol L^{-1} buffer, 10^{-2} mol L^{-1} KBr and 2×10^{-4} mol L^{-1} metalloporphyrin.	86A243
83	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatozinc(II) ion**						
	$Br_2^{\cdot-}$ + $ZnTMpyP^{4+}$ → 2 Br^- + $[ZnTMpyP]^{\cdot 5+}$	4.2×10^9	3.2-12	0.01	p.r.	P.b.k. at 690-700 nm in N_2O-satd. buffered soln. contg. KBr and (1-4) $\times 10^{-4}$ mol L^{-1} porphyrin; the π-radical cation complexes (ϵ_{705nm} = 11,500 L mol^{-1} cm^{-1}) with Br^-.	85A038
		2.4×10^9	7	0.1	p.r.	D.k. at 360 nm as well as p.b.k. at 700 nm (radical cation) in N_2O-satd. soln. contg. Br^-.	81A317
84	**5,10,15,20-Tetrakis(4-*N*,*N*,*N*-trimethylammoniophenyl)porphinatozinc(II) ion**						
	$Br_2^{\cdot-}$ + $ZnTAPP^{4+}$ → 2 Br^- + $[ZnTAPP]^{\cdot 5+}$	6.0×10^9	7.0	0.01	p.r.	P.b.k. at 690-700 nm in N_2O-satd. buffered soln. contg. KBr and (1-4) $\times 10^{-4}$ mol L^{-1} porphyrin; π-radical cation probably complexed with Br^-.	85A038
		4.7×10^9	7	0.1	p.r.	D.k. at 360 nm as well as p.b.k. at 700 nm (radical cation) in N_2O-satd. soln. contg. Br^-.	81A317
85	**5,10,15,20-Tetrakis[4-*N*-(3-sulfonatopropyl)pyridyl]porphinatozinc(II)**						
	$Br_2^{\cdot-}$ + ZnTZP → 2 Br^- + $[ZnTZP]^{\cdot +}$	6.0×10^8	7.0	0.01	p.r.	P.b.k. at 690-700 nm in N_2O-satd. buffered soln. contg. KBr and (1-4) $\times 10^{-4}$ mol L^{-1} porphyrin; π-radical cation probably complexed with Br^-.	85A038
		3.1×10^9	6.8	0.1	p.r.	D.k. at 350 nm in soln. contg. 0.1 mol L^{-1} Br^-.	83C026
86	**5,10,15,20-Tetrakis(4-sulfonatophenyl)porphinatozincate(II) ion**						
	$Br_2^{\cdot-}$ + $ZnTPPS^{4-}$ → 2 Br^- + $[ZnTPPS]^{\cdot 3-}$	6.0×10^8	3.2-12	0.01	p.r.	P.b.k. at 690-700 nm in N_2O-satd. buffered soln. contg. KBr and (1-4) $\times 10^{-4}$ mol L^{-1} porphyrin; ϵ_{700} = 8805 L mol^{-1} cm^{-1}, pK = 7.6 for the π-radical cation.	85A038
		1.5×10^9	7	0.1	p.r.	D.k. at 360 nm as well as p.b.k. at 700 nm (radical cation) in N_2O-satd. soln. contg. Br^-.	81A317
87	**5,10,15,20-Tetrakis(2-hydroxyphenyl)porphinatozinc(II)**						
	$Br_2^{\cdot-}$ + $(HO)ZnT(HOP)P^{5-}$ → 2 Br^- + $[(HO)ZnT(HOP)P]^{\cdot 4-}$	1.1×10^9	12		p.r.	P.b.k. at 700 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr and 10^{-2} mol L^{-1} KOH	86A242
88	**5,10,15,20-Tetrakis(3-hydroxyphenyl)porphinatozinc(II)**						
	$Br_2^{\cdot-}$ + $(HO)ZnT(HOP)P^{5-}$ → 2 Br^- + $[(HO)ZnT(HOP)P]^{\cdot 4-}$	1.4×10^9	12		p.r.	P.b.k. at 700 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr and 10^{-2} mol L^{-1} KOH	86A242
89	**5,10,15,20-Tetrakis(4-hydroxyphenyl)porphinatozinc(II)**						
	$Br_2^{\cdot-}$ + $(HO)ZnT(HOP)P^{5-}$ → 2 Br^- + $[(HO)ZnT(HOP)P]^{\cdot 4-}$	1.1×10^9	12		p.r.	P.b.k. at 700 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr and 10^{-2} mol L^{-1} KOH	86A242

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
90	**Acetaminophen**						
	$Br_2^{\cdot-}$ + $AcNHC_6H_4OH$ → 2 Br^- + $AcNHC_6H_4O\cdot$	~5 × 10^7 ~6 × 10^8	9 11	0.1	p.r.	Values from graph; pK_a = 9.9; radical deprotonates, pK_a = 11.1.	85A460
91	***N*-Acetylmethionine**						
	$Br_2^{\cdot-}$ + AcMet → Br^- + $CH_3\dot{S}(Br)CH_2CH_2CHNHAcCO_2^-$	2.4 × 10^9 3.0 × 10^9	2.2 10		p.r.	D.k. at 360 nm.	81A339
92	***N*-Acetyltryptophan**						
	$Br_2^{\cdot-}$ + AcTrpH → 2 Br^- + H^+ + AcTrp·	8.3 × 10^8	7, 12		p.r.	D.k. at 355 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr; radical cation forms which deprotonates.	86A110
93	***N*-Acetyltyrosinamide**						
	$Br_2^{\cdot-}$ + $AcTyrOH(NH_2)$ → 2 Br^- + $AcTyrO\cdot(NH_2)$ + H^+	7.2 × 10^8	12		p.r.	D.k. at 355 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr; radical cation forms which deprotonates.	86A110
94	**Acriflavine (3,6-Diamino-10-methylacridinium)**						
	$Br_2^{\cdot-}$ + $ACFl^+$ → 2 Br^- + $ACFl^{2+}$	3.7 × 10^9			p.r.	D.k. of $Br_2^{\cdot-}$ in N_2O-satd. 10^{-3} mol L^{-1} Br^- soln. as well as dye bleaching at 450 nm.	700241
95	**Adenine**						
	$Br_2^{\cdot-}$ + A^- → 2 Br^- + A·	4.6 × 10^7	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} adenine (pK_a = 4.15, 9.8).	86C005
96	**Adenosine**						
	$Br_2^{\cdot-}$ + A^- → 2 Br^- + A·	4.5 × 10^6	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} adenosine (pK_a = 3.3, 12.5).	86C005
97	**2-[(3-Aminopropyl)amino]ethanethiol**						
	$Br_2^{\cdot-}$ + $HSCH_2CH_2NH(CH_2)_3NH_3^+$ →	1.6 × 10^8	4		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr; calcd. from k_{obs} = 1.8 × 10^8 at pH 6.3.	84A411
	$Br_2^{\cdot-}$ + $^-S(CH_2)_2NH(CH_2)_3NH_3^+$ →	1.6 × 10^9	8.4		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 10^{-4} mol L^{-1} substrate (pK_a = 7.3).	84A411
98	**Aniline**						
	$Br_2^{\cdot-}$ + $C_6H_5NH_2$ → 2 Br^- + $[C_6H_5NH_2]^{\cdot+}$	2.1 × 10^8	6-11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-.	85A428
99	**Ascorbic acid**						
	$Br_2^{\cdot-}$ + AH_2 → 2 Br^- + 2 H^+ + $A^{\cdot-}$	1.1 × 10^8	2		p.r.	pK = 4.2, 11.6.	720266
100	**Ascorbate ion**						
	$Br_2^{\cdot-}$ + AH^- → 2 Br^- + H^+ + $\cdot A^-$	5.2 × 10^8	11	→0	p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 10^{-3}-10^{-1} mol L^{-1} Br^-.	771036
		8.7 × 10^8	7.2	0.5	p.r.	D.k. in N_2O-satd. Br^- soln.	733006
		1.1 × 10^9	7		p.r.	D.k.	720266
101	**L-Ascorbate-2-sulfate ion**						
	$Br_2^{\cdot-}$ + $[SO_4A]^{2-}$ → 2 Br^- + $[SO_4A]^{\cdot-}$	7.1 × 10^7	5-10	→0	p.r.	D.k. at 360 nm in soln.; k_{obs} in 0.02 mol L^{-1} KBr = 9.0 × 10^7.	83A203

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
102	**2,2'-Azinobis(3-ethylbenzothiazoline-6-sulfonate ion)**						
	$Br_2^{\cdot -}$ + ABTS → 2 Br^- + $ABTS^{\cdot +}$	1.1×10^9			p.r.	D.k. at 360 nm (as well as p.b.k. at 415 nm) in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr.	82A196
103	**4-Bromophenoxide ion**						
	$Br_2^{\cdot -}$ + $BrC_6H_4O^-$ → 2 Br^- + $BrC_6H_4O\cdot$	2.8×10^8	12.5		p.r.	P.b.k.	743052
104	**α-Bromotetronate ion**						
	$Br_2^{\cdot -}$ + $BrTr^-$ → 2 Br^- + $BrTr\cdot$	4.9×10^8	10.9		p.r.	D.k. (both reactants) in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 10^{-3} mol L^{-1} BrTr.	741053
105	**Camphor**						
	$Br_2^{\cdot -}$ + $C_{10}H_{16}O$ →	$<1 \times 10^6$			p.r.	D.k. at 360 nm in N_2O-satd. soln. contb. 10^{-1} mol L^{-1} KBr.	79A191
106	**β-Carotene**						
	$Br_2^{\cdot -}$ + car → 2 Br^- + $car^{\cdot +}$	$\sim 1 \times 10^8$			p.r.	P.b.k. in N_2O-satd. micellar (2% Triton X 100) soln. contg. 0.3 mol L^{-1} NaBr and 10^{-4} mol L^{-1} carotene.	83N014
107	**4-Chlorophenoxide ion**						
	$Br_2^{\cdot -}$ + $ClC_6H_4O^-$ → 2 Br^- + $ClC_6H_4O\cdot$	1.7×10^8	12.5		p.r.	P.b.k.	743052
108	**Chlorophyll a**						
	$Br_2^{\cdot -}$ + Chl a → 2 Br^- + $[Chl\text{-}a]^{\cdot +}$	$\sim 2 \times 10^9$	7		p.r.	Micellar soln. of 2% Triton X-100 contg. 0.1 mol L^{-1} NaBr, 10^{-3} mol L^{-1} phosphate buffer, satd. with N_2O.	82N150
		1.2×10^9			p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} Br^-; rate for aqueous phase, k in micellar phase = 2×10^9.	81N146
109	**Chlorophyll a, triplet state**						
	$Br_2^{\cdot -}$ + $^3(Chl\ a)^*$ → 2 Br^- + $[Chl\text{-}a]^{\cdot +}$	$\sim 4 \times 10^9$	7		p.r.	Micellar soln. of 2% Triton X-100 contg. 1.3 mol L^{-1} 2-PrOH, 10^{-3} mol L^{-1} phosphate buffer, satd. with N_2O; 43% triplet produced by photolysis at 640 nm.	82N150
110	**Chlorophyll *b***						
	$Br_2^{\cdot -}$ + Chl b → 2 Br^- + $[Chl\text{-}b]^{\cdot +}$	1.0×10^9			p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5×10^{-2} mol L^{-1} Br^-; rate for aqueous phase, k in micellar phase = 5.7×10^8.	81N146
111	**Chlorpromazine**						
	$Br_2^{\cdot -}$ + CZ^+ → 2 Br^- + $CZ^{\cdot +}$	7.7×10^9	3.5	→0	p.r.	P.b.k. at 505 nm as well as d.k. at 360 nm in N_2O-satd. soln. contg. KBr; overall rate constant, 85% electron transfer.	83A272
		5.0×10^9	3.7-5.5	0.01	p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.01 mol L^{-1} KBr; product grew in at 525 nm.	79A060

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
112	**4-Cyanophenoxide ion**						
	$Br_2\cdot^- + CNC_6H_4O^- \rightarrow 2\ Br^- + CNC_6H_4O\cdot$	1.8×10^8	12.5		p.r.	P.b.k.	743052
113	**Cystamine**						
	$Br_2\cdot^- + S_2(CH_2CH_2NH_2)_2 \rightarrow 2\ Br^- + [H_3NCH_2CH_2S]_2\cdot^+$	$\leq 1 \times 10^8$ 5.4×10^8 1.0×10^9	7 ~9 ~11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.05 mol L^{-1} KBr and 0.9-6 $\times 10^{-4}$ mol L^{-1} disulfide (pK = 8.82, 9.16).	81A008
114	**Cysteamine**						
	$Br_2\cdot^- + H_3N^+CH_2CH_2S^- \rightarrow$	3×10^8			p.r.		741168
115	**Cysteamine, negative ion**						
	$Br_2\cdot^- + H_2NCH_2CH_2S^- \rightarrow 2\ Br^- + H_2NCH_2CH_2S\cdot$	$\sim 2 \times 10^9$	9.6		p.r.	P.b.k. at 410 nm in soln. contg. 0.1 mol L^{-1} KBr and 2×10^{-4} mol L^{-1} cysteamine.	84A233
116	**Cysteine**						
	$Br_2\cdot^- + CysSH \rightarrow$	1.8×10^8 $\sim 2 \times 10^9$	6.6 10-11	0.1	p.r.	D.k. in N_2O-satd. Br^- soln.	720036
117	**Cystine**						
	$Br_2\cdot^- + S_2[CH_2CH(NH_2)CO_2^-]_2 \rightarrow 2\ Br^- + \cdot S_2[CH_2CH(NH_2)CO_2]_2^-$	$<5 \times 10^7$ 1.7×10^8 2.6×10^8	7 ~9 ~11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.05 mol L^{-1} KBr and 0.9-6 $\times 10^{-4}$ mol L^{-1} disulfide (pK = 8.02, 8.71).	81A008
118	**L-Cystinylbisglycine**						
	$Br_2\cdot^- + (CysGly)_2 \rightarrow$	$<3 \times 10^7$			p.r.	D.k.	85A061
119	**Cytosine**						
	$Br_2\cdot^- + Cy^- \rightarrow 2\ Br^- + Cy\cdot$	2×10^8	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 $\times 10^{-3}$ mol L^{-1} cytosine (pK_a = 4.6, 12.16).	86C005
120	**Deoxyguanosine 5'-monophosphate**						
	$Br_2\cdot^- + dGMP \rightarrow 2\ Br^- + dGMP\cdot^+$	4×10^7 2×10^8	7 12		p.r.		741168
121	**1,6-Diazabicyclo[4.4.4]tetradecane radical cation**						
	$Br_2\cdot^- + DABCT\cdot^+ \rightarrow 2\ Br^- + DABCT^{2+}$	2.6×10^9		$\rightarrow 0$	p.r.	D.k. at 480 nm (as well as 365 nm, Br_2^-) in N_2O-satd. soln. contg. 0.02-2.0 $\times 10^{-3}$ mol L^{-1} radical cation and 0.1 mol L^{-1} KBr; k_{obs} = 1.7×10^9.	86A272
122	**Diethyl disulfide**						
	$Br_2\cdot^- + C_2H_5SSC_2H_5 \rightarrow 2\ Br^- + [C_2H_5SSC_2H_5]\cdot^+$	1.8×10^9	4-5	0.02	p.r.	D.k. in N_2O-satd. Br^- soln., as well as p.b.k. at 430 nm ($RSSR\cdot^+$).	761143
123	**Diethyl sulfide**						
	$Br_2\cdot^- + (C_2H_5)_2S \rightarrow Br^- + (C_2H_5)_2SBr\cdot$	2.0×10^9	<3		p.r.	D.k as well as p.b.k. at 400 nm.	80A377
		$\sim 2 \times 10^9$	3.9	0.2	p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.2 mol L^{-1} KBr and 2.8 $\times 10^{-4}$ mol L^{-1} sulfide.	771164
124	**Dihydrolumiflavin**						
	$Br_2\cdot^- + LFH^- \rightarrow 2\ Br^- + LF\cdot^- + H^+$	5.0×10^9	7, 9, 11		p.r.	P.b.k. at 530 nm, as well as d.k. at 360 nm; pK_a of dihydrolumiflavin = 6.5	85A389

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
125	**3,4-Dihydroxyacetophenone**						
	$Br_2^{\cdot-}$ + $(HO)_2C_6H_3COCH_3$ → 2 Br^- + 2 H^+ + $\cdot O(O^-)C_6H_3COCH_3$	1.0×10^9 1.3×10^9	5-7 ~9		p.r.	D.k. in N_2O-satd. soln. contg. Br^-.	85A492
126	**4,6-Dihydroxy-2-methylpyrimidine**						
	$Br_2^{\cdot-}$ + $C_5H_6N_2O_2$ →	$<10^7$ 7.5×10^8	3-4 7.5		p.r.	P.b.k. at 370-380 nm in N_2O-satd. soln. contg. 2-5 × 10^{-2} mol L^{-1} Br^- and 2-10 × 10^{-4} mol L^{-1} pyrimidine.	87A026
127	**4,6-Dihydroxy-5-methylpyrimidine**						
	$Br_2^{\cdot-}$ + $C_5H_6N_2O_2$ →	$<10^7$ 9.6×10^8	3-4 7.7		p.r.	P.b.k. at 370-380 nm in N_2O-satd. soln. contg. 2-5 × 10^{-2} mol L^{-1} Br^- and 2-10 × 10^{-4} mol L^{-1} pyrimidine.	87A026
128	**3-(3,4-Dihydroxyphenyl)alanine**						
	$Br_2^{\cdot-}$ + $(HO)_2C_6H_3CH_2CH(NH_3^+)CO_2^-$ → 2 Br^- + 2 H^+ + $\cdot O(O^-)C_6H_3CH_2CH(NH_3^+)CO_2^-$	$\sim 1 \times 10^8$	6.5		p.r.	D.k. at 360 nm in N_2O-satd. soln.	84B013
129	**2,3-Dihydroxy-2-propenal**						
	$Br_2^{\cdot-}$ + TRH_2 → $TR^{\cdot-}$ $Br_2^{\cdot-}$ + TRH^- → $TR^{\cdot-}$	2.2×10^8 1.8×10^9			p.r.	D.k. at 340 nm; pK_a = 5.0, 13.0; pK_a (radical) = 1.4.	85A392
130	**4,6-Dihydroxypyrimidine**						
	$Br_2^{\cdot-}$ + $C_4H_4N_2O_2$ →	$<10^7$ 6.0×10^8	3-4 7.4		p.r.	P.b.k. at 370-380 nm in N_2O-satd. soln. contg. 2-5 × 10^{-2} mol L^{-1} Br^- and 2-10 × 10^{-4} mol L^{-1} pyrimidine.	87A026
131	**3,5-Diiodotyrosine**						
	$Br_2^{\cdot-}$ + I_2TyrOH → 2 Br^- + H^+ + $I_2TyrO\cdot$	$\sim 1 \times 10^9$	7-8		p.r.	D.k. in N_2O-satd. 0.04 mol L^{-1} Br^- soln.; values from graph; at pH 6 k < 1×10^8.	731067
132	**Dimethyl disulfide**						
	$Br_2^{\cdot-}$ + CH_3SSCH_3 → 2 Br^- + $[CH_3SSCH_3]^{\cdot+}$	2.2×10^9	4-5	0.02	p.r.	D.k. in N_2O-satd. Br^- soln., as well as p.b.k. at 430 nm ($RSSR^{\cdot+}$).	761143
132a	**2,3-Dimethylindole**						
	$Br_2^{\cdot-}$ + Me_2InH → 2 Br^- + $Me_2InH^{\cdot+}$	2.6×10^9	4		p.r.	P.b.k. at 520 nm nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^- and the indole at different concentrations, e.g. 5 × 10^{-4} mol L^{-1}.	87A247
133	***N,N*-Dimethyl-4-nitrosoaniline**						
	$Br_2^{\cdot-}$ + $Me_2NC_6H_4NO$ → 2 Br^- + $[Me_2C_6H_4NO]^{\cdot+}$	7.1×10^8			p.r.	D.k. at 440 nm in N_2O-satd. soln. contg. Br^-.	680066
134	**2,3-Dimethyl-1-phenyl-3-pyrazolin-5-one (Antipyrine)**						
	$Br_2^{\cdot-}$ + DMPPZO → 2 Br^- + $[DMPPZO]\cdot$	3.3×10^8	7-12		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-.	85A390
135	**3,4-Dimethyl-2-pyrazolin-5-one**						
	$Br_2^{\cdot-}$ + DMPZO → 2 Br^- + $[DMPZO]\cdot$	5.6×10^8 1.3×10^9	6.6 12.4		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-; pK_a = 8.9.	85A390
136	**Dimethyl sulfide**						
	$Br_2^{\cdot-}$ + $(CH_3)_2S$ → Br^- + $(CH_3)_2SBr\cdot$	3.2×10^9	<3		p.r.	D.k as well as p.b.k. at 400 nm.	80A377
137	**Diphenylamine**						
	$Br_2^{\cdot-}$ + $(C_6H_5)_2NH$ → 2 Br^- + $[(C_6H_5)_2NH]^{\cdot+}$	2.2×10^9			p.r.	D.k.	85A283

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
138	**3,3'-Dithiobis(propionate ion)**						
	$Br_2^{\cdot -} + (SCH_2CH_2CO_2^-)_2 \rightarrow 2\ Br^- + \cdot S_2(CH_2CH_2CO_2)_2^{\cdot -}$	4.4×10^8 4.3×10^8 4.0×10^8	7 ~9 ~11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.05 mol L^{-1} KBr and 0.9-6 $\times 10^{-4}$ mol L^{-1} disulfide.	81A008
139	**Ephedrine**						
	$Br_2^{\cdot -}$ + $PhCHOHCH(CH_3)NH_2^+CH_3 \rightarrow$		7		p.r.	No reaction.	83A176
140	**Ethylenediaminetetraacetate ion**						
	$Br_2^{\cdot -} + [CH_2N(CH_2CO_2^-)_2]_2 \rightarrow$	$<1 \times 10^7$			p.r.	D.k. of $Br_2^{\cdot -}$ unaffected by EDTA in N_2O-satd. 0.1 mol L^{-1} KBr.	78A436
141	***m*-Fluorotyrosine**						
	$Br_2^{\cdot -}$ + FTyrOH → 2 Br^- + FTyrO· + H^+	~2×10^7 ~3×10^8	6 11		p.r.	D.k. in N_2O-satd. 0.04 mol L^{-1} Br^- soln.; values from graph.	731067
142	**Formate ion**						
	$Br_2^{\cdot -} + HCO_2^- \rightarrow$	$\leq 10^3$	7		p.r.	D.k. in N_2O-satd. 1 mol L^{-1} Br^- soln.	78A093
143	**Glutathione, oxidised**						
	$Br_2^{\cdot -}$ + GSSG → 2 Br^- + GSSG$^{\cdot +}$	~7×10^7	11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.05 mol L^{-1} KBr; pK_a = 8.02, 8.71; no reaction detected at pH 7.	81A008
144	**Guanine**						
	$Br_2^{\cdot -}$ + G^- → 2 Br^- + G·	2.5×10^8	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 $\times 10^{-3}$ mol L^{-1} guanine (pK_a = 3.3, 9.2, 12.3).	86C005
145	**Guanosine**						
	$Br_2^{\cdot -}$ + G^- → 2 Br^- + G·	2.5×10^8	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 $\times 10^{-3}$ mol L^{-1} guanosine (pK_a = 1.9, 9.25, 12.33).	86C005
146	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene**						
	$Br_2^{\cdot -}$ + 4,11-diene →	$<1 \times 10^5$			p.r.	D.k.	79A038
147	**Histidine**						
	$Br_2^{\cdot -}$ + His →	1.9×10^7	9.0		p.r.	D.k. at 360 nm in N_2O-satd. 0.1 mol L^{-1} KBr soln. contg. 2×10^{-3} mol L^{-1} histidine; k for HisH$^+$ = 2.0×10^7.	86A187
		1.5×10^7	7.6	0.1	p.r.	D.k. in N_2O-satd. Br^- soln.; same value at pH 12.	720036
148	**Homocystine**						
	$Br_2^{\cdot -}$ + $[^-O_2CCH(NH_3^+)CH_2CH_2S]_2 \rightarrow$ 2 Br^- + $[^-O_2CCH(NH_3^+)CH_2CH_2S]_2^{\cdot +}$	2.9×10^8 5.1×10^8 5.6×10^8	7 ~9 ~11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.05 mol L^{-1} KBr and 0.9-6 $\times 10^{-4}$ mol L^{-1} disulfide (pK = 8.52, 9.44).	81A008
149	**Hydroquinone**						
	$Br_2^{\cdot -} + C_6H_4(OH)_2 \rightarrow 2\ Br^- + 2\ H^+ + \cdot OC_6H_4O^-$	7×10^7	6.7		p.r.		85A255
		1×10^8			p.r.		741168
150	**4-Hydroxyacetophenone**						
	$Br_2^{\cdot -} + HOC_6H_4COCH_3 \rightarrow 2\ Br^- + H^+ + \cdot OC_6H_4COCH_3$	1.5×10^9	5-7, 9		p.r.	D.k. in N_2O-satd. soln. contg. Br^-.	85A492

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
151	**4-Hydroxybenzoate ion**						
	$Br_2^{\cdot -}$ + $(^-O)C_6H_4CO_2^-$ → 2 Br^- + $^-O_2CC_6H_4O\cdot$	2.3×10^8	12.5		p.r.	P.b.k.	743052
152	**p-Hydroxycinnamate ion**						
	$Br_2^{\cdot -}$ + $^-OC_6H_4CH{=}CHCO_2^-$ → 2 Br^- + $\cdot OC_6H_4CH{=}CHCO_2^-$	9.9×10^8	11.5	~1	p.r.	P.b.k. at 595 nm in N_2O-satd. soln. contg. 1 mol L^{-1} Br^-.	84A206
153	**6-Hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid**						
	$Br_2^{\cdot -}$ + ArOH → 2 Br^- + ArO·	6.7×10^8	4.5-6.5		p.r.	D.k. at 260 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 2-40 × 10^{-4} mol L^{-1} Trolox.	86A492
154	**α-Hydroxytetronate ion**						
	$Br_2^{\cdot -}$ + $HOTr^-$ → 2 Br^- + $\cdot OTr^-$ + H^+	5.0×10^8			p.r.	D.k. at 415 nm.	741053
155	**Hypoxanthine**						
	$Br_2^{\cdot -}$ + HxO^- → 2 Br^- + HxO·	2.6×10^8	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} hypoxanthine (pK_a = 1.91, 8.96, 12.18).	86C005
155a	**Indole**						
	$Br_2^{\cdot -}$ + InH → 2 Br^- + $InH^{\cdot +}$	1.8×10^9	4		p.r.	P.b.k. at 520 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^- and the indole at different concentrations, e.g. 5 × 10^{-4} mol L^{-1}.	87A247
156	**Linolenate ion**						
	$Br_2^{\cdot -}$ + $CH_3(CH_2CH{=}CH)_3(CH_2)_7CO_2^-$ →	$\leq 4 \times 10^6$	11		p.r.	D.k.	86A191
157	**Lysylglycyltryptophanyllysine, *tert*-butyl ester**						
	$Br_2^{\cdot -}$ + LysGlyTrpLysO-*tert*-Bu(3+) →	5.0×10^9	6.2		p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059
158	**Lysylglycyltryptophanyllysine**						
	$Br_2^{\cdot -}$ + LysGlyTrpLys(2+) →	3.9×10^9	6.2		p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059
159	**Lysyltryptophanyllysine**						
	$Br_2^{\cdot -}$ + LysTrpLys(2+) →	1.2×10^9	6.2		p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059
160	**Lysyltyrosyllysine**						
	$Br_2^{\cdot -}$ + LysTyrLys(2+) →	4.6×10^7 4.5×10^7 2.4×10^8	6.2 9.2 11.2		p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059
161	**Lysyltyrosyllysine, *N*-ethyl**						
	$Br_2^{\cdot -}$ + LysTyrLysNHEt(3+) →	9.7×10^7 1.1×10^9	6.2 10.0		p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059
162	**Maleic hydrazide**						
	$Br_2^{\cdot -}$ + MH_2 →		2		p.r.	No reaction	83A165

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
163	**Methionine**						
	$Br_2\cdot^- + Met \rightarrow Br^- + CH_3\dot{S}(Br)CH_2CH_2CH(NH_3^+)CO_2^-$	2.5×10^9 1.7×10^9 2×10^9	<3 5 11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^- and 2×10^{-3} mol L^{-1} methionine.	81A330
		$\sim 2 \times 10^9$	11-12		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-.	720036
164	**1-*O*-Methyl-L-ascorbic acid**						
	$Br_2\cdot^- + CH_3AH \rightarrow 2\ Br^- + CH_3A\cdot^- + H^+$	3.7×10^8	6-7		p.r.	D.k. at 360 nm in soln. contg. KBr.	84A095
165	**2-*O*-Methyl-L-ascorbic acid**						
	$Br_2\cdot^- + CH_3AH \rightarrow 2\ Br^- + CH_3A\cdot^- + H^+$	6.1×10^8	3.6-6.8		p.r.	D.k. at 360 nm in soln. contg. KBr.	84A095
166	**3-*O*-Methyl-L-ascorbic acid**						
	$Br_2\cdot^- + CH_3AH \rightarrow 2\ Br^- + CH_3A\cdot^- + H^+$	7.5×10^7 9.8×10^8	6.4 9		p.r.	D.k. at 360 nm in soln. contg. KBr.	84A095
167	***S*-Methylcysteine**						
	$Br_2\cdot^- + CH_3SCH_2CH(NH_3^+)CO_2^- \rightarrow$	1.8×10^8 7.7×10^8 $\geq 1 \times 10^9$	7 ~9 ~11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.05 mol L^{-1} KBr and 0.9-6 $\times 10^{-4}$ mol L^{-1} disulfide (pK_a = 8.75)	81A008
168	**1-Methylcytosine**						
	$Br_2\cdot^- + MeCy^- \rightarrow 2\ Br^- + MeCy\cdot$	2×10^6	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 $\times 10^{-3}$ mol L^{-1} 1-methylcytosine.	86C005
168a	**1-Methylindole**						
	$Br_2\cdot^- + MeIn \rightarrow 2\ Br^- + MeIn\cdot^+$	2.4×10^9	4		p.r.	P.b.k. at 520 nm nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^- and the indole at different concentrations, e.g. 5×10^{-4} mol L^{-1}.	87A247
168b	**2-Methylindole**						
	$Br_2\cdot^- + MeInH \rightarrow 2\ Br^- + MeInH\cdot^+$	3.0×10^9	4		p.r.	P.b.k. at 520 nm nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^- and the indole at different concentrations, e.g. 5×10^{-4} mol L^{-1}.	87A247
168c	**3-Methylindole**						
	$Br_2\cdot^- + MeInH \rightarrow 2\ Br^- + MeInH\cdot^+$	3.1×10^9	4		p.r.	P.b.k. at 520 nm nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^- and the indole at different concentrations, e.g. 5×10^{-4} mol L^{-1}.	87A247
169	**4-Methylphenoxide ion**						
	$Br_2\cdot^- + CH_3C_6H_4O^- \rightarrow 2\ Br^- + CH_3C_6H_4O\cdot$	3.7×10^8	12.5		p.r.	P.b.k.	743052
170	**3-Methyl-2-pyrazolin-5-one**						
	$Br_2\cdot^- + C_4H_6N_2O \rightarrow 2\ Br^- + H^+ + C_4H_5N_2O$	7.0×10^8	8.8		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-; pK_a = 8.9	85A390
171	**4-Methyl-2-pyrazolin-5-one**						
	$Br_2\cdot^- + C_4H_6N_2O \rightarrow 2\ Br^- + H^+ + C_4H_5N_2O$	7.9×10^8	8.8		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-; pK_a = 8.9	85A390

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
172	**5-Methyl-1-thia-5-azacyclooctane**						
	$Br_2^{\cdot -} + C_6H_{15}NS \rightarrow 2\ Br^- + [C_6H_{15}NS]^{\cdot +}$	~2 × 10^8	10		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.03 mol L^{-1} KBr and 3-8 × 10^{-4} mol L^{-1} substrate.	84A250
173	**1-Methyluracil**						
	$Br_2^{\cdot -} + MeU^- \rightarrow 2\ Br^- + MeU\cdot$	2.2 × 10^6	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} 1-methyluracil (pK_a = 9.7).	86C005
174	**3-Methyluracil**						
	$Br_2^{\cdot -} + MeU^- \rightarrow 2\ Br^- + MeU\cdot$	2.8 × 10^8	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} 3-methyluracil (pK_a = 9.85).	86C005
175	**Metiazinic acid**						
	$Br_2^{\cdot -} + MZ^- \rightarrow 2\ Br^- + MZ\cdot$	3.4 × 10^9	10		p.r.	D.k. at 360 nm in N_2O-satd. 0.02 mol L^{-1} KBr.	81A162
176	**Nafazatrom (3-Methyl-1-[2-(1-naphthyloxy)ethyl]-2-pyrazoline-5-one)**						
	$Br_2^{\cdot -}$ + MNPZO → 2 Br^- + [MNPZO]·	1.4 × 10^9	9.4		p.r.	D.k. at 360 in N_2O-satd. soln. contg. 0.1 mol L^{-1} Br^-. pK_a (Nafazatrom) = 9.4.	83A308
177	**Nicotinamide adenine dinucleotide, reduced**						
	$Br_2^{\cdot -}$ + NADH → 2 Br^- + H^+ + NAD·	1.0 × 10^9	4.2-13.5		p.r.		83A170
		9.0 × 10^8			p.r.	P.b.k. at ~ 400 nm in N_2O-satd. 0.1 mol L^{-1} Br^- soln.	710158
178	**Nitrilotriacetate ion**						
	$Br_2^{\cdot -} + NTA^{3-} \rightarrow$	<1 × 10^7			p.r.	D.k. of $Br_2^{\cdot -}$ unaffected by solute in N_2O-satd. 0.1 mol L^{-1} KBr.	78A436
179	**Penicillamine**						
	$Br_2^{\cdot -}$ + PenS$^-$ → 2 Br^- + PenS·	1.8 × 10^9			p.r.	P.b.k.	84A233
180	**Penicillamine disulfide**						
	$Br_2^{\cdot -} + (PenS)_2 \rightarrow 2\ Br^- + (PenS)_2^{\cdot +}$	7.5 × 10^7 3.1 × 10^8 3.3 × 10^8	7 9 11		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.05 mol L^{-1} KBr and *tert*-BuOH; pK = 7.9, 8.5.	81A008
181	**Phenol**						
	$Br_2^{\cdot -} + C_6H_5OH \rightarrow 2\ Br^- + H^+ + C_6H_5O\cdot$	6 × 10^6	6		p.r.		743003
182	**Phenoxide ion**						
	$Br_2^{\cdot -} + C_6H_5O^- \rightarrow 2\ Br^- + C_6H_5O\cdot$	5 × 10^8	10		p.r.		743003
		2.9 × 10^8	12.5		p.r.	P.b.k.	743052
183	**Phenylalanine**						
	$Br_2^{\cdot -}$ + Phe →	<1 × 10^6	7.0	0.1	p.r.	D.k. in N_2O-satd. Br^- soln.	720036
184	**Pheophytin *a***						
	$Br_2^{\cdot -}$ + Ph a → 2 Br^- + [Ph-a]$^{\cdot +}$	1.2 × 10^8			p.r.	D.k. in N_2O-satd. soln. contg. 2% Triton X 100 (micelles) and 5 × 10^{-2} mol L^{-1} Br^-.	81N146

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
185	**Promethazine**						
	$Br_2{\cdot}^- + PZH^+ \rightarrow 2\ Br^- + PZH{\cdot}^{2+}$	6.2×10^9	3.5	$\rightarrow 0$	p.r.	P.b.k. at 505 nm as well as d.k. at 360 nm; overall rate constant, 80% electron transfer.	83A272
186	**Propyl gallate**						
	$Br_2{\cdot}^- + (HO)_3C_6H_2CO_2C_3H_7 \rightarrow 2\ Br^- + 2\ H^+ + {\cdot}O(O^-)(OH)C_6H_2CO_2C_3H_7$	1.1×10^9	~9		p.r.	D.k. in N_2O-satd. soln. contg. Br^-.	85A492
187	**Pyrazole**						
	$Br_2{\cdot}^- + C_3H_4N_2 \rightarrow$	$<1 \times 10^6$	8.8		p.r.	D.k. at 360 nm	85A390
188	**Pyrene (triplet state)**						
	$Br_2{\cdot}^- + {}^3Py \rightarrow 2\ Br^- + Py^+$	1×10^9			p.r.	D.k. at 414 nm (^{3}Py) or 360 nm ($Br_2{\cdot}^-$) or p.b.k. at 448 nm (Py^+) in 0.02 mol L^{-1} Br^- contg. 10^{-2} mol L^{-1} hexadecyltrimethyl ammonium bromide; triplet formed by flash photolysis; two kinetic steps obs.	761181
189	***N*-Stearoyltryptophan methyl ester**						
	$Br_2{\cdot}^- + STME \rightarrow 2\ Br^- + STME{\cdot}$	5.6×10^9	7.0		p.r.	P.b.k. at 520 nm in micellar soln. contg. 2×10^{-3} mol L^{-1} tetradecyl trimethylammonium bromide, 0.1 mol L^{-1} phosphate buffer and 0.1 mol L^{-1} NaBr; $k = <2 \times 10^7$ in SDS by d.k. of $Br_2{\cdot}^-$ at 380 nm.	86N145
190	**Tetrafluorohydroquinone**						
	$Br_2{\cdot}^- + C_6F_4(OH)_2 \rightarrow 2\ Br^- + {\cdot}OC_6F_4O^- + 2\ H^+$	7.4×10^8	~10.5		p.r.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr.	83B063
191	**1,2,4,5-Tetramethoxybenzene**						
	$Br_2{\cdot}^- + TMB \rightarrow 2\ Br^- + TMB{\cdot}^+$	1.9×10^9			p.r.	D.k. at 380 nm in N_2O-satd. soln. contg. Br^-.	87A041
192	**2,2,6,6-Tetramethyl-4-piperidone *N*-oxyl**						
	$Br_2{\cdot}^- + TAN \rightarrow$	1.6×10^9	5-6		p.r.	D.k. at 380 nm.	710618
193	**Tetraphenylborate ion**						
	$Br_2{\cdot}^- + Ph_4B^- \rightarrow 2\ Br^- + Ph_4B{\cdot}$	2×10^7			p.r.	P.b.k.	86A469
194	**Thymine**						
	$Br_2{\cdot}^- + 5\text{-MeU}^- \rightarrow 2\ Br^- + 5\text{-MeU}{\cdot}$	2×10^8	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 $\times 10^{-3}$ mol L^{-1} thymine (pK_a = 9.94).	86C005
		$<10^7$	3-4		p.r.	P.b.k. at 370-380 nm in N_2O-satd. soln. contg. 2-5 $\times 10^{-2}$ mol L^{-1} Br^- and 2-10 $\times 10^{-4}$ mol L^{-1} pyrimidine.	87A026
		2×10^8 $< 1 \times 10^7$	12 7		p.r.		741168
195	**α-Tocopherol**						
	$Br_2{\cdot}^- + ArOH \rightarrow 2\ Br^- + H^+ + ArO{\cdot}$	7.2×10^8	7.0		p.r.	P.b.k. at 440 nm in micellar soln. contg. 2×10^{-3} mol L^{-1} tetradecyl trimethylammonium bromide, 0.1 mol L^{-1} phosphate buffer and 0.4 mol L^{-1} NaBr.	86N145

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
196	**2',4',5'-Trihydroxybutyrophenone**						
	$Br_2^{\cdot -}$ + $(HO)_3C_6H_2COCH_2CH_2CH_3$ →	7.2×10^8 1.4×10^9	5-7 ~9		p.r.	D.k. in N_2O-satd. soln. contg. Br^-.	85A492
197	**2',4',6'-Trihydroxy-β-(4-hydroxyphenyl)-propiophenone**						
	$Br_2^{\cdot -}$ + $(HO)_3C_6H_2CO(CH_2)_2C_6H_4OH$ →	1.9×10^9	~9		p.r.	D.k. in N_2O-satd. soln. contg. Br^-.	85A492
198	**2',4',5'-Trihydroxy-α-(4-methoxyphenyl)-acetophenone**						
	$Br_2^{\cdot -}$ + $(HO)_3C_6H_2COCH_2C_6H_4OCH_3$ →	1.3×10^9	8.5-9.5		p.r.	D.k. in N_2O-satd. soln. contg. Br^-.	85A492
199	**2,4,5-Trihydroxypyrimidine**						
	$Br_2^{\cdot -}$ + $C_4H_3N_2O_3^-$ → 2 Br^- + $C_4H_3N_2O_3$	1.3×10^9	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} isobarbiturate ion (pK_a = 8.11, 11.5).	86C005
200	**2,4,6-Trihydroxypyrimidine (Barbiturate ion)**						
	$Br_2^{\cdot -}$ + $C_4H_3N_2O_3^-$ → 2 Br^- + $C_4H_3N_2O_3$	1.1×10^9	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} barbiturate (pK_a = 4.0, 12.5).	86C005
201	**Tryptamine**						
	$Br_2^{\cdot -}$ + TrpH → 2 Br^- + Trp· + H^+	1×10^9	7, 13		p.r.	D.k. at 355 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr; radical cation forms which deprotonates.	86A110
		1.3×10^9	6.2		p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059
202	**Tryptophan**						
	$Br_2^{\cdot -}$ + TrpH → 2 Br^- + Trp· + H^+	7.0×10^8	7-10		p.r.	D.k. at 360 nm in N_2O-satd. 0.1 mol L^{-1} KBr soln.	86A187
		5.8×10^8	6.2		p.r.	P.b.k. at 510 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059
		7.0×10^8			p.r.	D.k. at 360 nm or p.b.k. at 500 nm in N_2O-satd. soln. contg. 5 × 10^{-3} mol L^{-1} KBr.	78A315
		7.7×10^8	7-13	0.1	p.r.	D.k. in N_2O-satd. Br^- soln.	72O036
203	**Tryptophanamide**						
	$Br_2^{\cdot -}$ + TrpH → 2 Br^- + Trp· + H^+	1.1×10^9	7, 13		p.r.	D.k. at 355 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr; radical cation forms which deprotonates.	86A110
204	**Tryptophan methyl ester**						
	$Br_2^{\cdot -}$ + TrpH → 2 Br^- + Trp· + H^+	8.3×10^8	7, 13		p.r.	D.k. at 355 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr; radical cation forms which deprotonates.	86A110
205	**Tryptophyltyrosine**						
	$Br_2^{\cdot -}$ + c-TrpHTyrOH →	6.8×10^8	4		p.r.	D.k.	81A032
206	**Tyrosine**						
	$Br_2^{\cdot -}$ + TyrOH → 2 Br^- + H^+ + TyrO·	2×10^8 5×10^8	7 13		p.r.	D.k. at 355 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr.	86A110
		2×10^7	6.2		p.r.	P.b.k. at 405 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
206	**Tyrosine**—Continued						
		~1×10^7 ~3.5×10^8	6 12		p.r.	D.k. in N_2O-satd. 0.04 mol L^{-1} Br^- soln.; values from graph.	731067
		2.0×10^7 5×10^8	7.5 12	0.1	p.r.	D.k. in N_2O-satd. Br^- soln.; k increases with pH.	720036
207	**Tyrosine methyl ester**						
	$Br_2^{\cdot-}$ + MeTyrOH → 2 Br^- + MeTyrO· + H^+	1.5×10^7 1.5×10^9	7 13		p.r.	D.k. at 355 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr; radical cation forms which deprotonates.	86A110
208	**Uracil**						
	$Br_2^{\cdot-}$ + U^- → 2 Br^- + U·	2×10^8	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} uracil (pK_a = 9.5).	86C005
		2×10^8 $< 1 \times 10^7$	12 7		p.r.		741168
209	**Urate ion**						
	$Br_2^{\cdot-}$ + UrO^- → 2 Br^- + UrO·	1.5×10^9	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} urate (pK_a = 5.4, 5.54, 12.73).	86C005
210	**Xanthine**						
	$Br_2^{\cdot-}$ + XO^- → 2 Br^- + XO·	8.8×10^8	13		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 0.05-5 × 10^{-3} mol L^{-1} xanthine (pK_a = 7.53, 11.63).	86C005
211	**Alcohol dehydrogenase**						
	$Br_2^{\cdot-}$ + ALDH →	2.6×10^9	7		p.r.	D.k. in 0.05 mol L^{-1} Br^- soln.; enzyme from yeast; $k = 1.0 \times 10^9$ for horse liver enzyme.	741125 78R007
212	**Apocarbonic anhydrase**						
	$Br_2^{\cdot-}$ + apo-CAHD →	4.5×10^8	7.0		p.r.	D.k.; at pH 11.5 $k = 5.8 \times 10^8$.	81A299
213	**Carbonic anhydrase**						
	$Br_2^{\cdot-}$ + CAHD →	4.6×10^8 1.9×10^9	7.0 10.8		p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr and 1.5 mg mL^{-1} carbonic anhydrase (from beef blood); cor. for Br^- binding of enzyme; inhibition of reaction by other anions was also studied.	81A300, 81A299
214	**Carboxypeptidase A**						
	$Br_2^{\cdot-}$ + CPD-A →	8×10^8 1×10^9 2×10^9 2.5×10^9	8 9 10 11		p.r.	D.k. in 0.05 mol L^{-1} Br^- soln.; values from graph.	731060
215	**α-Chymotrypsin**						
	$Br_2^{\cdot-}$ + α-Chymotrypsin →	1.6×10^9	6.7		p.r.	D.k. in N_2O-satd. 0.04 mol L^{-1} Br^-; mol. wt. = 20,000.	741096
216	**Concanavalin A**						
	$Br_2^{\cdot-}$ + Con A →	7×10^9	7.1		p.r.	P.b.k. at 530 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr.	78R005

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
217	**Coproferriheme**						
	$Br_2^{\cdot-}$ + Coproferriheme →	$>1 \times 10^9$	5.6		p.r.	Estd. from rapid change in spectrum in N_2O-satd. soln. contg. 0.1 mol L^{-1} KBr and 10^{-5} mol L^{-1} coproheme, assuming $2k(Br_2^{\cdot-} + Br_2^{\cdot-}) = 4 \times 10^9$.	84B199
218	**Cytochrome C**						
	$Br_2^{\cdot-}$ + Cyt C (Fe^{3+}) →	$\sim 5 \times 10^7$	7	0.073	p.r.	D.k. at 360 nm in N_2O-satd. soln.	81A069
219	**Cytochrome C (ferro)**						
	$Br_2^{\cdot-}$ + Cyt C (Fe^{2+}) → 2 Br^- + Cyt C (Fe^{3+})	9.7×10^8	7	0.073	p.r.	D.k. at 339 ($Br_2^{\cdot-}$) or 450 or 550 nm (cyt) in N_2O-satd. soln.; 100% e-transfer; same rate at pH 8; $k = 1.6 \times 10^{10}$ cor. to $I = 0$.	81A069
220	**Isocitrate dehydrogenase**						
	$Br_2^{\cdot-}$ + ICDH →	7.7×10^8 $\sim 2 \times 10^9$	7 ~11		p.r.	D.k. at 360 nm; enzyme from pig heart.	82A318
221	**Laccase**						
	$Br_2^{\cdot-}$ + Cu-OXD → addn.	$\sim 1.5 \times 10^{10}$	6.0		p.r.	D.k.	82A422
222	**Lactate dehydrogenase**						
	$Br_2^{\cdot-}$ + LADH →	5.5×10^9	7.2	0.005	p.r.	D.k. in N_2O-satd. soln. contg. 5×10^{-3} mol L^{-1} Br^- and $3.6\text{-}18.3 \times 10^{-6}$ mol L^{-1} enzyme from beef heart; there is a fast initial rate; reported k is for decay after first half-life; p.b.k. at 500 nm is in good agreement but with no fast initial rate.	771132
223	**Lipoxidase (soybean)**						
	$Br_2^{\cdot-}$ + LOX →	2.5×10^9			p.r.	Product is Fe(III) yellow enzyme, 60% reaction at the Fe(II) center est from final abs. spectrum.	80A296
224	**Papain**						
	$Br_2^{\cdot-}$ + Papain →	1.1×10^9 2.3×10^9	7 11.5		p.r.	D.k. in 0.05 mol L^{-1} Br^- soln.; activated enzyme used.	741026
225	**Pepsin**						
	$Br_2^{\cdot-}$ + Pepsin →	1.6×10^9	4.3		p.r.	D.k.	79A185
226	**Peroxidase (horseradish)**						
	$Br_2^{\cdot-}$ + Fe^{III} HRP → HRP Compound II	$\sim 2 \times 10^6$	6.3		phot.	C.k.; obs. Compound II formn. in soln. contg. $S_2O_8^{2-}$ and NaBr; rel. to $2k(Br_2^{\cdot-} + Br_2^{\cdot-}) = (1.6 - 2.6) \times 10^9$.	80R177
227	**Phage T4 gene 32 protein**						
	$Br_2^{\cdot-}$ + gp32 →	9.5×10^9	6.2		p.r.	P.b.k. at 510 nm (formn. of Trp·) in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} KBr (phosphate buffer).	84A059
228	**Ribonuclease**						
	$Br_2^{\cdot-}$ + RNase →	4.6×10^9	4.5		p.r.	D.k. in 10^{-2} mol L^{-1} Br^- soln.	720037
229	**Subtilisin**						
	$Br_2^{\cdot-}$ + Subtilisin →	1×10^9 $\sim 2 \times 10^9$ $\sim 7 \times 10^9$	7 10 12		p.r.	D.k. in N_2O-satd. 0.04 mol L^{-1} Br^- soln.; subtilisin Carlsberg; values from graph; $k = 1.3 \times 10^9$ at pH 7 for subtilisin Novo.	731147, 741119

TABLE 22. Rate constants for reactions of dibromine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
230	**Superoxide dismutase**						
	$Br_2^{\cdot -}$ + SOD →	4.4×10^8 3.4×10^8	7-10 11.3		p.r.	Bovine enzyme; $k = 1.2 \times 10^9$ for human enzyme at pH < 10.	731148, 743081
231	**Trypsin**						
	$Br_2^{\cdot -}$ + Tryp →	2.6×10^9 5.3×10^9	7-8 11.5		p.r.	D.k. in N_2O-satd. 0.04 mol L^{-1} Br^-.	731067

TABLE 23. Rate constants for reactions of diiodine radical ions in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
1	**Diiodine radical ion**						
	$I_2^{\cdot -} + I_2^{\cdot -} \rightarrow I_3^- + I^-$	3.2×10^9	7	0.1	p.r.	D.k. at 725 nm in N_2O-satd. soln. of KI (value from graph); k detd. at 22-91 °C at various [KI]; $\epsilon = 2560$ L mol^{-1} cm^{-1}.	84A281
		3×10^9	9.5		p.r.	D.k. at 400 nm in N_2O-satd. soln. contg. 1×10^{-3} mol L^{-1} KI, and borate ion; ($\epsilon_{380} = 9100$ L mol^{-1} cm^{-1}).	80G098
		4.5×10^9	alk.		p.r.	Computer analysis of abs. at 335 and 390 nm in N_2O-satd. 2×10^{-4}-1×10^{-2} mol L^{-1} I^- soln. contg. 1.3×10^{-4} H^+ to 10 mol L^{-1} OH^-; ϵ(390 nm) = 15,600 L mol^{-1} cm^{-1}; ϵ(335 nm) = 8200 L mol^{-1}	761105
		3.9×10^9	1.4-6		f.p.	D.k. at 404.7 nm in 3×10^{-5} to 10^{-3} mol L^{-1} I^- soln.; ϵ(404.7 nm) = 11,700 L mol^{-1} cm^{-1}.	577007
2	**Cobalt(II) ion**						
	$I_2^{\cdot -} + Co^{2+} \rightarrow$				f.p.	no reaction	737316
3	**Pentaammine(iodo)cobalt(III) ion**						
	$I_2^{\cdot -} + Co(NH_3)_5I^{2+} \rightarrow I_3^- + Co^{2+} + 5\ NH_3$	$\sim 2.5 \times 10^4$			f.p.	Estd. from intensity dependence of $\Phi(Co^{II})$.	727506
4	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecobalt(II) ion**						
	$I_2^{\cdot -} + Co(4,11\text{-dieneN}_4)^{2+} \rightarrow I^- + ICo(4,11\text{-dieneN}_4)^{2+}$	7.2×10^9	2	0.03	f.p.	D.k.; $I_2^{\cdot -}$ from ion pair: $Co(NH_3)_6^{3+}$, I^-.	727506
5	**1,3,6,8,10,13,16,19-Octaazabicyclo[6.6.6]eicosanecobalt(II) ion**						
	$I_2^{\cdot -} + Co(sepulchrate)^{2+} \rightarrow 2\ I^- + Co(sepulchrate)^{3+}$	5.0×10^9			p.r.	D.k. at 375 nm in soln. contg. 0.1 mol L^{-1} KI and 1×10^{-4} mol L^{-1} $Co(sepulchrate)^{3+}$.	86A342
6	**Chromium(II) ion**						
	$I_2^{\cdot -} + Cr^{2+} \rightarrow I^- + CrI^{2+}$	1.5×10^9	1	0.2	p.r.	D.k.; inner-sphere substitution.	741104
7	**Nitrilotriacetatocuprate(II) ion**						
	$I_2^{\cdot -} + CuNTA^- \rightarrow$				p.r.	unreactive	78A436
8	**Ethylenediaminetetraacetatocuprate(II) ion**						
	$I_2^{\cdot -} + CuEDTA^{2-} \rightarrow$				p.r.	unreactive	78A436
9	**Iron(II) ion**						
	$I_2^{\cdot -} + Fe^{2+} \rightarrow I^- + FeI^{2+}$	3.6×10^6			p.r.	Inner-sphere substitution.	741104
10	**Nitrilotriacetatoferrate(II) ion**						
	$I_2^{\cdot -} + FeNTA^- \rightarrow$	1.1×10^8	4.8		p.r.	D.k.	78A436
11	**Ethylenediaminetetraacetatoferrate(II) ion**						
	$I_2^{\cdot -} + FeEDTA^{2-} \rightarrow$	$<5 \times 10^7$	4.8		p.r.	D.k.	78A436
12	**Hypoiodite ion**						
	$I_2^{\cdot -} + IO^- \rightarrow 2\ I^- + IO$	$<1 \times 10^7$			p.r.	No reaction detected	85A037
		5.1×10^7		0.01	f.p.	D.k. at 370 nm; also studied variation of I and D (alcohol).	80A199
		5.0×10^7	13.6		f.p.	D.k. in (1-3) $\times 10^{-4}$ mol L^{-1} IO^- and I^- soln.	700018
13	**Hypoiodous acid**						
	$I_2^{\cdot -} + HOI \rightarrow 2\ I^- + H^+ + IO$	$\sim 1 \times 10^5$			γ-r.	Estd. from yields.	85A037

TABLE 23. Rate constants for reactions of diiodine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
14	**Azide ion**						
	$I_2^{\bullet-} + N_3^- \rightarrow$	$<5 \times 10^5$			p.r.	D.k. at 380 nm (I_2^-) in N_2O-satd. soln. contg. 0.2 mol L^{-1} NaN_3	87C002
15	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion**						
	$I_2^{\bullet-} + Ni(aneN_4)^{2+} \rightarrow$	$<1 \times 10^7$	1		f.p.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} I^-.	79A038
16	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienenickel(II) ion**						
	$I_2^{\bullet-} + Ni(4,11\text{-}dieneN_4)^{2+} \rightarrow$	$<1 \times 10^7$			f.p.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} I^-.	79A002
17	**5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-1,4,8,11-tetraenenickel(II) ion**						
	$I_2^{\bullet-} + Ni(tetraeneN_4)^{2+} \rightarrow$	$<1 \times 10^7$	1		f.p.	D.k. in N_2O-satd. soln. contg. 0.1 mol L^{-1} I^-.	79A038
18	**Nitrilotriacetatonickelate(II) ion**						
	$I_2^{\bullet-} + NiNTA^- \rightarrow$				p.r.	unreactive	78A436
19	**Ethylenediaminetetraacetatonickelate(II) ion**						
	$I_2^{\bullet-} + NiEDTA^{2-} \rightarrow$				p.r.	unreactive	78A436
20	**Tris(2,2'-bipyridine)osmium(II) ion**						
	$I_2^{\bullet-} + Os(bpy)_3^{2+} \rightarrow 2\ I^- + Os(bpy)_3^{3+}$	1.1×10^8	3	0.1	p.r.	D.k. at 630 nm in soln. contg. 0.1 mol L^{-1} I^- and 10^{-4} mol L^{-1} complex; $k_r = 3.3 \times 10^4$ L^{-2} mol^{-2} s^{-1}.	82A115
21	**Tris(2,2'-bipyridine)osmium(III) ion**						
	$I_2^{\bullet-} + Os(bpy)_3^{3+} \rightarrow I_2 + Os(bpy)_3^{2+}$	1.2×10^{10}	3	0.1	p.r.	D.k. at 630 nm in soln. contg. 0.1 mol L^{-1} I^- and 10^{-4} mol L^{-1} complex.	82A115
22	**Pentaammine(pyridine)ruthenium(II) ion**						
	$I_2^{\bullet-} + Ru(NH_3)_5py^{2+} \rightarrow 2\ I^- + Ru(NH_3)_5py^{3+}$	2.3×10^9			p.r.	Preliminary results; H. Cohen.	84A035
23	**Hydrogen sulfite ion**						
	$I_2^{\bullet-} + HSO_3^- \rightarrow 2\ I^- + H^+ + \dot{S}O_3^-$	1.1×10^6	3		p.r.	D.k. at 380 nm in N_2O-satd. I^- soln.	85A103
24	**Sulfite ion**						
	$I_2^{\bullet-} + SO_3^{2-} \rightarrow 2\ I^- + \dot{S}O_3^-$	1.9×10^8	11		p.r.	D.k. at 380 nm in N_2O-satd. I^- soln.	85A103
24a	**Uranium(III) ion**						
	$I_2^{\bullet-} + U^{3+} \rightarrow I^- + UI^{3+}$	1.2×10^9	<1		p.r.	D.k. in He-satd. soln. contg. 0.5 mol L^{-1} $HClO_4$ contg. 0.1 mol L^{-1} NaI; inner-sphere mechanism.	85A122
25	**Vanadium(II) ion**						
	$I_2^{\bullet-} + V^{2+} \rightarrow 2\ I^- + V^{3+}$	1.4×10^8	1	0.2	p.r.	D.k.; outer-sphere electron transfer.	741104
26	**5,10,15,20-Tetrakis(4-*N*-methylpyridyl)porphinatozinc(II) ion**						
	$I_2^{\bullet-} + ZnTMpyP^{4+} \rightarrow 2\ I^- + [ZnTMpyP]^{\bullet 5+}$	$\sim 1 \times 10^8$	7	0.01	p.r.	P.b.k. at 690-700 nm in N_2O-satd. buffered soln. contg. NaI and (1-4) $\times$ 10^{-4} mol L^{-1} porphyrin; the π-radical cation complexes with I^-.	85A038
27	**Acriflavine (3,6-Diamino-10-methylacridinium)**						
	$I_2^{\bullet-} + ACFl^+ \rightarrow$	$<2 \times 10^8$			p.r.	Decay of $I_2^{\bullet-}$ only slightly increased in presence of dye.	700241

TABLE 23. Rate constants for reactions of diiodine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
28	**Aniline**						
	$I_2^{\cdot-} + C_6H_5NH_2 \rightarrow 2\ I^- + H^+ + C_6H_5\dot{N}H$	4.4×10^9	10		p.r	D.k. at 380 nm nm in N_2O-satd. I^- soln.	87A220
29	**Ascorbate ion**						
	$I_2^{\cdot-} + AH^- \rightarrow 2\ I^- + H^+ + \cdot A^-$	3.1×10^8	10		p.r	D.k. at 380 nm nm in N_2O-satd. I^- soln.	87A220
		1.7×10^8	11	→0	p.r.	P.b.k. at 360 nm in N_2O-satd. soln. contg. 5×10^{-3} mol L^{-1} I^-.	771036
		1.4×10^8	7		p.r.	D.k.	720266
30	**Ascorbic acid**						
	$I_2^{\cdot-} + AH_2 \rightarrow 2\ I^- + A\cdot^- + 2\ H^+$	$\leq 6 \times 10^5$			p.r.	D.k. at 380 nm	85A392
		5×10^6	2		p.r.	D.k.	720266
31	**4-Bromophenoxide ion**						
	$I_2^{\cdot-} + BrC_6H_4O^- \rightarrow 2\ I^- + BrC_6H_4O\cdot$	5.0×10^7	12.5		p.r.	P.b.k. at 400 nm; at pH 7 $k \simeq 5 \times 10^6$.	743052
32	**4-Chlorophenoxide ion**						
	$I_2^{\cdot-} + ClC_6H_4O^- \rightarrow 2\ I^- + ClC_6H_4O\cdot$	5.8×10^7	12.5		p.r.	P.b.k. at 400 nm.	743052
33	**Chlorpromazine**						
	$I_2^{\cdot-} + CZH^+ \rightarrow 2\ I^- + CZH\cdot^{2+}$	2.0×10^9	3.5		p.r.	P.b.k. at 505 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KI; overall rate constant, 58% electron transfer.	83A272
34	**Cysteine**						
	$I_2^{\cdot-} + CysSH \rightarrow$	1.1×10^8 $\sim 1 \times 10^9$	6.8 10-11	0.1	p.r.	D.k. in N_2O-satd. I^- soln.	720036
35	**1,6-Diazabicyclo[4.4.4]tetradecane radical cation**						
	$I_2^{\cdot-} + DABCT\cdot^+ \rightarrow 2\ I^- + DABCT^{2+}$	1.9×10^8		→0	p.r.	D.k. at 480 nm (as well as 380 nm, I_2^-) in N_2O-satd. soln. contg. 0.02-2.0×10^{-3} mol L^{-1} radical cation and 0.1 mol L^{-1} KI; $k_{obs} = 1.1 \times 10^8$.	86A272
36	**2,3-Dihydroxy-2-propenal**						
	$I_2^{\cdot-} + TRH_2 \rightarrow 2\ I^- + 2\ H^+ + TR\cdot^-$	$\leq 1 \times 10^6$			p.r.	D.k. at 380 nm; pK_a = 5.0, 13.0; pK_a (radical) = 1.4.	85A392
	$I_2^{\cdot-} + TRH^- \rightarrow 2\ I^- + H^+ + TR\cdot^-$	3.4×10^8					
37	**Dithiothreitol**						
	$I_2^{\cdot-} + DTT \rightarrow$	1.9×10^7	7		p.r.	D.k.	731020
38	**Histidine**						
	$I_2^{\cdot-} + His \rightarrow$	$<1 \times 10^6$	7	0.1	p.r.	D.k. in N_2O-satd. I^- soln.	720036
39	**Lipoate ion**						
	$I_2^{\cdot-} + RSSR \rightarrow 2\ I^- + RSSR\cdot^+$	5.2×10^8	9		p.r.	D.k. at 380 nm in N_2O-satd. soln. contg. KI and various concns. disulfide; $k = 2.2 \times 10^8$ cor. for I; $k_r = 3.5 \times 10^9$ L^{-2} mol^{-2} s^{-1}.	86A403
40	**Lipoic acid**						
	$I_2^{\cdot-} + RSSR \rightarrow 2\ I^- + RSSR\cdot^+$	6.8×10^8	3.6		p.r.	D.k. at 380 nm in N_2O-satd. soln. contg. KI and various concns. disulfide; $k_r = 1.44 \times 10^{10}$ ($k_r = 3.0 \times 10^{10}$ L^{-2} mol^{-2} s^{-1} cor. for I).	86A403

TABLE 23. Rate constants for reactions of diiodine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
41	**2-Mercapto-1-methylimidazole**						
	$I_2\cdot^- + MMI \rightarrow 2\ I^- + MMI\cdot^+$	2.0×10^9			p.r.	P.b.k. at 510 nm in soln. contg. 10^{-2} mol L^{-1} KI and 10^{-4} mol L^{-1} MMI.	84A317
42	**Methionine**						
	$I_2\cdot^- + Met \rightarrow$	$<1 \times 10^6$	7	0.1	p.r.	D.k. at N_2O-satd. I^- soln.	720036
		$<1 \times 10^6$	3		p.r.	D.k.	81A339
		$<1 \times 10^7$	11				
43	**4-Methylphenoxide ion**						
	$I_2\cdot^- + CH_3C_6H_4O^- \rightarrow 2\ I^- + CH_3C_6H_4O\cdot$	9.8×10^7	12.5		p.r.	P.b.k. at 400 nm.	743052
44	**Nicotinamide adenine dinucleotide, reduced**						
	$I_2\cdot^- + NADH \rightarrow 2\ I^- + H^+ + NAD\cdot$	$\sim 5 \times 10^7$		0.1	p.r.	D.k. at 370 nm in N_2O-satd. I^- soln.	710158
45	**Phenoxide ion**						
	$I_2\cdot^- + C_6H_5O^- \rightarrow 2\ I^- + C_6H_5O\cdot$	5.7×10^7	12.5		p.r.	P.b.k. at 400 nm.	743052
46	**Phenylalanine**						
	$I_2\cdot^- + Phe \rightarrow$	$<1 \times 10^6$	7	0.1	p.r.	D.k. in N_2O-satd. I^- soln.	720036
47	***p*-Phenylenediamine**						
	$I_2\cdot^- + C_6H_4(NH_2)_2 \rightarrow 2\ I^- + H^+ + H_2NC_6H_4NH$	7.0×10^7	10		p.r	P.b.k. at 480 nm in N_2O-satd. I^- soln.	87A220
48	**Promethazine**						
	$I_2\cdot^- + PZH^+ \rightarrow 2\ I^- + PZH\cdot^{2+}$	6.6×10^8	3.5		p.r.	P.b.k. at 505 nm as well as d.k. at 410 nm in N_2O-satd. soln. contg. 0.1 mol L^{-1} KI; overall rate constant	83A273
49	***N,N,N',N'*-Tetramethyl-*p*-phenylenediamine**						
	$I_2\cdot^- + TMPD \rightarrow 2\ I^- + TMPD\cdot^+$	6.6×10^8	10		p.r	P.b.k. at 560 nm in N_2O-satd. I^- soln.	87A220
50	**2,2,6,6-Tetramethyl-4-piperidone *N*-oxyl**						
	$I_2\cdot^- + TAN \rightarrow$	1.7×10^9	5-6		p.r.	D.k. at 390 nm; final product may be I_3^-.	710618
51	**Tryptophan**						
	$I_2\cdot^- + TrpH \rightarrow$	$<1 \times 10^6$	7	0.1	p.r.	D.k. in N_2O-satd. I^- soln.	720036
		$\sim 1 \times 10^7$	12-13				
52	**Tyrosine**						
	$I_2\cdot^- + TyrOH \rightarrow$	$<1 \times 10^6$	7	0.1	p.r.	D.k. in N_2O-satd. I^- soln.	720036
53	**Urate ion**						
	$I_2\cdot^- + UrO^- \rightarrow 2\ I^- + UrO\cdot$	8.4×10^8	13		p.r	D.k. at 380 nm in N_2O-satd. I^- soln.	87A220
54	**Alcohol dehydrogenase**						
	$I_2\cdot^- + ALDH \rightarrow$	$\sim 1.2 \times 10^9$			p.r.	Est. from d.k. in N_2O-satd. I^- soln.; enzyme from yeast; reaction of horse-liver ALDH with $I_2\cdot^-$ not important, inactivation probably by I· [78R007].	731065
55	**Aldolase (rabbit muscle)**						
	$I_2\cdot^- + ALD \rightarrow$	$\sim 3 \times 10^8$			p.r.	Est. from d.k. in N_2O-satd. I^- soln.	731065

TABLE 23. Rate constants for reactions of diiodine radical ions in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	I	Method	Comment	Ref.
56	**Lactate dehydrogenase**						
	$I_2^{\cdot-}$ + LADH →	4.3×10^{9}	7.2	0.005	p.r.	D.k. at N_2O-satd. I^- soln. contg. 5 $\times 10^{-6}$ mol L^{-1} LADH; $[I_2^{\cdot-}]$ = 5-100 $\times 10^{-6}$ mol L^{-1}; k for I· reaction also derived.	771132
57	**Trypsin**						
	$I_2^{\cdot-}$ + Tryp →	$\sim 1 \times 10^{8}$ $\sim 6 \times 10^{8}$	11 12		p.r.	D.k. in N_2O-satd. 0.04 mol L^{-1} I^- soln.; values from graph.	731067

TABLE 24. Rate constants for reactions of chlorine dioxide in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Bromide ion**					
	$ClO_2\cdot + Br^- \rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468
2	**Dibromine radical anion**					
	$ClO_2\cdot + Br_2\cdot^- \rightarrow$	1.2×10^9	5	f.p.	D.k. in Br^--ClO_2 soln.; some $BrCl\cdot^-$ possible.	737043
3	**Dichlorine radical anion**					
	$ClO_2\cdot + Cl_2\cdot^- \rightarrow$	1.0×10^9	5	f.p.	D.k. in ClO_2-Cl^- soln.	737043
4	**Bis(2,2',6',2''-terpyridine)cobalt(II) ion**					
	$ClO_2\cdot + Co(terpy)_2^{2+} \rightarrow ClO_2^- + Co(terpy)_2^{3+}$	2.1×10^7	2.5-6.5	s.f.	Activation parameters were obtained from measurements at 5-30°C; obs. change in abs. at 316 and 505 nm.	84A454
5	**Tris(1,10-phenanthroline)iron(II) ion**					
	$ClO_2\cdot + Fe(phen)_3^{2+} \rightarrow ClO_2^- + Fe(phen)_3^{3+}$	4.5×10^4	1-1.7	s.f.	D.k. at 510 nm (Fe(II)); $k_r = 2.3 \times 10^7$; $I = 0.1$.	83A404
6	**Ferrocyanide ion**					
	$ClO_2\cdot + Fe(CN)_6^{4-} \rightarrow ClO_2^- + Fe(CN)_6^{3-}$	7.4×10^7	9.2	p.r.	P.b.k. at 420 nm.	86A059
7	**Iodide ion**					
	$ClO_2\cdot + I^- \rightarrow$	1.4×10^3	9-10		D.k. at 360 nm	82A468
8	**Hexabromoiridate(III) ion**					
	$ClO_2\cdot + IrBr_6^{3-} \rightarrow ClO_2^- + IrBr_6^{2-}$	6.9×10^5	5.6-6.2	s.f.	D.k. at 588 nm; derived from reverse reaction; $I = 0.1$; $K_{eq} = 37.3$.	84A454
9	**Hexachloroiridate(III) ion**					
	$ClO_2\cdot + IrCl_6^{3-} \rightarrow ClO_2^- + IrCl_6^{2-}$	5.9×10^4	1.4-4	s.f.	D.k. at 487 nm; derived from reverse reaction; $I = 0.1$; $K_{eq} = 5.55$.	84A454
10	**Ammonia**					
	$ClO_2\cdot + NH_3 \rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468
11	**Nitrite ion**					
	$ClO_2\cdot + NO_2^- \rightarrow$	1.1×10^2	4-10		D.k. at 360 nm	82A468
12	**Hydroxyl radical**					
	$ClO_2\cdot + \cdot OH \rightarrow ClO_3^- + H^+$	4.0×10^9	~7	p.r.	D.k. at 360 nm in N_2O-satd. soln.	85A039
13	**Oxide radical anion**					
	$ClO_2\cdot + O\cdot^- \rightarrow ClO_3^-$	2.7×10^9	alk.	p.r.	D.k. at 360 nm in N_2O-satd. soln.	85A039
14	**Perhydroxyl radical**					
	$ClO_2\cdot + HO_2\cdot \rightarrow$	$<1 \times 10^6$	<4	p.r.	Derived from second-order d.k. at 358 nm in ClO_2^- soln. by varying pulse intensity; at pH 3.2 $k_{obs} = 1.4 \times 10^6$.	86A059
15	**Superoxide radical ion**					
	$ClO_2\cdot + O_2\cdot^- \rightarrow ClO_2^- + O_2$	3×10^9	9.4	p.r.	Derived from second-order d.k. at 358 nm in ClO_2^- soln. by varying pulse intensity.	86A059
		3.3×10^9	12	p.r.	D.k. at 360 nm in soln. contg. 10^{-2} mol L^{-1} ClO_2^- and 1.3×10^{-2} mol L^{-1} H_2O_2.	81A242
16	**Hydroperoxide ion**					
	$ClO_2\cdot + HO_2^- \rightarrow$	8×10^4	7-13	p.r.	D.k. at 360 nm; k calcd. from plot of $[HO_2^-]$ vs. k_{obs} where $pK_a(H_2O_2) = 11.65$; at pH <7 $k(ClO_2 + H_2O_2)$ estd. to be <4.	81A242

TABLE 24. Rate constants for reactions of chlorine dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
17	**Ozone**					
	$ClO_2\cdot + O_3 \rightarrow ClO_3 + O_2$	1.1×10^3	3-11	s.f.	D.k. at 260 and 360-420 nm in soln. contg. 4-40 $\times 10^{-4}$ mol L^{-1} ClO_2 and 2-7 $\times 10^{-5}$ mol L^{-1} O_3	85A039
		1.1×10^3	2-9		D.k. at 258 nm in soln. contg. 0.2-2 $\times 10^{-4}$ mol L^{-2} ClO_2 and 10-30 $\times 10^{-3}$ mol L^{-1} *tert*-BuOH.	85A221
		1.3×10^3	2-6		D.k. at 360 nm	82A468
18	**Ozonide ion**					
	$ClO_2\cdot + O_3\cdot^- \rightarrow ClO_3^- + O_2$	1.8×10^5	12,13	p.r.	D.k. at 470 nm; ratio of ozone and ozonide radical ion yields vs [ClO_2].	85A039
19	**Sulfite ion**					
	$ClO_2\cdot + SO_3^{2-} \rightarrow ClO_2^- + SO_3^-$	2.7×10^6	11.4	p.r.	D.k. at 358 nm in ClO_2^- soln.	86A059
		7.8×10^5 8.6×10^5 1.2×10^6	8.7 10.0 11.5	s.f.	D.k. at 380 nm in soln. contg. 0.03 mol L^{-1} phosphate buffer, 2-14 $\times 10^{-4}$ mol L^{-1} sulfite and 1-7 $\times 10^{-4}$ mol L^{-1} chlorine dioxide; $T = 10$ °C.	78A489
20	**Acetate ion**					
	$ClO_2\cdot + CH_3CO_2^- \rightarrow$	$\ll 10^{-2}$	8		D.k. at 360 nm; k from graph.	82A468
21	**Alanine**					
	$ClO_2\cdot$ + Ala $\rightarrow$	$\ll 10^{-2}$	8		D.k. at 360 nm; k from graph.	82A468
22	**2-Aminoethanol**					
	$ClO_2\cdot + H_2NCH_2CH_2OH \rightarrow$	1.4×10^{-2}			D.k. at 357 nm; error in paper, quoted as 1.4×10^2; k calcd. for deprotonated amine using pK_a = 9.44.	679138
23	**3-Aminophthalate ion**					
	$ClO_2\cdot + H_2NC_6H_3(CO_2)_2^{2-} \rightarrow$	1.5×10^5		p.r.	D.k. in soln. contg. ClO_2^- and H_2O_2	81A244
24	**Aniline**					
	$ClO_2\cdot + C_6H_5NH_2 \rightarrow ClO_2^- + [C_6H_5NH_2]\cdot^+$	4.5×10^5	6.9	p.r.	D.k. at 358 nm in ClO_2^- soln.; pK_a for the aniline radical cation ~7.	86A059
25	**Anisole**					
	$ClO_2\cdot + C_6H_5OCH_3 \rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468
26	**Anthracene**					
	$ClO_2\cdot$ + An $\rightarrow$	3.3×10^3	7	s.f.	Fluorescence decay at 377 nm in soln. contg. 4-30 $\times 10^{-7}$ mol L^{-1} chlorine dioxide and 0.05 mol L^{-1} phosphate buffer and 6 $\times 10^{-10}$ mol L^{-1} anthracene (added in CH_2Cl_2 soln.)	85A490
27	**Benzaldehyde**					
	$ClO_2\cdot + C_6H_5CHO \rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468
28	**Benzo-2,3-dihydrophthalazine-1,4-dione**					
	$ClO_2\cdot$ + -NHNH- $\rightarrow ClO_2^- + H^+$ + -N-NH-	3×10^5	7	s.f.	D.k. at 360 nm in soln. contg. $NaClO_2$; substrate oxidized as monoanion.	86A399
29	**1,4-Benzoquinone**					
	$ClO_2\cdot$ + Q $\rightarrow$	$\ll 10^{-2}$	8		D.k. at 360 nm; no reaction obs.	82A468
30	**Benzylamine**					
	$ClO_2\cdot + C_6H_5CH_2NH_2 \rightarrow [C_6H_5CH_2NH_2]\cdot^+$	3.9×10^{-2}			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 9.6.	679138
		4.1×10^{-2}	8.96		D.k. at 400 nm; 72.8% H abstr.	679139

TABLE 24. Rate constants for reactions of chlorine dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
31	**Benzyl-*tert*-butylamine**					
	$ClO_2\cdot + C_6H_5CH_2NHC(CH_3)_3 \rightarrow ClO_2^- + [C_6H_5CH_2NHC(CH_3)_3]\cdot^+$	2.8×10^2			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 10.19.	679138
		2.9×10^2	8.4		D.k. at 400 nm; at 40°C $k = 6.5 \times 10^2$; 25% H abstr. at pH 8.4, 16% at pH 7.1, 31% at pH 7.1, 40°C.	679139
32	**4-Bromophenoxide ion**					
	$ClO_2\cdot + BrC_6H_4O^- \rightarrow ClO_2^- + BrC_6H_4O\cdot$	2.7×10^7	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. chlorite ion soln.	86A254
33	***N-tert*-Butylpyrrolidine**					
	$ClO_2\cdot + C_8H_7N \rightarrow$	1.3×10^6			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 11.13.	679138
34	**Butyraldehyde**					
	$ClO_2\cdot + CH_3CH_2CH_2CHO \rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468
35	**4-Cyanophenoxide ion**					
	$ClO_2\cdot + NCC_6H_4O^- \rightarrow ClO_2^- + CNC_6H_4O\cdot$	$<4 \times 10^3$	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. chlorite ion soln.	86A254
36	**Cysteine**					
	$ClO_2\cdot + CysSH \rightarrow$	$\sim 1 \times 10^2$	2.5		D.k. at 360 nm; k from graph.	82A468
		$\sim 1 \times 10^3$	3.5			
37	**Cystine**					
	$ClO_2\cdot + S_2[CH_2CH(NH_3^+)CO_2^-]_2 \rightarrow$	$\sim 1 \times 10^1$	2		D.k. at 360 nm; k from graph.	82A468
38	**1,4-Diazabicyclo[2.2.2]octane**					
	$ClO_2\cdot$ + DABCO $\rightarrow ClO_2^-$ + DABCO$\cdot^+$	4.1×10^4	7	s.f.	P.b.k. at 465 nm, as well as d.k. at 357 nm, in soln. contg. 0.01-0.04 mol L^{-1} DABCO and $\sim 5 \times 10^{-4}$ mol L^{-1} chlorine dioxide; $k_r = 4.6 \times 10^5$; pK = 8.93.	72A024
39	**1,4-Diazabicyclo[2.2.2]octane radical cation**					
	$ClO_2\cdot$ + DABCO$\cdot^+ \rightarrow$	1.3×10^4	9	s.f.	D.k. at 465 nm, as well as d.k. at 357 nm, in soln. contg. 0.02-0.04 mol L^{-1} DABCO, 0.01-0.04 mol L^{-1} chlorite ion and $\sim 5 \times 10^{-4}$ mol L^{-1} chlorine dioxide; radical cation formed in reaction of ClO_2 with DABCO; steady state assumption.	72A024
40	**Dibenzylamine**					
	$ClO_2\cdot + (C_6H_5CH_2)_2NH \rightarrow ClO_2^- + [(C_6H_5CH_2)_2NH]\cdot^+$	8.3	7.1		D.k. at 400 nm; 35.1% H abstr. at 40.7°C; k calcd. for deprotonated amine using pK_a = 8.43.	679139
41	**2,4-Dichlorophenol**					
	$ClO_2\cdot + Cl_2C_6H_3OH \rightarrow$	$\sim 1 \times 10^2$	2-3		D.k. at 360 nm; k from graph; pH dependent	82A468
42	**Diethylamine**					
	$ClO_2\cdot + (C_2H_5)_2NH \rightarrow$	$\sim 1 \times 10^3$	7.1		D.k.	639026
43	**2,3-Dihydro-1,4-phthalazinedione**					
	$ClO_2\cdot$ + -NHN$^-$- $\rightarrow ClO_2^-$ + -$\dot{N}$-NH- + H^+	1.5×10^5	7	s.f.	D.k. at 360 nm in soln. contg. $NaClO_2$; substrate oxidized as monoanion.	86A399
44	**Diisopropylamine**					
	$ClO_2\cdot + [(CH_3)_2CH]_2NH \rightarrow ClO_2^- + [(CH_3)_2CH]_2NH]\cdot^+$	3.5×10^2			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 11.01.	679138

TABLE 24. Rate constants for reactions of chlorine dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
44	**Diisopropylamine**—Continued					
		3.6×10^2	8.9		D.k. at 400 nm	679139
45	**Dimethylamine**					
	$ClO_2\cdot + (CH_3)_2NH \rightarrow$	<1	7-9		D.k. at 360 nm; k from graph.	82A468
46	**6-(Dimethylamino)-2,3-dihydrophthalazine-1,4-dione**					
	$ClO_2\cdot$ + -NHN$^-$- $\rightarrow ClO_2^-$ + -$\dot{N}$-NH- + H^+	1.5×10^6	7	s.f.	D.k. at 360 nm in soln. contg. $NaClO_2$; substrate oxidized as monoanion, pK_a ~ 7.	86A399
47	***N,N*-Dimethylaniline**					
	$ClO_2\cdot + C_6H_5N(CH_3)_2 \rightarrow ClO_2^- + [C_6H_5N(CH_3)_2]\cdot^+$	6.5×10^7	9.6	p.r.	D.k. at 358 nm in ClO_2^- soln.	86A059
48	***N,N*-Dimethylbenzylamine**					
	$ClO_2\cdot + C_6H_5CH_2N(CH_3)_2 \rightarrow$	2.7×10^4			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 9.03.	679138
49	***N,N*-Dimethyl-*tert*-butylamine**					
	$ClO_2\cdot + (CH_3)_3CN(CH_3)_2 \rightarrow$	2.3×10^5			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 10.69.	679138
50	***N,N*-Dimethyl-3-chlorobenzylamine**					
	$ClO_2\cdot + ClC_6H_4CH_2N(CH_3)_2 \rightarrow$	1.6×10^4			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 8.67.	679138
51	***N,N*-Dimethyl-4-chlorobenzylamine**					
	$ClO_2\cdot + ClC_6H_4CH_2N(CH_3)_2 \rightarrow$	2.0×10^4			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 8.83.	679138
52	***N,N*-Dimethyl-4-fluorobenzylamine**					
	$ClO_2\cdot + FC_6H_4CH_2N(CH_3)_2 \rightarrow$	2.0×10^4			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 8.94.	679138
53	**2,5-Dimethylfuran**					
	$ClO_2\cdot + C_6H_8O \rightarrow$	1×10^2	2-6		D.k. at 360 nm; k from graph.	82A468
53a	**2,3-Dimethylindole**					
	$ClO_2\cdot + Me_2InH \rightarrow ClO_2^- + Me_2In\cdot + H^+$	1.1×10^8		p.r.	P.b.k. at 520 nm.	87A247
54	***N,N*-Dimethyl-3-methoxybenzylamine**					
	$ClO_2\cdot + CH_3OC_6H_4CH_2N(CH_3)_2 \rightarrow$	2.9×10^4			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 9.04.	679138
55	***N,N*-Dimethyl-4-methoxybenzylamine**					
	$ClO_2\cdot + CH_3OC_6H_4CH_2N(CH_3)_2 \rightarrow$	4.9×10^4			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 9.32.	679138
56	***N,N*-Dimethyl-4-methylbenzylamine**					
	$ClO_2\cdot + CH_3C_6H_4CH_2N(CH_3)_2 \rightarrow$	3.5×10^4			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 9.22.	679138
57	***N,N*-Dimethyl-3-nitrobenzylamine**					
	$ClO_2\cdot + NO_2C_6H_4CH_2N(CH_3)_2 \rightarrow$	6.2×10^3			D.k. at 400 nm; k calcd. for deprotonated amine using pK_a = 8.195.	679138
58	***N,N*-Dimethyl-4-nitrobenzylamine**					
	$ClO_2\cdot + NO_2C_6H_4CH_2N(CH_3)_2 \rightarrow$	4.5×10^3			D.k. at 400 nm; k calcd. for deprotonated amine using pK_a = 8.14.	679138
59	**Formate ion**					
	$ClO_2\cdot + HCO_2^- \rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468

TABLE 24. Rate constants for reactions of chlorine dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
60	**Furfuryl alcohol**					
	$ClO_2\cdot + C_5H_6O_2 \rightarrow$	$\sim 5 \times 10^{-1}$	3-9		D.k. at 360 nm; k from graph.	82A468
61	**Glucose**					
	$ClO_2\cdot$ + glucose $\rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468
62	**Glyoxylate ion**					
	$ClO_2\cdot + HCOCO_2^- \rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468
63	**Hydroquinone**					
	$ClO_2\cdot + C_6H_4(OH)_2 \rightarrow ClO_2^- + H^+ + \cdot OC_6H_4OH$	3.9×10^4	4.0	s.f.	D.k. at 359 nm.	82A467
64	**Hydroquinone monoanion**					
	$ClO_2\cdot + HOC_6H_4O^- \rightarrow ClO_2^- + H^+ + {}^-OC_6H_4O\cdot$	9.0×10^8		p.r.	D.k. at 358 nm in ClO_2^- soln.; adjusted values using data of [82A467] and [86A059] and pK_a = 9.9 and 11.5	86A059
65	**Hydroquinone dianion**					
	$ClO_2\cdot + {}^-OC_6H_4O^- \rightarrow ClO_2^- + {}^-OC_6H_4O\cdot$	1.7×10^9		p.r.	D.k. at 358 nm in ClO_2^- soln.; adjusted values using data of [82A467] and [86A059] and pK_a = 9.9 and 11.5	86A059
66	**1-Hydroxypiperidine**					
	$ClO_2\cdot + C_5H_{10}NOH \rightarrow H^+ + ClO_2^- + C_5H_{10}NO$	4×10^4			cited from *Khim. Fiz.* 1982, 1518 (Vorob'eva, Kozlov, et. al) and *Zh. Fiz. Khim.*, in press (Kozlov, Purmal' and Usakov)	86A459
67	**Indigotrisulfonate ion**					
	$ClO_2\cdot + ITS^{3-} \rightarrow$	$>2 \times 10^5$			D.k. at 360 nm	82A468
67a	**Indole**					
	$ClO_2\cdot + InH \rightarrow ClO_2^- + In\cdot + H^+$	1.2×10^4		s.f.	D.k. at 360 nm.	87A247
68	***N*-Isopropylbenzylamine**					
	$ClO_2\cdot + C_6H_5CH_2NHCH(CH_3)_2 \rightarrow$	9.1			D.k. at 357 nm; k calcd. for deprotonated amine using pK_a = 9.69.	679138
69	**Linoleic acid**					
	$ClO_2\cdot + LH \rightarrow$	$\ll 10^{-2}$			D.k. at 360 nm; k from graph.	82A468
70	**Luminol, monoanion**					
	$ClO_2\cdot$ + -N$^-$NH- $\rightarrow ClO_2^-$ + -$\dot{N}$-NH-	1×10^6	7	s.f.	D.k. at 360 nm in soln. contg. $NaClO_2$; substrate oxidized as monoanion.	86A399
		2×10^6 6×10^6 1.5×10^7 1.6×10^8	8 11 13 14	p.r.	D.k. at 360 nm in soln. contg. ClO_2^- and H_2O_2 as well as p.b.k. at 550 nm; intermed. adduct formn. was assumed followed by loss of ClO_2^- to give 5-aminophthalazine-1,4-dione; k from graph.	81A243
70	**Maleic hydrazide**					
	$ClO_2\cdot + MH_2 \rightarrow$		2	p.r.	No reaction.	83A165
72	**4-Methylphenol**					
	$ClO_2\cdot + CH_3C_6H_4OH \rightarrow ClO_2^- + H^+ + CH_3C_6H_4O\cdot$	1×10^2 1×10^4	<3.5 6		D.k. at 360 nm; k from graph; pH dependent.	82A468
73	**3-Methoxyphenoxide ion**					
	$ClO_2\cdot + CH_3OC_6H_4O^- \rightarrow ClO_2^- + CH_3OC_6H_4O\cdot$	4.9×10^7	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. chlorite ion soln.	86A254

TABLE 24. Rate constants for reactions of chlorine dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
74	**4-Methoxyphenoxide ion**					
	$ClO_2\cdot + CH_3OC_6H_4O^- \rightarrow ClO_2^- + CH_3C_6H_4O\cdot$	7.4×10^8	12	p.r.	P.b.k. at 420 nm in ClO_2^- soln.	86A059
75	**Methylamine**					
	$ClO_2\cdot + CH_3NH_2 \rightarrow$	<1	7-10		D.k. at 360 nm; k from graph.	82A468
75a	**1-Methylindole**					
	$ClO_2\cdot + MeIn \rightarrow ClO_2^- + MeIn\cdot^+$	1.6×10^4		s.f.	D.k. at 360 nm.	87A247
75b	**2-Methylindole**					
	$ClO_2\cdot + MeInH \rightarrow ClO_2^- + MeIn\cdot + H^+$	8.1×10^5		p.r.	D.k. at 360 nm.	87A247
75c	**3-Methylindole**					
	$ClO_2\cdot + MeInH \rightarrow ClO_2^- + MeIn\cdot + H^+$	1.9×10^6		p.r.	D.k. at 360 nm.	87A247
76	***N*-Methyl-4-methoxybenzylamine**					
	$ClO_2\cdot + CH_3OC_6H_4CH_2NHCH_3 \rightarrow$	2.7×10^2			D.k. at 357 nm; k calcd. for deprotonated amine using $pK_a = 9.97$.	679138
77	**3-Methylphenoxide ion**					
	$ClO_2\cdot + CH_3C_6H_4O^- \rightarrow ClO_2^- + CH_3C_6H_4O\cdot$	4.7×10^7	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. chlorite ion soln.	86A254
78	**4-Methylphenoxide ion**					
	$ClO_2\cdot + CH_3C_6H_4O^- \rightarrow ClO_2^- + CH_3C_6H_4O\cdot$	2.6×10^8	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. chlorite ion soln.	86A254
79	***N*-Methylpiperidine**					
	$ClO_2\cdot + C_6H_{13}N \rightarrow$	8.7×10^4			D.k. at 357 nm; k calcd. for deprotonated amine using $pK_a = 10.38$.	679138
80	**4-Nitrophenoxide ion**					
	$ClO_2\cdot + NO_2C_6H_4O^- \rightarrow$	$<4 \times 10^5$	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. chlorite ion soln.	86A254
81	**Phenol**					
	$ClO_2\cdot + C_6H_5OH \rightarrow$	0.24			Adjusted value using data of [73M375], [82A467], and [86A059] with $pK_a = 9.98$.	
82	**Phenoxide ion**					
	$ClO_2\cdot + C_6H_5O^- \rightarrow ClO_2^- + C_6H_5O\cdot$	2.7×10^7			Adjusted value using data of [73M375], [82A467], and [86A059] with $pK_a = 9.98$.	
83	***p*-Phenylenediamine**					
	$ClO_2\cdot + C_6H_4(NH_2)_2 \rightarrow ClO_2^- + [H_2NC_6H_4NH_2]\cdot^+$	3.5×10^8	9.2	p.r.	D.k. at 358 nm in ClO_2^- soln.	86A059
84	**Piperidine**					
	$ClO_2\cdot + C_5H_{11}N \rightarrow$	2.4×10^3			D.k. at 357 nm; k calcd. for deprotonated amine using $pK_a = 11.20$.	679138
85	**Piperidine-1-oxyl**					
	$ClO_2\cdot + C_5H_{10}NO \rightarrow$	$>5 \times 10^6$			cited from *Khim. Fiz.* 1982, 1518 (Vorob'eva, Kozlov, et. al) and *Zh. Fiz. Khim.*, in press (Kozlov, Purmal' and Usakov)	86A459
86	**Resorcinol dianion**					
	$ClO_2\cdot + {}^-OC_6H_4O^- \rightarrow ClO_2^- + {}^-OC_6H_4O\cdot$	1.4×10^9	12.3	p.r.	P.b.k. at 400-430 nm in N_2O-satd. chlorite ion soln.	86A254

TABLE 24. Rate constants for reactions of chlorine dioxide in aqueous solution—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
87	**Salicylate ion**					
	$ClO_2\cdot + HOC_6H_4CO_2^- \rightarrow$	$\sim 1 \times 10^2$	3-8		D.k. at 360 nm; k from graph; k is lower at pH <3 and higher at pH >7.	82A468
88	**Styrene**					
	$ClO_2\cdot + C_6H_5CH{=}CH_2 \rightarrow ClO + C_8H_8O$	4×10^2	2-6		D.k. in water-*tert*-BuOH 3.4:1 v/v contg. 10^{-2} mol L^{-1} ClO_2 and 1.5×10^{-2} mol L^{-1} styrene (33°C); k is the same with 10^{-2} mol L^{-1} sulfamic acid, lower with 0.5 mol L^{-1} NaCl.	82M375
89	**Triethylamine**					
	$ClO_2\cdot + (C_2H_5)_3N \rightarrow ClO_2^- + [(C_2H_5)_3N]\cdot^+$	2.0×10^5	6.6		D.k. at 400 nm; at pH 7.14 $k = 2.16 \times 10^5$; k calcd. for deprotonated amine using pK_a = 10.78.	679139
		2×10^5	6.6		D.k.	639026
90	**Trimethylamine**					
	$ClO_2\cdot + (CH_3)_3N \rightarrow ClO_2^- + [(CH_3)_3N]\cdot^+$	~ 1 $\sim 1 \times 10^2$	6 8		D.k. at 360 nm; k from graph.	82A468
		1.0×10^5			D.k. at 400 nm; k calcd. for deprotonated amine using pK_a = 9.92.	679139
		$\sim 1 \times 10^5$	6.8		D.k.	639026
91	**Tryptophan**					
	$ClO_2\cdot + TrpH \rightarrow ClO_2^- + H^+ + Trp\cdot$	7.6×10^5	~12	p.r.	P.b.k. in N_2O-satd. soln. contg. $NaClO_2$ and tryptophan.	87A179
92	**Tyrosine**					
	$ClO_2\cdot + TyrOH \rightarrow ClO_2^- + TyrO\cdot + H^+$	8.2×10^7	~12	p.r.	P.b.k. in N_2O-satd. soln. contg. $NaClO_2$ and tyrosine.	87A179

TABLE 25. Rate constants for reactions of bromine dioxide in aqueous solution

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Bromine dioxide**					
	$BrO_2\cdot + BrO_2\cdot \rightarrow Br_2O_4$	3.0×10^9	nat	p.r.	Calcd. from d.k. at 480 nm in N_2-satd. soln. contg. BrO_3^-; data fitting.; $K_{eq} = 1.9 \times 10^4$ L mol^{-1}	82A169
		$\sim 3 \times 10^7$ $\sim 1 \times 10^9$	7 13	f.p.	D.k.; radical from photolysis in BrO_4^- soln.; assume $\epsilon(475)$ BrO_2 = 1000 L mol^{-1} cm^{-1}.	757099
		2.2×10^7 7×10^8	~7 13	p.r.	D.k. at 475 nm (ϵ = 1000 L mol^{-1} cm^{-1}) in N_2-satd. soln. contg. BrO_3^-; dependent on $[OH^-]$, $k(BrO_4 + OH^-) \simeq 7 \times 10^8$; in basic soln. Br_2O_4 disproportionates to BrO_3^- and BrO_2^-; $K_{eq} = 1.9 \times 10^4$ L mol^{-1}.	680153
2	**Chlorite ion**					
	$BrO_2\cdot + ClO_2^- \rightarrow BrO_2^- + ClO_2\cdot$	3.6×10^7	9.2	p.r.	D.k. at 475, as well as p.b.k. at 360 nm, in BrO_3^- soln.	86A059
3	**Ferrocyanide ion**					
	$BrO_2\cdot + Fe(CN)_6^{4-} \rightarrow BrO_2^- + Fe(CN)_6^{3-}$	1.9×10^9	nat	p.r.	D.k. at 480 nm, as well as p.b.k. at 420 nm, in N_2-satd. soln. contg. 4×10^{-3} mol L^{-1} BrO_3^- and $\sim 10^{-4}$ mol L^{-1} ferrocyanide.	82A169
4	**Manganese(II) ion**					
	$BrO_2\cdot + Mn^{2+} \rightarrow BrO_2^- + Mn^{3+}$	$\sim 1.5 \times 10^6$	nat	p.r.	D.k. at 480 nm in N_2-satd. soln. contg. 4×10^{-3} mol L^{-1} BrO_3^-; complicated by reaction of $Br_2O_4 + Mn^{2+}$ ($k \simeq 1 \times 10^8$).	82A169
5	**Nitrite ion**					
	$BrO_2\cdot + NO_2^- \rightarrow BrO_2^- + NO_2$	2×10^6	9.2	p.r.	D.k. at 475 nm in BrO_3^- soln.	86A059
6	**Hydroxyl radical**					
	$BrO_2\cdot + \cdot OH \rightarrow BrO_3^- + H^+$	2.0×10^9	nat	p.r.	D.k. in N_2-satd. soln. contg. 4×10^{-3} mol L^{-1} BrO_3^-; estd. by scavenging $\cdot$OH by Ce(III).	82A169
7	**Sulfite ion**					
	$BrO_2\cdot + SO_3^{2-} \rightarrow BrO_2^- + \dot{S}O_3^-$	9.5×10^8	9.3	p.r.	D.k. at 475 nm; radical from $e_{aq}^- + BrO_3^-$	86A059
8	***N,N*-Dimethylaniline**					
	$BrO_2\cdot + C_6H_5N(CH_3)_2 \rightarrow BrO_2^- + [C_6H_5N(CH_3)_2]\cdot^+$	3.6×10^9	9.3	p.r.	P.b.k. at 460 nm; radical from $e_{aq}^- + BrO_3^-$	86A059
9	**Hydroquinone**					
	$BrO_2\cdot + C_6H_4(OH)_2 \rightarrow BrO_2^- + 2\ H^+ + {}^-OC_6H_4O\cdot$	2.7×10^8	6.9	p.r.	P.b.k. at 430 nm; radical from $e_{aq}^- + BrO_3^-$	86A059
10	**Phenol**					
	$BrO_2\cdot + C_6H_5OH \rightarrow BrO_2^- + C_6H_5O\cdot + H^+$	$\sim 3 \times 10^5$	nat	p.r.	D.k. at 480 nm, as well as p.b.k. at 401 nm, in N_2-satd. soln. contg. 4×10^{-3} mol L^{-1} BrO_3^-; complicated by reaction of Br_2O_4 + phenol ($k > 5 \times 10^8$).	82A169
11	**Phenoxide ion**					
	$BrO_2\cdot + C_6H_5O^- \rightarrow BrO_2^- + C_6H_5O\cdot$	2.6×10^9	~12	p.r.	P.b.k. at 402 nm in N_2-satd. soln. contg. 4×10^{-3} mol L^{-1} BrO_3^-; data fitting with $k(PhO\cdot + PhO\cdot) = 3 \times 10^8$.	82A169

TABLE 26. Rate constants for miscellaneous chlorine-containing radicals

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Chlorine atom**					
1.1	$Cl\cdot + Cl\cdot \rightarrow Cl_2$	8.8×10^7		f.p.	Calcd. from d.k. at 340 nm in soln. contg. 5×10^{-3}-2 mol L^{-1} NaCl; $\epsilon(Cl_2^-) = 12{,}000$ L mol^{-1} cm^{-1}; also detd. at 40 and 60°C; assumed mechanism.	80A351
1.2	$Cl\cdot + Cl^- \rightarrow Cl_2\cdot^-$	6.5×10^9		f.p.	P.b.k. at 360 nm, in ClO^- soln. contg. Cl^-.	85A069
		8×10^9	~3.5	f.p.	Cl_2^- from SO_4^- produced by phot. at 248 nm of $S_2O_8^{2-}$; obs. recovery of abs. at 340 or 360 nm following photolysis which caused dissociation.	85A132
		2.1×10^{10}	2	p.r.	Abs. at 340 nm depends on [Cl^-]; cor. for decay of Cl_2^- ($2k = 1.7 \times 10^{10}$); $k_r = 1.1 \times 10^5$ s^{-1}	731039
1.3	$Cl\cdot + H_2O \rightarrow ClOH^- + H^+$	1.6×10^5 s^{-1}		f.p.	$K(Cl\cdot + H_2O \rightleftharpoons Cl^- + \cdot OH + H^+) = 1.1 \times 10^{-5}$ mol^2 L^{-2}.	85A069
1.4	$Cl\cdot + OH^- \rightarrow ClOH^-$	1.8×10^{10}		f.p.	$k_r = 23$ s^{-1}; $K(Cl\cdot + OH^- \rightleftharpoons Cl^- + \cdot OH) = 1.1 \times 10^9$	85A069
1.5	$Cl\cdot + ClO^- \rightarrow ClO\cdot + Cl^-$	8.2×10^9		f.p.	no details; [84A323] indicates data will be published	85A069
1.6	$Cl\cdot + HOCl \rightarrow ClO\cdot + H^+ + Cl^-$	3×10^9		f.p.	no details; [84A323] indicates data will be published	85A069
1.7	$Cl\cdot + Fe^{2+} \rightarrow Cl^- + Fe^{3+}$	1.3×10^{10}	~0	p.r.	P.b.k. at 304 nm in aerated soln. contg. 10^{-3} mol L^{-1} ferrous ammonium sulfate in 0.4 mol L^{-1} sulfuric acid and 10^{-4}-10^{-2} mol L^{-1} Cl^{-1}; best fit assuming $k(Cl_2\cdot^- + HO_2\cdot) = 1 \times 10^9$.	87A291
2	**Chlorine oxide**					
2.1	$ClO\cdot + ClO\cdot \rightarrow$	2.5×10^9		f.p.	no details; [84A323] indicates data will be published	85A069
		7.5×10^9	11.4	p.r.	D.k. in N_2O-satd. soln. contg. 10^{-3} mol L^{-1} ClO^-; ϵ(280 nm) = 890 L mol^{-1} cm^{-1}.	720301
2.2	$ClO\cdot + ClO_2^- \rightarrow ClO^- + ClO_2\cdot$	9.4×10^8	10.1	p.r.	P.b.k. in N_2O-satd. soln. contg. ~1×10^{-2} mol L^{-1} ClO^- and 3-25 $\times 10^{-5}$ mol L^{-1} ClO_2^-.	87A907
2.3	$ClO\cdot + N_3^- \rightarrow ClO^- + \cdot N_3$	2.5×10^8	11.3	p.r.	C.k. in N_2O-satd. soln. contg. (1 or 7) $\times 10^{-2}$ mol L^{-1} ClO^- and 0.89 $\times 10^{-3}$ mol L^{-1} 2,5-dimethoxybenzoate ion and 0.56-2.2 $\times 10^{-3}$ mol L^{-1} azide ion.; rel. to $k(ClO\cdot + 2,5\text{-}(CH_3O)_2C_6H_3CO_2^-)$.	87A907
2.4	$ClO\cdot + C_6H_5CO_2^- \rightarrow$	$<3 \times 10^6$	12	p.r.	C.k. in N_2O-satd. soln. contg. ClO^- and benzoate ion; rel. to $k(ClO\cdot + 2,5\text{-}(CH_3O)_2C_6H_3CO_2^-)$.	87A907
2.5	$ClO\cdot + 4\text{-}CNC_6H_4O^- \rightarrow ClO^- + 4\text{-}CNC_6H_4O\cdot$	1.4×10^9	13	p.r.	P.b.k. in N_2O-satd. soln. contg. ClO^- and 4-cyanophenoxide ion.	87A907
2.6	$ClO\cdot + 1,4\text{-}C_6H_4(OCH_3)_2 \rightarrow ClO^- + [1,4\text{-}C_6H_4(OCH_3)_2]\cdot^+$	2.1×10^9	13	p.r.	P.b.k. in N_2O-satd. soln. contg. ClO^- and 1,4-dimethoxybenzene.	87A907
2.7	$ClO\cdot + 2,5\text{-}(CH_3O)_2C_6H_3CO_2^- \rightarrow ClO^- + [2,5\text{-}(CH_3O)_2C_6H_3CO_2]\cdot$	7.0×10^8	13	p.r.	P.b.k. in N_2O-satd. soln. contg. ClO^- and 2,5-dimethoxybenzoate ion.	87A907
2.8	$ClO\cdot + HCO_2^- \rightarrow$	$<1 \times 10^6$	12	p.r.	C.k. in N_2O-satd. soln. contg. ClO^- and formate ion; rel. to $k(ClO\cdot + 2,5\text{-}(CH_3O)_2C_6H_3CO_2^-)$.	87A907
2.9	$ClO\cdot + CH_3OC_6H_4CH_2OH \rightarrow$	$<1 \times 10^7$	11	p.r.	C.k. in N_2O-satd. soln. contg. ClO^- and 4-methoxybenzyl alcohol; rel. to $k(ClO\cdot + 2,5\text{-}(CH_3O)_2C_6H_3CO_2^-)$.	87A907
2.10	$ClO\cdot + 4\text{-}NO_2C_6H_4O^- \rightarrow ClO^- + 4\text{-}NO_2C_6H_4O\cdot$	1.5×10^9	10	p.r.	D.k. at 390-440 nm in N_2O-satd. soln. contg. ClO^- and 4-nitrophenoxide ion.	87A907

TABLE 26. Rate constants for miscellaneous chlorine-containing radicals—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
2	**Chlorine oxide**—Continued					
2.11	$ClO\cdot + 2,4,5\text{-}(CH_3O)_3C_6H_2CO_2^- \rightarrow ClO^- + [2,4,5\text{-}(CH_3O)_3C_6H_2CO_2]\cdot$	1.1×10^9	13	p.r.	P.b.k. in N_2O-satd. soln. contg. ClO^- and 2,4,5-trimethoxybenzoate ion.	87A907

TABLE 27. Rate constants for miscellaneous bromine-containing radicals

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Bromine atom**					
1.1	$Br\cdot + Br^- \rightarrow Br_2\cdot^-$	9×10^9		f.p.	Br_2^- from SO_4^- produced by phot. at 248 nm of $S_2O_8^{2-}$; obs. bleaching at 380 nm by subsequent photolysis which caused dissociation.	85A132
		1.2×10^{10}		f.p.	P.b.k. at 360 nm in soln. contg. benzyl bromide; d.k. of Br_2^- is first-order, $k = 3.5 \times 10^4$ s^{-1}.	84A132
		1.1×10^{10}	~2	f.p.	Calcd. from buildup of $Br_2\cdot^-$ in Br^--Br_2 soln.	757222
		5.4×10^9	2	p.r.	Calcd. from dependence of $[Br_2\cdot^-]$ on $[Br^-]$; $K^{-1} = 2.2 \times 10^5$ L mol^{-1}.	650383
1.2	$Br\cdot + H_2O \rightarrow BrOH^- + H^+$	1.4 s^{-1}		f.p.	$K(Br\cdot + H_2O \rightleftarrows Br^- + \cdot OH + H^+) = 9.6 \times 10^{-14}$ mol^2 L^{-2}.	85A069
1.3	$Br\cdot + OH^- \rightarrow BrOH^-$	1.3×10^{10}		f.p.	$k(BrOH^- \rightarrow Br^- + \cdot OH) = 3.3 \times 10^7$ s^{-1}; $K(Br\cdot + OH^- \rightleftarrows Br^- + \cdot OH) = 9.6$	85A069
1.4	$Br\cdot + BrO^- \rightarrow Br^- + BrO^-$	4.1×10^9		f.p.	no details; [84A323] indicates data will be published	85A069
2	**Bromine oxide**					
2.1	$BrO + BrO \rightarrow BrO^- + BrO_2^-$	2.8×10^9		f.p.	no details; [84A323] indicates data will be published	85A069
		2.4×10^9	4.6	p.r.	D.k. in air-free soln. contg. 0.1 mol L^{-1} $KBrO_3$; cor. for abs. of products. ϵ(360 nm) = 900 L mol^{-1} cm^{-1} and $\epsilon(BrO^-)$ = 200 L mol^{-1} cm^{-1}.	700424
2.2	$BrO + BrO_2^- \rightarrow BrO^- + BrO_2\cdot$	4.0×10^8	11.9	p.r.	D.k. in air-free soln. contg. 0.44 mol L^{-1} $KBrO_3$ and 1.0×10^{-4} mol L^{-1} BrO_2^-; cor. for abs. of products, $\epsilon(BrO^-)$ = 200 L mol^{-1} cm^{-1}.	700424

TABLE 28. Rate constants for miscellaneous iodine-containing radicals

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
1	**Iodine atom**					
1.1	$I\cdot + I\cdot \rightarrow I_2$	8×10^9		f.p.	I^- soln.; $k = 2.4 \times 10^{10}$ and 1.6×10^{10} in MeOH and 2-PrOH, resp.	737475
1.2	$I\cdot + I^- \rightarrow I_2\cdot^-$	1.2×10^{10}	4	p.r.	Obs. $I_2\cdot^-$ as a function of $[I^-]$ in 10^{-4} mol L^{-1} I_2 with various concn. I^- (N_2O and Ar-satd. (cor. for I^- produced); $K_{eq} = 1.1 \times 10^5$ mol L^{-1}.	86A070
		1.1×10^{10}			Calcd. from equil. const.	86A465
		1.1×10^{10}		f.p.	$I_2\cdot^-$ by photolysis; obs. bleaching at 380 nm by subsequent photolysis which caused dissociation.	85A132
		2×10^{10}		f.p.	P.b.k. at 385 nm in soln. contg. Hg(II) iodide and I^-; $k_r = 1.7 \times 10^6$ s^{-1}.; $K_{eq} = 1.4 \times 10^4$.	747224
		9.8×10^9		f.p.	P.b.k. in soln. contg. I_3^-; $k_r = 9 \times 10^5$ s^{-1}.	747554
		7.6×10^9		p.r.	P.b.k. at 365 nm in N_2O-satd. soln. contg. 1-24 $\times 10^{-6}$ mol L^{-1} I^{-1}; $k_r = 6 \times 10^4$ s^{-1}; detd. by effect of $[I^-]$ on $[I_2\cdot^-]$.	680375
1.3	$I\cdot + NO_2^- \rightarrow I^- + \cdot NO_2$	8.8×10^9		f.p.	C.k. in soln. contg. 1.5×10^{-2} mol L^{-1} I^- and 3-100 $\times 10^{-3}$ mol L^{-1} NO_2^-; $k_r < 1 \times 10^7$ by p.r.; rel. to $k(I\cdot + I^-)$; $K_{eq} = >8.8 \times 10^2$.	747554
1.4	$I\cdot + ACFl^+ \rightarrow$	$\geq 2 \times 10^{10}$		p.r.	D.k. at 450 nm (dye) as well as p.b.k. at 360 nm in N_2O-satd. soln. contg. 10^{-5} mol L^{-1} I^- and 10^{-5} mol L^{-1} acriflavin.	700241
1.5	$I\cdot$ + LADH $\rightarrow$	1.0×10^{11}		p.r.	Lactate dehydrogenase	771132
1.6	$I\cdot$ + ALD $\rightarrow$	$\sim 3 \times 10^{10}$		p.r.	C.k. in N_2O-satd. soln. contg. rabbit muscle aldolase and I^-; rel. to $k(I\cdot + I^-)$.	731065
1.7	$I\cdot$ + ALDH $\rightarrow$	1.1×10^{12}		p.r.	D.k. at 380 nm (c.k. with $I\cdot + I^-$); alcohol dehydrogenase from horse liver; $I_2\cdot^-$ estd. to be unreactive.	78R007
		$\sim 2 \times 10^{11}$		p.r.	C.k. in N_2O-satd. soln. contg. 2-8 $\times 10^{-4}$ mol L^{-1} I^-; abs. at 380 nm; alcohol dehydrogenase from yeast; k for $I_2\cdot^-$ + ALDH) estd. to be $\sim 1.2 \times 10^9$.; rel. to $k(I\cdot + I^-)$.	731065
2	**Iodine bromide radical anion**					
2.1	$IBr\cdot^- + IBr\cdot^- \rightarrow$	1.5×10^{10}		f.p.	Radical from iodobenzene + Br^- in MeOH-water 9:1 soln. assuming ϵ same as $I_2\cdot^-$ (14,000 L mol^{-1} cm^{-1}).	707561
3	**Hypoiodous acid-OH adduct**					
3.1	$HOIOH \rightarrow IO + H_2O$	1.3×10^6 s^{-1}	9	p.r.	D.k.; species from OH + HOI; N_2O-satd. I^--free soln contg. 10^{-2} mol L^{-1} borax buffer and HOI (5-10 $\times 10^{-4}$ mol L^{-1}).	86A901
4	**Iodine(II) radicals**					
4.1	$IO + IO \rightarrow$	1.5×10^9	9	p.r.	D.k.; N_2O-satd. I^--free soln contg. 10^{-2} mol L^{-1} borax buffer and HOI (5-10 $\times 10^{-4}$ mol L^{-1}); ϵ(425 nm) = 1000 L mol^{-1} cm^{-1}.	86A901
		2.1×10^9	12.8	f.p.	D.k. at 495 nm in Ar-satd. soln. contg. 10^{-4} mol L^{-1} IO^-; $\epsilon_{max} = 900$ L mol^{-1} cm^{-1} [700018].	83F619
		2.0×10^9	13.6	p.r.	1.2×10^{-2} mol L^{-1} IO^-; ϵ(max) = 900 L mol^{-1} cm^{-1}; similar values detd. by f.p. as well as in neutral soln. of IO_3^- and IO_3^- + EtOH.	700018

TABLE 28. Rate constants for miscellaneous iodine-containing radicals—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
5	**Iodine(IV) radicals**					
5.1	$HIO_3^- + HIO_3^- \rightarrow$	2.6×10^9	3	p.r.	D.k. at 480 nm in Ar-satd. soln. contg. 2×10^{-2} mol L^{-1} IO_3^- and 0.2 mol L^{-1} formate ion; $\epsilon = 892$ L mol^{-1} cm^{-1}; p$K_a = 13.3$; Product could be dimer, $IO_2^- + H^+ + HIO_4^{2-}$, or $IO_3^- + H^+$.	85A037
5.2	$IO_3^{2-} + HIO_3^- \rightarrow$	2.3×10^9		p.r.	Calcd. using p$K(HIO_3^-) = 13.3$, $\epsilon_{480} =$ 890-1200 L mol^{-1} cm^{-1} at pH 3-14, in Ar-satd. IO_3^- soln. contg. formate.	85A037
5.3	$IO_3^{2-} + IO_3^{2-} \rightarrow$	1.3×10^9		p.r.	Calcd. using p$K(HIO_3^-) = 13.3$, $\epsilon_{480} =$ 890-1200 L mol^{-1} cm^{-1} at pH 3-14, in Ar-satd. IO_3^- soln. contg. formate.	85A037
5.4	$HIO_3^- + HIO_3^- \rightarrow$	3.5×10^9 1.8×10^9	6 12	p.r.	D.k. at 490 nm in soln. contg. 1-10 $\times$ 10^{-2} mol L^{-1} iodate; recalcd. based on $\epsilon = 940$ L mol^{-1} cm^{-1}.	730027
		1.9×10^9	7	p.r.	D.k. at 490 nm in soln. contg. 10^{-2} mol L^{-1} iodate; recalcd. based on $\epsilon = 940$ L mol^{-1} cm^{-1}.	720017
5.5	$HIO_3^- + IO_3^- \rightarrow$	3.5×10^5		p.r.	(1.0-8.0) $\times$ 10^{-2} mol L^{-1} IO_3^- (also f.p., ~ 10^{-2} mol L^{-1} IO_3^-.)	700018
5.6	$HIO_3^- + Me_2NC_6H_4NO \rightarrow$	5.5×10^9		p.r.	D.k. at 440 nm in Ar-satd. soln. contg. *N,N*-dimethyl-4-nitrosoaniline and IO_3^-.	680066
5.7	$HIO_3^- + C_2H_5OH \rightarrow$	$<5 \times 10^5$	6	p.r.	D.k. in 1-10 $\times$ 10^{-2} mol L^{-1} IO_3^- and 1-35 $\times$ 10^{-4} mol L^{-1} EtOH.	730027
5.8	$HIO_3^- + (CH_3)_2CHOH \rightarrow$	$<5 \times 10^5$	6	p.r.	D.k. in 0.1 mol L^{-1} IO_3^- and 1-1000 $\times$ 10^{-4} mol L^{-1} 2-PrOH.	730027
6	**Iodine(VI) radicals produced by oxidation**					
6.1	$IO_4^{2-} + IO_4^{2-} \rightarrow I^V + IO_4^-$	6.5×10^7	13	p.r.	D.k. at 350 and 500 nm in N_2O-satd. soln. contg. IO_3^-; species from O^- reaction; $\epsilon_{350} = 3700$ L mol^{-1} cm^{-1}.	85A037
		4.5×10^7	13.3	p.r.	D.k. in N_2O-satd. soln. contg. IO_3^-; $\epsilon = 3000$ L mol^{-1} cm^{-1}.	81A177
		6.5×10^7	>12	p.r.	D.k. in N_2O-satd. soln. contg. IO_3^-; p.r. and f.p.; $\epsilon_{360} = 2600$ L mol^{-1} cm^{-1}.	720017
6.2	$IO_3 + IO_3 \rightarrow$	1.8×10^9	~7	p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 10^{-3} mol L^{-1} IO_3^-; $\epsilon_{350} =$ ~3000 L mol^{-1} cm^{-1}.	85A037
		3.5×10^8	7	p.r.	D.k. at 360 nm.	730027
6.3	$I^{VI} + I^{VI} \rightarrow$	7.5×10^8	~7	p.r.	D.k. at 360 nm in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} IO_3^-; $\epsilon_{360} = 300$ L mol^{-1} cm^{-1}.	720017
		9.2×10^8		p.r.	(1.0-8.0) $\times$ 10^{-2} mol L^{-1} IO_3^-; ϵ(max) = 400 L mol^{-1} cm^{-1}.	700018
6.4	$(IO_3)_2^{\cdot -} + (IO_3)_2^{\cdot -} \rightarrow$	6×10^8	7	p.r.	D.k. at 360 nm; $\epsilon(360) = 800$ L mol^{-1} cm^{-1}; computer fit to derived $k(IO_3 + IO_3)$.	730027
6.5	$(IO_3)_2^{\cdot -} + IO_3 \rightarrow$	2×10^8	7	p.r.	$\epsilon(360) = 800$ for IO_3^{2-}	730027
6.6	$IO_4^{2-} \rightarrow IO_3 + O^{\cdot -}$	3.3×10^3 s^{-1}	13.3	p.r.		81A177
7	**Iodine(VI) radicals produced by reduction**					
7.1	$I^{VI} + I^{VI} \rightarrow$	1.7×10^8	>11	p.r.	Mixture of $H_5IO_6^- + H_4IO_6^{2-}$; no apparent effect of I^{VII} concn.	81A177
		1.8×10^8	13	p.r.	D.k. at 350 nm in soln. contg. 5×10^{-3} mol L^{-1} IO_4^-; species from e_{aq}^- reaction; at pH 6.4 $2k/\epsilon = 4.1 \times 10^4$ from p.b.k. at 525 nm in 10^{-3} mol L^{-1} IO_4^-.	85A037

TABLE 28. Rate constants for miscellaneous iodine-containing radicals—Continued

No.	Reaction	k (L mol^{-1} s^{-1})	pH	Method	Comment	Ref.
7	**Iodine(VI) radicals produced by reduction**—Continued					
		2.3×10^{8}	11.5-13.3	p.r.	D.k. at 360 nm in Ar-satd. soln. contg. 5-50 × 10^{-1} mol L^{-1} I^{VII}; ε = 3400-4000.	78A443
7.2	$I^{VI} \rightarrow I^{V} + \cdot OH$	3.6×10^{3} s^{-1}	>11	p.r.	Mixture of $H_5IO_6^-$ + $H_4IO_6^{2-}$.	81A177
7.3	$H_5IO_6^- + IO_4^- \rightarrow$	2.8×10^{8}		p.r.	pH dependence (6.8-8.6) of d.k. of I(VI) in Ar-satd. soln. contg. 10^{-2} mol L^{-1} I(VII) and 10^{-2} mol L^{-1} formate.	85A037
7.4	$H_4IO_6^{2-} + IO_4^- \rightarrow$	5.5×10^{7}		p.r.	pH dependence (6.8-8.6) of d.k. of I(VI) in Ar-satd. soln. contg. 10^{-2} mol L^{-1} I(VII) and 10^{-2} mol L^{-1} formate.	85A037
		~4-10 × 10^{7}	8.3-10	p.r.		81A177
7.5	$I^{VI} + IO_4^- \rightarrow I^{V} + I^{VIII}$	1.3×10^{8}	5-7	p.r.		78A443
7.6	$I^{VI} + \cdot CH_2C(CH_3)_2OH \rightarrow$	1.3×10^{9}		p.r.	D.k. at 350 nm in Ar-satd. soln. contg. 1 mol L^{-1} *tert*-BuOH and IO_4^-.	85A037
8	**Iodine(VI) radicals produced by photolysis**					
8.1	$HIO_5^{3-} + HIO_5^{3-} \rightarrow I^{V} + IO_4^-$	4.5-7 × 10^{8}	12-13.7	f.p.	0.5-1.5 × 10^{-3} mol^{-1} I(VII)	81A177
8.2	$H_2IO_5^{2-} \rightarrow I^{V} + O\cdot^-$	3.3×10^{3} s^{-1}	>11	f.p.		81A177
8.3	$H_2IO_5^{2-} + IO_4^- \rightarrow I^{V} + I^{VIII}$	4-10 × 10^{7}	8.3-10	f.p.	1 × 10^{-3} mol^{-1} I(VII)	81A177
8.4	$I^{VI} + I^{VI} \rightarrow$	1.1×10^{9}		f.p.		700018

TABLE 29. Rate constants for miscellaneous radicals

No.	Reaction	k (L mol^{-1}s^{-1})	pH	Method	Comment	Ref.
1	**Oxygen atom**					
1.1	$O(^3P) + BrO_3^- \rightarrow BrO_2^- + O_2$	1.5×10^7		f.p.	C.k.; rel. to $k(O(^3P) + O_2) = 4 \times 10^9$.	84A323
		6×10^7		phot.	C.k. in soln. contg. 0.01 mol L^{-1} BrO_3^- and cyclopentene, obs. ethylene yields; rel. to $k(O(^3P) + c\text{-}C_5H_8)/k(O(^3P) + O_2) = 2.6$.	80G037
1.2	$O(^3P) + ClO_4^- \rightarrow$	$<6 \times 10^5$		phot.	C.k.; Obs. ethylene yields; O atoms from ClO^-; rel. to $k(O(^3P); c\text{-}C_5H_8) = 1.2 \times 10^{10}$.	80G109
1.3	$O(^3P) + OH^- \rightarrow HO_2^-$	4.2×10^8	8.7-12.9	phot.	Obs. quantum yields in H_2O_2 soln.; best fit to complex mechanism using $k(O(^3P) + c\text{-}C_5H_8)/k(O(^3P) + O_2) = 2.6$.	84F102
1.4	$O(^3P) + H_2O_2 \rightarrow \cdot OH + HO_2\cdot$	1.6×10^9	8.7-12.9	phot.	Obs. quantum yields in H_2O_2 soln.; best fit to complex mechanism using $k(O(^3P) + c\text{-}C_5H_8)/k(O(^3P) + O_2) = 2.6$.	84F102
1.5	$O(^3P) + HO_2^- \rightarrow \cdot OH + O_2\cdot^-$	5.3×10^9	8.7-12.9	phot.	Obs. quantum yields in H_2O_2 soln.; best fit to complex mechanism using $k(O(^3P) + c\text{-}C_5H_8)/k(O(^3P) + O_2) = 2.6$.	84F102
1.6	$O(^3P) + O_2 \rightarrow O_3$	4.0×10^9		f.p.	P.b.k. at 260 nm in O_2-satd. [1.27×10^{-3} mol L^{-1}] and air-satd. [2.5×10^{-4} mol L^{-1}] soln.; O atom from photolysis of BrO_3^-, ClO_3^-, or HClO.	84A323
1.7	$O(^3P) + c\text{-}C_5H_8 \rightarrow$	1.2×10^{10}		f.p.	C.k. in soln. contg. 0.01 mol L^{-1} BrO_3^-, cyclopentene and oxygen; obs. relative yields of ozone and ethylene; rel. to $k(O(^3P) + O_2) = 4 \times 10^9$,	78G193
2	**Ozonide ion**					
2.1	$O_3\cdot^- + \cdot OH \rightarrow O_2\cdot^- + HO_2\cdot$	8.5×10^9	10-13	p.r.	D.k. at 430 nm as well as p.b.k. at 260 nm in soln. (under 40 atm. of N_2O) contg. 1.2×10^{-3} mol L^{-1} O_2 and ~0.9 mol L^{-1} N_2O; computer simulation; overall reaction; products are $O_2\cdot^-$ (re-forming O_3^-) and OH^- + O_3 (about 30% of total reaction).	84A040
2.2	$O_3\cdot^- + O\cdot^- \rightarrow O_2\cdot^- + O_2\cdot^-$	7.0×10^8	13-14	p.r.	D.k. at 430 nm (O_3^-) as well simultaneous buildup at 250 nm ($O_2\cdot^-$) and decay, in soln. satd. with 4×10^6 N m^{-2} N_2O and 0-1×10^6 N m^{-2} O_2; computer simulation.	82A133
	$O_3\cdot^- + O\cdot^- \rightarrow O_4^{2-}$	~7×10^8	>13	p.r.	D.k. (O_3^-); k estd. from steady state approx. for [$\cdot O^-$]; rel. to $k(\cdot O^- + O_2) = 3.6 \times 10^9$.	690002
2.3	$O_3\cdot^- + O_3\cdot^- \rightarrow$	9×10^8	11.5	f.p.	D.k. at 430 nm ($\epsilon = 2000$ L mol^{-1} cm^{-1}) in soln contg. SO_4^{2-} and O_2 (0.01 mol L^{-1})	78B076
2.4	$O_3\cdot^- \rightarrow O\cdot^- + O_2$	6.2×10^3 s^{-1}	12.8	p.r.	D.k. at 430 nm in N_2O-O_2 soln.	761129
		3.3×10^3 s^{-1}		p.r.	D.k.	690002
		5×10^3 s^{-1}	13-13.7	f.p.	D.k. at 430 nm in the presence of H_2O_2; $E_a = 46$ kJ mol^{-1}.	687277
2.5	$O_3\cdot^- + BrO_2\cdot \rightarrow O_3 + BrO_2^-$	5×10^8	>12	f.p.	D.k., assuming $2k(BrO_2\cdot + BrO_2\cdot) = 7 \times 10^8$.	84A323
2.6	$O_3\cdot^- + CO_3\cdot^- \rightarrow O_3 + CO_3^{2-}$	6×10^7	12-13.8	p.r.	D.k. at 430 nm (O_3^-), 600 nm ($CO_3\cdot^-$) and p.b.k. at 260 nm (O_3) in soln. contg. 10^{-2}-1 mol L^{-1} Na_2CO_3, ~0.9 mol L^{-1} N_2O (4×10^6 N m^{-2}) and 1.2×10^{-3}-0.12 mol L^{-1} O_2 (0.1-10×10^6 N m^{-2}); computer simulation.	82A134

TABLE 29. Rate constants for miscellaneous radicals—Continued

No.	Reaction	k (L mol^{-1}s^{-1})	pH	Method	Comment	Ref.
2	**Ozonide ion—Continued**					
2.7	$O_3\cdot^- + ClO\cdot \rightarrow O_3 + ClO^-$	1×10^9	>12	f.p.	D.k., assuming $2k(ClO\cdot + ClO\cdot) = 2.5 \times 10^9$	84A323
2.8	$O_3\cdot^- + ClO_2\cdot \rightarrow O_2 + ClO_3^-$	1.8×10^5	12,13	p.r.	D.k. at 470 nm; ratio of ozone and ozonide radical ion yields vs $[ClO_2]$.	85A039
2.9	$O_3\cdot^- + H^+ \rightarrow \cdot OH + O_2$	9×10^{10}		p.r.	D.k. at 430 nm; estimated.	84A040
	$O_3\cdot^- + H^+ \rightarrow HO_3\cdot$	5.2×10^{10}	5	p.r.	D.k. at 350-440 nm; $k_r = 3.7 \times 10^2$ s^{-1}; $k(HO_3 \rightarrow \cdot OH + O_2) = 1.1 \times 10^5$ s^{-1}.	84A164
2.10	$O_3\cdot^- + H_2PO_4^- \rightarrow HO_3\cdot + HPO_4^{2-}$	9.1×10^7		p.r.	D.k. in O_2/O_3 soln. contg. phosphate buffer; $k_r = 9.1 \times 10^6$; pK_a = 8.2.	84A164
2.11	$O_3\cdot^- + C_2H_5OH \rightarrow$	2.1×10^6		f.p.		707262
3	**Phosphinate radical ion**					
3.1	$HPO_2\cdot^- + HPO_2\cdot^- \rightarrow$	2.0×10^7	12	p.r.	D.k. in N_2O-satd. soln. of $H_2PO_2^-$	82A085
		4.7×10^8	12.2	e-r.	C.k. in N_2O-satd. soln. contg. 10^{-2} mol L^{-1} $H_2PO_2^-$; rel. to $k(\cdot CH_2CO_2^- + \cdot CH_2CO_2^-) = 1.0 \times 10^9$.	725049
4	**Silicate radical ion**					
4.1	$SiO_3\cdot^- + C_2H_5OH \rightarrow$	8.3×10^5		f.p.		707262
5	**Tellurite radical ion**					
5.1	$TeO_3^- + TeO_3^- \rightarrow$	7.3×10^8	5.5	f.p.	D.k. in O_2-satd. soln. contg. 2×10^{-2} mol L^{-1} TeO_3^{2-}; $2k/\epsilon = 4.2 \times 10^5$; ϵ(335 nm) = 3500 L mol^{-1} cm^{-1}	78A407
6	**Xenate(V) ion**					
6.1	$XeO_3^- + XeO_3^- \rightarrow$	$<8 \times 10^9$	8-9	p.r.		82A160
7	**Xenon trioxide**					
7.1	$XeO_3 + UO_2^+ \rightarrow XeO_3^- + UO_2^{2+}$	6.5×10^2			XeO_3 from Na_4XeO_6 in 0.1 mol L^{-1} $HClO_4$; U(V) from U(VI) + Eu(II); obs. luminescence quenching of U(VI).	85A467

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87A179 Selective oxidation of tyrosine. Oxidation by NO_2 and ClO_2 at basic pH. Alfassi, Z.B., *Radiat. Phys. Chem.* **29** 405-6 (1987)

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87G007 The reverse of the 'repair' reaction of thiols: H-abstraction at carbon by thiyl radicals. Akhlaq, M.S.; Schuchmann, H.-P.; von Sonntag, C., *Int. J. Radiat. Biol. Relat. Stud. Phys., Chem. Med.* **51**: 91-102 (1987)

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10. Indexes

10.1. Molecular Formula Index

The index refers to the entry numbers in Tables 3-29. The digit(s) before the period indicate the table number and the digits following the period indicate the entry number within the table. Thus, 3.2 is the second entry in Table 3.

$C_{16}H_{32}Cl_2CoN_4^+$ Dichloro(5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene)cobalt(III) ion *3.27*
$C_{16}H_{32}CoN_4^{2+}$ 5,7,7,12,12,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,14-dienecobalt(II) ion *3.8*
5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecobalt(II) ion *3.7, 4.10, 21.9, 22.14, 23.4*
$C_{16}H_{32}CoN_4^{3+}$ 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecobalt(III) ion *3.25*
$C_{16}H_{32}CuN_4^{2+}$ 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecopper(II) ion *3.63, 21.14*
$C_{16}H_{32}CuN_4^{3+}$ 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienecopper(III) ion *22.188*
$C_{16}H_{32}N_4$ 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene *21.107, 22.146*
$C_{16}H_{32}N_4Ni^{2+}$ 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienenickel(II) ion *3.110, 21.33, 22.53, 23.16*
$C_{16}H_{36}CuN_4^{2+}$ 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanecopper(II) ion *3.62, 21.13*
$C_{16}H_{36}N^+$ Tetrabutylammonium ion *12.69, 15.129, 21.135*
$C_{16}H_{36}N_4Ni^{2+}$ 5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion *3.109, 20.15, 21.32, 22.52, 23.15*
$C_{17}H_{19}ClN_2S$ Chlorpromazine *14.13, 21.81*
$C_{17}H_{20}ClN_2S^+$ Chlorpromazine, conjugate acid *6.31, 20.41, 22.111, 23.33*
$C_{17}H_{20}N_4O_5S$ 2-Thioriboflavine *3.241*
$C_{17}H_{20}N_4O_6$ Riboflavine *3.234, 13.74*
$C_{17}H_{21}N_2S^+$ Promethazine, conjugate acid *6.79, 20.75, 21.127, 22.185, 23.48*
$C_{17}H_{22}N_2^{2+}$ 4,5,4',5'-Tetramethyl-1,1'-trimethylene-2,2'-bipyridinium *3.239*
$C_{17}H_{24}N_3O_3$ Tryptophylleucine *6.100*
$C_{18}H_{18}FeN_2O_6^+$ Ethylenediaminebis[2-(2-hydroxyphenyl)acetato]iron(III) ion *3.77a*
$C_{18}H_{18}N_4O_6S_4^{2-}$ 2,2'-Azinobis(3-ethylbenzothiazoline-6-sulfonate ion) *8.14, 20.33, 22.102*
$C_{18}H_{24}N_2^{2+}$ 4,5,4',5'-Tetramethyl-1,1'-tetramethylene-2,2'-bipyridinium *3.238*
$C_{18}H_{29}O_2^-$ Linolenate ion *6.61, 14.26, 20.62, 22.156*
$C_{18}H_{31}O_2^-$ Linoleate ion *8.27, 14.25*
$C_{18}H_{32}O_2$ Linoleic acid *5.166, 24.69*
$C_{18}H_{33}O_4^-$ 13-Hydroperoxylinoleate ion *6.57*
$C_{18}H_{34}O_2$ Oleic acid *5.197*
$C_{18}H_{36}N_4Ni^{2+}$ 1,4,5,7,7,8,11,12,14,14-Decamethyl-1,4,8,11-tetraazacyclotetradecanenickel(II) ion *3.111*
$C_{19}H_{36}O_2$ Methyl oleate *5.184*
$C_{19}H_{42}ClN$ Hexadecyltrimethylammonium chloride *21.106*
$C_{20}H_6Br_4O_5^{2-}$ Eosin dianion *3.181*
$C_{20}H_{10}O_5^{2-}$ Fluorescein dianion *3.186*
$C_{20}H_{12}$ Benzo[*a*]pyrene *5.84*
$C_{20}H_{16}CoN_4^{2+}$ Bis(2,2'-bipyridine)cobalt(II) ion *3.12*
$C_{20}H_{22}N_3O_4$ Tryptophyltyrosine *6.101, 22.205*
Tyrosyltryptophan *6.104*
$C_{20}H_{24}O_4$ Crocetin *14.15*
$C_{20}H_{26}CuN_4^{2+}$ 2,2,4,11,13-Hexamethyl-1,5,10,14-tetraazacyclooctadeca-4,13-dienecopper(II) ion *3.64*
$C_{20}H_{32}N_6O_{12}S_2$ Glutathione, oxidized *3.191, 4.119, 22.143*
$C_{21}H_{22}N_2O_5S$ 5-Dimethylamino-1-naphthalenesulfonyl-L-tyrosine *6.48*
$C_{21}H_{26}N_7O_{13}P_2^+$ Nicotinamide adenine dinucleotide *3.216, 6.74*
$C_{21}H_{29}N_7O_{14}P$ Nicotinamide adenine dinucleotide, reduced *20.69, 22.177, 23.44*
$C_{21}H_{35}N_5O_5^{2+}$ Lysyltyrosyllysine *22.160*
$C_{21}H_{56}CoN_{14}O_5Os^{5+}$ Pentaammineosmium(III)(isonicotinylpr prolinato)pentaamminecobalt(III) ion *3.115*
$C_{22}H_{17}N_3O_6S.Na$ Acid Blue 40 *20.27*
$C_{22}H_{18}N_2^{2+}$ 1,1'-Diphenyl-4,4'-bipyridinium *3.179*
$C_{22}H_{23}N_3O_5$ L-Seryl-L-tyrosyl-β-naphthylamide *6.84*
$C_{23}H_{36}N_6O_4^{2+}$ Lysyltryptophanyllysine *22.159*
$C_{23}H_{40}N_5O_5^{3+}$ Lysyltyrosyllysine, *N*-ethyl *22.161*
$C_{24}H_{16}N_4^{2+}$ 1,1'-Bis(4-cyanophenyl)-4,4'-bipyridinium *3.148*
$C_{24}H_{18}N_{12}Ru^{2+}$ Tris(2,2'-bipyridazine)ruthenium(II) ion *3.119*
$C_{24}H_{20}B^-$ Tetraphenylborate ion *6.91, 20.81, 22.193*
$C_{24}H_{21}N_3O_9S_3^{2-}$ Acid Red 265 dianion *20.61*
$C_{24}H_{22}N_2^{2+}$ 1,1'-Dibenzyl-4,4'-bipyridinium *3.161, 13.61*
$C_{24}H_{24}CoN_2^{2+}$ Bis(4,4'-dimethyl-2,2'-bipyridine)cobalt(II) ion *3.13*
$C_{24}H_{26}N_4^{4+}$ 1,1''-Ethanediylbis(1'-methyl-4,4'-bipyridinium) *13.65*
$C_{24}H_{30}N_4O_8S_2$ L-Cystinylbis-L-tyrosine *6.40*
$C_{25}H_{28}N_4^{4+}$ 1,1''-Propanediylbis(1'-methyl-4,4'-bipyridinium) *13.73*
$C_{25}H_{30}N_3^+$ Crystal Violet cation *3.157*
$C_{25}H_{39}N_7O_5^{2+}$ Lysylglycyltryptophanyllysine *22.158*
$C_{26}H_{30}N_4^{4+}$ 1,1''-Butanediylbis(1'-methyl-4,4'-bipyridinium) *3.152, 13.60*
$C_{27}H_{29}NO_{10}$ Daunomycin *3.159*
$C_{27}H_{30}NO_{11}^+$ Adriamycin, conjugate acid *3.140*
$C_{27}H_{33}N_9O_5P_2$ Flavine mononucleotide *3.185*
$C_{27}H_{33}N_9O_{15}P_2$ Flavine adenine dinucleotide *3.184*
$C_{28}H_{31}ClN_2O_3$ Rhodamine B *3.233*

10.2. Chemical Name Index

The index refers to the entry numbers in Tables 3-29. The digit(s) before the period indicate the table number and the digits following the period indicate the entry number within the table. Thus, 20.100 is the one-hundredth entry in Table 20.