Selected Specific Rates of Reactions of Transients From Water in Aqueous Solution.

II. Hydrogen Atom

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Foreword

The National Standard Reference Data System provides access to the quantitative data of physical science, critically evaluated and compiled for convenience and readily accessible through a variety of distribution channels. The System was established in 1963 by action of the President's Office of Science and Technology and the Federal Council for Science and Technology, and responsibility to administer it was assigned to the National Bureau of Standards.

NSRDS receives advice and planning assistance from a Review Committee of the National Research Council of the National Academy of Sciences-National Academy of Engineering. A number of Advisory Panels, each concerned with a single technical area, meet regularly to examine major portions of the program, assign relative priorities, and identify specific key problems in need of further attention. For selected specific topics, the Advisory Panels sponsor subpanels which make detailed studies of users' needs, the present state of knowledge, and existing data resources as a basis for recommending one or more data compilation activities. This assembly of advisory services contributes greatly to the guidance of NSRDS activities.

The System now includes a complex of data centers and other activities in academic institutions and other laboratories. Components of the NSRDS produce compilations of critically evaluated data, reviews of the state of quantitative knowledge in specialized areas, and computations of useful functions derived from standard reference data. The centers and projects also establish criteria for evaluation and compilation of data and recommend improvements in experimental techniques. They are normally associated with research in the relevant field.

The technical scope of NSRDS is indicated by the categories of projects active or being planned: nuclear properties, atomic and molecular properties, solid state properties, thermodynamic and transport properties, chemical kinetics, and colloid and surface properties.

Reliable data on the properties of matter and materials is a major foundation of scientific and technical progress. Such important activities as basic scientific research, industrial quality control, development of new materials for building and other technologies, measuring and correcting environmental pollution depend on quality reference data. In NSRDS, the Bureau's responsibility to support American science, industry, and commerce is vitally fulfilled.

Richard W. Roberts

RICHARD W. ROBERTS, *Director*

Preface

This report is one of a series of data publications on radiation chemistry; the aim of the series is to compile, evaluate, and present the numerical results on processes occurring in systems which have been subjected to ionizing radiation. Various kinds of data are important in radiation chemistry. The quantities which were measured first were the observed radiation yields or G values (molecules formed or destroyed per 100 eV). Various indirect methods based on G values have been used to determine yields of transient species and relative rates of reactions. The spectral properties (optical, electron spin resonance) of transients have provided a direct method for their identification, and rates of the very fast reactions of transients which occur in irradiated systems have been measured directly by spectroscopic methods. Conductivity and luminescence methods have also provided a means of measuring properties of transients and their kinetics. Some reactions which occur in irradiated systems have also been studied by other methods, such as photochemistry, electric discharge, ultrasonics, chemical initiation, electron impact, etc. The emphasis in these publications is on the data of radiation chemistry, but where other pertinent data exist, they are included.

The data of radiation chemistry are voluminous; thousands of systems have been investigated. As a result there are certain collections, *e.g.* rate constants of particular types of reactions or certain properties of transients, for which tabulations of the data are considered essential, but for which critical assessment of each value is impossible. On the other hand, certain systems and properties have been studied so extensively that critical examination of these data is desirable and timely. Authors of this series of data publications have been asked to evaluate the extent to which the data can be critically assessed, to describe their criteria for evaluation, and to designate preferred values whenever possible.

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Rates of reactions of hydrogen atoms (from radiolysis of water and other sources) with organic and inorganic molecules, ions, and transients in aqueous solution have been tabulated. Directly measured rates obtained by kinetic spectroscopy or conductimetric methods, and relative rates determined by competition kinetics are included.

Key words: Aqueous solution; chemical kinetics; data compilation; hydrogen atom; radiation chemistry; rates.

Introduction

The radiolysis of water yields three major intermediates: the hydrogen atom, the hydrated electron, and the hydroxyl radical. Tables of rates of hydrated electron reactions comprise part I of this series (73–0030). This compilation contains tables of rates of hydrogen atom reactions in aqueous solution and covers the literature through 1972. The rate data for the hydroxyl radical have been compiled and will be published in part III of this series.

The hydrogen atom is the simplest chemical species, carrying a single electron. Being such a fundamental entity, its reactivity with other chemical species is of special interest to theoretical chemists as well as to anyone involved in the research of mechanisms of chemical reactions. In addition, the hydrogen atom is one of the important products of the radiolysis of water and its reactivity determines, therefore, the behavior of radiolyzed systems. As such the hydrogen atom reactions are of great importance to radiation chemists and radiobiologists.

The chemical behavior of hydrogen atoms may be summarized in the following examples:

$$H + Br_2 \rightarrow HBr + Br \text{ (abstraction)}$$

$$H + CH_3CH_2OH \rightarrow H_2 + CH_3CHOH \text{ (abstraction)}$$

$$H + CH_2{=}CH{-}CH_2CH_3 \rightarrow CH_3CHCH_2CH_3 \text{ (addition)}$$

$$H + C_6H_6 \rightarrow C_6H_7 \text{ (addition)}$$

$$H + H \rightarrow H_2 \text{ (radical combination)}$$

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$$H + O_2 \rightarrow HO_2 \text{ (addition)}$$

$$H + Cu^{2+} \rightarrow Cu^{+} + H^{+} \text{ (charge transfer)}$$

$$H + OH^{-} \rightleftharpoons e_{aq}^{-} + H_2O$$

These reactions include abstraction reactions, some of which—like hydrogen abstraction—may b defined as oxidation processes. Additions to double bonds or aromatic rings and to free radicals biradicals may be considered as reducing processes. The third category of H atom reactions are reductio processes which proceed probably via electron transfer mechanisms. Finally there are the $H + OH^-$ and H F^- reactions which yield hydrated electrons and which have no simple analog in chemistry.

In acid solutions hydrated electrons are converted into hydrogen atoms,

$$e_{aq}^{-} + H^{+} \rightarrow H_{aq}$$

with a specific rate of 2.3 x 10^{10}dm^3/mol·s. In alkaline solutions hydrogen atoms are converted int hydrated electrons (see 2.90);

$$H + OH^{-} \rightarrow e_{aq}^{-}$$

thus, the amount of H present in strongly alkaline solutions is very small, but irradiated acidic and neutra aqueous solutions contain hydrogen atoms which react with each other, with other transients from water and with organic and inorganic materials in the solution. A large number of such reactions have bee studied, although the number of H atom reactions for which rates are available is less than the nearly 70 e_{aq}^{-} reactions listed in part I. One reason for the larger number of hydrated electron rates is the ease o their direct measurement by kinetic spectroscopy. Hydrogen atom reactions have been studied in a numbe of ways, but only a few of the data have been obtained by direct methods.

Methods for Specific Rate Determination

Generation of H by pulse radiolysis of aqueous solutions and direct observations of the hydrogen atom by esr or optical spectroscopy, by conductivity methods, as well as by measurements on transients produce by H addition or abstraction, can be used in some cases to determine rates.

The reaction $H + H \rightarrow H_2$ has been measured directly by following the decay of the optical absorption of the hydrogen atom at 200 nm. The rate law is $-d[H]/dt = 2k[H]^2$. In this compilation, values of k are reported. In other cases, absolute specific rates of reactions have been measured by following the growth of the optical absorption signal due to a product of the reaction. For reactions, where none of the products has optical absorption, the relative rates have been measured by competition with reactions which produce products with optical absorption. Interference by OH, or transients from OH reactions, must be avoided in all optical studies by removing the OH from the solution. Alcohols such as *tert*–butanol and CD_3OH, which react much more slowly with H than with OH, have been used as scavengers for OH: another method for removing OH is saturation with H_2 at high pressures which converts OH to H by the reaction $OH + H_2 \rightarrow H + H_2O$.

The esr signals of hydrogen atoms are observed in irradiated aqueous solutions as a result of their enhancement by spin polarization effects. These signals decrease with time because of relaxation processes. This relaxation has been used to measure relative and absolute rates of reactions of the hydrogen atom by steady state and pulse radiolysis, respectively.

There are about 60 reactions in these tables for which specific rates have been determined directly the rates are listed in the column under k. More commonly, the kinetics of reactions of H are studie indirectly by steady state radiolysis, or in a few cases by atomized hydrogen gas flow techniques, b comparing measurements made on two reactants. The result is a ratio of rate constants obtained b analyzing the data assuming a kinetic mechanism. The majority of the nearly 400 reactions in these table list relative rates which have been determined by competition kinetics, either by steady state or puls techniques. The measured rate ratios are included in the column under *Ratio* and are given in the for

k/k_X, where k_X is $k(H + X)$ and X is the competing reactant. Certain values of k have been chosen for normalization of the relative data; those values are listed in table 1. Values of k are calculated from the ratios using those values and are designated as relative (rel.). The values listed in table 1 have been chosen either because they are *directly* measured values or because they give the best agreement among various values of relative rates. These values, some of which had to be chosen arbitrarily, are not presented as recommended values and are open for revision.

Abbreviations used for X, and other abbreviations and symbols used in the tables, are collected at the end of this section.

Arrangement of Tables

Arrangement of these tables is similar to the arrangement in part I; reactions of H with other transients from water are in table 2. Reactions of H with inorganic solutes are listed in table 3 in alphabetical order by main element. Reactions of H with organic solutes are listed in table 4 in alphabetical order by name. In most cases IUPAC nomenclature has been used. All reported values of specific rates have been included except when a measurement has been superseded by a more reliable measurement by the same author. In a few cases values were omitted because it was apparent that the reported value did not refer to the stated reaction or that the value was completely out of line with a number of well–established superseding measurements. Within the tables both solute and reaction have been included when product identification has been made; otherwise only the solute is listed.

Columns are included identifying the source of the radical and the method of measurement; other descriptive information is given under *Comments*. The serial number used in the Radiation Chemistry Data Center files has been used for citing references; the first two digits of the number specify year. All references are given following the tables. A formula index is also included, following the tables, as an aid in locating specific compounds.

Abbreviations and Symbols

abs.	absorption
abstr.	abstraction
acac	acetylacetone
AcO	acetate
anal.	analysis
bipy	bipyridine
BzOH	benzoic acid
calc.	calculated
chem.	chemical
c.k.	competition kinetics
concn.	concentration
condy.	electrical conductivity
cor.	corrected
d.k.	decay kinetics
e.d.	electrical discharge
en	ethylenediamine
e–r.	electron radiolysis
esr	electron spin resonance spectroscopy
estd.	estimated
EtOH	ethanol
ferri	ferricyanide ion
g	primary radiation yield (per 100 eV)
G	radiation yield (per 100 eV)
γ–r.	gamma radiolysis
k	specific rate
M	mol/dm^3
mass spec.	mass spectroscopy
Me	methyl
MeOH	methanol
MeOH(3D)	methanol–d_3
nat.	natural (pH)
obs.	observed
opt.	optical spectroscopy
oxid.	oxidation
oxy	oxygen
p.b.k.	product buildup kinetics
perox	hydrogen peroxide
phen	1,10–phenanthroline
PhOH	phenol
phot.	photolysis
PNBA	*p*–nitrobenzoic acid
p.r.	pulse radiolysis
2–PrOH	2–propanol
2–PrOH(7D)	2–propanol–d_7
Q	benzoquinone
r.	radiolysis
rel.	relative
soln.	solution
son.	sonolysis
unpubl.	unpublished
X–r.	X–radiolysis

TABLE 1. *Values of k used to normalize relative rates*

Reactant	Reaction	$k(dm^3 mol^{-1} s^{-1})$
H (2.2)[a]	$H + H \rightarrow H_2$	1 x 10^{10}
Ag^+ (2.5)	$H + Ag^+ \rightarrow H^+ + Ag$	3.1 x 10^{10}
ferri (2.63)	$H + Fe(CN)_6^{3-} \rightarrow H^+ + Fe(CN)_6^{4-}$	7 x 10^9
perox (2.69)	$H + H_2O_2 \rightarrow H_2O + OH$	6 x 10^7
nitrite (2.85)	$H + NO_2^- \rightarrow NO + OH^-$	7 x 10^8
oxy (2.89)	$H + O_2 \rightarrow HO_2$	2 x 10^{10}
OH^- (2.90)	$H + OH^- \rightarrow e_{aq}^-$	1.5 x 10^7
BzOH (2.149)	$H + C_6H_5COOH \rightarrow C_6H_6COOH$	1.0 x 10^9
Q (2.152)	$H + O{=}C_6H_4{=}O \rightarrow O{=}C_6H_4OH$	8.3 x 10^9
$ClAcO^-$ (2.178)	$H + ClCH_2COO^- \rightarrow H_2 + ClCHCOO^-$	1.9 x 10^6
dioxane (2.218)	$H + C_4H_8O_2 \rightarrow H_2 + C_4H_7O_2$	1.3 x 10^7
EtOH (2.224)	$H + CH_3CH_2OH \rightarrow H_2 + CH_3CHOH$	2.6 x 10^7
$HCOO^-$ (2.239)	$H + HCOO^- \rightarrow H_2 + COO^-$	1.5 x 10^8
$DCOO^-$ (2.240)	$H + DCOO^- \rightarrow HD + COO^-$	2.3 x 10^7
HCOOH (2.241)	$H + HCOOH \rightarrow H_2 + COOH$	7.5 x 10^5
glucose (2.245)	$H + C_6H_{12}O_6 \rightarrow H_2 + C_6H_{11}O_6$	4.7 x 10^7
MeOH (2.296)	$H + CH_3OH \rightarrow H_2 + CH_2OH$	2 x 10^6
MeOH(3D) (2.298)	$H + CD_3OH \rightarrow HD + CD_2OH$	1 x 10^5
PNBA (2.309)	$H + NO_2C_6H_4COOH \rightarrow NO_2C_6H_5COOH$	1 x 10^9
PhOH (2.320)	$H + OHC_6H_5 \rightarrow OHC_6H_6$	1.8 x 10^9
2–PrOH (2.334)	$H + CH_3CHOHCH_3 \rightarrow H_2 + CH_3COHCH_3$	7.9 x 10^7
MeCDOHMe (2.335)	$H + CH_3CDOHCH_3 \rightarrow HD + CH_3COHCH_3$	1 x 10^7
2–PrOH(7D) (2.336)	$H + CD_3CDOHCD_3 \rightarrow HD + CD_3COHCD_3$	1 x 10^7

[a] Number in parentheses indicates the number of the reaction in the following tables.

TABLE 2. *Reactions of H with water and transients from water*

No.	Solute and Reaction	pH	$k(dm^3mol^{-1}s^{-1})$	Ratio	Source	Method	Comment	Ref.
2.1	e^-_{aq} $H + e^-_{aq} \rightarrow H_2 + OH^-$	basic	2.5×10^{10} (rel.)	—	—	—	*See* 1.5, 1.6.	73–0030
2.2	H $H + H \rightarrow H_2$	<1	7.5×10^9 (rel.)	$k/k_{perox} = 125$	p.r.	chem.	c.k.; obs. $G(H_2)$ at various dose rates.	62–0133
		0.4	1×10^{10} (rel.) 6.4×10^9 (rel.)	$k/k_{oxy} = 0.5$ $k/k_{perox} = 106$	p.r.	chem.	obs. $G(H_2O_2)$; computer anal.	63–0043
		<3	6×10^9 (rel.)	—	*e*–r.	chem.	obs. $G(H_2)$ in $Fe^{3+} - H_2O_2$ soln.; computer anal.	63–0043
		0.8	1.5×10^{10}	$k^{1/2}/k_{Fe^{2+}} = 6.3 \times 10^{-3}$	p.r.	opt.	c.k.; obs. $G(Fe^{3+})$ at various dose rates.	63–0047
		0.4–3	1.3×10^{10} (rel.)	—	p.r.	chem.	obs. $G(H_2)$ and $G(O_2)$ in H_2O_2 soln.; computer anal.	64–0092
		2		$2k/k_{Fe^{3+}} = 225 \pm 25$	p.r.	opt.	c.k.; see however 70–0063.	64–0093
		0.4	1×10^{10} (rel.)	—	p.r.	chem.	c.k.; obs. $G(H_2)$ at various dose rates in H_2O_2, O_2 and Cu^{2+} solns.	65–0017
		1.1	—	—	γ–r.	chem.	$k_H/k_D = 3.5 \pm 0.2$.	66–0182
		2–3	1.3×10^{10} (rel.)	$k/k_{ferri} = 1.9$	p.r.	opt.	c.k.; computer anal.	68–0324
		3	$(7.8 \pm 0.5) \times 10^9$	—	p.r.	opt.	d.k. at 200 nm; $\epsilon = 900 \pm 30$ $dm^3mol^{-1}cm^{-1}$	69–0083
		<3	1.4×10^{10} (rel.)	—	p.r.	opt.	obs. $G(Fe^{3+})$ in $FeSO_4 - CuSO_4$ soln. at various dose rates; best fit.	70–0063
		1	7.4×10^9 (rel.)	—	p.r.	opt.	obs. $G(Fe^{3+})$ in $FeSO_4$ soln. at various dose rates.	71–0268
		acid	—	—	p.r.	chem.	$k_H/k_D = 3.2 \pm 0.1$.	72–0013
			For other ratios see:	2.3, 2.4, 2.59, 2.67, 2.178, 2.179, 2.241, 2.301				
2.3	OH $H + OH \rightarrow H_2O$	<1	8×10^{10} (rel.)	$k/k_{oxy} = 4.1$	p.r.	—	—	60–0099
		0.4	2×10^{10} (rel.)	$k/k_H = 2$	p.r.	chem.	obs. $G(H_2)$; computer anal.	63–0043
		3	3.2×10^{10} (rel.)	—	p.r.	chem.	obs. $G(H_2)$ and $G(O_2)$ in H_2O_2 soln.; computer anal.	64–0092
		<1	6×10^{11} (rel.)	$k/k_{oxy} \cong 30$ $k/k(OH + Fe^{2+}) \cong 300$	p.r.	—	see 70–0063.	64–0293
		3	7×10^9	—	p.r.	opt.	d.k. at 260 nm (OH).	65–0010

TABLE 2. *Reactions of H with water and transients from water* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3mol^{-1}s^{-1}})$	Ratio	Source	Method	Comment	Ref.
		<3	2×10^{10} (rel.)	—	p.r.	chem.	obs. $G(Fe^{3+})$ in $FeSO_4 - CuSO_4$ soln. at various dose rates; best fit.	70–0063
		3	$(1.5 \pm 0.3) \times 10^{10}$	—	p.r.	opt.	d.k. at 200 – 240 nm; computer anal.	70–0213
		acid	$(2.5 \pm 0.5) \times 10^{10}$	—	p.r.	chem.	obs. $G(H_2)$; computer anal.	72–0013
2.4	$HO_2^{\cdot}$ $H + HO_2 \rightarrow H_2O_2$	0.4	2×10^{10} (rel.)	$k/k_H = 2$	p.r.	chem.	obs. $G(H_2)$; computer anal.	63–0043
		—	2×10^{10}	—	p.r.	—	assumed value.	64–0049
		<3	2×10^{10} (rel.)	—	p.r.	chem.	obs. $G(Fe^{3+})$ in $FeSO_4 - CuSO_4$ soln. at various dose rates; best fit.	70–0063

TABLE 3. *Reactions of H with inorganic solutes*

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.5	Ag^+ $H + Ag^+ \rightarrow Ag + H^+$	2	$(1.10 \pm 0.06) \times 10^{10}$	—	p.r.	opt.	p.b.k. at 310 nm; superseded by following value.	67–0550
		2	$(3.10 \pm 0.30) \times 10^{10}$	—	p.r.	opt.	p.b.k. at 365 nm.	68–0436
		1	2.83×10^{10}	—	p.r.	opt.	p.b.k. at 410 nm; contains *tert*–BuOH; *k* increases with pressure 0 → 6.72 kbar.	73–1053
		For ratios see: 2.218, 2.224, 2.231, 2.249, 2.250, 2.296, 2.301, 2.333, 2.334						
2.6	As(III) $H + As(III) \rightarrow H^+ + As(II)$	2.7	1.2×10^9 (rel.)	$k/k_{perox} = 20$	X–r.	chem.	c.k.	62–0018
2.7	AsF_6^-	5	8.8×10^5 (rel.)	$k/k_{MeCDOHMe} = 8.8 \times 10^{-3}$	γ–r.	chem.	c.k.	66–0401
2.8	$AuCl_4^-$ $H(\text{or } e_{aq}^-) + AuCl_4^- \rightarrow H^+(\text{or } H_2O) + AuCl_4^{2-}$	4	$(5.7 \pm 1.5) \times 10^9$	—	p.r.	opt.	p.b.k. at 330 nm.	68–0302
2.9	$B_4O_7^{2-}$	~7	$< 10^4$ (rel.)	$k/k_{ClAcO^-} < 4 \times 10^{-3}$	son.	chem.	c.k.; $B_4O_7^{2-}$ is either nonreactive towards H or is less reactive than F^-.	67–0099
2.10	Br_2 $H + Br_2 \rightarrow HBr + Br \rightarrow H^+ + Br^- + Br \rightarrow H^+ + Br_2^-$	1	$\sim 10^{10}$	—	p.r.	opt.	p.b.k. at 360 nm (Br_2^-), uncertainty in the value is 5–fold.	65–0382
		~0.8	4.2×10^{10}(rel.)	$k/k_{perox} \cong 700$	γ–r.	chem.	c.k., obs. $G(-Br^-)$ and $G(H_2O_2 + Br_2)$.	67–0008
2.10a	Br^- $H + Br^- \rightarrow HBr^-$	~ 7	2.0×10^7 (rel.)	$k/k_{HCOO^-} = 0.132$	γ–r.	chem.	c.k.	72–0264
2.11	BrO_3^-	7	3.2×10^7 (rel.)	$k/k_{2\text{-}PrOH} = 0.4$	γ–r.	chem.	c.k.	66–0402
2.12	CO $H + CO \rightarrow HCO$	1.2		$k/k_{Fe^{2+}} = 2.2 \pm 0.3$	γ–r.	chem.	c.k.	63–0014
		1		$k/k_{HCHO} = 14.8 \pm 3$	γ–r.	chem.	c.k.	63–0014
		—	3.8×10^8	—	—	—	Unpubl. data.	70–7235
2.13	CO_2 $H + CO_2 \rightarrow COOH$	1	$< 10^6$	—	p.r.	opt.	no abs. at 250 nm.	65–0384
		—	$< 8 \times 10^6$	—	γ–r.	chem.	estd. from yields in carboxylation of methanol.	65–0375
2.14	HCO_3^-	8	3.4×10^4(rel.)	$k/k_{MeOH} = 1.7 \times 10^{-2}$	X–r.	chem.	c.k.	63–0049
2.15	HCN $H + HCN \rightarrow H_2CN$	—	1.1×10^8(rel.)	$k/k_{2\text{-}PrOH} = 1.4$	γ–r.	chem.	c.k.	68–0593
2.16	CN^-	7	4.1×10^9 (rel.)	$k/k_{2\text{-}PrOH} = 52$	γ–r.	chem.	c.k.	66–0402
2.17	C_2N_2	6	$< 10^7$	—	p.r.	opt.	react. not obs. at low concn.	71–0038
2.18	CNS^-	7	2.7×10^8 (rel.)	$k/k_{2\text{-}PrOH} = 3.4$	γ–r.	chem.	c.k.	66–0402
2.19	Cd^{++}	—	$< 3 \times 10^5$(rel.)	$k/k_{EtOH} < 10^{-2}$	γ–r.	chem.	c.k.	65–0192
2.20	$Cd(CN)_4^{2-}$	5	$> 2.4 \times 10^9$ (rel.)	$k/k_{MeCDOHMe} > 235$	γ–r.	chem.	c.k.	66–0401
2.21	Ce^{4+}	1	5.5×10^7(rel.)	$k/k_{EtOH} = 2.1 \pm 0.4$	γ–r.	chem.	c.k.	70–1059
2.21a	Cl^-	~7	$< 10^5$ (rel.)	—	γ–r.	chem.	c.k. with $HCOO^-$	72–0264

TABLE 3. *Reactions of H with inorganic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.22	$Co(NH_3)_6^{3+}$ $H + Co(NH_3)_6^{3+} \rightarrow Co(II)$	4–6	1.85×10^6 (rel.)	—	e.d.	opt.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	65–0014
		4–6	2×10^6 (rel.)	$k/k_{MeOH(3D)} = 20$	γ–r.	chem.	c.k.	65–0085
		1	$< 9 \times 10^4$(rel.)	$k/k_{EtOH} < 3.4 \times 10^{-3}$	γ–r.	chem.	c.k.	66–0010
2.23	$Co(NH_3)_5H_2O^{3+}$ $H + Co(NH_3)_5H_2O^{3+} \rightarrow Co(II)$	1.8–3.88	4.5×10^5 (rel.)	—	e.d.	opt.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	65–0014
		1	$< 7 \times 10^5$(rel.)	$k/k_{EtOH} < 2.6 \times 10^{-2}$	γ–r.	chem.	c.k.	66–0010
		5	$< 10^6$ (rel.)	$k/k_{MeCDOHMe} < 0.1$	γ–r.	chem.	c.k.	66–0401
2.24	$Co(NH_3)_5OH^{2+}$ $H + Co(NH_3)_5OH^{2+} \rightarrow Co(II)$	6.66–11.0	3.1×10^7 (rel.)	—	e.d.	opt.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	65–0014
		7.5	3×10^7 (rel.)	$k/k_{MeCDOHMe} = 2.95$	γ–r.	chem.	c.k.	65–0085
2.25	$Co(NH_3)_5F^{2+}$ $H + Co(NH_3)_5F^{2+} \rightarrow Co(II)$	4–6	1.1×10^6 (rel.)	—	e.d.	opt.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	65–0014
		4–6	1.2×10^6 (rel.)	$k/k_{MeOH(3D)} = 15$	γ–r.	chem.	c.k.	65–0085
		1	$< 1.4 \times 10^6$ (rel.)	$k/k_{EtOH} < 5.3 \times 10^{-2}$	γ–r.	chem.	c.k.	66–0010
2.26	$Co(NH_3)_5Cl^{2+}$ $H + Co(NH_3)_5Cl^{2+} \rightarrow Co(II)$	4–6	7.3×10^7 (rel.)	—	e.d.	opt.	calcd. from diffusion model; rel, to $k_H = 3 \times 10^{10}$.	65–0014
		4–6	2.6×10^8 (rel.)	$k/k_{MeCDOHMe} = 26$	γ–r.	chem.	c.k.	65–0085
		1	1.1×10^9 (rel.)	$k/k_{EtOH} = 42$	γ–r.	chem.	c.k.	66–0010
2.27	$Co(NH_3)_5Br^{2+}$ $H + Co(NH_3)_5Br^{2+} \rightarrow Co(II)$	4–6	4.6×10^8 (rel.)	—	e.d.	opt.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	65–0014
		4–6	1.2×10^9 (rel.)	$k/k_{MeCDOHMe} = 118$	γ–r.	chem.	c.k.	65–0085
		1	9.6×10^9 (rel.)	$k/k_{EtOH} = 370$	γ–r.	chem.	c.k.	66–0010
2.28	$Co(NH_3)_5I^{2+}$ $H + Co(NH_3)_5I^{2+} \rightarrow Co(II)$	4–6	3.3×10^9 (rel.)	—	e.d.	opt.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	65–0014
		1	3.5×10^9 (rel.)	$k/k_{MeCDOHMe} = 350$	γ–r.	chem.	c.k.	65–0085
		1	2.3×10^{10} (rel.)	$k/k_{EtOH} = 870$	γ–r.	chem.	c.k.	66–0010
2.29	$Co(NH_3)_5CN^{2+}$ $H + Co(NH_3)_5CN^{2+} \rightarrow Co(II)$	4–6	4.4×10^7 (rel.)	$k/k_{MeCDOHMe} = 4.35$	γ–r.	chem.	c.k.	65–0085
		1	4.2×10^7 (rel.)	$k/k_{EtOH} = 1.6$	γ–r.	chem.	c.k.	66–0010
2.30	$Co(NH_3)_5NCS^{2+}$	1	4.6×10^9 (rel.)	$k/k_{EtOH} = 166$	γ–r.	chem.	c.k.	66–0010
2.31	$Co(NH_3)_5N_3^{2+}$	4–6	4.6×10^8 (rel.)	$k/k_{MeCDOHMe} = 46$	γ–r.	chem.	c.k.	65–0085
		1	7.5×10^8 (rel.)	$k/k_{EtOH} = 29$	γ–r.	chem.	c.k.	66–0010
2.32	$Co(NH_3)_5(H{-}fumarate)^{2+}$	1	4.2×10^8 (rel.)	$k/k_{EtOH} = 160$	γ–r.	chem.	c.k.	66–0010
2.33	$Co(NH_3)_5NO_2^{2+}$	1	1.1×10^8 (rel.)	$k/k_{EtOH} = 4.2$	γ–r.	chem.	c.k.	66–0010
2.34	$Co(NH_3)_3(NO_2)_3$	1	6.5×10^8 (rel.)	$k/k_{EtOH} = 25$	γ–r.	chem.	c.k.	66–0010
2.35	$Co(CN)_6^{3-}$	1	1.4×10^7 (rel.)	$k/k_{EtOH} = 0.53$	γ–r.	chem.	c.k.	66–0010
		5	1.1×10^9 (rel.)	$k/k_{MeCDOHMe} = 105$	γ–r.	chem.	c.k.	66–0401

TABLE 3. *Reactions of H with inorganic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.36	$Co(NH_3)_5(AcO)^{2+}$	1	$< 9 \times 10^5$ (rel.)	$k/k_{EtOH} < 3.4 \times 10^{-2}$	γ–r.	chem.	c.k.	66–0010
2.37	$Co(NH_3)_5PO_4$	1	$< 5 \times 10^5$ (rel.)	$k/k_{EtOH} < 1.76 \times 10^{-2}$	γ–r.	chem.	c.k.	66–0010
2.38	$Co(NH_3)_5(OOCCF_3)^{2+}$	1	$< 1.8 \times 10^5$ (rel.)	$k/k_{EtOH} < 7.1 \times 10^{-3}$	γ–r.	chem.	c.k.	66–0010
2.39	$Co(NH_3)_5(OCOC_6H_5)^{2+}$ $H + Co(NH_3)_5(OCOC_6H_5)^{2+} \rightarrow Co(NH_3)_5(OCOC_6H_6)^{2+}$	1.0	$(1.6 \pm 0.4) \times 10^9$	—	p.r.	opt.	p.b.k. at 345 nm.	71–0282
2.40	$Co(en)_3^{3+}$ $H + Co(en)_3^{3+} \rightarrow Co(II)$	3.5	6×10^5 (rel.)	—	e.d.	chem.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	71–9218
2.41	$Co(en)_2(H_2O)_2^{3+}$ $H + Co(en)_2(H_2O)_2^{3+} \rightarrow Co(II)$	3.5	1.6×10^7 (rel.)	—	e.d.	chem.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$	71–9218
2.42	$Co(en)_2F_2^+$ $H + Co(en)_2F_2^+ \rightarrow Co(II)$	3.5	2.7×10^6 (rel.)	—	e.d.	chem.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	71–9218
2.43	$Co(en)_2Cl_2^+$	5	8.1×10^8 (rel.)	$k/k_{MeCDOHMe} = 81$	γ–r.	chem.	c.k.	66–0401
2.44	$Co(en)_2CO_3^+$	5	$< 2.4 \times 10^6$ (rel.)	$k/k_{MeCDOHMe} < 0.24$	γ–r.	chem.	c.k.	66–0401
2.45	$Co(en)_2(C_2O_4)^+$ $H + Co(en)_2(C_2O_4)^+ \rightarrow Co(II)$	3.5	8×10^5 (rel.)	—	e.d.	chem.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	71–9218
2.46	$Co(en)(C_2O_4)_2^-$ $H + Co(en)(C_2O_4)_2^- \rightarrow Co(II)$	3.5	2.8×10^6 (rel.)	—	e.d.	chem.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	71–9218
2.47	$Co(C_2O_4)_3^{3-}$ $H + Co(C_2O_4)_3^{3-} \rightarrow Co(C_2O_4)_2^{2-} + C_2O_4^{2-} + H^+$	7	1.8×10^8 (rel.)	$k/k_{nitrite} = 0.15$	γ–r.	chem.	c.k.; assumed $g(H) = 2.8$.	67–0498
		3.5	4.2×10^6 (rel.)	—	e.d.	chem.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	71–9218
2.48	$Co(acac)_3$	1	1.3×10^9 (rel.)	$k/k_{2\text{-}PrOH} = 17$	γ–r.	chem.	c.k.	70–0094
2.49	$Cr(NH_3)_5Cl^{2+}$	5	2.1×10^6 (rel.)	$k/k_{MeCDOHMe} = 0.21$	γ–r.	chem.	c.k.	66–0401
2.50	$CrCl_2(H_2O)_4^+$	5	2.4×10^7 (rel.)	$k/k_{MeCDOHMe} = 2.4$	γ–r.	chem.	c.k.	66–0401
2.51	$Cr(C_2O_4)_3^{3-}$ $H + Cr(C_2O_4)_3^{3-} \rightarrow Cr(II)$	3.5	1.1×10^6 (rel.)	—	e.d.	chem.	calcd. from diffusion model; rel. to $k_H = 3 \times 10^{10}$.	71–9218
2.52	CrO_4^{2-}	—	7.8×10^7 (rel.)	$k/k_{HCOO^-} = 0.52$	γ–r.	chem.	c.k.	66–0616
		—	1.6×10^{10} (rel.)	$k/k_{EtOH} = 600 \pm 300$	γ–r.	chem.	c.k.	65–0192
2.53	$Cr_2O_7^{2-}$	—	2.6×10^{10} (rel.)	$k/k_{EtOH} = (1 \pm 0.2) \times 10^3$	γ–r.	chem.	c.k.	65–0192
2.54	Cu^{2+} $H + Cu^{2+} \rightarrow Cu^+ + H^+$	1	4.2×10^7 (rel.)	$k/k_{HCOOH} = 56$	X–r.	chem.	c.k.	56–0012
		1	6.6×10^7 (rel.)	$k/k_{MeOH} = 33$	X–r.	chem.	c.k.	58–0006
		~6	9.8×10^8 (rel.)	$k/k_{2\text{-}PrOH} = 12.4 \pm 3$	γ–r.	chem.	c.k.	63–0041, 64–0095
		—	6×10^8 (rel.)	$k/k_{EtOH} = 23 \pm 3$	γ–r.	chem.	c.k.; $CuSO_4$ used.	65–0192
		—	1.2×10^9 (rel.)	$k/k_{EtOH} = 45 \pm 8$	γ–r.	chem.	c.k.; $Cu(NO_3)_2$ used.	65–0192
		1.5	6.8×10^7 (rel.)	$k/k_{EtOH} = 2.64 \pm 0.06$	γ–r.	chem.	c.k.	66–0138
		0.4	6×10^9 (rel.)	$k/k_{oxy} = 0.3$	γ–r.	chem.	c.k.; $CuSO_4 - Fe^{2+} - O_2$ system.	66–0334, 68–0355

TABLE 3. *Reactions of H with inorganic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3 mol^{-1} s^{-1})$	Ratio	Source	Method	Comment	Ref.
		7	5.9×10^8 (rel.)	$k/k_{MeCDOHMe} = 59$	γ–r.	chem.	c.k.	66–0401
		—	2.5×10^8 (rel.)	$k/k_{2\text{-}PrOH} = 3.2 \pm 0.5$	γ–r.	chem.	c.k.	66–0616
		—	3.5×10^8 (rel.)	$k/k_{HCOO^-} = 2.3 \pm 0.5$	γ–r.	chem.	c.k.	66–0616
		1–2	7.6×10^7 (rel.)	$k/k_{MeOH} = 38 \pm 2$	γ–r.	chem.	c.k.	68–0444
		~7	4.2×10^7 (rel.)	$k/k_{HCOO^-} = 0.28$	γ–r.	chem.	c.k.	72–0264
			For other ratios see:	2.110, 2.197, 2.256, 2.297				
	$D + Cu^{2+} \rightarrow D^+ + Cu^+$	1.25	9.4×10^7 (rel.)	$k/k_{EtOH} = 3.62$	—	—	—	66–0621
2.55	F^- $H + F^- \rightarrow e^-_{aq} + HF$	8.5	$(1.9 \pm 0.5) \times 10^4$ (rel.)	$k/k_{MeOH(3D)} = 0.19$	γ–r.	mass spec.	c.k.; obs. $G(H_2\text{–}HD)$	67–0099
		~7	1.5×10^4 (rel.)	$k/k_{ClAcO^-} = 8 \times 10^{-3}$	γ–r., son.	chem.	c.k.; obs. $G(Cl^-)$.	67–0099
		8.3	$(1.0 \pm 0.5) \times 10^4$	—	p.r.	opt.	effect of H_2 concn. on e^-_{aq} decay in 1.0 *M* KF.	67–0115
2.56	Fe^{2+} $H + Fe^{2+}(+H^+) \rightarrow Fe^{3+} + H_2$ $Fe^{2+} + H \rightleftharpoons FeH^{2+}$ (1) $FeH^{2+} + H^+ \rightarrow Fe^{3+} + H_2$ (2)	0.4	1.6×10^7 (rel.)	$k/k_{oxy} = 8.3 \times 10^{-4}$	γ–r.	chem.	c.k.	57–0009
		2.1	1.3×10^7 (rel.)	$k/k_{oxy} = 6.7 \times 10^{-4}$	X–r.	chem.	c.k.	58–0004
		0.8–1.2	2×10^7	—	p.r.	chem.	obs. $G(Fe^{3+})$; effect of pulse length.	63–0047, 64–0049
		0	$(7.5 \pm 2) \times 10^6$ (rel.)	—	p.r.	opt.	p.b.k. at 270 nm (Fe^{3+}); computer anal.; rel. to $k_H = 2.6 \times 10^{10}$; $k_2 = (1.06 \pm 0.1) \times 10^4$.	69–0434
		0.4	2.8×10^7 (rel.)	$k/k_{oxy} = 1.4 \times 10^{-3}$	γ–r.	chem.	c.k.	70–0533
		1.5	1.1×10^8 (rel.)	$k/k_{oxy} = 5.5 \times 10^{-3}$	γ–r.	chem.	c.k.	70–0534
			For other ratios see:	2.2, 2.12, 2.57, 2.58, 2.60, 2.61, 2.83, 2.297				
2.57	Fe^{3+} $Fe^{3+} + H \rightarrow Fe^{2+} + H^+$	<1	8×10^7 (rel.)	$k/k_{oxy} = 4 \times 10^{-3}$	γ–r.	chem.	c.k. in HCl or $HClO_4$.	57–0008
		1	6×10^6 (rel.)	$k/k_{MeOH} = 3$	X–r.	chem.	c.k.	58–0006
		0.4		$k/k_{Fe^{2+}} = 0.081 \pm 0.010$	γ–r.	chem.	c.k. in H_2SO_4.	57–0009
		2	1.4×10^8 (rel.)	$k/k_{oxy} = 7 \times 10^{-3}$	γ–r.	chem.	c.k.	57–0010
		1.57		$k/k_{Fe^{2+}} = 1.35 \pm 0.1$	γ–r.	chem.	c.k.	58–0004
		2.1		$k/k_{Fe^{2+}} = 7.2 \pm 0.7$	γ–r.	chem.	c.k.	58–0004
		0.8		$k/k_{Fe^{2+}} = 170$	γ–r.	chem.	c.k. in HCl.	58–0011
		~1–3	5×10^8 (rel.)	$k/k_{oxy} = 2.45 \times 10^{-2}$	γ–r.	chem.	c.k. in $HClO_4$.	63–0004
		~1–3		$k/k_{Fe^{2+}} < 0.1$	e.d.	chem.	c.k. in $HClO_4$.	66–0345
		0.4–3		$k/k_{Fe^{2+}} \cong 0.1$	e.d.	chem.	c.k. in H_2SO_4; reactant $FeSO_4^+$.	66–0345
		~1–2	$< 2 \times 10^6$ (rel.)	$k/k_{MeOH} < 1$	γ–r.	chem.	c.k. in $HClO_4$ soln.; $k_{FeOH^{2+}} > 500\ k_{Fe^{3+}}$.	68–0444
			For other ratios see:	2.2, 2.67, 2.68, 2.96, 2.98, 2.297				
2.58	$FeOH^{2+}$	~1–3		$k/k_{Fe^{2+}} = 1.60$	e.d.	chem.	c.k. in $HClO_4$.	66–0345
		~1–2	1×10^9 (rel.)	$k/k_{MeOH} = 480$	γ–r.	chem.	c.k. in $HClO_4$.	68–0444

TABLE 3. *Reactions of H with inorganic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.59	FeH^{2+} $FeH^{2+} + H \rightarrow Fe^{2+} + H_2$	0.8–1.2		$k^2/k_H k_2^2 = 0.25$	p.r.	chem.	c.k.; reactant is produced from H + Fe^{2+}; reaction 2 is $FeH^{2+} + H^+ \rightarrow Fe^{3+} + H_2$.	63–0047
2.60	$FeF^{2+} + FeF_2^+$	0.8		$k/k_{Fe^{2+}} \cong 0.04$	e.d.	chem.	c.k.	66–0345
2.61	$FeCl^{2+}$	0.8	4.6 x 10^9 (rel.)	$k/k_{oxy} = 0.23$	γ–r.	chem.	c.k. in HCl.	57–0008
	$FeCl^{2+} + H \rightarrow Fe^{2+} + Cl^- + H^+$	0.8		$k/k_{Fe^{2+}} = 300$	e.d.	chem.	c.k. in HCl.	66–0345
2.63	$Fe(CN)_6^{3-}$ (ferri) $H + Fe(CN)_6^{3-} \rightarrow Fe(CN)_6^{4-} + H^+$ (I)	2–9	1.5 x 10^9 (rel.)	—	e.d.	opt.	calcd. by diffusion model; assume $k_H = 3$ x 10^{10}.	66–0345
	$H + Fe(CN)_6^{3-} \rightarrow$	acid		$k_{II}/k_I = 0.28$	γ–r.	chem.	c.k.	66–0286
	$Fe(CN)_5^{3-} + H^+ +$	2–3	(6.5 ± 0.5) x 10^9	—	p.r.	opt.	d.k. at 420 nm.	68–0324
	CN^-(II)	1.9	7.5 x 10^9	—	p.r.	opt.	d.k. at 410 nm.	71–0618
			For other ratios see:	2.2, 2.83, 2.85, 2.89, 2.90, 2.118, 2.150, 2.163, 2.194, 2.224, 2.225, 2.239, 2.241, 2.245, 2.249, 2.296, 2.316, 2.334, 2.346, 2.363				
2.64	$Fe(C_2O_4)_3^{3-}$ $H + Fe(C_2O_4)_3^{3-} \rightarrow Fe(II)$	3.5	3.4 x 10^6(rel.)	—	e.d.	chem.	calcd. from diffusion model; rel. to $k_H = 3$ x 10^{10}.	71–9218
2.65	$Fe(bipy)_3^{3+}$	0.3	2.2 x 10^9 (rel.)	—	e.d.	opt.	calcd. by diffusion model; assume $k_H = 3$ x 10^{10}.	66–0345
2.66	$Fe(phen)_3^{3+}$	0.3	2.9 x 10^9 (rel.)	—	e.d.	opt.	calcd. by diffusion model; assume $k_H = 3$ x 10^{10}.	66–0345
2.67	H^+ $H + H^+ \rightarrow H_2^+$	~1–2	3.4 x 10^2 (rel.)	$k^2/2k_H = 1.2$ x 10^{-5}	e.d.	chem.	c.k.	59–0008
		<3.5	(2.6 ± 1.1) x 10^3	—	phot.	chem.	estd. from pH effect on quantum yields of N_2, I_2 and H_2 in I^- – N_2O soln.	62–0057
		<0.8	2.8 x 10^4 (rel.)	$k/k_{oxy} = 1.4$ x 10^{-6}	γ–r.	chem.	c.k.	62–0096
		2–3		$k/k_{Fe^{3+}} = 2.8$ x 10^{-3}	γ–r.	chem.	c.k.	63–0004
		<0		$k/k_{Fe^{3+}} = 3.6$ x 10^{-4}	X–r, γ–r.	chem.	c.k.; in 17.3 *M* H_2SO_4.	65–0371
			For other ratios see:	2.102				
	$D + H^+ \rightarrow HD^+$	acid	2 x 10^2	—	γ–r.	—	estd.; D_2 soln.	58–0047
2.68	D_2 $H + D_2 \rightarrow HD + D$	2.12		$k/k_{Fe^{3+}} = 8.3$ x 10^{-3}	γ–r.	chem.	c.k.	59–0012
2.69	H_2O_2 (perox) $H + H_2O_2 \rightarrow H_2O + OH$	2.85	> 6 x 10^6 (rel.)	$k/k_{oxy} > 3.3$ x 10^{-4}	γ–r.	chem.	c.k.	62–0051
		0.8–7	4.4 x 10^7 (rel.)	$k/k_{oxy} = 2.2$ x 10^{-3}	phot.	chem.	c.k.	62–7001
		0.4	6.6 x 10^7 (rel.)	$k/k_{oxy} = 3{,}3$ x 10^{-3}	p.r.	chem.	c.k.	63–0043
		2.1	(9 ± 1) x 10^7	—	p.r.	opt.	p.b.k. (Cl_2^- at 350 nm; soln. contains 0.2 *M* Cl^-).	64–0093
		—	6.1 x 10^7	—	p.r.	—	—	66–0559
		~7	3.0 x 10^7 (rel.)	$k/k_{HCOO^-} = 0.2$	γ–r.	chem.	c.k.	72–0264
			For other ratios see:	2.2, 2.6, 2.10, 2.79, 2.100, 2.222, 2.224, 2.361				

TABLE 3. *Reactions of H with inorganic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.70	Hg^{2+} $Hg^{2+} + H \rightarrow Hg^+ + H^+$	~ 7	3.9 x 10^{10} (rel.)	$k/k_{\mathrm{EtOH}} = (1.5 \pm 0.1)$ x 10^3	γ–r.	chem.	c.k.	65–0192
		~ 7	1.7 x 10^9 (rel.)	$k/k_{\mathrm{HCOO^-}} = 11 \pm 5$	γ–r.	chem.	c.k.; 8 x 10^{-8} to 8 x 10^{-6} *M* $HgCl_2$ and 2 x 10^{-5} *M* HCOONa.	66–0616
		1.5	2 x 10^9 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 26$	γ–r.	chem.	c.k.	69–0275
		1	(1.0 ± 0.5) x 10^{10}	—	p.r.	opt.	p.b.k. at 330 nm.	73–0043
2.70a	Hg_2^{2+}	—	4.7 x 10^9 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 0.60$	γ–r.	chem.	c.k.	72–0290
2.71	I_2	0.8	4 x 10^{10} (rel.)	$k/k_{\mathrm{oxy}} = 2$	γ–r.	chem.	c.k.	64–0245
	$I_2 + H \rightarrow HI + I$	—	1 x 10^{10} (rel.)	k/k_{MeOH} ~5 x 10^3	—	—	c.k.; no details given.	67–0041
2.72	I^- $H + I^- + H^+$(or HSO_4^-) $\rightarrow H_2 + I$	>0.4	5.3 x 10^6dm^{6}mol^{-2}s^{-1} (rel.)	—	γ–r.	chem.	c.k. assuming $k(H + I_3^-$ or $I_2)$ = 3 x 10^{10} and $g(H) = 3.45–3.65$.	69–0338
	$H + I^- \rightarrow HI^-$	~7	2.4 x 10^7 (rel.)	$k/k_{\mathrm{HCOO^-}} = 0.162$	γ–r.	chem.	c.k.	72–0264
2.73	I_2^- $H + I_2^- \rightarrow H^+ + 2I^-$	3.5–11	(1.8 ± 0.8) x 10^7	—	phot.	chem.	estd.	62–0057
2.74	I_3^- $H + I_3^- \rightarrow H^+ + I^- + I_2^-$	2.92	8 x 10^9 (rel.)	$k/k_{\mathrm{MeOH}} = 4$ x 10^{-3}	phot.	chem.	c.k.	68–7194
		1.72–2.92	2.3 x 10^{10} (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 285$	phot.	chem.	c.k.	68–7194
		1.5	3.3 x 10^{10} (rel.)	$k/k_{\mathrm{glucose}} = 700$	γ–r.	chem.	c.k.	69–0338
2.75	IO_3^-	7	9.5 x 10^7 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 1.2$	γ–r.	chem.	c.k.	66–0402
2.76	Mn^{2+}	6	3 x 10^7 (rel.)	$k/k_{\mathrm{MeCDOHMe}} = 3$	γ–r.	chem.	c.k.	66–0401
2.77	MnO_4^-	3	2.8 x 10^{10}	—	p.r.	opt.	d.k.	65–0044
	$H + MnO_4^- \rightarrow H^+ + MnO_4^{2-}$	3	(2.36 ± 0.2) x 10^{10}	—	p.r.	opt.	d.k. at 545 nm.	65–0385
		acid	4.6 x 10^{10} (rel.)	$k/k_{\mathrm{oxy}} = 2.3$	p.r.	opt.	c.k.	65–0385
2.78	NH_4^+	7	<2.3 x 10^4 (rel.)	$k/k_{\mathrm{DCOO^-}} < 10^{-3}$	γ–r.	chem.	c.k.	64–0095
2.79	$N_2H_5^+$ $H + N_2H_5^+ \rightarrow N_2H_3 + H^+ + H_2$	2	3 x 10^4 (rel.)	$k/k_{\mathrm{perox}} \cong 5$ x 10^{-4}	γ–r.	chem.	c.k.	55–0004
		~0.7	1.7 x 10^4 (rel.)	$k/k_{\mathrm{perox}} = 2.8$ x 10^{-4}	γ–r.	chem.	c.k.	69–0598
		6	7.8 x 10^4 (rel.)	$k/k_{\mathrm{perox}} = 1.3$ x 10^{-3}	γ–r.	chem.	c.k.	69–0598
2.80	NH_3	1.2	1.1 x 10^8 (rel.)	$k/k_{\mathrm{EtOH}} = 4.2$	γ–r.	chem.	c.k.	66–0010
2.81	N_3^-	—	4.9 x 10^8 (rel.)	$k/k_{\mathrm{EtOH}} = 19$	γ–r.	chem.	c.k.	66–0010
		~ 7	4.3 x 10^9 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 54$	γ–r.	chem.	c.k.	71–0007
2.82	NO $H + NO \rightarrow HNO$	7	1.1 x 10^{10} (rel.)	$k/k_{\mathrm{nitrite}} = 15$	γ–r.	chem.	c.k.	67–0231
2.83	N_2O $H + N_2O \rightarrow N_2 + OH$	~ 2		$k/k_{\mathrm{Fe^{2+}}} = 1.7$ x 10^{-2}	γ–r.	chem.	c.k.; data from 60–0068.	60–0035
		3.5–11	(1.25 ± 0.5) x 10^4	—	phot.	chem.	estd.	62–0057
		< 10	> 1.7 x 10^4 (rel.)	—	γ–r.	chem.	estd. by c.k. with H_2O_2.	65–0011
		7	~ 10^5 (rel.)	—	phot.	chem.	estd. from $k(OH + CH_3OH)/k$ = 25.	65–7006
		alk.	2.3 x 10^6 (rel.)	$k/k_{\mathrm{ferri}} = (3.3 \pm 1.8)$ x 10^{-4}	γ–r.	chem.	c.k.	68–0693
2.84	HNO_2 $H + HNO_2 \rightarrow H_2O + NO$	1	6.8 x 10^8 (rel.)	$k/k_{\mathrm{EtOH}} = 26$	γ–r.	chem.	c.k.	66–0010

TABLE 3. *Reactions of H with inorganic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3mol^{-1}s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.85	NO_2^- $H + NO_2^- \rightarrow NO + OH^-$	7.6	1.5×10^9 (rel.)	$k/k_{ferri} = 0.22 \pm 0.09$	X–r.	chem.	c.k.	62–0017
		~8	6×10^8 and 1×10^9 (rel.)	$k/k_{MeOH} = 300$ and 430.	X–r.	chem.	c.k.	62–0017
		~6	2.1×10^8 (rel.)	$k/k_{2\text{-}PrOH} = 2.7 \pm 0.3$	γ–r.	chem.	c.k.	63–0041, 64–0095
		nat.	1.4×10^9 (rel.)	$k/k_{MeOH} = 590 \pm 70$	γ–r.	chem.	c.k.	65–0192
		nat.	2.1×10^9 (rel.)	$k/k_{2\text{-}PrOH} = 27 \pm 3$	γ–r.	chem.	c.k.	65–0192
		nat.	6.1×10^8 (rel.)	$k/k_{HCOO^-} = 4.1 \pm 0.2$	γ–r.	chem.	c.k.	65–0192
		nat.	2.8×10^9 (rel.)	$k/k_{EtOH} = 109 \pm 7$	γ–r.	chem.	c.k.	65–0192
		7–8	1.6×10^9 (rel.)	$k/k_{EtOH} = 63$	γ–r.	chem.	c.k.	66–0010
		6	1.1×10^9 (rel.)	$k/k_{MeCDOHMe} = 1.06$	γ–r.	chem.	c.k.	66–0401
		nat.	8×10^8 (rel.)	$k/k_{2\text{-}PrOH} = 10 \pm 1$	γ–r.	chem.	c.k.	66–0616
		nat.	7.3×10^8 (rel.)	$k/k_{HCOO^-} = 4.8 \pm 0.4$	γ–r.	chem.	c.k.	66–0616
		7	7.1×10^8	—	p.r.	esr	d.k. (H signal).	71–0303
			For other ratios see:	2.47, 2.82, 2.107, 2.245, 2.249				
2.86	NO_3^- $NO_3^- + H \rightarrow NO_2 + OH^-$ or NO_3H^-	~ 6	4×10^7 (rel.)	$k/k_{2\text{-}PrOH} = 0.51 \pm 0.07$	γ–r.	chem.	c.k.	63–0041, 64–0095
		nat.	1.1×10^7 (rel.)	$k/k_{EtOH} = 0.42 \pm 0.05$	γ–r.	chem.	c.k.	65–0192
		5.6	1.4×10^7 (rel.)	$k/k_{2\text{-}PrOH} = 0.18$	γ–r.	chem.	c.k.	65–0372, 66–0114
		5.7–	5.2×10^6 (rel.)	$k/k_{EtOH} = 0.2$	γ–r.	chem.	c.k.	66–0147
		7.1	3.0×10^6 (rel.)	$k/k_{HCOO^-} = 0.02$	γ–r.	chem.	c.k.	66–0147
			4.7×10^6 (rel.)	$k/k_{2\text{-}PrOH} = 0.06$	γ–r.	chem.	c.k.	66–0147
		6	2.1×10^7 (rel.)	$k/k_{MeCDOHMe} = 2.1$	γ–r.	chem.	c.k.	66–0401
		1	8.2×10^6 (rel.)	$k/k_{HCOOH} = 11$	γ–r.	chem.	c.k.	68–0343
		~ 7	2.9×10^6 (rel.)	$k/k_{HCOO^-} = (1.9 \pm 0.3) \times 10^{-2}$	γ–r.	chem.	c.k.	70–0859
		2.5	1.4×10^6	—	p.r.	esr	d.k. (H signal); high concn. of NO_3^-; *k* concn. dependent.	71–0303
		~ 7	7.2×10^6 (rel.)	$k/k_{HCOO^-} = 4.8 \times 10^{-2}$	γ–r.	chem.	c.k.	72–0264
			For other ratios see:	2.107				
2.87	$NO(SO_3^-)_2$ (Fremy's salt)	8.5	1.8×10^9 (rel.)	$k/k_{HCOO^-} = 12 \pm 2$	γ–r.	chem.	c.k.; 0.1 *M* Na_2HPO_4 used to adjust pH.	69–0649
2.88	Ni^{2+}	nat.	$< 2.6 \times 10^5$ (rel.)	$k/k_{EtOH} < 10^{-2}$	γ–r.	chem.	c.k.	65–0192
2.89	O_2 (oxy) $H + O_2 \rightarrow HO_2$	acid	1.2×10^{10}	—	p.r.	chem.	obs. $G(H_2O_2)$; estd. value.	63–0043
		1.2	2.1×10^{10}	—	p.r.	opt.	p.b.k. at 240 nm.	64–0043
		3	2.6×10^{10}	—	p.r.	opt.	mathematical anal.	64–0092
		—	2×10^{10} (rel.)	$k/k_{MeOH} \cong 10^4$	—	—	c.k.; details not given.	67–0041
		1.9	1.6×10^{10} (rel.)	$k/k_{ferri} = 2.3$	p.r.	opt.	c.k.; obs. $Fe(CN)_6^{3-}$ decay at 410 nm.	71–0618

TABLE 3. *Reactions of H with inorganic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3mol^{-1}s^{-1})$	Ratio	Source	Method	Comment	Ref.
		1.9	2.5 x 10^{10} (rel.)	$k/k_Q = 3.1$	p.r.	opt.	c.k.; obs. benzoquinone H–adduct formn. at 410 nm.	71–0618
			For other ratios see:	2.2, 2.3, 2.54, 2.56, 2.57, 2.61–62, 2.67, 2.69, 2.71, 2.77, 2.94, 2.95, 2.205, 2.224, 2.229, 2.245, 2.249, 2.271, 2.292, 2.296, 2.334, 2.374				
2.90	OH^- $H + OH^- \rightarrow e^-_{aq}$	11–13	1.4 x 10^7 (rel.)	$k/k_{HCOO^-} = 0.09$	X–r.	*chem.*	c.k.	*63–0049*
		11.5	(1.5 – 2.3) x 10^7	—	p.r.	opt.	p.b.k.	64–0108
		11.6	(1.8 ± 0.6) x 10^7	—	p.r.	opt.	p.b.k.; soln. contains 100 atm H_2.	65–0009
		—	2.3 x 10^7	—	p.r.	—	—	66–0842
		11–13	1.5 x 10^7 (rel.)	$k/k_{ferri} = (2.1 \pm 1.0) \times 10^{-3}$	γ–r., X–r.	chem.	c.k.; soln. contains N_2O and $Fe(CN)_6^{3-}$; obs. $G(N_2)$; assume $k/k(H + N_2O) > 12.5$.	68–0693
		10.5–11.5	1.5 x 10^7 (rel.)	$k/k_{BzOH} = 1.5 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
			For other ratios see:	2.91, 2.107, 2.110, 2.178, 2.239				
2.91	HPO_3^{2-} $H + HPO_3^{2-} \rightarrow H_2 + PO_3^{2-}$	13.6	1.5 x 10^9 (rel.)	$k/k_{OH^-} = 100$	γ–r.	chem.	c.k.	65–0155
		—	(1.8 ± 0.6) x 10^9 (rel.)	—	γ–r.	chem.	c.k.; rel. to k_{OH} (value not given).	69–0051
2.91a	H_3PO_4 $H + H_3PO_4 \rightarrow H_2 + H_2PO_4$	0	(5 ± 3) x 10^5	—	p.r.	opt.	p.b.k. at 500 nm.	73–1049
2.91b	$H_2PO_4^-$ $H + H_2PO_4^- \rightarrow H_2 + HPO_4^-$	3.85–4.0	(5 ± 3) x 10^5	—	p.r.	opt.	p.b.k. at 500 nm.	73–1049
2.92	HPO_4^{2-}	~ 7	< 5 x 10^3 (rel.)	—	γ–r., son.	chem.	c.k. with CH_3OH and $Co(NH_3)_5F^{2+}$; obs. $G(H_2)$; also c.k. with $ClCH_2COO^-$, obs. $G(Cl^-)$.	67–0099
		9.0–12.3	< 5 x 10^4	—	p.r.	opt.	p.b.k. at 500 nm.	73–1049
2.92a	Pr(III)	1.9	< 10^3 (rel.)	—	—	—	c.k. with CH_3OH.	72–0066
2.93	$Pt(CN)_4^{2-}$	5	> 2.4 x 10^9 (rel.)	$k/k_{MeCDOHMe} > 235$	γ–r.	chem.	c.k.	66–0401
2.93a	$Ru(bipy)_3^{2+}$	~ 2	9.5 x 10^9	—	p.r.	opt.	p.b.k. at 420 nm.	72–0381
2.93b	$Ru(bipy)_3^{3+}$	<4.5	1.7 x 10^9	—	—	—	no details.	72–0462
2.93c	D_2S $D + D_2S \rightarrow D_2 + DS$	6.0–6.5	1 x 10^9 (rel.)	$k/k_{HCOO^-} = 7.5$	γ–r.	chem.	c.k.	65–0013
2.94	$S_2O_8^{2-}$ $H + S_2O_8^{2-} \rightarrow HSO_4 + SO_4^{2-}$	~ 0	2.4 x 10^7 (rel.)	$k/k_{oxy} = (1.2 \pm 0.1) \times 10^{-3}$	γ–r.	chem.	c.k.; ceric – cerous system used.	70–0169
2.95	H_2SO_5 $H + H_2SO_5 \rightarrow H_2O + HSO_4$	~ 0	2.2 x 10^8 (rel.)	$k/k_{oxy} = (1.06 \pm 0.06) \times 10^{-2}$	γ–r.	chem.	c.k.; ceric – cerous system used.	70–0169
2.96	Sn(II) $H + Sn(II) \rightarrow Sn(I) + H^+$	0.8		$k/k_{Fe^{3+}} \cong 6 \times 10^4$	γ–r.	chem.	c.k.	59–0007
2.97	SnF_3^-	5	*2.4 x 10^9 (rel.)*	$k/k_{MeCDOHMe} = 235$	γ–r.	chem.	c.k.	66–0401

TABLE 3. *Reactions of H with inorganic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.98	Sn(IV) $H + Sn(IV) \rightarrow H^+ + Sn(III)$	0.8		$k/k_{Fe^{3+}} = 2$	γ-r.	chem.	c.k.	59-0007
2.99	SnF_6^{2-}	5	1.1×10^7 (rel.)	$k/k_{MeCDOHMe} = 1.06$	γ-r.	chem.	c.k.	66-0401
2.100	Te(VI) $H + Te(VI) \rightarrow Te(V)$	0.4	6.6×10^7 (rel.)	$k/k_{perox} = 1.1$	γ-r.	chem.	c.k.	68-0356
2.101	Tl^+	1,5	1.2×10^8 (rel.)	$k/k_{MeCDOHMe} = 12$	γ-r.	chem.	c.k.	66-0401
2.102	UO_2^{2+} $H + UO_2^{2+} \rightarrow UO_2^+ + H^+$	0-2		$k/k_{H^+} = 1.2$	γ-r.	chem.	c.k. with Fe^{2+} oxid. at varying pH; authors assume that $Fe^{2+} + H_2^+ \rightarrow Fe^{3+} + H_2$.	61-0099
2.103	Zn^{2+}	—	$< 2.6 \times 10^5$ (rel.)	$k/k_{EtOH} < 10^{-2}$	γ-r.	chem.	c.k.	65-0192

TABLE 4. *Reactions of H with organic solutes*

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.104	acetaldehyde $H + CH_3CHO \rightarrow H_2 + CH_2CHO$ (or CH_3CO) (I)	1	3.4×10^7 (rel.)	$k/k_{BzOH} = 3.4 \times 10^{-2}$	*e*–r.	esr	Decay of spin polarization, compared with 2–PrOH(7D).	71–0003
	$H + CH_3CHO \rightarrow CH_3CHOH$ (II)	1	2.9×10^7 (I) (rel.)	$k_I/k_{II} = 4.9$	γ–r.	chem.	83% H abstr.	73–0053
2.105	acetamide	1	1.3×10^5 (rel.)	$k/k_{BzOH} = 1.3 \times 10^{-4}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	1.9×10^5 (rel.)	$k/k_{BzOH} = 1.9 \times 10^{-4}$	γ–r.	chem.	c.k. with 2–PrOH(7D), H abstr.	71–0017
2.106	acetanilide	8–9	1.1×10^9 (rel.)	$k/k_{2\text{-}PrOH} = 13.4$	γ–r.	chem.	c.k.	66–0500
	$H + C_6H_5NHCOCH_3 \rightarrow C_6H_6NHCOCH_3$	1	1.1×10^9 (rel.)	$k/k_{BzOH} = 1.1$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.107	acetate ion $H + CH_3COO^- \rightarrow H_2 + CH_2COO^-$	~ 8	3.2×10^5 (rel.)	$k/k_{nitrite} = 4.5 \times 10^{-4}$	X–r.	chem.	c.k.	62–0017
		7	2.8×10^5 (rel.)	$k/k_{DCOO^-} = (1.2 \pm 0.1) \times 10^{-2}$	γ–r.	chem.	c.k.	63–0041, 64–0095
		~ 7		$k/k_{nitrate} = 4 \times 10^{-2}$	X–r.	chem.	c.k.	63–0049
		11–12	2×10^5 (rel.)	$k/k_{OH^-} = (1.1–2) \times 10^{-2}$	X–r.	chem.	c.k.	63–0049
		7	3.5×10^5 (rel.)	$k/k_{BzOH} = 4.2 \times 10^{-4}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.108	acetate ion–d_3 $H + CD_3COO^- \rightarrow HD + CD_2COO^-$	6	2×10^4 (rel.)	$k/k_{AcO^-} = (4.5 \pm 0.8) \times 10^{-2}$	γ–r.	chem.	c.k.	64–0141
2.109	acetic acid	1	7.5×10^4 (rel.)	$k/k_{HCOOH} = 0.10$	X–r.	chem.	c.k.	56–0012
	$H + CH_3COOH \rightarrow H_2 + CH_2COOH$	1	8×10^4 (rel.)	$k/k_{BzOH} = 8 \times 10^{-5}$	*e*–r.	esr	decay of spin polarization; compared with $CD_3CDOHCD_3$.	71–0003
		1	1.3×10^5 (rel.)	$k/k_{BzOH} = 1.3 \times 10^{-4}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
2.110	acetone $H + CH_3COCH_3 \rightarrow$ prod.	1	2.8×10^6 (rel.)	$k/k_{BzOH} = 2.8 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with $CD_3CDOHCD_3$.	71–0003
	$H + CH_3COCH_3 \rightarrow H_2 + CH_2COCH_3$ (I)	1	2.5×10^5 (I) (rel.)	$k_I/k_{HCOOH} = 0.34$	X–r.	chem.	c.k.	56–0012
		~7	6.4×10^5 (I) (rel.)	$k_I/k_{DCOO^-} = (2.8 \pm 0.3) \times 10^{-2}$	γ–r.	chem.	c.k.	63–0041, 64–0095
		11–13	1.2×10^6 (I) (rel.)	$k_I/k_{OH^-} = 8.3 \times 10^{-2}$	X–r.	chem.	c.k.	63–0049
		1		$k_I/k_{Cu^{2+}} = 1.4 \times 10^{-2}$	X–r.	chem.	c.k.	63–0049
		—	2.3×10^6 (I) (rel.)	$k_I/k_{dioxane} = 0.18$	γ–r.	chem.	c.k.; solvent dioxane contg. 2.2 *M* water.	67–0222
		1	1.7×10^6 (I) (rel.)	$k_I/k_{BzOH} = 1.7 \times 10^{-3}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
		1	1.9×10^6 (I) (rel.)	$k_{II}k_I = 0.49$	γ–r.	chem.	67% H abstr.; 2.5×10^{-4}% enol.	73–0053

TABLE 4. *Reactions of H with organic solutes — Continued*

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
	$H + CH_3COCH_3 \rightarrow CH_3COHCH_3$ (II)	~ 7		$k_{II}/k_I = 0.2$	X–r.	chem.	—	63–0049
		1		$k_{II}/k_I = 0.3$	X–r.	chem.	—	63–0049
		1.2		$k_{II}/k_I = 0.33 \pm 0.06$	γ–r.	chem.	—	65–0016
		< 1		$k_{II}/k_I = 0.33$	γ–r.	chem.	—	68–0525
2.111	acetonitrile $H + CH_3CN \rightarrow CH_2CN + H_2$ (I) $H + CH_3CN \rightarrow CH_3CNH$ (II)	1	1.5×10^6 (rel.)	$k/k_{BzOH} - 1.5 \times 10^{-3}$	e–r.	esr	Decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	8×10^4 (rel.) (I)	$k_I/k_{BzOH} = 8 \times 10^{-5}$	—	—	estimated.	71–0017
		1	2.7×10^6 (rel.) (II)	$k_{II}/k_{BzOH} = 2.7 \times 10^{-3}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
		1	1×10^5 (I) (rel.)	$k_{II}/k_I = 13.3$	γ r.	chem.	7% H abstr.	73 0053
2.112	acetophenone	8.9	2×10^9 (rel.)	$k/k_{2-PrOH} = 26$	γ–r.	chem.	c.k.	66–0500
	$H + C_6H_5COCH_3 \rightarrow C_6H_6COCH_3$ (I)	1	$(1.1 \pm 0.2) \times 10^9$	—	p.r.	opt.	p.b.k.; CD_3OD as OH scavenger.	69–0001
	$H + C_6H_5COCH_3 \rightarrow H_2 + C_6H_5COCH_2$ (II)	1	1.2×10^9 (rel.)	$k/k_{BzOH} = 1.2$	*e*–r.	esr	Decay of spin polarization, compared with EtOH.	72–0025
		1	$\sim 1 \times 10^7$ (II) (rel.)	$k_{II}/k_I \simeq 0.01$	γ–r.	chem.	~ 1% H abstr.	73–0053
		1.0	$(3.4 \pm 0.6) \times 10^9$	—	p.r.	opt.	p.b.k. (H adduct); *tert*–BuOH as OH scavenger.	72–0171
2.113	acetylacetone $H + CH_3COCH_2COCH_3 \rightarrow CH_3COC{=}C(OH)CH_3 + H_2$ (I)	1	8.2×10^7 (rel.)	—	*e*–r.	esr	unpubl. data, P. Neta and R.H. Schuler.	73–0053
	$H + CH_3COCH_2COCH_3 \rightarrow$ no H_2 (II)		$\sim 2 \times 10^6$ (I) (rel.)	$k_{II}/k_I \simeq 0.3$	γ–r.	chem.	23% H abstr.; 80% enol form.	73–0053
2.114	acetylene	7	1.1×10^8 (rel.)	$k/k_{HCOO^-} = 0.73$	γ–r.	chem.	c.k.	68–0502
2.115	acetylenedicarboxylic acid	1	1.0×10^9 (rel.)	$k/k_{BzOH} = 1$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.116	*N*–acetylalanine	1	8.0×10^6 (rel.)	$k/k_{BzOH} = 8.0 \times 10^{-3}$	*e*–r	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.117	*N*–acetylglycine	1	3.8×10^6 (rel.)	$k/k_{BzOH} = 3.8 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, *compared with* 2–PrOH(7D).	71–0003
2.118	acrylamide	1–2	3.5×10^{10} (rel.)	$k/k_{ferri} = 5.0 \pm 0.6$	p.r.	opt.	c.k., $Fe(CN)_6^{3-}$ measured at 420 nm.	70–0052
2.119	adenine	7–8	8.5×10^7 (rel.)	$k/k_{DCOO^-} = 3.7 \pm 3$	γ–r.	chem.	c.k.	68–3038
		1	8.3×10^7 (rel.)	$k/k_{BzOH} = 8.3 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		2	6×10^7	—	*e*–r.	esr	decay of H signal.	71–0303
		7	1×10^8	—	*e*–r.	esr	decay of H signal.	71–0303
		7	$(0.9 - 1.5) \times 10^8$ (rel.)	$k/k_{BzOH} = 0.09 - 0.15$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040

Table 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.120	adenosine	7–8	1.4×10^8 (rel.)	$k/k_{\mathrm{DCOO^-}} = 6$	γ–r.	chem.	c.k.	68–3038
		1	1.1×10^8 (rel.)	$k/k_{\mathrm{BzOH}} = 0.11$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		7	$(1.4–2) \times 10^8$ (rel.)	$k/k_{\mathrm{BzOH}} = 0.14–0.2$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.121	adenosine–5–phosphate	7–8	1.5×10^8 (rel.)	$k/k_{\mathrm{DCOO^-}} = 6.5$	γ–r.	chem.	c.k.	68–3038
2.122	α–alanine	1	2.4×10^5 (rel.)	—	γ–r.	chem.	c.k. assuming *k*(H + allyl alc.) $= 2.8 \times 10^9$.	68–0343
		1	2.9×10^5 (rel.)	$k/k_{\mathrm{BzOH}} = 2.9 \times 10^{-4}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.123	β–alanine	1	3.4×10^5 (rel.)	$k/k_{\mathrm{BzOH}} = 3.4 \times 10^{-4}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.124	allyl alcohol $H + CH_2{=}CHCH_2OH \rightarrow H_2 + C_3H_5O$ (I)	~ 6	3.6×10^9 (rel.)	$k/k_{\mathrm{2-PrOH}} = 46 \pm 5$	γ–r.	chem.	c.k.	63–0041, 64–0095
		~0.4	4.7×10^9 (rel.)	$k/k_{\mathrm{glucose}} = 100$	γ–r.	chem.	c.k.	68–0525
		1	1.9×10^9 (rel.)	$k/k_{\mathrm{HCOOH}} = 2.6 \times 10^3$	γ–r.	chem.	c.k.; author calcd. $k = 2.8 \times 10^9$ assuming $k_{\mathrm{HCOOH}} = 1.1 \times 10^6$.	68–0343
	$H + CH_2{=}CHCH_2OH \rightarrow C_3H_6OH$ (II)	1,7		$k_{\mathrm{I}}/k_{\mathrm{II}} = (2.0 \pm 0.2) \times 10^{-2}$	γ–r.	chem.	c.k.; effect on $G(H_2)$ from water.	70–0468
		1	~ 5×10^7 (I) (rel.)	$k_{\mathrm{I}}/k_{\mathrm{II}} \cong 2 \times 10^{-2}$	γ–r.	chem.	~ 2% H abstr.	73–0053
			For rates relative to allyl alcohol see: 2.122, 2.125a, 2.204, 2.206, 2.247, 2.272, 2.282, 2.287, 2.292, 2.292a, 2.292b, 2.312a, 2.317a, 2.330, 2.353, 2.371, 2.387.					
2.125	aminoacetonitrile $H + H_2NCH_2CN \rightarrow H_2 + H_2NCHCN$ (I)	1	6.6×10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 6.6 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
	$H + H_2NCH_2CN \rightarrow H_2NCH_2CHN$ (II)	7	5.6×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 5.6 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
		1 7	~ 6×10^4 (I) (rel.) 3.2×10^7 (I) (rel.)	$k_{\mathrm{I}}/k_{\mathrm{II}} = 10^{-2}$ $k_{\mathrm{I}}/k_{\mathrm{II}} = 1.4$	γ–r.	chem.	~ 1% H abstr. (58% at pH7).	73–0053
2.125a	2–aminobutyric acid	1	6.0×10^5 (rel.)	—	γ–r.	chem.	c.k. assuming *k*(H + allyl alc.) $= 2.8 \times 10^9$.	68–0343
2.126	2–aminoethanol	1	3.0×10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 3.0 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.127	2–amino–2–methyl–propionic acid	1	8×10^4 (rel.)	$k/k_{\mathrm{BzOH}} = 8 \times 10^{-5}$	e–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.128	aniline $H + C_6H_5NH_2 \rightarrow C_6H_6NH_2$	8–9	2.8×10^9 (rel.)	$k/k_{\mathrm{2-PrOH}} = 36$	γ–r.	chem.	c.k.	66–0500
		7	2.6×10^9 (rel.)	$k/k_{\mathrm{BzOH}} = 2.6$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025, 72–0039
		—	$(2.9 \pm 0.7) \times 10^9$	—	p.r.	opt.	p.b.k. at 350 nm.	72–0289

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3mol^{-1}s^{-1})$	Ratio	Source	Method	Comment	Ref.
2.129	anilinium ion $H + C_6H_5NH_3^+ \rightarrow C_6H_6NH_3^+$	1	4.9×10^8 (rel.)	$k/k_{BzOH} = 0.49$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	72-0025
		3	$(1.3 \pm 0.2) \times 10^9$	—	p.r.	opt.	p.b.k. at 310 nm.	72-0289
2.130	anisole	1	1.2×10^9 (rel.)	$k/k_{BzOH} = 1.2$	*e*-r.	esr	decay of spin polarization; compared with EtOH.	72-0025
2.131	anthracene	—	1.0×10^9 (rel.)	$k/k_{dioxane} = 78$	γ-r.	chem.	c.k.; solvent dioxane contg. 2.2 *M* water.	67-0222
2.132	9,10-anthraquinone-2-sulfonate ion	1.0	$(4.1 \pm 0.3) \times 10^9$	—	p.r.	opt.	p.b.k. (H adduct); *tert*-BuOH as OH scavenger.	72-0171
2.133	L-arabinose	1	5.7×10^7 (rel.)	$k/k_{BzOH} = 5.7 \times 10^{-2}$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.134	L-arginine	1	4.9×10^6 (rel.)	$k/k_{BzOH} = 4.9 \times 10^{-3}$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.135	ascorbate ion	7	$(3-6) \times 10^8$ (rel.)	$k/k_{BzOH} = 0.3 - 0.6$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	72-0039
2.136	ascorbic acid $H + C_5H_7O_6 \rightarrow H_2 + C_5H_6O_6$ (I) $H + C_5H_7O_6 \rightarrow$ no H_2 (II)	—	3.6×10^8 (rel.)	$k/k_{2\text{-}PrOH} = 4.5$	γ-r.	chem.	c.k.	70-3023
		1	1.1×10^8 (rel.)	$k/k_{BzOH} = 0.11$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
		1	$\sim 2 \times 10^6$ (I)	$k_I/k_{II} \cong 0.02$	γ-r.	chem.	~ 2% H abstr.	73-0053
		1	1.7×10^8 (rel.)	$k/k_{2\text{-}PrOH} = 2.2$	p.r.	opt.	c.k.; obs. 360 nm abs.	72-0266
2.137	DL-asparagine	1	4.7×10^5 (rel.)	$k/k_{BzOH} = 4.7 \times 10^{-4}$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.138	aspartate ion	7	2.9×10^6 (rel.)	$k/k_{BzOH} = 2.9 \times 10^{-3}$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	72-0039
2.139	DL-aspartic acid	1	8×10^5 (rel.)	$k/k_{BzOH} = 8 \times 10^{-4}$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.140	barbiturate ion	7	2.0×10^9 (rel.)	$k/k_{BzOH} = 2.0$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	72-0039
2.141	barbituric acid $H + C_4H_4N_2O_3 \rightarrow H_2 + C_4H_3N_2O_3$ (I)	1	2.0×10^7 (rel.)	$k/k_{BzOH} = 0.02$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
	$H + C_4H_4N_2O_3 \rightarrow$ no H_2 (II)	1	2.4×10^6 (II) (rel.)	$k_{II}/k_I = 7.3$	γ-r.	chem.	12% H abstr.	73-0053

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3mol^{-1}s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.142	benzaldehyde $C_6H_5CHO + H \rightarrow$ $C_6H_5CO + H_2$ (I) $C_6H_5CHO + H \rightarrow$ C_6H_6CHO (II)	1	1.5×10^9 (rel.)	$k/k_{\mathrm{BzOH}} = 1.5$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
		1	6×10^7 (I) (rel.)	$k_{\mathrm{II}}/k_{\mathrm{I}} \cong 24$	γ–r.	chem.	~ 4 % H abstr.	73–0053
2.143	benzamide	1	8.9×10^8 (rel.)	$k/k_{\mathrm{BzOH}} = 0.89$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.144	benzene $H + C_6H_6 \rightarrow C_6H_7$	0	9×10^8 (rel.)	$k/k_{\mathrm{PhOH}} \cong 0.5$	γ–r.	chem.	compared effect of C_6H_6 and C_6H_5OH on $G(\mathrm{Fe^{3+}})$ in $\mathrm{Fe^{2+}}$ soln.	59–0006
		3	$(1.1 \pm 0.1) \times 10^9$	—	p.r.	opt.	p.b.k. at 311 nm; contains ~ 2 x 10^{-2} *M* CH_3OH, assumed $k(H + CH_3OH) = 1.6 \times 10^6$.	67–0246
		2.0	5.3×10^8 (rel.)	$k/k_{\mathrm{PNBA}} = 5.3 \times 10^{-1}$	p.r.	opt.	c.k.; build–up of *p*–nitrobenzoic acid–H adduct	70–0211
2.145	benzenesulfonate ion $H + C_6H_5SO_3^- \rightarrow$ $C_6H_6SO_3^-$	8–9	6.7×10^8 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 8.6$	γ–r.	chem.	c.k.	66 0500
		1	$(8.2 \pm 1.3) \times 10^8$	—	p.r.	opt.	p.b.k. CD_3OD as OH scavenger.	69–0001
	$D + C_6H_5SO_3^- \rightarrow$ $C_6H_5DSO_3^-$	1	6.3×10^8	—	p.r.	opt.	p.b.k.; in D_2O.	69–0001
2.146	1,3,5–benzene–tricarboxylic acid	1	6.5×10^8 (rel.)	$k/k_{\mathrm{BzOH}} = 0.65$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.147	benzil $H + C_6H_5COCOC_6H_5 \rightarrow$ $C_6H_6COCOC_6H_5$	1.0	$(1.0 \pm 0.2) \times 10^{10}$	—	p.r.	opt.	p.b.k. (H adduct); *tert*–BuOH as OH scavenger.	72–0171
2.148	benzoate ion	8–9	1.4×10^9 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 17.4$	γ–r.	chem.	c.k.	66–0500
	$H + C_6H_5COO^- \rightarrow$ $C_6H_6COO^-$	7	9.2×10^8 (rel.)	$k/k_{\mathrm{BzOH}} = 0.92$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.149	benzoic acid (BzOH) $H + C_6H_5COOH \rightarrow$ $\dot{C}_6H_6COOH$	3	1.0×10^9	—	p.r.	opt.	p.b.k. at 347 nm; CD_3OH as OH scavenger.	69–0001
		—	1.2×10^9 (rel.)	$k/k_{\mathrm{MeOH}} = 590$	p.r.	opt.	c.k.; p.b.k.	69–0001
		1	8.1×10^8 (rel.)	$k/k_{\mathrm{2\text{-}PrOH(7D)}} = 81$	*e*–r.	esr	decay of spin polarization.	71–0003
		—	8.3×10^8	—	*e*–r.	esr	decay of H signal.	71–0303
		1	8.8×10^8 (rel.)	$k/k_{\mathrm{EtOH}} = 34$	*e*–r.	esr	decay of spin polarization.	72–0025
		1	—	—	γ–r.	chem.	< 1% H abstr.	73–0053

For other ratios see: 2.90, 2.104–5, 2.107, 2.109–12, 2.115–17, 2.119–20, 2.122–3, 2.125–30, 2.133–43, 2.146, 2.148–50, 2.153–4, 2.159–60, 2.162, 2.168–72, 2.175, 2.177, 2.181, 2.183–4, 2.189–91, 2.197, 2.200, 2.202, 2.205, 2.207, 2.209, 2.211–16, 2.218–9, 2.223–4, 2.229–32, 2.237, 2.239, 2.241, 2.244, 2.245–7, 2.249, 2.250–5, 2.259, 2.261–70, 2.272–7, 2.279–83, 2.285–90, 2.294, 2.296, 2.303, 2.305, 2.307, 2.311, 2.313, 2.315, 2.317–8, 2.320–1, 2.323–7, 2.330, 2.332–9, 2.342–7, 2.349, 2.351, 2.353–5, 2.357, 2.358, 2.360, 2.362, 2.365–8, 2.370–1, 2.374, 2.377, 2.380, 2.383–8

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3mol^{-1}s^{-1})$	Ratio	Source	Method	Comment	Ref.
	D + C_6H_5COOH → C_6H_5DCOOH	1	7.6 x 10^8	—	p.r.	opt.	p.b.k.; in D_2O.	69–0001
2.150	benzonitrile	8–9	7.2 x 10^8 (rel.)	$k/k_{2\text{-PrOH}} = 9.06$	γ–r.	chem.	c.k.	66–0500
	H + C_6H_5CN → C_6H_6CN	1	6.8 x 10^8	—	p.r.	opt.	p.b.k.; CD_3OH as OH scavenger	69–0001
		—	8 x 10^8 (rel.)	$k/k_{MeOH} = 4$ x 10^{-2}	p.r.	opt.	c.k.; p.b.k.	69–0001
		2	5.5 x 10^8 (rel.)	$k/k_{ferri} = 7.8$ x 10^{-2}	p.r.	opt.	c.k.	70–0657
		1	6.4 x 10^8 (rel.)	$k/k_{BzOH} = 0.64$	e–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.151	benzophenone	—	3 x 10^8 (rel.)	$k/k_{dioxane} = 24$	γ–r.	chem.	c.k.; solvent is dioxane containing 2.2 *M* water.	67–0222
		1.0	(5.6 ± 0.3) x 10^9	—	p.r.	opt.	p.b.k. (H adduct); *tert*–BuOH as OH scavenger.	72–0171
2.152	benzoquinone (Q)	1.0	2.3 x 10^9 (rel.)	$k/k_{HCOOH} = 3000$	X–r.	chem.	c.k.	56–0012
	H + $O{=}C_6H_4{=}O$ → $O{=}C_6H_4OH$	—	1.5 x 10^9 (rel.)	$k/k_{MeOH} = 750 \pm 40$	γ–r.	chem.	c.k.	58–0009
		—	1.4 x 10^{10} (rel.)	$k/k_{EtOH} = 550 \pm 150$	γ–r.	chem.	c.k.	65–0192
		1.9	8.3 x 10^9	—	p.r.	opt.	p.b.k. at 410 nm.	71–0618, 71–0619
			For other ratios see:	2.89, 2.363				
2.152a	2–benzoylpyridine	1.0	(2.3 ± 0.4) x 10^9	—	p.r.	opt.	p.b.k. at 348 nm; H adduct formn.	72–0359
2.152b	3–benzoylpyridine	1.0	(3.7 ± 0.6) x 10^9	—	p.r.	opt.	p.b.k. at 400 nm; H adduct formn.	72–0359
2.152c	4–benzoylpyridine	1.0	(2.4 ± 0.3) x 10^9	—	p.r.	opt.	p.b.k. at 375 nm; H adduct formn.	72–0359
2.153	benzyl alcohol H + $C_6H_5CH_2OH$ →	6	1 x 10^9 (rel.)	$k/k_{2\text{-PrOH}} = 13 \pm 2.0$	γ–r.	chem.	c.k.	63–0041, 64–0095
	H_2 + C_6H_5CHOH (I)	~0.4	9.4 x 10^8 (rel.)	$k/k_{glucose} = 20$	γ–r.	chem.	c.k.	68–0525
	H + $C_6H_5CH_2OH$ → $C_6H_6CH_2OH$ (II)	1	1.1 x 10^9 (rel.)	$k/k_{BzOH} = 1.1$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
		1	8 x 10^7 (I) (rel.)	$k_I/k_{II} \cong 0.07$	γ–r.	chem.	7% H abstr.	73–0053
2.154	betaine	1	8 x 10^4 (rel.)	$k/k_{BzOH} = 8$ x 10^{-5}	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.155	biacetyl H + $CH_3COCOCH_3$ → H_2 + $CH_2COCOCH_3$	1	4.7 x 10^6 (rel.)	—	*e*–r.	esr	unpubl. data, P. Neta and R.H. Schuler.	73–0053
	(I) H + $CH_3COCOCH_3$ → no H_2 (II)	1	9.4 x 10^5 (I) (rel.)	$k_I/k_{II} = 0.25$	γ–r.	chem.	20% H abstr.	73–0053
2.156	2,2′–bipyridine	1	1.5 x 10^8	—	p.r.	opt.	p.b.k.	71–0582
2.157	4,4′–bipyridine	1	2 x 10^8	—	p.r.	opt.	p.b.k.	71–0582
2.158	bromoacetate ion							
	H + $BrCH_2CO_2^-$ → HBr + $CH_2CO_2^-$	8.5	5.5 x 10^8 (rel.)	$k/k_{2\text{-PrOH}} = 7.0$	γ–r.	chem.	c.k.	67–0050
	D + $BrCH_2CO_2^-$ → HD + $BrCHCOO^-$	8.5	3.2 x 10^6 (rel.)	$/k_{2\text{-PrOH}} \leqslant 4$ x 10^{-2}	γ–r.	chem.	c.k. in D_2O.	67–0050

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.159	bromoacetic acid							
	$H + BrCH_2COOH \rightarrow H_2 + CHBrCOOH$ (I)	1	< 3.6 x 10^6 (rel.)(I)	$k_I/k_{BzOH} < 3.6 \times 10^{-3}$	γ−r.		estimated; c.k. with 2−PrOH(7D).	71−0017
	$H + BrCH_2COOH \rightarrow HBr + CH_2COOH$ (II)	1.0	4.7 x 10^8 (rel.) (II)	$k_{II}/k_{2\text{-}PrOH} = 6.0$	γ−r.	chem.	c.k.	67−0050
		1	2.6 x 10^8 (rel.) (II)	$k/k_{BzOH} = 0.26$	*e*−r.	esr	decay of spin polarization, compared with 2−PrOH(7D).	71−0003
		1	3.6 x 10^8 (rel.) (II)	$k_{II}/k_{BzOH} = 0.36$	γ−r.	chem.	c.k. with 2−PrOH(7D).	71−0017
		~0.4	4.7 x 10^8 (rel.) (II)	$k_{II}/k_{glucose} = 10$	γ−r.	chem.	c.k.	68−0525
	$D + BrCH_2COOH \rightarrow HD + CHBrCOOH$	1.0	< 4.7 x 10^5 (rel.)	$k/k_{2\text{-}PrOH} \leqslant 6 \times 10^{-3}$	γ−r.	chem.	c.k. in D_2O.	67−0050
2.160	bromoethane $H + BrCH_2CH_3 \rightarrow H_2 + BrC_2H_4$ (I) $H + BrCH_2CH_3 \rightarrow HBr + C_2H_5$ (II)	1	1.7 x 10^8 (rel.)	$k/k_{BzOH} = 0.17$	*e*−r.	esr	decay of spin polarization, compared with 2−PrOH(7D).	71−0003
		1	~ 5 x 10^6 (I) (rel.)	$k_I/k_{II} \cong 0.03$	γ−r.	chem.	~ 3% H abstr.	73−0053
2.161	2−bromoethanol							
	$H + BrCH_2CH_2OH \rightarrow HBr + CH_2CH_2OH$	1,9	2.7 x 10^8 (rel.)	$k/k_{2\text{-}PrOH} = 3.4$	γ−r.	chem.	c.k.	67−0050
	$D + BrCH_2CH_2OH \rightarrow HD + BrCHCH_2OH$	1,9	2.7 x 10^7 (rel.)	$k/k_{2\text{-}PrOH} = 0.34$	γ−r.	chem.	c.k. in D_2O.	67−0050
2.162	5−bromoorotic acid	1	2.1 x 10^8 (rel.)	$k/k_{BzOH} = 0.21$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	71−0040
2.163	*p*−bromophenol	—	4.9 x 10^9 (rel.)	$k/k_{ferri} = 0.7$	e.d.	condy.	obs. Br^- formn. and ferricyanide reduction (opt.)	71−9384
2.164	2−bromopropionate ion							
	$H + CH_3CHBrCOO^- \rightarrow HBr + CH_3CHCOO^-$	8.5	1.3 x 10^9 (rel.)	$k/k_{2\text{-}PrOH} = 17$	γ−r.	chem.	c.k.	67−0050
	$D + CH_3CHBrCOO^- \rightarrow HD + CH_3CBrCOO^-$	8.5	2.5 x 10^7 (rel.)	$k/k_{2\text{-}PrOH} = 0.32$	γ−r.	chem.	c.k. in D_2O.	67−0050
2.165	3−bromopropionate ion							
	$H + BrCH_2CH_2COO^- \rightarrow HBr + CH_2CH_2COO^-$	8.5	3 x 10^8 (rel.)	$k/k_{2\text{-}PrOH} = 3.8$	γ−r.	chem.	c.k.	67−0050
	$D + BrCH_2CH_2COO^- \rightarrow HD + BrCHCH_2COO^-$	8.5	1.1 x 10^7 (rel.)	$k/k_{2\text{-}PrOH} = 0.14$	γ−r.	chem.	c.k. in D_2O.	67−0050
2.166	2−bromopropionic acid							
	$H + CH_3CHBrCOOH \rightarrow HBr + CH_3CHCOOH$	1.0	1.5 x 10^9 (rel.)	$k/k_{2\text{-}PrOH} = 19$	γ−r.	chem.	c.k.	67−0050
	$D + CH_3CHBrCOOH \rightarrow HD + CH_3CBrCOOH$	1.0	6.3 x 10^6 (rel.)	$k/k_{2\text{-}PrOH} = 0.08$	γ−r.	chem.	c.k. in D_2O.	67−0050
2.167	3−bromopropionic acid							
	$H{+}CH_2BrCH_2COOH \rightarrow HBr + CH_2CH_2COOH$	1.0	2.7 x 10^8 (rel.)	$k/k_{2\text{-}PrOH} = 3.4$	γ−r.	chem.	c.k.	67−0050
	$D{+}CH_2BrCH_2COOH \rightarrow HD + CHBrCH_2COOH$	1.0	4.7 x 10^6 (rel.)	$k/k_{2\text{-}PrOH} = 0.06$	γ−r.	chem.	c.k. in D_2O.	67−0050
2.168	5−bromouracil	1	2.2 x 10^8 (rel.)	$k/k_{BzOH} = 0.22$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	71−0040
2.168a	butadiene	—	1 x 10^{10} (rel.)	$k/k_{MeOH} = 5 \times 10^3$	—	—	c.k.; no details given.	67−0041

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.169	butane	1	3.9×10^7 (rel.)	$k/k_{BzOH} = 3.9 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.170	1–butanol $H + CH_3(CH_2)_3OH \rightarrow H_2 + C_4H_8OH$	1	3.84×10^7 (rel.)	$k/k_{BzOH} = 3.84 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	3.7×10^7 (rel.)	$k/k_{BzOH} = 3.7 \times 10^{-2}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
2.171	2–butanol $H + C_2H_5CHOHCH_3 \rightarrow H_2 + C_4H_8OH$	1	1.3×10^8 (rel.)	$k/k_{BzOH} = 0.13$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	9.5×10^7 (rel.)	$k/k_{BzOH} = 9.5 \times 10^{-2}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
2.172	*tert*–butanol $H + (CH_3)_3COH \rightarrow H_2 + C_4H_8OH$	7	1.0×10^5 (rel.)	$k/k_{DCOO^-} = 4.4 \pm 0.7) \times 10^{-3}$	γ–r.	chem.	c.k.	63–0041, 64–0095
		1	8×10^4 (rel.)	$k/k_{BzOH} = 8 \times 10^{-5}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		2	1.7×10^5	—	p.r.	esr	decay of H signal; high concn.; *k* concn. dependent.	71–0303
2.173	1–butene $H + C_4H_8 \rightarrow C_4H_9$	—	5.4×10^9 (rel.)	$k/k_{MeOH} = 2.7 \times 10^3$	—	—	c.k., no details given.	67–0041
2.174	butyrate ion $H + CH_3CH_2CH_2COO^- \rightarrow H_2 + C_3H_6COO^-$	7	1.4×10^5 (rel.)	$k/k_{MeCDOHMe} = 1.4 \times 10^{-2}$	γ–r.	chem.	c.k.	66–0422
2.175	butyric acid $H + CH_3CH_2CH_2COOH \rightarrow H_2 + C_3H_6COOH$	1	8.6×10^6 (rel.)	$k/k_{BzOH} = 8.6 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	7.4×10^6 (rel.)	$k/k_{BzOH} = 7.4 \times 10^{-3}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
2.176	carbon disulfide $H + CS_2 \rightarrow H^+ + SCS^-$	1	2.0×10^{10}	—	p.r.	opt.	p.b.k. at 310 nm.	73–1015
2.177	carbon tetrachloride $H + CCl_4 \rightarrow H^+ + Cl^- + CCl_3$	1	4.8×10^7 (rel.)	$k/k_{BzOH} = 4.8 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		—	3.2×10^7	—	p.r.	condy.	p.b.k.	71–0778
2.178	chloroacetate ion $H + ClCH_2COO^- \rightarrow H_2 + Cl\dot{C}HCOO^-$ (I)	3–8	1.5×10^5 (rel.)	$k/k_H = 1.5 \times 10^{-5}$	e.d.	chem.	c.k.	62–9008
		12.7	3.3×10^6 (rel.)	$k_I/k_{OH^-} = 0.22$	e.d.	chem.	c.k.	62–9011
		~ 7	1.9×10^6 (rel.)	$k/k_{DCOO^-} = (8.4 \pm 1.2) \times 10^{-2}$	γ–r.	chem.	c.k.	63–0041, 64–0095
	$H + ClCH_2COO^- \rightarrow HCl + CH_2COO^-$ (II)	3–8		$k_{II}/k_I = 0.09$	e.d.	chem.	—	62–9008
			For other ratios see: 2.9, 2.55					

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.179	chloroacetic acid $H + ClCH_2COOH \rightarrow H_2 + CHClCOOH$ (I)	0.4–2	1.3×10^{4} (rel.)	$k/k_H = 1.3 \times 10^{-6}$	e.d.	chem.	c.k.	62–9008
		1		$k_{II}/k_I = 0.55$	γ–r.	chem.	—	61–0025
		< 2		$k_{II}/k_I = 0.5 \pm 0.1$	e.d.	chem.	—	62–9008
	$H + ClCH_2COOH \rightarrow HCl + CH_2COOH$ (II)	~ 0.4		$k_{II}/k_I = 0.61$	γ–r.	chem.	—	68–0525
2.180	*p*–chlorobenzoic acid $H + C_6H_4ClCOOH \rightarrow C_6H_5ClCOOH$	1	1.13×10^{9}	—	p.r.	opt.	p.b.k.; CD_3OH as OH scavenger.	69–0001
2.181	chloroethane	1	1.8×10^{6} (rel.)	$k/k_{BzOH} = 1.8 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.182	2–chloroethanol $H + ClCH_2CH_2OH \rightarrow HCl + CH_2CH_2OH$	—	2.4×10^{6} (rel.)	$k/k_{2\text{-}PrOH} = 3 \times 10^{-2}$	γ–r.	chem.	c.k.	67–0050
	$D + ClCH_2CH_2OH \rightarrow HD + CHClCH_2OH$	—	2.4×10^{7} (rel.)	$k/k_{2\text{-}PrOH} = 0.3$	γ–r.	chem.	c.k. in D_2O.	67–0050
2.183	chloroform $H + CHCl_3 \rightarrow HCl + CHCl_2$ (II)	~ 1	8.5×10^{5} (II) (rel.)	—	r.	chem.	c.k. in presence of Fe^{2+} assuming $k(OH + CHCl_3) = 7.4 \times 10^{6}$.	62–0012, 66–9002
		1	1.2×10^{7} (rel.)	$k/k_{BzOH} = 1.2 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
	$H + CHCl_3 \rightarrow H_2 + CCl_3$ (I)	1	2.4×10^{6} (I) (rel.)	$k_I/k_{II} = 0.25$	γ–r.	chem.	20% H abstr.	73–0053
2.184	chloromethane $H + CH_3Cl \rightarrow H_2 + CH_2Cl$ (I)	1	7×10^{4} (rel.)	$k/k_{BzOH} = 7 \times 10^{-5}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
	$H + CH_3Cl \rightarrow$ no H_2 (II)	1	3×10^{4} (I) (rel.)	$k_I/k_{II} = 0.59$	γ–r.	chem.	37% H abstr.	73–0053
2.185	2–chloropropionate ion $H + CH_3CHClCO_2^- \rightarrow HCl + CH_3CHCO_2^-$	8.5	1.9×10^{7} (rel.)	$k/k_{2\text{-}PrOH} = 0.24$	γ–r.	chem.	c.k.	67–0050
	$D + CH_3CHClCO_2^- \rightarrow HD + CH_3CClCO_2^-$	8.5	4.7×10^{6} (rel.)	$k/k_{2\text{-}PrOH} = 6 \times 10^{-2}$	γ–r.	chem.	c.k. in D_2O.	67–0050
2.186	3–chloropropionate ion $H + CH_2ClCH_2CO_2^- \rightarrow HCl + CH_2CH_2CO_2^-$	8.5	9.1×10^{7} (rel.)	$k/k_{2\text{-}PrOH} = 1.2$	γ–r.	chem.	c.k.	67–0050
	$D + CH_2ClCH_2CO_2^- \rightarrow HD + CHClCH_2CO_2^-$	8.5	2.4×10^{7} (rel.)	$k/k_{2\text{-}PrOH} = 0.3$	γ–r.	chem.	c.k. in D_2O.	67–0050
2.187	2–chloropropionic acid $H + CH_3CHClCOOH \rightarrow HCl + CH_3CHCOOH$	1.0	5×10^{6} (rel.)	$k/k_{2\text{-}PrOH} = 6.4 \times 10^{-2}$	γ–r.	chem.	c.k.	67–0050
	$D + CH_3CHClCOOH \rightarrow HD + CH_3CClCOOH$	1.0	4×10^{6} (rel.)	$k/k_{2\text{-}PrOH} = 5 \times 10^{-2}$	γ–r.	chem.	c.k. in D_2O.	67–0050

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.188	3-chloropropionic acid $H+CH_2ClCH_2COOH \rightarrow HCl + CH_2CH_2COOH$	1.0	3×10^7 (rel.)	$k/k_{2\text{-PrOH}} = 0.38$	γ-r.	chem.	c.k.	67-0050
	$D+CH_2ClCH_2COOH \rightarrow HD + CHClCH_2COOH$	1.0	1.6×10^7 (rel.)	$k/k_{2\text{-PrOH}} = 0.2$	γ-r.	chem.	c.k. in D_2O.	67-0050
2.189	chlorotrifluoromethane	1	$< 10^6$ (rel.)	$k/k_{\mathrm{BzOH}} < 10^{-3}$	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D).	71-0003
2.190	5-chlorouracil	1	1.6×10^8 (rel.)	$k/k_{\mathrm{BzOH}} = 0.16$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
		7	2.2×10^8 (rel.)	$k/k_{\mathrm{BzOH}} = 0.22$	γ-r.	chem.	c.k. with 2-PrOH(7D).	72-0049
2.191	citric acid	1	4.3×10^5 (rel.)	$k/k_{\mathrm{BzOH}} = 4.3 \times 10^{-4}$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.192	cyanoacetic acid $H + NCCH_2COOH \rightarrow H_2 + NCCHCOOH$ (I)	1	3.2×10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 3.2 \times 10^{-3}$	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D).	71-0003
	$H + NCCH_2COOH \rightarrow HNCCH_2COOH$ (II)	1	4×10^5 (I) (rel.)	$k_I/k_{II} = 0.14$	γ-r.	chem.	12% H abstr.	73-0053
2.193	cyclobutanecarboxylic acid	1	1.3×10^7 (rel.)	—	*e*-r.	esr	unpubl. data, P. Neta and R.H. Schuler.	73-0053
	$H + C_4H_7COOH \rightarrow H_2 + C_4H_6COOH$(I) $H + C_4H_7COOH \rightarrow C_4H_8COOH$ (II)	1	9.2×10^6 (I) (rel.)	$k_I/k_{II} = 2.4$	γ-r.	chem.	71% H abstr.	73-0053
2.194	cycloheptatriene	—	8.4×10^9 (rel.)	$k/k_{\mathrm{ferri}} = 1.2$	p.r.	opt.	c.k.	71-0710
2.195	1,3-cyclohexadiene	2.0	$(9.8 \pm 2.0) \times 10^9$ (rel.)	$k/k_{\mathrm{PNBA}} = 9.8 \pm 2.0$	p.r.	opt.	c.k., p.b.k. at 400 nm.	70-0211
2.196	1,4-cyclohexadiene	2.0	$(4.7 \pm 1.0) \times 10^9$ (rel.)	$k/k_{\mathrm{PNBA}} = 4.7 \pm 1.0$	p.r.	opt.	c.k., p.b.k. at 400 nm.	70-0211
2.197	cyclohexane	—		$k/k_{\mathrm{Cu^{2+}}} = 1.2$	γ-r.	chem	c.k.	66-0810
	$H + C_6H_{12} \rightarrow H_2 + C_6H_{11}$	1	3×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 0.03$	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D).	71-0003
2.198	cyclohexene	2.0	$(3.0 \pm 0.6) \times 10^9$ (rel.)	$k/k_{\mathrm{PNBA}} = 3.0 \pm 0.6$	p.r.	opt.	c.k., p.b.k. at 400 nm.	70-0211
2.199	*cis*-4-cyclohexene-1,2-dicarboxylic acid	1	1.0×10^9 (rel.)	—	*e*-r.	esr	unpubl. data, P. Neta and R.H. Schuler.	73-0053
	$H + C_6H_8(COOH)_2 \rightarrow H_2 + C_6H_7(COOH)_2$ (I) $H + C_6H_8(COOH)_2 \rightarrow$ no H_2 (II)	1	8×10^7 (I) (rel.)	$k_I/k_{II} \cong 0.08$	γ-r.	chem.	8% H abstr.	73-0053
2.200	cyclopentane	1	3×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 0.03$	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D).	71-0003
2.201	1-cyclopentanecarboxylic acid	1	1.5×10^9 (rel.)	—	*e*-r.	esr	Unpubl. data, P. Neta and R.H. Schuler.	73-0053
	$H + C_5H_9COOH \rightarrow H_2 + C_5H_8COOH$(I) $H + C_5H_9COOH \rightarrow$ no H_2 (II)	1	1.4×10^8 (I) (rel.)	$k_I/k_{II} \cong 0.09$	γ-r.	chem.	9% H abstr.	73-0053

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.202	cyclopropane	1	7×10^5 (rel.)	$k/k_{BzOH} = 7 \times 10^{-4}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.203	cyclopropane–carboxylic acid	1	5.3×10^6 (rel.)	—	*e*–r.	esr	Unpubl. data P. Neta and R.H. Schuler.	73–0053
	$H + C_3H_5COOH \rightarrow H_2 + C_3H_4COOH$ (I)	1	4×10^4 (I) (rel.)	$k_I/k_{II} \cong 0.08$	γ–r.	chem.	8% H abstr.	73–0053
	$H + C_3H_5COOH \rightarrow$ no H_2 (II)							
2.204	cysteamine	2	3.0×10^9	—	p.r.	esr	decay of H signal.	71–0303
	$H + HSCH_2CH_2NH_3^+ \rightarrow H_2$ (I)	1	7.0×10^8 (rel.) (I + II)	—	γ–r.	chem.	c.k. assuming *k*(H + allyl alc.) = 2.8×10^9.	73–0241
	$H + HSCH_2CH_2NH_3^+ \rightarrow H_2S$ (II)		4.9×10^8 (I) (rel.) 2.1×10^8 (II) (rel.)	$k_I/k_{II} = 2.3 \pm 0.2$				
2.205	cysteine (positive ion)	0.72		$k_I/k_{II} = 1.5$	γ–r.	chem.	c.k.	64–0151
	$HSCH_2CH(NH_3^+)COOH + H \rightarrow H_2$ (I)	1	2.5×10^9 (rel.) (I)	—	—	—	c.k. *with* cystine; cystine formn.	66–0402
	$HSCH_2CH(NH_3^+)COOH + H \rightarrow H_2S$ (II)	0		$k_I/k_{II} = 3.5$	γ–r.	chem.	based on yields of H_2, H_2S and cystine; ratio at 1°C = 8.6.	67–0148
		1	4×10^9 (rel.) (I)	$k_I/k_{oxy} = 1.95 \times 10^{-1}$	γ–r.	chem.	c.k.	68–0540
		1		$k_I/k_{II} = 3.66$	γ–r.	chem.	c.k.; $k_I/k_{oxy} = 5.4 \times 10^{-2}$.	68–0540
		1	4×10^9 (rel.)	$k/k_{BzOH} = 4$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
		2	3.0×10^9	—	p.r.	esr	decay of H signal.	71–0303
		1	2.7×10^9 (I) (rel.)	$k_I/k_{II} = 2.1$	γ–r.	chem.	68% H abstr.	73–0053
		1	1.5×10^9 (rel.) (I + II) 1.3×10^9 (I) (rel.) 2.5×10^8 (II) (rel.)	— $k_I/k_{II} = 5.2 \pm 0.7$	γ–r.	chem.	c.k. assuming *k*(H + allyl alc.) = 2.8×10^9.	73–0241
2.206	cysteine (zwitterion)							
	$HSCH_2CH(NH_3^+)CO_2^- + H \rightarrow H_2$ (I)	6	$(1.0 \pm 0.08) \times 10^9$ (I)	—	e.d.	chem.	d.k. for –SH groups at ~ 5°C.	64–9012
	$HSCH_2CH(NH_3^+)CO_2^- + H \rightarrow H_2S$ (II)	6	$(1.1 - 1.4) \times 10^8$ (II)	—	e.d.	chem.	p.b.k. for H_2S at ~ 5°C.	64–9012
	$HSCH_2CH(NH_3^+)CO_2^- + D \rightarrow HD$ (III)	6	$< 5 \times 10^7$ (III)	—	—	—	in D_2O; H abstr. from C–H.	66–0402
2.207	cystine	6	1.5×10^9	—	e.d.	chem.	p.b.k. for H_2S or –SH groups at ~ 5°C.	64–9012
		1	7.9×10^9 (rel.)	$k/k_{2\text{-}PrOH} = 100$	γ–r.	chem.	c.k.	66–0402
		1	2.15×10^9 (rel.)	$k/k_{HCOOH} = 2870$	γ–r.	chem.	c.k.	68–0343
		1	8×10^9 (rel.)	$k/k_{BzOH} = 8$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.208	cytochrome–C	~ 7	7.5×10^9 (rel.)	$k/k_{HCOO^-} = 50$	X–r.	chem.	c.k.	62–3002
	H + ferri–cytC → ferro–cytC + H^+	—	1.5×10^{10}	—	p.r.	opt.	p.b.k. at 550 nm (ferro–cytC); H_2–satd.	71–0930, 72–1002
	H + ferri–cyt C → H adduct	2.5, 6.5	1×10^{10} (rel.)	—	p.r.	opt.	p.b.k. (290–325 nm); *tert*–BuOH as OH *scavenger*.	71–3087
2.209	cytosine	1	9×10^7 (rel.)	$k/k_{BzOH} = 0.09$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		7	$(1.0 - 1.5) \times 10^8$ (rel.)	$k/k_{BzOH} = 0.1 - 0.15$	e–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.210	2–deoxy–D–ribose H + $C_5H_{10}O_4 \rightarrow H_2 + C_5H_9O_4$	7	2.3×10^7 (rel.)	$k/k_{DCOO^-} = 1.0 \pm 0.1$	γ–r.	chem.	c.k.	64–0095
2.211	dichlorodifluoro–methane	1	$< 10^6$ (rel.)	$k/k_{BzOH} < 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.212	dichloromethane H + $CH_2Cl_2 \rightarrow H_2 + CHCl_2$ (I)	1	4×10^6 (rel.)	$k/k_{BzOH} = 4 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
	H + $CH_2Cl_2 \rightarrow$ no H_2 (II)	1	1.1×10^6 (I) (rel.)	$k_I/k_{II} = 0.37$	γ–r.	chem.	27% H abstr.	73–0053
2.213	*o*–dicyanobenzene	1	5.5×10^8 (rel.)	$k/k_{BzOH} = 0.55$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.214	*m*–dicyanobenzene	1	5.2×10^8 (rel.)	$k/k_{BzOH} = 0.52$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.215	*p*–dicyanobenzene	1	2.8×10^8 (rel.)	$k/k_{BzOH} = 0.28$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
		2	$(3.5 \pm 0.4) \times 10^8$	—	p.r.	opt.	p.b.k. at 320 nm.	73–0121
2.216	2,3–dihydroxy–fumaric acid H + $(COHCOOH)_2 \rightarrow H_2$ + HOOCCOCOHCOOH (I)	1	9×10^7 (rel.)	$k/k_{BzOH} = 0.09$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
	H + $(COHCOOH)_2 \rightarrow$ no H_2 (II)	1	1.4×10^6 (I) (rel.)	$k_I/k_{II} = 0.19$	γ–r.	chem.	16% H abstr.	73–0053
2.217	5,6–dihydrothymine	7–8	2.3×10^8 (rel.)	$k/k_{DCOO^-} = 10$	γ–r.	chem.	c.k.	68–3038
2.217a	dimethyl fumarate	0.7	9.0×10^9	—	p.r.	opt.	p.b.k.	73–0097
2.218	dioxane H + $C_4H_8O_2 \rightarrow H_2 + C_4H_7O_2$	—	6.2×10^6 (rel.)	$k/k_{MeCDOHMe} = 6.2 \times 10^{-1}$	γ–r.	chem.	c.k.	66–0422
		—	1.3×10^7 (rel.)	$k/k_{Ag^+} = 4.18 \times 10^{-4}$	p.r.	opt.	c.k.; p.b.k. at ~ 310 nm (Ag_2^+)	67–0550, 68–0436
		1	1.3×10^7 (rel.)	$k/k_{BzOH} = 1.3 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
			For other ratios see:	2.110, 2.131, 2.151, 2.364				

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3mol^{-1}s^{-1})$	Ratio	Source	Method	*Comment*	*Ref.*
2.219	dithiodiglycolic acid	1	1×10^{10} (rel.)	$k/k_{BzOH} = 10$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	71−0040
		1	—	—	γ−r.	chem.	no H abstr.	73−0053
2.220	DNA	7−8	8×10^{11} (rel.)	—	γ−r.	chem.	c.k. with $DCOO^-$; mol. wt. = 5×10^6; $k = 5 \times 10^7$ per base unit.	68−3038
2.221	dodecyl sodium sulfate	—	1.1×10^8 (rel.)	$k/k_{2-PrOH(7D)} = 11$	γ−r.	chem.	c.k.	71−0586
2.222	erythrosin *See* tetraiodofluorescein							
2.223	ethane	1	2.5×10^6 (rel.)	$k/k_{BzOH} = 2.5 \times 10^{-3}$	*e*−r.	esr	decay of spin polarization, compared with 2−PrOH(7D).	71−0003
2.224	ethanol (EtOH) $H + C_2H_5OH \rightarrow H_2 + C_2H_4OH$	1.0	2.0×10^7 (rel.)	$k/k_{HCOOH} = 14$	γ−r.	chem.	c.k.	56−0012
		1−3	2.8×10^7 (rel.)	$k/k_{ferri} = 4 \times 10^{-3}$	X−r.	chem.	c.k.	62−0022, 62−0033
		1.2	4.2×10^7 (rel.)	$k/k_{ferri} = 6 \times 10^{-3}$	X−r.	chem.	c.k.	62−0087
		~ 6	1.5×10^7 (rel.)	$k/k_{DCOO^-} = (6.6 \pm 1.0) \times 10^{-1}$	γ−r.	chem.	c.k.	63−0041, 64−0095
		—	1.3×10^8 (rel.)	$k/k_{Ag^+} = 4.3 \times 10^{-3}$	γ−r.	chem.	c.k.	65−0192
		~ 7	3.9×10^7 (rel.)	$k/k_{ferri} = 5.5 \times 10^{-3}$	γ−r.	chem.	c.k.	65−0192
		1.1	2.4×10^7 (rel.)	$k/k_{ferri} = 3.45 \times 10^{-3}$	γ−r.	chem.	c.k.	65−0192
		1	3.8×10^7 (rel.)	$k/k_{oxy} = 1.9 \times 10^{-3}$	γ−r.	chem.	c.k.	66−0010
		—	1.7×10^7 (rel.)	$k/k_{MeOH} = 8.4$	γ−r.	chem.	c.k., no details given.	67−0041
		~ 7	2.5×10^7 (rel.)	$k/k_{perox} = 0.41$	γ−r.	chem.	c.k.	67−0094
		~ 7	5×10^7 (rel.)	$k/k_{oxy} = 2.5 \times 10^{-3}$	γ−r.	chem.	c.k.	67−0094
		1.69	4.4×10^7 (rel.)	$k/k_{oxy} = 2.2 \times 10^{-3}$	γ−r.	chem.	c.k.	67−0094
		—	3.7×10^7 (rel.)	$k/k_{Ag^+} = 12.0 \times 10^{-4}$	p.r.	opt.	c.k.; p.b.k. at 313 nm (Ag_2^+).	67−0550, 68−0436
		~0.4	4.6×10^7 (rel.)	$k/k_{oxy} = 2.3 \times 10^{-3}$	γ−r.	chem.	c.k.	68−0525
		>13	~ 2×10^7 (rel.)	—	γ−r.	chem.	c.k. with OH^-	69−0051
		1	2.6×10^7 (rel.)	$k/k_{BzOH} = 2.6 \times 10^{-2}$	*e*−r.	esr	decay of spin polarization, compared with 2−PrOH(7D).	71−0003
		1	2.5×10^7 (rel.)	$k/k_{BzOH} = 2.5 \times 10^{-2}$	γ−r.	chem.	c.k. with 2−PrOH(7D).	71−0017
		1	1.3×10^7	—	p.r.	esr	decay of H signal.	71−0303
			For other ratios see: 2.19, 2.21, 2.22, 2.23, 2.25−38, 2.52−54, 2.70, 2.80, 2.81, 2.84, 2.85, 2.86, 2.88, 2.103, 2.152, 2.226, 2.243, 2.310−12, 2.315, 2.316, 2.350, 2.352.					
	$D + C_2H_5OH \rightarrow HD + C_2H_4OH$	2	2.4×10^7	—	p.r.	esr	decay of H signal.	71−0303
2.225	ethanol-d_2 $H + CH_3CD_2OH \rightarrow HD + CH_3CDOH$	1.2	2.9×10^6 (rel.)	$k/k_{ferri} = 9.5 \times 10^{-4}$	X−r.	chem.	c.k.	62−0087
2.226	ethoxide ion $H + C_2H_5O^- \rightarrow C_2H_4O^- + H_2$	> 13	3.7×10^9 (rel.)	$k/k_{EtOH} = 144$	γ−r.	chem.	c.k. with OH^-.	69−0051

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.227	ethyl acetate $H + CH_3COOC_2H_5 \rightarrow H_2 + CH_3CO_2C_2H_4$	1.0	4.2 x 10^5 (rel.)	$k/k_{\mathrm{HCOOH}} = 0.56$	X–r.	chem.	c.k.	56–0012
2.228	ethyl acetoacetate $H + MeCOCH_2COOEt \rightarrow H_2 + MeCOCHCOOEt$	1	1.3 x 10^7 (rel.)	—	*e*–r.	esr	unpubl. data, P. Neta and R.H. Schuler.	73–0053
	$+MeC(OH)=CCOOEt$ (I) $H + MeCOCH_2COOEt \rightarrow$ no H_2 (II)	1	2.9 x 10^6 (I) (rel.)	$k_{\mathrm{I}}/k_{\mathrm{II}} = 0.27$	γ–r.	chem.	22% H abstr.; 8% enol formn.	73–0053
2.229	ethylene	—	3.2 x 10^9 (rel.)	$k/k_{\mathrm{MeOH}} = 1600$	—	—	c.k. no details.	67–0041
	$H + CH_2{=}CH_2 \rightarrow C_2H_5$	1	6.6 x 10^8 (rel.)	$k/k_{\mathrm{oxy}} = 3.3 \times 10^{-2}$	γ–r.	chem.	c.k.	68–0052
		1	3 x 10^9 (rel.)	$k/k_{\mathrm{BzOH}} = 3$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.230	ethylenediamine–tetraacetic acid	1	6.5 x 10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 6.5 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.231	ethyleneglycol $H + HOCH_2CH_2OH \rightarrow HOCHCH_2OH + H_2$	~ 7	1.0 x 10^7 (rel.)	$k/k_{\mathrm{DCOO^-}} = (4.3 \pm 0.5) \times 10^{-1}$	γ–r.	chem.	c.k.	63–0041, 64–0095
		—	8.2 x 10^6 (rel.)	$k/k_{\mathrm{MeCDOHMe}} = 8.2 \times 10^{-1}$	γ–r.	chem.	c.k.	66–0422
		—	2.1 x 10^7 (rel.)	$k/k_{\mathrm{Ag^+}} = 6.9 \times 10^{-4}$	p.r.	opt.	c.k.; p.b.k. at 313 nm (Ag_2^+).	67–0550, 68–0436
		1	1.7 x 10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 1.7 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	2.1 x 10^7 (rel.)	$k/k_{\mathrm{Ag^+}} = 6.7 \times 10^{-4}$	p.r.	opt.	c.k.; obs. Ag at 410 nm; contains *tert*–BuOH; *k* increases with pressure 0 → 6.72 kbar.	73–1053
2.232	ethyl ether	1	4.7 x 10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 4.7 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.233	ethyl dihydrogen phosphate $H + C_2H_5OPO(OH)_2 \rightarrow H_2 + CH_3CHOPO(OH)_2$	1.3	2.1 x 10^6 (rel.)	$k/k_{\mathrm{MeOH(3D)}} = 21$	phot.	chem.	c.k.	65–7019
2.233a	*N*–ethylmaleamic acid	1.0	$(1.3 \pm 0.2) \times 10^9$	—	p.r.	opt.	p.b.k.	72–0144
2.234	*N*–ethylmaleimide	1.0	$(1.4 \pm 0.2) \times 10^{10}$	—	p.r.	opt.	p.b.k.	72–0144
2.235	fluorenone	1.0	$(5.4 \pm 0.6) \times 10^9$	—	p.r.	opt.	p.b.k. (H adduct); *tert*–BuOH as OH scavenger.	72–0171
2.236	fluoroacetate ion							
	$H + FCH_2CO_2^- \rightarrow H_2 + FCHCO_2^-$	8.5	5 x 10^5 (rel.)	$k/k_{\mathrm{MeOH(3D)}} = 5$	γ–r.	chem.	c.k.	67–0050
	$H + FCH_2CO_2^- \rightarrow HF + CH_2CO_2^-$	8.5	< 10^3 (rel.)	—	γ–r.	chem.	practically no F^- formed.	67–0050

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3 mol^{-1} s^{-1})$	Ratio	Source	Method	Comment	Ref.
2.237	5-fluorouracil	1	1.8×10^8 (rel.)	$k/k_{BzOH} = 0.18$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.238	formaldehyde	1.0	3.5×10^6 (rel.)	$k/k_{HCOOH} = 4.7$	X-r.	chem.	c.k.	56-0012
	$H + HCHO \rightarrow H_2 + CHO$ (I)	1	5×10^6 (rel.)	—	*e*-r.	esr	unpubl. data, P. Neta and R.H. Schuler.	73-0053
	$H + HCHO \rightarrow$ no H_2 (II)	1	4×10^6 (I) (rel.)	$k_I/k_{II} = 5$	γ-r.	chem.	83% H abstr.	73-0053
			For other ratios see:	2.12				
2.239	formate ion $H + HCO_2^- \rightarrow H_2 + CO_2^-$	7.6	3.9×10^8 (rel.)	$k/k_{ferri} = 5.5 \times 10^{-2}$	X-r.	chem.	c.k.	62-0017, 62-0024
		7	4.5×10^8 (rel.)	$k/k_{ferri} = 6.4 \times 10^{-2}$	X-r.	chem.	c.k.	62-0022, 62-0024
		11-13	1.7×10^8 *(rel.)*	$k/k_{OH^-} = 11$	X-r.	chem.	c.k.	*63-0049*
		5.7-7.1		$k/k_{nitrate} = 50$	γ-r.	chem.	c.k.	66-0147
		7	3×10^8 *(rel.)*	$k/k_{ferri} = 0.044$	X-r.	*chem.*	*c.k.*	*67-0064*
		7-13.5	1.8×10^8 (rel.)	$k/k_{OH^-} = 12$	X-r.	chem.	c.k.	67-0064
		7	1.3×10^8 (rel.)	$k/k_{BzOH} = 0.13$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	72-0039
			For other ratios see:	2.10a, 2.52, 2.54, 2.69, 2.70, 2.72, 2.85, 2.86, 2.87, 2.90, 2.93c, 2.114, 2.208, 2.240.				
2.240	*d*-formate ion $H + DCOO^- \rightarrow HD + CO_2^-$	—	2.3×10^7 (rel.)	$k/k_{HCOO^-} = 1.51 \times 10^{-1}$	γ-r.	chem.	c.k.	63-0041, 64-0095
		6	2.3×10^7 (rel.)	$k/k_{HCOO^-} = 1.53 \times 10^{-1}$	γ-r.	chem.	c.k.	64-0141
			For other ratios see:	2.78, 2.107, 2.110, 2.119-2.121, 2.172, 2.178, 2.210, 2.217, 2.224, 2.231, 2.257, 2.296, 2.334, 2.372-4.				
2.241	formic acid $H + HCOOH \rightarrow H_2 + COOH$	~ 1	2.1×10^6 (rel.)	$k/k_{ferri} = 3 \times 10^{-4}$	X-r.	chem.	c.k.	62-0022, 62-0033
		~ 2	7×10^6 (rel.)	$k/k_{ferri} = \sim 10^{-3}$	X-r.	chem.	c.k.	62-0033
		~ 3	7×10^7 (rel.)	$k/k_{ferri} = \sim 10^{-2}$	X-r.	chem.	c.k.	62-0033
		0.4	3.4×10^5 (rel.)	$k/k_H = 3.4 \times 10^{-5}$	p.r.	chem.	at dose rate $< 10^{19}$ eV/g·s.	*62-0144*
		1	7.4×10^5	$k/k_{BzOH} = 7.4 \times 10^{-4}$ (obs.)	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D); *cor.* for 40% formate ion.	71-0003, 72-0039
		1	—	—	γ-r.	chem.	100% H abstr.	73-0053
			For other ratios see:	2.54, 2.86, 2.109, 2.110, 2.124, 2.152, 2.207, 2.224, 2.227, 2.238, 2.242, 2.296, 2.298a, 2.324, 2.356, 2.382, 2.384.				
2.242	*d*-formic acid $H + DCOOH \rightarrow HD + COOH$	1	1.1×10^5 (rel.)	$k/k_{HCOOH} = 0.15$	X-r.	chem.	c.k.	56-0012
2.243	fumarate ion, hydrogen	—	4×10^9 (rel.)	$k/k_{EtOH} \cong 150$	γ-r.	chem.	c.k.; reactivity of the dianion is similar.	66-0010
2.244	fumaric acid	1	9×10^8 (rel.)	$k/k_{BzOH} = 0.9$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
		0.7	7.0×10^9	—	p.r.	opt.	p.b.k.	73-0097

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.245	glucose $H + C_6H_{12}O_6 \rightarrow H_2 + C_6H_{11}O_6$	1.2	7 x 10^7 (rel.)	$k/k_{ferri} \cong 10^{-2}$	X–r.	chem.	c.k.	62–0017
		~ 8	3 x 10^7 (rel.)	$k/k_{nitrite} \cong 4$ x 10^{-2}	X–r.	chem.	c.k.	62–0017
		7	8 x 10^7 (rel.)	$k/k_{ferri} \cong 1.2$ x 10^{-2}	X–r.	chem.	c.k.	62–0024
		~0.4	1 x 10^8 (rel.)	$k/k_{oxy} = 5$ x 10^{-3}	γ–r.	chem.	c.k.; ratio at 6.34 kbar.	68–0525
		1	4.7 x 10^7 (rel.)	$k/k_{BzOH} = 4.7$ x 10^{-2}	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
			For other ratios see:	2.74, 2.124, 2.153, 2.159.				
2.246	glutamate ion	7	5.6 x 10^6 (rel.)	$k/k_{BzOH} = 5.6$ x 10^{-3}	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.247	L–glutamic acid	1	1 x 10^6 (rel.)	—	γ–r.	chem.	c.k. assuming k(H + allyl alc.) = 2.8 x 10^9.	68–0343
		1	1.7 x 10^6 (rel.)	$k/k_{BzOH} = 1.7$ x 10^{-3}	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.248	glutathione (red.) H + GuSH → H_2 + GuS (I) H + GuSH → H_2S + Gu (II)	0		$k_I/k_{II} = 2.8 \pm 0.4$	γ–r.	chem.	c.k.	69–0022
2.248a	glutathione (oxid.) H + $(GuS)_2$ → GuS + GuSH or $(GuS)_2H$ (?)	1.5–2.5	(1.0 ± 0.2) x 10^{10}	—	p.r.	opt.	p.b.k.	72–0380
2:249	glycerol $H + C_3H_8O_3 \rightarrow H_2 + C_3H_7O_3$	1.2	3.5 x 10^7 (rel.)	$k/k_{ferri} = 5$ x 10^{-3}	X–r.	chem.	c.k.	62–0017
		~ 8	2.1 x 10^7 (rel.)	$k/k_{nitrite} = 3$ x 10^{-2}	X–r.	chem.	c.k.	62–0017
		7	5.4 x 10^7 (rel.)	$k/k_{ferri} = 7.7$ x 10^{-3}	X–r.	chem.	c.k.	62–0024
		2	4.1 x 10^7 (rel.)	$k/k_{Ag^+} = 13.2$ x 10^{-4}	p.r.	opt.	c.k.; p.b.k. at 313 nm (Ag_2^+)	67–0550, 68–0436
		~0.4	5.6 x 10^7 (rel.)	$k/k_{oxy} = 2.8$ x 10^{-3}	γ–r.	chem.	c.k.	68–0525
		1	3.6 x 10^7 (rel.)	$k/k_{BzOH} = 3.6$ x 10^{-2}	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		1	4.1 x 10^7 (rel.)	$k/k_{Ag^+} = 1.34$ x 10^{-3}	p.r.	opt.	c.k.; obs. Ag at 410 nm; contains *tert*–BuOH; k increases 0 → 6.72 kbar.	73–1053
2.250	glycine, positive ion	2	4.8 x 10^7 (rel.)	$k/k_{Ag^+} = 15.5$ x 10^{-4}	p.r.	opt.	c.k.; p.b.k. at 313 nm (Ag_2^+).	67–0550, 68–0436
		1	8 x 10^4 (rel.)	$k/k_{BzOH} = 8$ x 10^{-5}	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		(Unexplained discrepancy in the above data).						

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.251	glycine, zwitterion	7	9×10^4 (rel.)	$k/k_{BzOH} = 9 \times 10^{-5}$	e–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.252	glycolate ion	7	4.0×10^7 (rel.)	$k/k_{BzOH} = 4.0 \times 10^{-2}$	e–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.253	glycolic acid $H + CH_2OHCOOH \rightarrow H_2 + CHOHCOOH$ (I)	1	1.8×10^7 (rel.)	$k/k_{BzOH} = 1.8 \times 10^{-2}$	e–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
	$H + CH_2OHCOOH \rightarrow$ no H_2 (II)	1	1.7×10^7 (I) (rel.)	$k_I/k_{II} = 24$	γ–r.	chem.	96% H abstr.	73–0053
2.254	glycylglycine	1	2.6×10^6 (rel.)	$k/k_{BzOH} = 2.6 \times 10^{-3}$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.255	glycylglycylglycine	1	5.5×10^6 (rel.)	$k/k_{BzOH} = 5.5 \times 10^{-3}$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.256	glyoxal	1.3		$k/k_{Cu^{2+}} = 0.57$	r.	chem.	c.k.	68–0503
	$H + CHOCHO \rightarrow H_2 + COCHO$	1	—	—	γ–r.	chem.	80% H abstr.	73–0053
2.257	glyoxylate ion $H + CHOCO_2^- \rightarrow H_2 + COCO_2^-$	7	3.7×10^7 (rel.)	$k/k_{DCOO^-} = 1.6 \pm 1$	γ–r.	chem.	c.k.	63–0041, 64–0095
2.258	glyoxylic acid $H + CHOCOOH \rightarrow H_2 + COCOOH$	1	2×10^7 (rel.)	—	γ–r.	chem.	est. from $G(H_2)$ at different dose rates and concn.; assume $k_H = 8 \times 10^9$.	71–0925
		1	2.4×10^7 (rel.)	—	e–r.	esr	Unpubl. data, P. Neta and R.H. Schuler.	73–0053
		1	2.4×10^7 (rel.)	—	γ–r.	chem.	100% H abstr.	73–0053
2.259	guanidine	1	1.3×10^6 (rel.)	$k/k_{BzOH} = 1.3 \times 10^{-3}$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.260	hexadecyltrimethyl ammonium bromide	—	1.5×10^8 (rel.)	$k/k_{2-PrOH(7D)} = 15.2$	γ–r.	chem.	c.k.	71–0586
2.261	hexamethyleneimine	1	1.5×10^7 (rel.)	$k/k_{BzOH} = 1.5 \times 10^{-2}$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.262	hexane	1	1.5×10^8 (rel.)	$k/k_{BzOH} = 0.15$	e–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.263	1,6–hexanediamine	1	4.7×10^6 (rel.)	$k/k_{BzOH} = 4.7 \times 10^{-3}$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.264	hexanoate ion	7	5.3×10^7 (rel.)	$k/k_{BzOH} = 5.3 \times 10^{-2}$	e–r.	esr	decay of spin polarization, compared with EtOH.	72–0039

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.265	hexanoic acid	1	4.6 x 10^{7} (rel.)	$k/k_{\mathrm{BzOH}} = 4.6 \times 10^{-2}$	*e*−r.	esr	decay of spin polarization, compared with 2−PrOH(7D).	71−0003
2.266	hexanol	1	1.04 x 10^{8} (rel.)	$k/k_{\mathrm{BzOH}} = 0.104$	*e*−r.	esr	decay of spin polarization, compared with 2−PrOH(7D).	71−0003
		7	1.0 x 10^{8} (rel.)	$k/k_{\mathrm{BzOH}} = 0.1$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	72−0039
2.267	1−hexylammonium ion	1,7	3.5 x 10^{7} (rel.)	$k/k_{\mathrm{BzOH}} = 3.5 \times 10^{-2}$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	72−0040, 72−0039
2.268	hippuric acid	1	1.0 x 10^{9} (rel.)	$k/k_{\mathrm{BzOH}} = 1$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	71−0040
2.269	L−histidine, positive ion $H + ImCH_2CH(NH_3^+)COOH \rightarrow ImCH_2C(NH_3^+)COOH + H_2$ (I)	1	4.8 x 10^{7} (rel.)	$k/k_{\mathrm{BzOH}} = 4.8 \times 10^{-2}$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	71−0040
	$H + ImCH_2CH(NH_3^+)COOH \rightarrow$ no H_2(II)	3	5.1 x 10^{7} (rel.)	$k/k_{\mathrm{BzOH}} = 5.1 \times 10^{-2}$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	72−0039
	Im = imadazolyl	1	~ 1.5 x 10^{6} (I) (rel.)	$k_{\mathrm{I}}/k_{\mathrm{II}} \cong 0.03$	γ−r.	chem.	~ 3 % H abstr.	73−0053
2.269a	histidine, zwitterion	7	2.5 x 10^{8} (rel.)	$k/k_{\mathrm{BzOH}} = 0.25$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	72−0039
2.270	*p*−hydroxybenzoic acid	1	1.45 x 10^{9}	—	p.r.	opt.	p.b.k.; CD_3OH as OH scavenger	69−0001
	$H + HOC_6H_4COOH \rightarrow HOC_6H_5COOH$	—	1.8 x 10^{9} (rel.)	$k/k_{\mathrm{MeOH}} = 900$	p.r.	opt.	c.k.; p.b.k.	69−0001
2.270a	*p*−hydroxyphenyl−propionate ion	9.0	(4.0 ± 1.0) x 10^{9}	—	p.r.	opt.	p.b.k.	73−0003
2.271	*p*−hydroxyphenyl−propionic acid $HOC_6H_4CH_2CH_2COOH + H \rightarrow$ adduct	2.0−2.3	1.6 x 10^{9} (rel.)	$k/k_{\mathrm{oxy}} = 7.9 \times 10^{-2}$	p.r.	opt.	c.k.; p.b.k. at 320 and 330 nm (H adduct).	69−0445
2.272	L−hydroxyproline	1	1.6 x 10^{6} (rel.)	—	γ−r.	chem.	c.k. assuming k(H + allyl alc.) = 2.8 x 10^{9}.	68−0343
		1	6.0 x 10^{6} (rel.)	$k/k_{\mathrm{BzOH}} = 6.0 \times 10^{-3}$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	71−0040
2.273	imidazole	1	6.2 x 10^{7} (rel.)	$k/k_{\mathrm{BzOH}} = 6.2 \times 10^{-2}$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	71−0040, 72−0025
2.274	iminodiacetic acid	1	4.0 x 10^{5} (rel.)	$k/k_{\mathrm{BzOH}} = 4.0 \times 10^{-4}$	*e*−r.	esr	decay of spin polarization, compared with EtOH.	71−0040
2.274a	indole	1	4.4 x 10^{9} (rel.)	$k/k_{\mathrm{2-PrOH}} = 56$	γ−r.	chem.	c.k.	72−0541

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.274b	indole–3–acetic acid	1	6.6×10^9 (rel.)	$k/k_{\mathrm{2-PrOH}} = 84$	γ–r.	chem.	c.k.	72–0541
2.274c	indole 3 propionic acid	1	6.4×10^9 (rel.)	$k/k_{\mathrm{2-PrOH}} = 81$	γ–r.	chem.	c.k.	72–0541
2.275	iodomethane	1	$\geqslant 2 \times 10^9$ (rel.)	$k/k_{\mathrm{BzOH}} \geqslant 2$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.276	isobutane	1	1.2×10^8 (rel.)	$k/k_{\mathrm{BzOH}} = 0.12$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.277	isobutyl alcohol $H + (CH_3)_2CHCH_2OH \rightarrow H_2 + C_4H_8OH$	1	6.4×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 6.4 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	5×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 5 \times 10^{-2}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
2.278	isobutylene $H + C_4H_8 \rightarrow C_4H_9$	—	1×10^{10} (rel.)	$k/k_{\mathrm{MeOH}} = 5.3 \times 10^3$	—	—	c.k., no details given.	67–0041
2.279	isobutyrate ion $H + (CH_3)_2CHCO_2^- \rightarrow H_2 + C_3H_6CO_2^-$	—	3.3×10^7 (rel.)	$k/k_{\mathrm{MeCDOHMe}} = 3.3$	γ–r.	chem.	c.k.	66–0422
		7	5.9×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 5.9 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.280	isobutyric acid	1	2.6×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 2.6 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.281	isobutyronitrile	1	2.2×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 2.2 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.282	isoleucine	1	6.1×10^6 (rel.)	—	γ–r.	chem.	c.k. assuming *k*(H + allyl alc.) 2.8×10^9.	68–0343
		1	8×10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 8 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.283	isoorotic acid	1	9×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 9 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.284	isovalerate ion $H + Me_2CHCH_2COO^- \rightarrow H_2 + C_4H_8COO^-$	—	2.6×10^7 (rel.)	$k/k_{\mathrm{MeCDOHMe}} = 2.6$	γ–r.	chem.	c.k.	66–0422
2.285	lactic acid	1	2.2×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 2.2 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.286	L–leucine	1	1.7×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 1.7 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.287	L–lysine	1	9.9 x 10^5 (rel.)	—	γ–r.	chem.	c.k. assuming k(H + allyl alc.) = 2.8 x 10^9	68–0343
		1	1.6 x 10^6 (rel.)	k/k_{BzOH} = 1.6 x 10^{-3}	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.288	maleic acid	1	6 x 10^8 (rel.)	k/k_{BzOH} = 0.6	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		0.7	8.0 x 10^9	—	p.r.	opt.	p.b.k.	73–0097
2.28o	malic acid	1	2.2 x 10^7 (rel.)	k/k_{BzOH} = 2.2 x 10^{-2}	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.290	malonic acid $H + CH_2(COOH)_2 \rightarrow H_2 + CH(COOH)_2$ (I)	1	4.2 x 10^5 (rel.)	k/k_{BzOH} = 4.2 x 10^{-4}	e–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
	$H + CH_2(COOH)_2 \rightarrow$ no H_2 (II)	1	4.4 x 10^5 (rel.)	k/k_{BzOH} = 4.4 x 10^{-4}	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
		1	3.3 x 10^5 (I) (rel.)	$k_I/k_{II} = 3$	γ–r.	chem.	75% H abstr.	73–0053
2.291	malononitrile	1	—	—	γ–r.	chem.	5% H abstr.	73–0053
2.292	2–mercaptoethanol	0	1.6 x 10^9 (I) (rel.)	$k_I/k_{oxy} = 0.08$	p.r.	opt.	c.k.	71–0175
	$HSCH_2CH_2OH + H \rightarrow H_2 + SCH_2CH_2OH$ (I)	0	3.2 x 10^8 (II) (rel.)	$k_I/k_{II} = 5$	X–r.	chem.	product analysis, $G(H_2S)$.	71–0175
	$HSCH_2CH_2OH + H \rightarrow H_2S + CH_2CH_2OH$ (II)	1	1.6 x 10^9 (I + II) (rel.) 1.3 x 10^9 (I) (rel.) 2.3 x 10^8 (II) (rel.)	— k_I/k_{II} = 5.7 ± 0.6	γ–r.	chem.	c.k. assuming k(H + allyl alc.) = 2.8 x 10^9	73–0241
2.292a	2–mercaptopropionic acid $H + CH_3CH(SH)COOH \rightarrow H_2$ (I) $H + CH_3CH(SH)COOH \rightarrow H_2S$ (II)	1	2.7 x 10^9 (I + II) (rel.) 9.4 x 10^8 (I) (rel.) 1.8 x 10^9 (II) (rel.)	— k_I/k_{II} = 0.52 ± 0.05	γ–r.	chem.	c.k. assuming k(H + allyl alc.) = 2.8 x 10^9	73–0241
2.292b	3–mercaptopropionic acid $H + HSCH_2CH_2COOH \rightarrow H_2$ (I) $H + HSCH_2CH_2COOH \rightarrow H_2S$ (II)	1	1.1 x 10^9 (I + II) (rel.) 8.9 x 10^8 (I) (rel.) 2.2 x 10^8 (II) (rel.)	— k_I/k_{II} = 4.0 ± 0.4	γ–r.	chem.	c.k. assuming k(H + allyl alc.) = 2.8 x 10^9.	73–0241
2.293	mesitylene $H + C_6H_3(CH_3)_3 \rightarrow$ prod.	—	~ 7 x 10^9	—	—	—	estd. by analogy with benzene and toluene.	69–0503
	$T + C_6H_3(CH_3)_3 \rightarrow$ prod.	—		$k/k_{Cu^{2+}}$ = ~ 22	—	—	effect of Cu^{2+} on T exchange rate.	69–0503
2.294	methane	1	< 10^5 (rel.)	$k/k_{BzOH} < 10^{-4}$	e–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	< 10^4	—	γ–r.	chem.	deduced from results with chloromethanes.	73–0053
2.295	methanethiol $H + CH_3SH \rightarrow H_2 + CH_3S$ (I) $H + CH_3SH \rightarrow H_2S + CH_3$ (II)	0.72		$k_I/k_{II} = 6.4$	γ–r.	chem.	c.k.	64–0151

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3 mol^{-1} s^{-1})$	Ratio	Source	Method	Comment	Ref.
2.296	methanol (MeOH) $H + CH_3OH \rightarrow H_2 + CH_2OH$	1	1.1×10^6 (rel.)	$k/k_{HCOOH} = 1.5$	X–r.	*chem.*	c.k.	56–0012
		~ 7	4.7×10^6 (rel.)	$k/k_{ferri} = 6.7 \times 10^{-4}$	X–r.	chem.	c.k.	62–0024
		~ 6	1.7×10^6 (rel.)	$k/k_{DCOO^-} = (7.4 \pm 0.8) \times 10^{-2}$	γ–r.	chem.	c.k.	63–0041, 64–0095
		2	4.4×10^6 (rel.)	$k/k_{Ag^+} = 1.42 \times 10^{-4}$	p.r.	opt.	c.k.; p.b.k. at 313 nm (Ag_2^+).	67–0550, 68–0436
		~0.4	5.8×10^6 (rel.)	$k/k_{oxy} = 2.9 \times 10^{-4}$	γ–r.	chem.	c.k.; at 6.34 kbar $k/k_{oxy} = 2.1 \times 10^{-3}$.	68–0525
		>13	$(1.8 \pm 0.6) \times 10^6$ (rel.)	—	γ–r.	chem.	c.k. with OH^-.	69–0051
		1	2.4×10^6	—	p.r.	esr	decay of H signal.	71–0303
		1	1.6×10^6 (rel.)	$k/k_{BzOH} = 1.6 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	2.9×10^6 (rel.)	$k/k_{BzOH} = 2.9 \times 10^{-3}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
		7	1.6×10^6 (rel.)	$k/k_{BzOH} = 1.6 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
			For other ratios see: 2.14, 2.54, 2.57, 2.58, 2.71, 2.74, 2.85, 2.89, 2.149, 2.150, 2.152, 2.173, 2.224, 2.229, 2.270, 2.278, 2.298, 2.308, 2.334, 2.340, 2.350, 2.352.					
	$D + CH_3OH \rightarrow HD + CH_2OH$	1		$k/k_{Fe^{3+}} = 0.38$	X–r.	chem.	c.k.	58–0006
		1		$k/k_{Cu^{2+}} = 0.04$	X–r.	chem.	c.k.	58–0006
		2	3.6×10^6	—	p.r.	esr	decay of H signal.	71–0303
2.297	methanol–*d* $D + CH_3OD \rightarrow HD + CH_2OD$	1.2		$k/k_{Fe^{3+}} = 0.38$ $k/k_{Cu^{2+}} = 3.7 \times 10^{-2}$ $k/k_{Fe^{2+}} = 0.42$	X–r.	chem.	c.k.	58–0006
2.298	methanol–d_3 (MeOH(3D)) $H + CD_3OH \rightarrow HD + CD_2OH$	6	1×10^5 (rel.)	$k/k_{MeOH} = 5 \times 10^{-2}$	γ–r.	chem.	c.k.	64–0141
			For other ratios see: 2.22, 2.25, 2.55, 2.233, 2.236					
2.298a	methionine	1	6.0×10^8 (rel.)	$k/k_{HCOOH} = 799$	γ–r.	chem.	c.k.	68–0343
2.299	methoxide ion $H + CH_3O^- \rightarrow H_2 + CH_2O^-$	> 13	1.8×10^9 (rel.)	—	γ–r.	chem.	c.k. with OH^-.	69–0051
2.300	methyl acetate	7	6×10^4 (rel.)	—	—	—	c.k. with CD_3OH.	66–0843
2.301	*methylammonium ion* $H + CH_3NH_3^+ \rightarrow H_2 + CH_2NH_3^+$	4	7×10^3 (rel.)	$k/(2k_H)^{1/2} = 0.05$	γ–r.	chem.	estd.	65–0188
		3	2.7×10^6 (rel.)	$k/k_{PhOH} = 1.5 \times 10^{-3}$	p.r.	opt..	c.k.	71–0595
		2.5	1.1×10^7 (rel.)	$k/k_{Ag^+} = 3.65 \times 10^{-4}$	p.r.	opt.	c.k.	71–0595
	3–methylbutanoate ion *See* isovalerate ion							
2.302	*2–methylbutanoic* acid	—	3.3×10^7 (rel.)	$k/k_{MeCDOHMe} = 3.3$	γ–r.	chem.	c.k.	66–0422
	2–methyl 1–propanol *See* isobutyl alcohol							
	2–methylpropionate ion *See* isobutyrate ion							
	2–methylpropionic acid *See* isobutyric acid							
2.303	6–methyluracil	1	7×10^8 (rel.)	$k/k_{BzOH} = 0.7$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040

Table 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.303a	1-naphthalene-acetic acid	1	3.2×10^9 (rel.)	$k/k_{2\text{-PrOH}} = 41$	γ-r.	chem.	c.k.	72-0541
2.304	1,4-naphthoquinone 2-sulfonate ion	1.0	$(6.8 \pm 0.4) \times 10^9$	—	p.r.	opt.	p.b.k. (H adduct); *tert*-BuOH as OH scavenger.	72-0171
2.305	neopentyl alcohol	1	2.9×10^7 (rel.)	$k/k_{\mathrm{BuOH}} = 2.9 \times 10^{-2}$	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D).	71-0003
2.306	nicotinic acid	1	5×10^8	—	p.r.	opt.	p.b.k.; *tert*-BuOH as OH scavenger.	71-0582
2.307	nitrilotriacetic acid	1	7.5×10^6 (rel.)	$k/k_{\mathrm{BuOH}} = 7.5 \times 10^{-3}$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.308	nitrobenzene	8-9	2.6×10^9 (rel.)	$k/k_{2\text{-PrOH}} = 33$	γ-r.	chem.	c.k.	66-0500
	$H + C_6H_5NO_2 \rightarrow C_6H_6NO_2$	1	$(5.6 \pm 0.6) \times 10^9$	—	p.r.	opt.	p.b.k. at 410 nm; Tl^+ as OH scavenger.	67-0458
		1	1.04×10^9	—	p.r.	opt.	p.b.k.; CD_3OH as OH scavenger.	69-0001
		—	1.4×10^9 (rel.)	$k/k_{\mathrm{MeOH}} = 700$	p.r.	opt.	c.k.; p.b.k.	69-0001
		1	—	—	γ-r.	chem.	no H abstr.	73-0053
2.309	*p*-nitrobenzoic acid (PNBA)	1	9.8×10^8	—	p.r.	opt.	p.b.k.; CD_3OH as OH scavenger.	69-0001
	H + PNBA $\rightarrow 4\text{-}NO_2C_6H_5COOH$	2	$(1.0 \pm 0.1) \times 10^9$	—	p.r.	opt.	p.b.k. at 400 nm; CD_3OH as OH scavenger.	70-0211
			For other ratios see:	2.144, 2.195, 2.196, 2.198				
2.310	nitroethane	—	7.15×10^7 (rel.)	$k/k_{\mathrm{EtOH}} = 2.75 \pm 0.10$	r.	chem.	c.k.	67-0180
2.310a	*anti*-5-nitro-2-furaldoxime	1,7	3×10^9	—	p.r.	opt.	p.b.k. at 500 nm. (H adduct).	73-1018
2.311	nitromethane	—	7.1×10^7 (rel.)	$k/k_{\mathrm{EtOH}} = 2.72 \pm 0.10$	r.	chem.	c.k.	67-0180
		1	4.4×10^7 (rel.)	$k/k_{\mathrm{BuOH}} = 4.4 \times 10^{-2}$	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D).	71-0003
		1	—	—	γ-r.	chem.	no H abstr.	73-0053
2.312	1-nitropropane	—	7.4×10^7 (rel.)	$k/k_{\mathrm{EtOH}} = 2.86 \pm 0.10$	r.	chem.	c.k.	67-0180
2.312a	norvaline	1	1.7×10^6 (rel.)	—	γ-r.	chem.	c.k. assuming $k(\mathrm{H + allyl\ alc.}) = 2.8 \times 10^9$.	68-0343
2.313	orotic acid	1.5	3.3×10^9	—	p.r.	opt.	p.b.k. at 345 nm (H adduct); *tert*-BuOH as OH scavenger.	70-0567
		1	5×10^8 (rel.)	$k/k_{\mathrm{BuOH}} = 0.5$	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.314	oxalacetic acid	1	2.1×10^7 (rel.)	—	*e*-r.	esr	Unpubl. data, P. Neta and R.H. Schuler.	73-0053
	$H + HOOCCOCH_2COOH \rightarrow H_2 + HOOCCOCHCOOH$ (I)	1	$\sim 2 \times 10^5$ (I) (rel.)	$k_I/k_{II} \simeq 0.01$	γ-r.	chem.	~ 1% H abstr.	73-0053
	$H + HOOCCOCH_2COOH \rightarrow$ no H_2 (II)							

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.315	oxalate ion $H + C_2O_4^{2-} \rightarrow$ no H_2	7	1.6×10^6 (rel.)	$k/k_{\mathrm{EtOH}} \cong 6 \times 10^{-2}$	γ–r.	chem.	c.k.	69–0646
		7	$\leq 4 \times 10^4$ (rel.)	$k/k_{\mathrm{BrOH}} \leq 4 \times 10^{-5}$	*e*–r.	esr	*decay of spin* polarization, compared with EtOH.	*72–0039*
2.316	oxalic acid + oxalate ion	1.3		$k_{\mathrm{I}} + k_{\mathrm{II}}/k_{\mathrm{ferri}} \leq 10^{-4}$	γ–r.	chem.	c.k.	69–0646
	(I)$H + H_2C_2O_4 \rightarrow H_2 + CO_2 + COOH$ (II)$H + HC_2O_4^- \rightarrow H_2 + CO_2 + COO^-$ (III)$H + H_2C_2O_4 \rightarrow H_2O + CO_2 + CHO$ (IV)$H + HC_2O_4^- \rightarrow OH^- + CO_2 + CHO$	1.3		$k_{\mathrm{III}} + k_{\mathrm{IV}}/k_{\mathrm{EtOH}} \cong 4.2 \times 10^{-2}$	γ–r.	chem.	c.k.	69–0646
2.317	oxalic acid $H + H_2C_2O_4 \rightarrow$ no H_2	1	3×10^5 (rel.)	$k/k_{\mathrm{BrOH}} = 3 \times 10^{-4}$	γ–r.	chem.	c.k. with 2–PrOH(7D); cor. for $k(e_{aq}^- + H_2C_2O_4) = 2.5 \times 10^{10}$.	71–0017
		1	4.1×10^5 (rel.)	$k/k_{\mathrm{BrOH}} = 4.1 \times 10^{-4}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	—	—	γ–r.	*chem.*	*no H abstr.*	*73–0053*
2.317a	penicillamine (RSH)	1	1.9×10^9 (I + II) (rel.)	—	γ–r.	chem.	c.k. assuming k(H + allyl alc.) $= 2.8 \times 10^9$.	73–0241
	$H + RSH \rightarrow H_2$ (I)		5.9×10^8 (I) (rel.)	$k_{\mathrm{I}}/k_{\mathrm{II}} = 0.44 \pm$ *0.03*				
	$H + RSH \rightarrow H_2S$(II)		*1.3×10^9 (II) (rel.)*					
2.318	pentane	1	7×10^7 (rel.)	$k/k_{\mathrm{BrOH}} = 0.07$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.319	pentanoate ion	—	1.9×10^7 (rel.)	$k/k_{\mathrm{MeCDOHMe}} = 1.9$	γ–r.	chem.	c.k.	66–0422
2.320	phenol (PhOH) $H + C_6H_5OH \rightarrow C_6H_6OH$	8–9	6.6×10^9 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 0.84$	γ–r.	chem.	c.k.	66–0500
		2.0	$(1.8 \pm 0.3) \times 10^9$	—	p.r.	opt.	p.b.k. at 330 nm.	67–0122
		7	2.1×10^9	—	p.r.	esr	decay of H signal.	71–0303
		1	1.4×10^9 (rel.)	$k/k_{\mathrm{BrOH}} = 1.4$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
		1	—	—	γ–r.	chem.	~ 3% H abstr.	73–0053
			For other ratios see:	2.144, 2.301.				
2.321	phenyl acetate	1	8.6×10^8 (rel.)	$k/k_{\mathrm{BrOH}} = 0.86$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.322	phenylacetate ion	8–9	1.2×10^9 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 15$	γ–r.	chem.	c.k.	66–0500
2.323	phenylacetic acid $H + C_6H_5CH_2COOH \rightarrow H_2 + C_6H_5CHCOOH$ (I) $H + C_6H_5CH_2COOH \rightarrow C_6H_6CH_2COOH$ (II)	1	1.01×10^9 (II)	—	p.r.	opt.	p.b.k.; CD_3OH as OH scavenger.	69–0001
		1	9.6×10^8 (rel.)	$k/k_{\mathrm{BrOH}} = 0.96$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
		1	2.5×10^9 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 31$	γ–r.	chem.	c.k.	72–0541
		1	$\sim 4 \times 10^7$ (rel.) (I)	$k_{\mathrm{I}}/k_{\mathrm{II}} = 0.042$	γ–r.	chem.	~ 4% H abstr.	73–0053

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.324	DL-phenylalanine	1	4.1 x 10^8 (rel.)	k/k_{HCOOH} = 546	γ-r.	chem.	c.k.	68-0643
		1	8.0 x 10^8 (rel.)	k/k_{BzOH} = 0.8	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.325	*o*-phenylenediamine	0	2.8 x 10^8 (rel.)	k/k_{BzOH} = 0.28	*e*-r.	esr	decay of spin polarization, compared with EtOH; at pH1 second amino group is 50% protonated; at pH2-3 one amino group is protonated; $k_{calc.}$ for diamine = 2.1 x 10^9.	72-0025
		1	7.3 x 10^8 (rel.)	k/k_{BzOH} = 0.73	*e*-r.	esr		
		2.0	1.0 x 10^9 (rel.)	k/k_{BzOH} = 1.0	*e*-r.	esr		
		3.1	1.1 x 10^9 (rel.)	k/k_{BzOH} = 1.1	*e*-r.	esr		
		4.2	1.6 x 10^9 (rel.)	k/k_{BzOH} = 1.6	*e*-r.	esr		
2.326	*m*-phenylenediamine	1	3.4 x 10^8 (rel.)	k/k_{BzOH} = 0.34	*e*-r.	esr	decay of spin polarization, compared with EtOH.	72-0025
2.327	*p*-phenylenediamine	1	3.0 x 10^8 (rel.)	k/k_{BzOH} = 0.3	*e*-r.	esr	decay of spin polarization, compared with EtOH.	72-0025
2.328	phenyl-β-D-glucopyranoside	1	3.5 x 10^7	—	p.r.	opt.	p.b.k. at 320 nm.	71-0055
	pivalate ion *See* trimethylacetate ion							
2.329	polyoxyethylene 1,5-nonylphenol	—	2 x 10^9 (rel.)	$k/k_{2-PrOH(7D)}$ = 200	γ-r.	chem.	c.k.; at concn. > 10^{-4} *M*, ratio = 47.	71-0586
2.330	L-proline	1	5.2 x 10^5 (rel.)	—	γ-r.	chem.	c.k. assuming k(H + allyl alc.) = 2.8 x 10^9	68-0343
		1	8 x 10^5 (rel.)	k/k_{BzOH} = 8 x 10^{-4}	*e*-r.	esr	decay of spin polarization, compared with EtOH.	71-0040
2.331	1,3-propanediol	7	1.9 x 10^7 (rel.)	$k/k_{MeCDOHMe}$ = 1.9	γ-r.	chem.	c.k.	66-0422
2.332	propane	1	2.2 x 10^7 (rel.)	k/k_{BzOH} = 2.2 x 10^{-2}	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D).	71-0003
2.333	1-propanol $H + CH_3CH_2CH_2OH \rightarrow H_2 + CH_3CH_2CHOH$	2	4 x 10^7 (rel.)	k/k_{Ag^+} = 1.3 x 10^{-3}	p.r.	opt.	c.k.; p.b.k. at 313 nm (Ag_2^+).	67-0550, 68-0436
		1	2.7 x 10^7 (rel.)	k/k_{BzOH} = 2.7 x 10^{-2}	γ-r.	chem.	c.k. with 2-PrOH(7D).	71-0017
		1	2.5 x 10^7 (rel.)	k/k_{BzOH} = 2.5 x 10^{-2}	*e*-r.	esr	decay of spin polarization, compared with 2-PrOH(7D).	71-0003
2.334	2-propanol (2-PrOH) (I)$H + (CH_3)_2CHOH \rightarrow H_2 + (CH_3)_2COH$ (II) $H + CH_3)_2CHOH \rightarrow H_2 + CH_2CHOHCH_3$	1.2	8.4 x 10^7 (rel.)	k/k_{ferri} = 1.2 x 10^{-2}	X-r.	chem.	c.k.	62-0017
		7	1.8 x 10^8 (rel.)	k/k_{ferri} = 2.6 x 10^{-2}	X-r.	chem.	c.k.	62-0024
		~ 7	5.2 x 10^7 (rel.)	k/k_{DCOO^-} = 2.25 ± 0.2	γ-r.	chem.	c.k.	63-0041, 64-0095
		~ 6	8.7 x 10^7 (rel.)	k/k_{ferri} = 0.012	γ-r.	chem.	c.k.	63-0041, 64-0095
		acid		$k_I/k_{II} \cong 110$	γ-r.	chem.		64-0141

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.334 cont.		—	5.3×10^7 (rel.)	$k/k_{\mathrm{MeOH}} = 26.4$	—	—	c.k.; no details given	67–0041
		2	1.1×10^8 (rel.)	$k/k_{\mathrm{Ag^+}} = 3.58 \times 10^{-3}$	p.r.	opt.	c.k.; formn. of Ag_2^+ at 313 nm.	67–0550, 68–0436
		~0.4	1.7×10^8 (rel.)	$k/k_{\mathrm{oxy}} = 8.33 \times 10^{-3}$	γ–r.	chem.	c.k.	68–0525
		1	6.5×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 6.5 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	7.9×10^7	—	p.r.	esr	decay of H signal.	71–0303
		1	7.8×10^7	$k/k_{\mathrm{BzOH}} = 7.8 \times 10^{-2}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
		1	—	—	γ–r.	chem.	100% H abstr.	73–0053
			For other ratios see:	2.11, 2.15, 2.16, 2.18, 2.48, 2.54, 2.70, 2.70a, 2.74, 2.75, 2.81, 2.85, 2.86, 2.106, 2.112, 2.119, 2.124, 2.128, 2.136 2.145, 2.148, 2.150, 2.153, 2.158, 2.159, 2.161, 2.164, 2.165, 2.166, 2.167, 2.182, 2.185–2.188, 2.207, 2.222, 2.308, 2.320, 2.322, 2.335, 2.336, 2.345, 2.361, 2.385				
	$D + (CH_3)_2CHOH \rightarrow HD + (CH_3)_2COH$	1	4.9×10^7	—	p.r.	esr	decay of H signal.	71–0303
2.335	2–propanol–2–*d* $H + (CH_3)_2CDOH \rightarrow HD + (CH_3)_2COH$	6, acid	1×10^7 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 0.13$	γ–r.	chem.	detd. $G(H_2)$ and $G(HD)$.	64–0141
		—	1.3×10^7 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 0.17$	—	—	assumed value.	66–0422
		—	1.1×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 1.05 \times 10^{-2}$	γ–r.	chem.	c.k.	71–0017
			For other ratios see:	2.6, 2.20, 2.23, 2.24, 2.26, 2.27–2.29, 2.31, 2.35, 2.43, 2.44, 2.49, 2.50, 2.54, 2.76, 2.86, 2.93, 2.97, 2.99, 2.101, 2.149, 2.174, 2.218, 2.231, 2.279, 2.284, 2.302, 2.319, 2.331, 2.337, 2.341, 2.360, 2.378				
2.336	2–propanol–d_7 $H + (CD_3)_2CDOH \rightarrow HD + (CD_3)_2COH$	0	8×10^6 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 10^{-1}$	γ–r.	chem.	detd. $G(H_2)$ and $G(HD)$.	69–0500
		1	1.1×10^7 (rel.)	$k/k_{\mathrm{2\text{-}PrOH}} = 1.34 \times 10^{-1}$	γ–r.	chem.	c.k.	71–0017
		1	1.1×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 1.05 \times 10^{-2}$	γ–r.	chem.	c.k.	71–0017
			For other ratios see:	2.221, 2.260, 2.329				
2.337	propionate ion $H + CH_3CH_2CO_2^- \rightarrow H_2 + C_2H_4CO_2^-$	—	1.3×10^7 (rel.)	$k/k_{\mathrm{MeCDOHMe}} = 1.3$	γ–r.	chem.	c.k.	66–0422
		7	1.8×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 1.8 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.338	propionic acid $H + CH_3CH_2COOH \rightarrow H_2 + C_2H_4COOH$ (I) $H + CH_3CH_2COOH \rightarrow$ no H_2 (II)	1	5.9×10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 5.9 \times 10^{-3}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
		1	6.4×10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 6.4 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
		1	5.1×10^6 (I) (rel.)	$k_I/k_{II} = 24$	γ–r.	chem.	96% H abstr.	73–0053
2.339	propionitrile	1	1.06×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 1.06 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.340	propylene $H + CH_3CH{=}CH_2 \rightarrow C_3H_7$	—	4×10^9 (rel.)	$k/k_{\mathrm{MeOH}} = 2000$	—	—	c.k.; no details given.	67–0041

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3mol^{-1}s^{-1})$	Ratio	Source	Method	Comment	Ref.
2.341	propylene glycol $H + HOCH_2CH_2CH_2OH \rightarrow$ $H_2 + HOCH_2CH_2CHOH$	—	1.9×10^7 (rel.)	$k/k_{MeCDOHMe} = 1.9$	γ–r.	chem.	c.k.	66–0422
2.342	purine	1	1.2×10^8 (rel.)	$k/k_{BzOH} = 0.12$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.343	pyrazine	1	3.3×10^8 (rel.)	$k/k_{BzOH} = 0.33$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.344	pyridazine	1	2.9×10^8 (rel.)	$k/k_{BzOH} = 0.29$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.345	pyridine $H + C_5H_5N \rightarrow$	~ 6	1.0×10^9 (rel.)	$k/k_{2-PrOH} = 13 \pm 2.5$	γ–r.	chem.	c.k.	64–0095
	C_5H_6N	7	6.5×10^8 (rel.)	$k/k_{BzOH} = 0.65$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
2.346	pyridinium ion $H + C_5H_5NH^+ \rightarrow$	1	2.9×10^8 (rel.)	$k/k_{ferri} = 4.2 \times 10^{-2}$	p.r.	opt.	c.k.	67–0251
	$C_5H_6NH^+$	1	1.7×10^8	—	p.r.	opt.	p.b.k.; *tert*–BuOH as OH scavenger.	71–0582
		1	2.2×10^8 (rel.)	$k/k_{BzOH} = 0.22$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.347	pyrimidine	1	1.0×10^8 (rel.)	$k/k_{BzOH} = 0.1$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025, 71–0040
2.348	ribonuclease H + RNase → H adduct	2.2–6.7	1.5×10^{10}	—	p.r.	opt.	p.b.k.	71–3087, 72–1004, 72–3094
2.349	D–ribose $H + C_5H_{10}O_5 \rightarrow$ $H_2 + C_5H_9O_5$ (I) $H + C_5H_{10}O_5 \rightarrow$	1	5.5×10^7 (rel.)	$k/k_{BzOH} = 5.5 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
	no H_2 (II)	1	4.6×10^7 (I) (rel.)	$k_Ik_{II} = 5$	γ–r.	chem.	83% H abstr.	73–0053
2.350	salicylate ion	2	$(2.4 \pm 0.4) \times 10^9$	—	p.r.	opt.	p.b.k. at 390 nm.	68–0305
	$H + OHC_6H_4COO^-$	2	1.1×10^9 (rel.)	$k/k_{MeOH} = 530$	p.r.	opt.	c.k.	68–0305
	$\rightarrow OHC_6H_5COO^-$	2	1.7×10^9 (rel.)	$k/k_{EtOH} = 66$	p.r.	opt.	c.k.	68–0305
2.351	sarcosine	1	1.2×10^5 (rel.)	$k/k_{BzOH} = 1.2 \times 10^{-4}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.352	selenourea $H + NH_2CSeNH_2 \rightarrow$	6.5	6.3×10^8	—	p.r.	opt.	p.b.k. at 410 nm $(NH_2C(=NH)Se^-)_2^-$	70–0240
	$H_2 + NH_2C(=NH)Se$	—	1.2×10^9 (rel.)	$k/k_{EtOH} = 47$	p.r.	opt.	c.k.	70–0240
		—	8×10^8 (rel.)	$k/k_{MeOH} = 400$	p.r.	opt.	c.k.	70–0240
2.353	DL–serine	1	3.6×10^6 (rel.)	—	γ–r.	chem.	c.k. assuming k(H + allyl alc.) $= 2.8 \times 10^9$.	68–0343
		1	1.3×10^6 (rel.)	$k/k_{BzOH} = 1.3 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(dm^3mol^{-1}s^{-1})$	Ratio	Source	Method	Comment	Ref.
2.354	succinate ion	7	1.1×10^7 (rel.)	$k/k_{BzOH} = 1.1 \times 10^{-2}$	*e*–r.	esr.	decay of spin polarization, compared with EtOH.	72–0039
2.355	succinic acid H + $(CH_2COOH)_2 \rightarrow$	1	2.3×10^6 (rel.)	$k/k_{BzOH} = 2.3 \times 10^{-3}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	71–0017
	H_2 + $HOOCCH_2CHCOOH$ (I)	1	3.5×10^6 (rel.)	$k/k_{BzOH} = 3.5 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
	H + $(CH_2COOH)_2 \rightarrow$ no H_2 (II)	1	2.7×10^6 (I) (rel.)	$k_{II}/k_I = 0.05$	γ–r.	chem.	95% H abstr.	73–0053
2.356	sucrose H + $C_{12}H_{22}O_{11} \rightarrow H_2 + C_{12}H_{21}O_{11}$	1.0	2.6×10^7 (rel.)	$k/k_{HCOOH} = 35$	X–r.	chem.	c.k.	56–0012
2.357	tartaric acid	1	1.7×10^7 (rel.)	$k/k_{BzOH} = 1.7 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, *compared with* 2–PrOH(7D).	71–0003
2.358	tartronic acid	1	2.3×10^7 (rel.)	$k/k_{BzOH} = 2.3 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.359	tetrafluoromethane H + $CF_4 \rightarrow$ no reaction	—	—	—	—	—	—	71–0026
2.360	tetrahydrofuran H + $C_4H_8O \rightarrow$	—	3.4×10^7 (rel.)	$k/k_{MeCDOHMe} = 3.4$	γ–r.	chem.	c.k.	66–0422
	$H_2 + C_4H_7O$	1	7.8×10^7 (rel.)	$k/k_{BzOH} = 7.8 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.361	tetraiodofluorescein	8.3	1.8×10^9 (rel.)	$k/k_{2-PrOH} = 23 \pm 4$	X–r.	phot.	c.k.	71–0354
		8.4	5.3×10^9 (rel.)	$k/k_{perox} = 88$	X–r.	phot.	c.k.	71–0295
2.362	*N*,*N*,*N′*,*N′*–tetramethyl–*p*–phenylenediamine	1	2.4×10^8 (rel.)	$k/k_{BzOH} = 0.24$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0025
2.363	2,2,6,6–tetramethyl–4–piperidone *N*–oxyl (TAN)	1.9	5.3×10^9 (rel.)	$k/k_{ferri} = 0.76$	p.r.	opt.	c.k.; d.k. at 410 nm (ferri).	71–0618
		—	6.7×10^9 (rel.)	$k/k_Q = 0.81$	p.r.	opt.	c.k.; p.b.k. at 410 nm (benzoquinone–H *adduct*).	71–0618
2.364	tetranitromethane	—	$(2.6 \pm 1.0) \times 10^9$	—	p.r.	opt.	p.b.k.	64–0133
	H + $C(NO_2)_4 \rightarrow H^+ + C(NO_2)_3^- + NO_2$	2	5.5×10^8	—	p.r.	opt.	p.b.k. at 366 nm (nitroform anion); cor. for k_H and k_{OH}.	65–0183
		—	1.4×10^8 (rel.)	$k/k_{dioxane} = 11$	γ–r.	chem.	c.k.; solvent dioxane contg. 2.2 *M* water.	67–0222
2.365	thioacetamide	1	6×10^9 (rel.)	$k/k_{BzOH} = 6 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.366	thiodiglycolic acid	1	2×10^9 (rel.)	$k/k_{BzOH} = 2$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		1	—	—	γ–r.	chem.	no H abstr.	73–0053

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.367	thioglycolic acid	1	4 x 10^9 (rel.)	$k/k_{\mathrm{BzOH}} = 4$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.368	thiomalic acid	1	3 x 10^9 (rel.)	$k/k_{\mathrm{BzOH}} = 3$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.369	thiophenol $H + C_6H_5SH \rightarrow H_2 + C_6H_5S$ (I)	1	4.0 x 10^9 (rel.)	—	e–r.	esr	Unpubl. data, P. Neta and R.H. Schuler.	73–0053
	$H + C_6H_5SH \rightarrow C_6H_6SH$ (II)	1	2.8 x 10^9 (I) (rel.)	$k_I/k_{II} = 2.45$	γ–r.	chem.	71% H abstr.	73–0053
2.370	thiourea	1	6 x 10^9 (rel.)	$k/k_{\mathrm{BzOH}} = 6 \times 10^{-3}$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.371	threonine, positive ion	1	7.9 x 10^6 (rel.)	—	γ–r.	chem.	c.k. assuming k(H + allyl alc.) = 2.8 x 10^9.	68–0343
		1	8 x 10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 8 \times 10^{-3}$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.372	thymidylic acid	7–8	2.3 x 10^8 (rel.)	$k/k_{\mathrm{DCOO^-}} = 10$	γ–r.	chem.	c.k.	68–3038
2.373	thymidine	7–8	2.5 x 10^8 (rel.)	$k/k_{\mathrm{DCOO^-}} = 11$	γ–r.	chem.	c.k.	68–3038
2.374	thymine	1	8 x 10^8 (rel.)	$k/k_{\mathrm{oxy}} = 4 \times 10^{-2}$	γ–r.	chem.	c.k.	68–0359
		0.7	7 x 10^8	—	p.r.	opt.	p.b.k. at 400 nm.	68–0597
		7–8	2.3 x 10^8 (rel.)	$k/k_{\mathrm{DCOO^-}} = 10$	γ–r.	chem.	c.k.	68–3038
		1	5 x 10^8 (rel.)	$k/k_{\mathrm{BzOH}} = 0.5$	e–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		0.65	(6.8 ± 0.2) x 10^8	—	p.r.	opt.	p.b.k. at 400 nm.	71–0529
2.375	toluene $H + C_6H_5CH_3 \rightarrow C_6H_6CH_3$	3	(2.6 ± 0.5) x 10^9	—	p.r.	opt.	p.b.k.; methanol as OH scavenger; cor. for k_{MeOH}.	67–0246
2.376	*p*–tolyl–*S*–*β*–D–thioglucopyranoside	—	2.1 x 10^9 (rel.)	—	p.r.	—	—	70–1056
2.377	trichlorofluoromethane	1	1.7 x 10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 1.7 \times 10^{-3}$	e–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
2.378	trimethylacetate ion $H + (CH_3)_3CCO_2^- \rightarrow H_2 + (CH_3)_2C(CH_2)COO^-$	—	2 x 10^6 (rel.)	$k/k_{\mathrm{MeCDOHMe}} = 2 \times 10^{-1}$	γ–r.	chem.	c.k.	66–0422
2.379	trimethylacetonitrile $H + (CH_3)_3CCN \rightarrow H_2 + (CH_3)_2(CH_2)CCN$ (I)	1	1.5 x 10^7 (rel.)	—	e–r.	esr	Unpubl. data, P. Neta and R.H. Schuler.	73–0053
	$H + (CH_3)_3CCN \rightarrow (CH_3)_3CCNH$ (II)	1	7.5 x 10^5 (I) (rel.)	$k_I/k_{II} = 0.053$	γ–r.	chem.	5% H abstr.	73–0053

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	k(dm^{3}mol^{-1}s^{-1})	Ratio	Source	Method	Comment	Ref.
2.380	trimethylanilinium ion	1	4.5 x 10^8 (rel.)	$k/k_{\mathrm{EtOH}} = 0.45$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–002
2.381	tropylium ion $H + C_7H_7^+ \rightarrow C_7H_7 + H_3O^+$	—	(7 ± 2) x 10^9	—	p.r.	opt.	p.b.k. at 315 nm.	71–071
2.382	L–tryptophan	1	2.25 x 10^9 (rel.)	$k/k_{\mathrm{HCOOH}} = 3000$	γ–r.	chem.	c.k.	68–034
		1	(7.4 ± 1) x 10^9	—	p.r.	opt.	p.b.k. at 325 nm; methanol as OH scavenger; cor. for *k*(H + MeOH) and *k*(OH + tryptophan).	69–045
2.383	DL–tryptophan	~ 6	2 x 10^8	—	e.d.	opt.	d.k. at 278 nm; cor. for product absorption and H + H.	64–9012
		1	≥ 2.3 x 10^9 (rel.)	$k/k_{\mathrm{EtOH}} \geq 2.3$	*e*–r.	esr	decay of spin polarization compared with EtOH.	71–0040
2.384	DL–tyrosine	~ 6	~ 4 x 10^8	—	e.d.	opt.	d.k. at 274 nm; cor. for product absorption and H + H.	64–9012
		1	8.2 x 10^8 (rel.)	$k/k_{\mathrm{HCOOH}} = 1090$	γ–r.	chem.	c.k. (L isomer).	68–0343
		1	1.1 x 10^9 (rel.)	$k/k_{\mathrm{EtOH}} = 1.1$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		1.0	(9.8 ± 0.4) x 10^9	—	p.r.	opt.	p.b.k.	71–0143
		9.0	(2.0 ± 0.5) x 10^9	—	p.r.	opt.	p.b.k.	73–0003
2.385	uracil	6	4.7 x 10^9 (rel.)	$k/k_{2\text{-PrOH}} = 59 \pm 7$	γ–r.	chem.	c.k.	64–0095
		2	(5.6 ± 0.6) x 10^9	—	p.r.	opt.	p.b.k. at 420 nm; formaldehyde as OH scavenger; cor. for H + CH_2O.	69–0571
		2	2.8 x 10^8	—	p.r.	esr	decay of H signal.	71–0303
		1	2.8 x 10^8 (rel.)	$k/k_{\mathrm{EtOH}} = 0.28$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
		7	2–3 x 10^8 (rel.)	$k/k_{\mathrm{EtOH}} = 0.2 - 0.3$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039
		7	2.4 x 10^8 (rel.)	$k/k_{\mathrm{EtOH}} = 2.4 \times 10^{-1}$	γ–r.	chem.	c.k. with 2–PrOH(7D).	72–0049
2.386	urea	1	< 3 x 10^4 (rel.)	$k/k_{\mathrm{EtOH}} < 3 \times 10^{-5}$	*e*–r.	esr	decay of spin polarization, compared with 2–PrOH(7D).	71–0003
	valerate ion *See* pentanoate ion							

TABLE 4. *Reactions of H with organic solutes* — Continued

No.	Solute and Reaction	pH	$k(\mathrm{dm^3 mol^{-1} s^{-1}})$	Ratio	Source	Method	Comment	Ref.
2.387	valine, positive ion	1	3.3×10^6 (rel.)	—	γ–r.	chem.	c.k. assuming $k(\mathrm{H} + \text{allyl alc.}) = 2.8 \times 10^9$	68–0343
		1	9×10^6 (rel.)	$k/k_{\mathrm{BzOH}} = 9 \times 10^{-3}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	71–0040
2.388	valine, zwitterion	7	1.3×10^7 (rel.)	$k/k_{\mathrm{BzOH}} = 1.3 \times 10^{-2}$	*e*–r.	esr	decay of spin polarization, compared with EtOH.	72–0039

Formula index

Ag^+, 2.5
As(III) Arsenic(III) ion, 2.6
AsF_6^- Hexafluoroarsenate(V) ion, 2.7
$AuCl_4^-$ Tetrachloroaurate(III) ion, 2.8
$B_4O_7^{2-}$ Tetraborate ion, 2.9
Br^- Bromide ion, 2.10a
BrO_3^- Bromate ion, 2.11
Br_2 Bromine, 2.10
$CClF_3$ Chlorotrifluoromethane, 2.189
CCl_2F_2 Dichlorodifluoromethane, 2.211
CCl_3F Trichlorofluoromethane, 2.377
CCl_4 Carbon tetrachloride, 2.177
CDO_2^- *d*–Formate ion, 2.240
CF_4 Tetrafluoromethane, 2.359
$CHCl_3$ Chloroform, 2.183
$CHDO_2$ *d*–Formic acid, 2.242
CHD_3O Methanol–d_3, 2.298
CHN Hydrogen cyanide, 2.15
CHO_2^- Formate ion, 2.239
CHO_3^- Bicarbonate ion, 2.14
CH_2Cl_2 Dichloromethane, 2.212
CH_2O Formaldehyde, 2.238
CH_2O_2 Formic acid, 2.241
CH_3Cl Chloromethane, 2.184
CH_3DO Methanol *d*, 2.297
CH_3I Iodomethane, 2.275
CH_3NO_2 Nitromethane, 2.311
CH_3O^- Methoxide ion, 2.299
CH_4 Methane, 2.294
CH_4N_2O Urea, 2.386
CH_4N_2S Thiourea, 2.370
CH_4N_2Se Selenourea, 2.352
CH_4O Methanol, 2.296
CH_4S Methanethiol, 2.295
CH_5N_3 Guanidine, 2.259
CH_6N^+ Methylammonium ion, 2.301
$CH_{15}CoN_6^{2+}$ Cyanopentaamminecobalt(III) ion, 2.29
$CH_{15}CoN_6S^{2+}$ Thiocyanatopentaamminecobalt(III) ion, 2.30
CN^- Cyanide ion, 2.16
CNS^- Thiocyanate ion, 2.18
CN_4O_8 Tetranitromethane, 2.364
CO Carbon monoxide, 2.12
CO_2 Carbon dioxide, 2.13
CS_2 Carbon disulfide, 2.176
$C_2D_3O_2^-$ Acetate ion–d_3, 2.108
$C_2HO_3^-$ Glyoxylate ion, 2.257
$C_2HO_4^-$ Oxalate ion, hydrogen, 2.316
C_2H_2 Acetylene, 2.114
$C_2H_2BrO_2^-$ Bromoacetate ion, 2.158
$C_2H_2ClO_2^-$ Chloroacetate ion, 2.178
$C_2H_2FO_2^-$ Fluoroacetate ion, 2.236
$C_2H_2O_2$ Glyoxal, 2.256
$C_2H_2O_3$ Glyoxylic acid, 2.258
$C_2H_2O_4$ Oxalic acid, 2.316–7
$C_2H_3BrO_2$ Bromoacetic acid, 2.159
$C_2H_3ClO_2$ Chloroacetic acid, 2.179
C_2H_3N Acetonitrile, 2.111
$C_2H_3O_2^-$ Acetate ion, 2.107
$C_2H_3O_3^-$ Glycolate ion, 2.252
C_2H_4 Ethylene, 2.229
$C_2H_4D_2O$ Ethanol–d_2, 2.225
$C_2H_4N_2$ Aminoacetonitrile, 2.125
C_2H_4O Acetaldehyde, 2.104
$C_2H_4O_2$ Acetic acid, 2.109
$C_2H_4O_2S$ Thioglycolic acid, 2.367
$C_2H_4O_3$ Glycolic acid, 2.253
C_2H_5Br Bromoethane, 2.160
C_2H_5BrO 2–Bromoethanol, 2.161
C_2H_5Cl Chloroethane, 2.181
C_2H_5ClO 2–Chloroethanol, 2.182
C_2H_5NO Acetamide, 2.105
$C_2H_5NO_2$ Glycine, 2.250–2.251; Nitroethane, 2.310
C_2H_5NS Thioacetamide, 2.365
$C_2H_5O^-$ Ethoxide ion, 2.226
C_2H_6 Ethane, 2.223
C_2H_6O Ethanol, 2.224
C_2H_6OS 2–Mercaptoethanol, 2.292
$C_2H_6O_2$ Ethylene glycol, 2.231
C_2H_7NO 2–Aminoethanol, 2.126
C_2H_7NS Cysteamine, 2.204
$C_2H_7O_4P$ Ethyldihydrogen phosphate, 2.233
$C_2H_{15}CoF_3N_5^{2+}$ Trifluoroacetatopentaammine–
  cobalt(III) ion, 2.38
$C_2H_{18}CoN_5O_2^{2+}$ Acetatopentaamminecobalt(III) ion, 2.36
C_2N_2 Cyanogen, 2.17
$C_2O_4^{2-}$ Oxalate ion, 2.315
C_3HD_7O 2–Propanol–d_7, 2.336
$C_3H_2N_2$ Malononitrile, 2.291
$C_3H_3NO_2$ Cyanoacetic acid, 2.192
$C_3H_4BrO_2^-$ 2–Bromopropionate ion, 2.164;
  3–Bromopropionate ion, 2.165
$C_3H_4ClO_2^-$ 2–Chloropropionate ion, 2.185;
  3–Chloropropionate ion, 2.186
$C_3H_4N_2$ Imidazole, 2.273
$C_3H_4O_4$ Malonic acid, 2.290
$C_3H_4O_5$ Tartronic acid, 2.358
$C_3H_5BrO_2$ 2–Bromopropionic acid, 2.166;
  3–Bromopropionic acid, 2.167
$C_3H_5ClO_2$ 2–Chloropropionic acid, 2.187;
  3–Chloropropionic acid, 2.188
C_3H_5N Propionitrile, 2.339
C_3H_5NO Acrylamide, 2.118
$C_3H_5O_2^-$ Propionate ion, 2.337
C_3H_6 Cyclopropane, 2.202; Propylene, 2.340
C_3H_6O Acetone, 2.110; Allyl alcohol, 2.124
$C_3H_6O_2$ Methyl acetate, 2.300; Propionic acid, 2.338
$C_3H_6O_2S$ 2–Mercaptopropionic acid, 2.292a;
  3–Mercaptopropionic acid, 2.292b
$C_3H_6O_3$ Lactic acid, 2.285
C_3H_7DO 2–Propanol–2–*d*, 2.335
$C_3H_7NO_2$ α–Alanine, 2.122; β–Alanine, 2.123;
  1–Nitropropane, 2.312; Sarcosine, 2.351
$C_3H_7NO_2S$ Cysteine, 2.205–2.206
$C_3H_7NO_3$ Serine, 2.353
C_3H_8 Propane, 2.332
C_3H_8O 1–Propanol, 2.333; 2–Propanol, 2.334
$C_3H_8O_2$ 1,3–Propanediol, 2.331
$C_3H_8O_3$ Glycerol, 2.249
$C_4CdN_4^{2-}$ Tetracyanocadmate(II) ion, 2.20
$C_4H_2O_4$ Acetylenedicarboxylic acid, 2.115
$C_4H_3BrN_2O_2$ 5–Bromouracil, 2.168
$C_4H_3ClN_2O_2$ 5–Chlorouracil, 2.190
$C_4H_3FN_2O_2$ 5–Fluorouracil, 2.237
$C_4H_3N_2O_3^-$ Barbiturate ion, 2.140
$C_4H_3O_4^-$ Fumarate ion, hydrogen, 2.243
$C_4H_4N_2$ Pyrazine, 2.343; Pyridazine, 2.344;

Pyrimidine, 2.347
$C_4H_4N_2O_2$ Uracil, 2.385
$C_4H_4N_2O_3$ Barbituric acid, 2.141
$C_4H_4O_4$ Fumaric acid, 2.244; Maleic acid, 2.288
$C_4H_4O_4{}^{2-}$ Succinate ion, 2.354
$C_4H_4O_5$ Oxalacetic acid, 2.314
$C_4H_4O_6$ 2,3-Dihydroxyfumaric acid, 2.216
$C_4H_5N_3O$ Cytosine, 2.209
C_4H_6 Butadiene, 2.168a
$C_4H_6NO_3$ *N*-Acetylglycine, 2.117
$C_4H_6NO_4{}^-$ Aspartate ion, 2.138
$C_4H_6O_2$ Biacetyl, 2.155; Cyclopropanecarboxylic acid, 2.203
$C_4H_6O_4$ Succinic acid, 2.355
$C_4H_6O_4S$ Thiodiglycolic acid, 2.366; Thiomalic acid, 2.368
$C_4H_6O_4S_2$ Dithiodiglycolic acid, 2.219
$C_4H_6O_5$ Malic acid, 2.289
$C_4H_6O_6$ Tartaric acid, 2.357
C_4H_7N Isobutyronitrile, 2.281
$C_4H_7NO_4$ DL-Aspartic acid, 2.139; Iminodiacetic acid, 2.274
$C_4H_7O_2{}^-$ Butyrate ion, 2.174; Isobutyrate ion, 2.279
C_4H_8 1-Butene, 2.173; Isobutylene, 2.278
$C_4H_8N_2O_3$ DL-Asparagine, 2.137; Glycylglycine, 2.254
C_4H_8O Tetrahydrofuran, 2.360
$C_4H_8O_2$ Butyric acid, 2.175; Dioxane, 2.218; Ethyl acetate, 2.227; Isobutyric acid, 2.280
$C_4H_9NO_2$ 2-Aminobutyric acid, 2.125a; 2-Amino-2-methylpropionic acid, 2.127
C_4H_{10} Butane, 2.169; Isobutane, 2.276
$C_4H_{10}NO_3{}^+$ Threonine, positive ion, 2.371
$C_4H_{10}O$ 1-Butanol, 2.170; 2-Butanol, 2.171; *tert*-Butanol, 2.172; Ethyl ether, 2.232; Isobutyl alcohol, 2.277
$C_4H_{16}Cl_2CoN_4{}^+$ Dichlorobis(ethylenediamine)cobalt(III) ion, 2.43
$C_4H_{16}CoF_2N_4{}^+$ Difluorobis(ethylenediamine)cobalt(III) ion, 2.42
$C_4H_{18}CoN_5O_4{}^+$ Fumarylpentaamminecobalt(III) ion, 2.32
$C_4H_{20}CoN_4O_2{}^{3+}$ Diaquobis(ethylenediamine)cobalt(III) ion, 2.41
$C_4N_4Pt^{2-}$ Tetracyanoplatinate(II) ion, 2.93
$C_5H_3BrN_2O_4$ 5-Bromoorotic acid, 2.162
$C_5H_4N_2O_4$ Orotic acid, 2.313; Isoorotic acid, 2.283; *anti*-5-Nitro-2-furaldoxime, 2.310a
$C_5H_4N_4$ Purine, 2.342
C_5H_5N Pyridine, 2.345
$C_5H_5N_5$ Adenine, 2.119
$C_5H_6N^+$ Pyridinium ion, 2.346
$C_5H_6N_2O_2$ Thymine, 2.374
$C_5H_6N_2S_2$ 6-Methyluracil, 2.303
$C_5H_8NO_3$ *N*-Acetylalanine, 2.116
$C_5H_8NO_4{}^-$ Glutamate ion, 2.246
$C_5H_8N_2O_2$ 5,6-Dihydrothymine, 2.217
$C_5H_8O_2$ Acetylacetone, 2.113; Cyclobutanecarboxylic acid, 2.193
C_5H_9N Trimethylacetonitrile, 2.379
$C_5H_9NO_2$ Proline, 2.330
$C_5H_9NO_3$ Hydroxyproline, 2.272
$C_5H_9O_2{}^-$ Isovalerate ion, 2.284; Pentanoate ion, 2.319; Trimethylacetate ion, 2.378
C_5H_{10} Cyclopentane, 2.200
$C_5H_{10}NO_4{}^+$ Glutamic acid, positive ion, 2.247
$C_5H_{10}O_2$ 2-Methylbutanoic acid, 2.302
$C_5H_{10}O_4$ Deoxyribose, 2.210
$C_5H_{10}O_5$ Arabinose, 2.133; Ribose, 2.349
$C_5H_{11}NO_2$ Norvaline, 2.312a; Valine, 2.387-8
$C_5H_{11}NO_2S$ Methionine, 2.298a; Penicillamine, 2.317a
C_5H_{12} Pentane, 2.318
$C_5H_{12}NO_2{}^+$ Betaine, 2.154
$C_5H_{12}O$ Neopentyl alcohol, 2.305
$C_5H_{16}CoN_4O_3{}^+$ Carbonatobis(ethylenediamine)cobalt(III) ion, 2.44
$C_6CoN_6{}^{3-}$ Hexacyanocobaltate(III) ion, 2.35
$C_6CoO_{12}{}^{3-}$ Trioxalatocobaltate(III) ion, 2.47
$C_6CrO_{12}{}^{3-}$ Trioxalatochromate(III) ion, 2.51
$C_6FeN_6{}^{3-}$ Hexacyanoferrate(III) ion, 2.63
$C_6FeO_{12}{}^{3-}$ Trioxalatoferrate(III) ion, 2.64
$C_6H_4O_2$ Benzoquinone, 2.152
C_6H_5BrO *p*-Bromophenol, 2.163
$C_6H_5NO_2$ Nicotinic acid, 2.306; Nitrobenzene, 2.308
$C_6H_5O_3S^-$ Benzenesulfonate ion, 2.145
C_6H_6 Benzene, 2.144
C_6H_6O Phenol, 2.320
C_6H_6S Thiophenol, 2.369
C_6H_7N Aniline, 2.128
$C_6H_7NO_2$ *N*-Ethylmaleimide, 2.234
$C_6H_7O_6{}^-$ Ascorbate ion, 2.135
C_6H_8 1,3-Cyclohexadiene, 2.195; 1,4-Cyclohexadiene, 2.196
$C_6H_8CoN_2O_8{}^-$ Dioxalatoethylenediaminecobaltate(III) ion, 2.46
$C_6H_8N^+$ Anilinium ion, 2.129
$C_6H_8N_2$ *o*-Phenylenediamine, 2.325; *m*-Phenylenediamine, 2.326; *p*-Phenylenediamine, 2.327
$C_6H_8O_4$ Dimethyl fumarate, 2.217a
$C_6H_8O_6$ Ascorbic acid, 2.136
$C_6H_8O_7$ Citric acid, 2.191
$C_6H_9NO_3$ *N*-Ethylmaleamic acid, 2.233a
$C_6H_9N_3$ Nitrilotriacetic acid, 2.307
$C_6H_9N_3O_2$ Histidine, 2.269
C_6H_{10} Cyclohexene, 2.198
$C_6H_{10}O_2$ 1-Cyclopentanecarboxylic acid, 2.201
$C_6H_{10}O_3$ Ethyl acetoacetate, 2.228
$C_6H_{11}O_2{}^-$ Hexanoate ion, 2.264
$C_6H_{11}N_3O_4$ Glycylglycylglycine, 2.255
C_6H_{12} Cyclohexane, 2.197
$C_6H_{12}N_2O_4S_2$ Cystine, 2.207
$C_6H_{12}O_2$ Hexanoic acid, 2.265
$C_6H_{12}O_6$ Glucose, 2.245
$C_6H_{13}N$ Hexamethyleneimine, 2.261
$C_6H_{13}NO_2$ Isoleucine, 2.282; Leucine, 2.286
C_6H_{14} Hexane, 2.262
$C_6H_{14}N_2O_2$ Lysine, 2.287
$C_6H_{14}N_4O_2$ L-Arginine, 2.134
$C_6H_{14}O$ 1-Hexanol, 2.266
$C_6H_{16}CoN_4O_4{}^+$ Oxalatobis(ethylenediamine)cobalt(III) ion, 2.45
$C_6H_{16}N^+$ 1-Hexylammonium ion, 2.267
$C_6H_{16}N_2$ 1,6-Hexanediamine, 2.263
$C_6H_{24}CoN_6{}^{3+}$ Tris(ethylenediamine)cobalt(III) ion, 2.40
$C_7H_5ClO_2$ *p*-Chlorobenzoic acid, 2.180
C_7H_5N Benzonitrile, 2.150
$C_7H_5NO_4$ *p*-Nitrobenzoic acid, 2.309
$C_7H_5O_2{}^-$ Benzoate ion, 2.148
$C_7H_5O_3{}^-$ Salicylate ion, 2.350
C_7H_6O Benzaldehyde, 2.142
$C_7H_6O_2$ Benzoic acid, 2.149
$C_7H_6O_3$ *p*-Hydroxybenzoic acid, 2.270
$C_7H_7{}^+$ Tropylium ion, 2.381
C_7H_7NO Benzamide, 2.143

C_7H_8 Cycloheptatriene, 2.194; Toluene, 2.375
C_7H_8O Anisole, 2.130; Benzyl alcohol, 2.153
$C_7H_{20}CoN_5O_2{}^{2+}$ Benzoatopentaamminecobalt(III) ion, 2.39
$C_8H_4N_2$ *o*–Dicyanobenzene, 2.213;
    m–Dicyanobenzene, 2.214; *p*–Dicyanobenzene, 2.215
C_8H_7N Indole, 2.274a
$C_8H_7O_2{}^-$ Phenylacetate ion, 2.322
C_8H_8O Acetophenone, 2.112
$C_8H_8O_2$ Phenyl acetate, 2.321;
    Phenylacetic acid, 2.323
C_8H_9NO Acetanilide, 2.106
$C_8H_{10}O_4$ *cis*–4–Cyclohexene–1,2–dicarboxylic acid, 2.199
$C_9H_6O_6$ 1,3,5–Benzenetricarboxylic acid, 2.146
$C_9H_9NO_3$ Hippuric acid, 2.268
$C_9H_9O_3{}^-$ *p*–Hydroxyphenylpropionate ion, 2.270a
$C_9H_{10}O_3$ *p*–Hydroxyphenylpropionic acid, 2.271
$C_9H_{11}NO_2$ Phenylalanine, 2.324
$C_9H_{11}NO_3$ Tyrosine, 2.384
C_9H_{12} Mesitylene, 2.293
$C_9H_{14}N^+$ Trimethylanilinium ion, 2.380
$C_9H_{16}NO_2$ 2,2,6,6–Tetramethyl–4–piperidone *N*–oxyl, 2.363
$C_{10}H_5O_5S^-$ 1,4–Naphthoquinone–2–sulfonate ion, 2.304
$C_{10}H_8N_2$ 2,2′–Bipyridine, 2.156; 4,4′–Bipyridine, 2.157
$C_{10}H_9NO_2$ Indole–3–acetic acid, 2.274b
$C_{10}H_{13}N_5O_4$ Adenosine, 2.120
$C_{10}H_{14}N_2O_5$ Thymidine, 2.373
$C_{10}H_{14}N_5O_7P$ Adenosine–5′–phosphate, 2.121
$C_{10}H_{15}N_2O_8P$ Thymidylic acid, 2.372
$C_{10}H_{16}N_2$ *N*,*N*,*N′*,*N′*–Tetramethyl–*p*–phenylenediamine, 2.362
$C_{10}H_{16}N_2O_8$ Ethylenediaminetetraacetic acid, 2.230
$C_{10}H_{16}N_3O_6S$ Glutathione, 2.248
$C_{11}H_{11}NO_2$ Indole–3–propionic acid, 2.274c
$C_{11}H_{12}N_2O_2$ Tryptophan, 2.382–3
$C_{12}H_9NO$ 2–Benzoylpyridine, 2.152a; 3–Benzoylpyridine,
    2.152b; 4–Benzoylpyridine, 2.152c
$C_{12}H_{10}O_2$ 1–Naphthaleneacetic acid, 2.303a
$C_{12}H_{16}O_6$ Phenyl–β–D–glucopyranoside, 2.328
$C_{12}H_{22}O_{11}$ Sucrose, 2.356
$C_{12}H_{25}NaO_4S$ Dodecyl sodium sulfate, 2.221
$C_{13}H_8O$ Fluorenone, 2.235
$C_{13}H_{10}O$ Benzophenone, 2.151
$C_{13}H_{18}O_5S$ *p*–Tolyl–*S*–β–D–thioglucopyranoside, 2.376
$C_{14}H_8O_5S$ 9,10–Anthraquinone–2–sulfonate ion, 2.132
$C_{14}H_{10}$ Anthracene, 2.131
$C_{14}H_{10}O_2$ Benzil, 2.147
$C_{15}H_{24}CoO_6{}^{3+}$ Tris(acetylacetonato)cobalt(III) ion, 2.48
$C_{19}H_{42}BrN$ Hexadecyltrimethylammonium bromide, 2.260
$C_{20}H_8O_5I_4$ Tetraiodofluorescein, 2.361
$C_{30}H_{24}FeN_6{}^{3+}$ Tris(2,2′–bipyridyl)iron(III) ion, 2.65
$C_{30}H_{24}N_6Ru^{2+}$ Tris(2,2′–bipyridyl)ruthenium(II) ion, 2.93a
$C_{30}H_{24}N_6Ru^{3+}$ Tris(bipyridyl)ruthenium(III) ion, 2.93b
$C_{36}H_{24}FeN_6{}^{3+}$ Tris(1,10–phenanthroline)iron(III)
    ion, 2.66
$C_{45}H_{84}O_{16}$ Polyoxyethylene(1,5)nonyl phenol, 2.329
Cd^{2+} Cadmium(II) ion, 2.19
Ce^{4+}, 2.21
Cl^- Chloride ion, 2.21a
$ClCrH_{15}N_5{}^{2+}$ Chloropentaamminechromium(III) ion, 2.49
$ClFe^{2+}$ Chloroiron(III) ion, 2.61
$Cl_2CrH_8O_4{}^+$ Dichlorotetraaquochromium(III) ion, 2.50
Cl_2Fe^+ Dichloroiron(III) ion, 2.62
$CoBrH_{15}N_5{}^{2+}$ Bromopentaamminecobalt(III) ion, 2.27
$CoClH_{15}N_5{}^{2+}$ Chloropentaamminecobalt(III) ion, 2.26
$CoFH_{15}N_5{}^{2+}$ Fluoropentaamminecobalt(III) ion, 2.25
$CoH_9N_6O_6$ Trinitrotrisamminecobalt(III), 2.34
$CoH_{15}IN_5{}^{2+}$ Iodopentaamminecobalt(III) ion, 2.28
$CoH_{15}N_5O_4P$ Phosphatopentaamminecobalt(III), 2.37
$CoH_{15}N_6O_2{}^{2+}$ Nitropentaamminecobalt(III) ion, 2.33
$CoH_{15}N_8{}^{2+}$ Azidopentaamminecobalt(III) ion, 2.31
$CoH_{16}N_5O^{2+}$ Hydroxopentaamminecobalt(III) ion, 2.24
$CoH_{17}N_5O^{3+}$ Aquopentaamminecobalt(III) ion, 2.23
$CoH_{18}N_6{}^{3+}$ Hexaamminecobalt(III) ion, 2.22
$CrO_4{}^{2-}$ Chromate(VI) ion, 2.52
$Cr_2O_7{}^{2-}$ Dichromate(VI) ion, 2.53
Cu^{2+} Copper(II) ion, 2.54
D_2 Deuterium, 2.68
D_2S Deuterium sulfide, 2.93c
F^- Fluoride ion, 2.55
FFe^{2+} Fluoroiron(III) ion, 2.60
F_2Fe^+ Difluoroiron(III) ion, 2.60
F_3Sn^- Trifluorostannate(II) ion, 2.97
F_6Sn^{2-} Hexafluorostannate(IV) ion, 2.99
Fe^{2+} Iron(II) ion, 2.56
Fe^{3+} Iron(III) ion, 2.57
$FeHO^{2+}$ Hydroxoiron(III) ion, 2.58
FeH^{2+} Hydroiron(III) ion, 2.59
H Hydrogen atom, 2.2
H^+, 2.67
HNO_2 Nitrous acid, 2.84
HO Hydroxyl radical, 2.3
HO^- Hydroxide ion, 2.90
HO_2 Perhydroxyl radical, 2.4
HO_3P^{2-} Hydrogen phosphite ion, 2.91
HO_4P^{2-} Hydrogen phosphate ion, 2.92
H_2O_2 Hydrogen peroxide, 2.69
$H_2O_4P^-$ Dihydrogenphosphate ion, 2.91b
H_2O_5S Peroxysulfuric acid, 2.95
H_3N Ammonia, 2.80
H_3O_4P Phosphoric acid, 2.91a
H_4N^+ Ammonium ion, 2.78
$H_5N_2{}^+$ Hydrazinium ion, 2.79
Hg^{2+}, 2.70
$Hg_2{}^{2+}$, 2.70a
I^- Iodide ion, 2.72
I_2 Iodine, 2.71
$I_2{}^-$, 2.73
$I_3{}^-$, 2.74
$IO_3{}^-$ Iodate ion, 2.75
Mn^{2+} Manganese ion, 2.76
$MnO_4{}^-$ Permanganate ion, 2.77
NO Nitric oxide, 2.82
$NO_2{}^-$ Nitrite ion, 2.85
$NO_3{}^-$ Nitrate ion, 2.86
$NO_7S_2{}^{2-}$ Nitrosyldisulfonate ion (Fremy's salt), 2.87
N_2O Nitrous oxide, 2.83
$N_3{}^-$ Azide ion, 2.81
Ni^{2+} Nickel(II) ion, 2.88
O_2 Oxygen, 2.89
O_2U^{2+} Uranyl(VI) ion, 2.102
$O_8S_2{}^{2-}$ Peroxydisulfate ion, 2.94
Pr(III) Praseodymium(III) ion, 2.92a
Sn(II) Tin(II) ion, 2.96
Sn(IV) Tin(IV) ion, 2.98
Te(VI) Tellurium(VI) ion, 2.100
Tl^+ Thallium(I) ion, 2.101
Zn^{2+} Zinc(II) ion, 2.103

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