Thermochemical Data on Gas-Phase Ion-Molecule Association and Clustering Reactions

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A comprehensive tabulation of the standard enthalpy change, ΔH°, entropy change, ΔS°, and free energy change, ΔG°, for the formation of ion clusters from ion-molecule association reactions is given. The experimental methods which are used to derive the data are briefly discussed. For some experiments, dissociation energies of ion clusters are reported and listed under the category of ΔH°. The relationship between ΔH° and dissociation energy is discussed in the text.

Key words: cluster ions; ion-molecule reactions; thermodynamics.

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1. Introduction

The last 15 years have been marked by a dramatic increase in research work on the formation and properties of gas-phase ion-molecule complexes and cluster ions. As a result of this interest, a large amount of data on the thermochemical properties of cluster ions has appeared in the literature. Work in this area spans a broad range of fields including geophysics, electrochemistry, organic chemistry, and chemical physics to name a few. The scope of applications of such data is due to the recognition of the value of the investigation of cluster ion formation in bridging the gap between the gas and condensed phases and in probing the details of molecular interactions and energy transfer. Studies of cluster ions are relevant to phenomena such as nucleation, the development of surfaces, catalysis, solvation, acid–base chemistry, combustion, and atmospheric processes. The entire research area has been the subject of a recent extensive review[1] to which the interested reader is referred.

Cluster ion thermochemistry has been discussed in several early reviews including three general ones by Kebarle[2–4] covering the period up through 1976. Several others devoted largely to the authors' own works, but with some attention to the general field include Kebarle[5,6] and Castleman and coworkers.[7–10] Other general reviews[11–18] also contain some information related to this topic. However, until the present, there has been no complete tabulation of thermochemical data on cluster ions. In this paper we have attempted to compile all known thermodynamic data on the bonding of ligands to ions. Since such a lofty goal is difficult to accomplish in practice, and since thermodynamic data are sometimes presented in articles whose titles do not always suggest their full content, we wish to apologize in advance to authors whose works we may have inadvertently overlooked. The subject of proton transfer and proton affinities is not covered and the interested reader is referred to other sources.[11,12,19]

2. Thermodynamics of Cluster Reactions

Cluster formation can be represented by a series of stepwise association reactions of the form

$$\mathrm{I}\cdot(n-1)\mathrm{L} + \mathrm{L} + \mathrm{M} = \mathrm{I}\cdot n\mathrm{L} + \mathrm{M}. \tag{1}$$

Here, I designates a positive or negative ion, L the clustering neutral (ligand), and M the third body necessary for collisional stabilization of the complex. Taking the standard state to be 1 atm, and making the usual assumptions[20] concerning ideal gas behavior and the proportionality of the chemical activity of an ion cluster to its measured intensity, the equilibrium constant $K_{n-1,n}$ for the nth clustering step is given by

$$\ln K_{n-1,n} = \ln \frac{C_n}{C_{n-1}P_{\mathrm{L}}} = -\frac{\Delta G^\circ_{n-1,n}}{RT}$$

$$= -\frac{\Delta H^\circ_{n-1,n}}{RT} + \frac{\Delta S^\circ_{n-1,n}}{R}. \tag{2}$$

Here, C_{n-1} and C_n represent the respective measured ion intensities; P_{L} the pressure (in atm) of the clustering species L; $\Delta G^\circ_{n-1,n}$, $\Delta H^\circ_{n-1,n}$, and $\Delta S^\circ_{n-1,n}$ the standard Gibbs free energy, enthalpy, and entropy changes, respectively; R the gas-law constant; and T, absolute temperature. By measuring the equilibrium constant $K_{n-1,n}$ as a function of temperature, the enthalpy and entropy change for each sequential association reaction can be obtained from the slope and intercept of the van't Hoff plot ($\ln K_{n-1,n}$ versus $1/T$).

Thermodynamic information also can be obtained by studying switching or exchange reactions of the form

$$\mathrm{I}\cdot n\mathrm{L} + \mathrm{L}' = \mathrm{I}\cdot(n-1)\mathrm{L}\cdot\mathrm{L}' + \mathrm{L}. \tag{3}$$

The thermodynamic quantities for the association of L′ onto $\mathrm{I}\cdot(n-1)\mathrm{L}$ are the sum of those for reactions (1) and (3).

3. Temperature Dependence of ΔH° and ΔS°

Experimental techniques that employ van't Hoff plots lead to enthalpy changes derived from slopes which are representable as straight lines over moderate temperature ranges. In actuality, the enthalpy change is a weak function of temperature due to the difference in heat capacity ΔC_p between products and reactants,

$$\Delta H_{T_2} = \Delta H_{T_1} + \int_{T_1}^{T_2} \Delta C_p(T)\, dT. \tag{4}$$

The various experimental techniques measure and report various related values: the enthalpy change ΔH°_T of association, the bond dissociation energy D_0 ($= -\Delta H^\circ_0$), or the potential well depth D_e ($= D_0 + \frac{1}{2}\Sigma_i h\nu_i$), where ν_i are the frequencies of the vibrational modes related to the association bond.

In almost all situations of interest to the field of cluster ions, the electronic contribution to the heat capacity is negligible. Important contributions to the heat capacity, then, are those arising from translation, rotation, and vibration. At temperatures above a few tens of kelvins, rotation is usually fully activated and it is the quantitative evaluation of the vibrational contribution which is difficult to make because it requires a knowledge of the vibrational frequencies of the cluster. Since ion–neutral bonds are relatively weak, the frequencies associated with these are typically low. Therefore, they are particularly important in calculating ΔC_p in the temperature range 100–600 K over which most association reaction thermochemical data are derived.

A few investigators (e.g., Conway and co-workers,[21–24] Castleman and co-workers,[10] and Keesee[25]) have considered in detail the problem of the effect of the vibrational contribution in heat capacity on the temperature dependence of ΔH°. For example, in the case of Cl^- associated with water,[10,25] the measured enthalpy change ΔH°_{470} is -14.9 kcal/mol. Using the calculated vibrational frequencies of Kistenmacher *et al.*,[26] ΔH°_{298} and ΔH°_0 ($= -D_0$) were calculated to be -14.9 and -14.2 kcal/mol, respectively. Thus the common practice in the literature to discuss measured enthalpy changes in terms of "bond energies" appears to be a reasonable approximation.

The van't Hoff plots also enable a determination of the entropy change. Rigorously the entropy is also dependent on temperature, although only weakly so. The entropy change can be calculated through use of standard statistical mechanics[27] with knowledge of both the structure, to determine moments of inertia, and vibrational frequencies. Based on the calculated frequencies and structure of $Cl^-\cdot H_2O$,[26] the entropy change at 470 K for the association of water onto Cl^- is calculated to be -19.1 cal/K mol compared to the experimentally determined value of -19.7. At 298 K, the entropy change is computed to be -18.9 cal/K mol.

The translational contribution to the entropy change due to the loss of translational degrees of freedom upon association is largely responsible for the overall negative value of ΔS°. The rotational and particularly the vibrational contributions are significant in that they reflect the details about the structure of the cluster ion. For examples of applications in this regard, the reader is referred to Dzidic and Kebarle[28] and Castleman *et al.*[29]

4. Experimental Techniques

The Knudsen cell technique[30] was apparently the method which provided one of the first direct measurements of a thermodynamic quantity for the formation of a cluster ion ($K^+\cdot H_2O$) that has stood the test of time. Other early observations of ion clusters were obtained in ion sources operated in the neighborhood of 10^{-4} Torr (1 Torr$\approx$133 Pa); but, equilibrium conditions were generally not attainable with the few collisions taking place and thermodynamic parameters could usually not be measured with confidence. Field,[31] Melton and Rudolf,[32] and Wexler and Marshall[33] were successful in observing reactions which required a third body for stabilization by using essentially conventional mass spectrometric ion sources, but equipped with small ion exit slits and improved pumping. However, it was generally impossible to ensure that complete thermalization of the ions and the attainment of equilibrium with respect to clustering had occurred.

The advent of high-pressure mass spectrometry (HPMS) has been particularly valuable in quantitatively determining the thermodynamic properties of ion clusters. The first application and development of this technique specifically to determine the thermodynamics of clustering reactions was made by Kebarle and co-workers.[34] In this technique, ions effuse from a high-pressure source (typically a few Torr) through a small aperture into a mass filter where the distribution of ion clusters is determined. Ionization may be initiated by various methods including radioactive sources, heated filaments, and electric discharges. The pressure of the ion source is maintained sufficiently high such that ions reside in a region of well-defined temperature for a time adequate to ensure the attainment of equilibria among the various ion cluster species of interest; but, at the same time, the pressure must be low enough to avoid additional clustering via adiabatic expansion as the gas exits the sampling orifice.

Other variations of the theme include low field drift tubes with sampling mass spectrometer (DTMS) and pulsed ionization sources as in pulsed high-pressure mass spectrometry (PHPMS) or stationary afterglow–mass spectrometry (SAMS). In pulsed ion sources, the kinetics (with corrections for diffusional losses) and approach to equilibrium with increasing residence time of the ions in the high-pressure source can be directly monitored. Thermodynamic data can be obtained at lower source pressures in the pulsed mode compared to continuous ionization modes. This is so since the collection of data can be delayed for some time after the pulse, thus avoiding those ions which exit the source with insufficient residence time.

The flowing afterglow technique (FA) developed by Ferguson, Fehsenfeld, and Schmeltekopf[35] and other related flow reactors such as the selected ion flow tube (SIFT)[36] have provided a wealth of data on general ion-molecule reactions[37] and in the process several ion clusters have also been studied.

In the flowing afterglow apparatus, the ionization with, for instance, a microwave discharge or electron gun, occurs upstream directly in the carrier gas. The flow tube is generally about 1 m long and 8 cm in diameter. Flow velocities are on the order of 10^2 m s^{-1} and tube pressures are typically around 1 Torr. While most of the gas is pumped away, a

small fraction is sampled through an orifice where the ions are mass identified and counted. Reactant gases are added into the flow, so kinetic data and the approach to equilibrium can be determined by varying the position of the reactant injection, the flow rate of reactant into the tube, or the bulk flow velocity. In comparison to PHPMS, the flow tube technique affords more versatility in making kinetic measurements and identifying mechanisms, whereas high-pressure mass spectrometry is more amenable to temperature control and enables measurements at higher pressures where equilibrium conditions can be more readily assured.

All the experimental techniques thus far described involve extraction of ions from a relatively high pressure into the high-vacuum region of a mass spectrometer. In these methods, draw-out potentials must be kept small to avoid cluster fragmentation. Additionally, Conway and Janik[24] pointed out that measurements made on larger clusters may be slightly influenced by unimolecular decomposition of the cluster ions following their exit from the high-pressure region. They specifically made estimates on the $O_2^+ \cdot nO_2$ cluster system. Sunner and Kebarle[38] have also considered this problem for the $K^+ \cdot nH_2O$ system.

Ion cyclotron resonance (ICR) experiments are typically performed at pressures of 10^{-5} Torr or less, so three-body association reactions are not likely to achieve equilibrium during typical ion trapping time (on the order of 1 s). Consequently, ICR data on ion clusters have been restricted to measuring the free energy change of switching reactions where the initial ion-molecule complex is formed by an elimination reaction such as[39]

$$Li^+ + (CH_3)_2CHCL \rightarrow Li^+(CH_3CH=CH_2) + HCl. \quad (5)$$

If a switching reaction involves an ion-molecule complex whose ΔG° of association is known by some other technique, then an absolute scale can be affixed to the ICR data. Enthalpy changes are estimated by calculating the entropy changes of the switching reactions based on the translational and rotational contributions.[40,41] The latter requires some assumption about the structure of the complex, but the result is not usually sensitive to the assumed structure. Also the vibrational contribution to the entropy change of the switching reaction is commonly assumed to be negligible. Some systems for which relative values are available, but an absolute scale is lacking, are $\eta^5C_5H_5Ni^+$,[42] Al^+,[43] Mn^+,[44] Cu^+,[45] Ni^+,[46] $FeBr^+$,[47] Co^+,[48] and CH_3Hg^+,[49] largely with organic ligands. Due to the low pressures in ICR experiments, questions concerning the temperature of the ions involved in the switching reactions are sometimes raised.

Photofragmentation (PF) and collision induced dissociation (CID) involve measurement of the energy thresholds of dissociation of ions and ion clusters in beams. Photoionization (PI) and electron impact ionization (EI) thresholds for clusters in neutral beams also have been used to derive bond energies D_0 for ion clusters. The bond energies can be derived from measurements of appearance potentials if it is assumed that adiabatic values are obtained from the measurements and if the bonding of the neutral precursor is known or can be adequately estimated. The bonding of ammonia to NH_4^+ has been derived from the photoionization of ammonia clusters,[50] where similar measurements have been determined by Stephan *et al.*[51] using electron impact ionization. The values differ significantly from those derived by high-pressure mass spectrometric techniques in the cases where ionization is followed by a spontaneous "internal" reaction such as $NH_3^+(NH_3)_n \rightarrow NH_4^+(NH_3)_{n-1} + NH_2$.

Other methods which have produced information on the bonding in ion-molecule association complexes include inversion of ionic mobility data (M) in rare gases which lead to potential well-depths D_e, scattering experiments (S), emission spectroscopy (ES), reactive energy thresholds (RET), and various drift tube experiments (DT). Arnold and co-workers[52,53] have made rough estimates of thermodynamic quantities of several cluster ions found in the stratosphere based on balloon measurements of relative ion densities along with estimates of atmospheric temperature and appropriate neutral concentrations. McDaniel and Vallee[54] measured halide–hydrogen halide bond energies by measuring the heat of absorption of HX into a crystal MX, where M^+ was chosen to minimize the lattice energy of the crystal, and assuming that this quantity was identical to the gas-phase process $X^- + HX \rightarrow HX_2^-$.

5. Thermodynamic Data

Tables 1–9 represent a compilation of thermodynamic data of ion-molecule association reactions as given by reaction (1) for the neutral (L) and the ion (I) for each addition step n. The tabulations are hopefully complete through 1984 and also include some more recent data. All thermodynamic values are expressed in the calorie system of units because most of the literature covered employs these units. For comparison of SI units, note that 1 cal = 4.184 J. The tables are arranged according to the clustering neutral species. Tables 1–3 compile data on the hydration of inorganic positive ions, inorganic negative ions, and organic ions, respectively. In Tables 1 and 2, atomic ions are listed first, then molecular ions, and finally cluster ions. In Table 3, the organic ions are ordered according to the number of carbon atoms followed by the number of hydrogen atoms, nitrogen atoms, and oxygen atoms. Cluster ions and negative organic ions are found at the end of this table. Tables 4–7 give data for the rare gases, diatomics, triatomics (except water), and inorganic

polyatomics. Table 8 presents data on the association of organic species with gaseous ions. The organic species are ordered as in Table 3 by the number of carbon atoms and then sequentially by the number of hydrogen, nitrogen, and oxygen atoms. The ions are listed in order of inorganic positive ions, organic positive ions (again ordered by number of carbon atoms except in the cases of cluster ions which immediately follow the listing for the unassociated ion), and negative ions. Table 9 includes data for organic systems where more than just the first association reaction was reported.

Our survey has been largely confined to data obtained by direct measurements of association or exchange reactions. In general, we have not attempted to follow up on values which may be derived through circuitous routes employing appearance potential measurements except where the original authors have devoted their paper to cluster-ion bonding. As an example, electron impact appearance potentials exist for several metal carbonyls from which thermodynamic data on the $M^+ \cdot nCO$ system could be derived. The interested reader is referred to the recent compilation of appearance potentials by Levin and Lias.[55] Also, in many cases where data are given for $AH^+ \cdot B$ or $A^- \cdot HB$, the thermodynamic values for $BH^+ \cdot A$ and $B^- \cdot HA$, are not included although they can be calculated if proton transfer (proton affinity) data are known. Such data are available in sources such as Lias *et al.*,[19] Taft,[11] and Bartmess *et al.*[56]

Thermodynamic data which are not directly measured quantities are shown in parentheses (with the caveat mentioned in the experimental section for those based on methods involving direct ionization of neutral clusters). Values annotated by an "s" indicate that the indirect measurement is based on a simple switching reaction or, in the case for ICR measurements, on a scale based on the indicated complex. Those annotated by a "c" involved more indirect thermodynamic cycles where an "s" indicates that measured switching reactions were used in the cycle. Bracketed values are entropy changes given in the cited references which have been assumed or calculated (particularly for switching reactions) from statistical mechanics and the enthalpy changes are those derived from the entropy changes and measured Gibbs free energy changes. Indirect measurements which require proton affinity differences have been based on the proton affinities of Lias *et al.*,[19] except in studies where these differences were measured directly during the same study. The abbreviation for the experimental methods are given in the previous section. When several references are listed for indirectly determined values, the experimental method shown is that of the reference listed first. The subsequent ones refer to the additional sources of the other thermodynamic values which are required. In the cases where cycles are used, it is assumed the measured reactions do not involve different isomeric forms. One should note, however, that Hiraoka and Kebarle,[57] for instance, found evidence of two isomeric forms of $C_2H_7^+$ from the association of H_2 with $C_2H_5^+$ depending on the temperature range of the reaction.

Enthalpy changes, bond dissociation energies, and potential well-depths are all listed under the heading of $-\Delta H^\circ$ for convenience. The actual quantity reported depends on the experimental method as described in the previous section. Many of the Gibbs energy changes, $-\Delta G^\circ$, which are given for 298 or 300 K were not measured at that temperature, but were extrapolated from van't Hoff plots. The temperature range of nearly all the reported van't Hoff plots lies between 100 and 600 K.

As a general guide, the uncertainties of the values in these tables are often reported to be in the range $\pm$ (0.5 to 1.5) kcal/mol for enthalpy changes, $\pm$ (2 to 4) cal/K mol for entropy changes, and $\pm$ (0.2 to 0.5) kcal/mol for free energy changes. The interested reader should, however, consult the specific references for reported uncertainties.

Table 1. Thermodynamic quantities for the gas-phase hydration of inorganic positive ions $M^+(H_2O)_{n-1} + H_2O \rightarrow M^+(H_2O)_n$.

Ref.	Ion	$-\Delta H^\circ_{n-1,n}$ (kcal/mol) 1	2	3	4	5	6	7	8	$-\Delta S^\circ_{n-1,n}$ (cal/K mol) 1	2	3	4	5	6	7	8
28	Li^+	(34)	25.8	20.7	16.4	13.9	12.1			[23]	21.1	24.9	29.9	31.4	32.0		
28	Na^+	24.0	19.8	15.8	13.8	12.3	10.7			21.5	22.2	21.9	25.0	28.1	26.0		
58		---	---	14.9	12.6	10.6				---	---	20.8	23.7	24.9			
59		---	---	---	13.6	11.6				---	---	---	26.0	26.5			
20		---	---	---	12.6					---	---	---	22.0				
297		26.5								22							
60	K^+	17.9	16.1	13.2	11.8	10.7	10.0			21.6	24.2	23.0	24.7	25.2	25.7		
61		16.9								19.9							
30		---								---							
297		19.4								21.3							
28	Rb^+	15.9	13.6	12.2	11.2	10.5				21.2	22.2	24.0	24.8	25.7			
297		16.0								20.1							
28	Cs^+	13.7	12.5	11.2	10.6					19.4	22.2	23.7	25.4				
62		11.9	11.3	9.7						14.3	16.6	16.6					
63	Ag^+	33.3	25.4	15.0	14.9	13.7	13.3			28.4	22.3	21.6	29.5	30.3	32.2		
64	Bi^+	22.8	17.7	14.0	12.0	10.5	9.7			27.1	25.5	24.4	23.5	22.7	23.6		
63	Cu^+	---	---	16.4	16.7	14.0				---	---	23.9	30.2	29.1			
59	Pb^+	22.4	16.9	12.2	10.8	10.0	9.6			35.5	25.3	20.2	20.8	22.3	23.6		
58	Sr^+	34.5	30.5	25.7	22.3	20.6	18.3	17.3	16.4	31.1	28.1	28.6	28.2	30.5	30.5	34.4	37.6
297	$SrOH^+$	29.9								21.5							
297	$CaOH^+$	34.4								21.5							
65	NO^+	18.5	16.1	---						23.0	25.5	---					
66		---								---							
67		---								---							
68		---								---							
69		---								---							
297		22.7								23.9							
70	H_3O^+	31.6	19.5	17.5	---					24.3	21.7	27.3	---				
71		36	22.3	17	15.3	13	11.7	10.3		33.3	29	28.3	32.6	30.3	29.6	27	
72		---	---	17.9	12.7	11.6	10.7			---	---	28.4	23.4	25.0	26.1		
73		33	21	16	---					33.6	19.8	20.3	---				
74		---	20	16.2	14.8					---	31	26.7	31.7				
75		7	13	16.8	12.9	8.5				-1	14	28	28	17			
76		16.5	---	---	---					16.3	---	---	---				
77		16.3	14.8	17.6	---					17.2	16.9	30	---				
78		---	---	---	12.7	11.4				---	---	---	23.3	23.5			
79		32	23	17	---					---	---	---	---				
69		---	---	---	---					---	---	---	---				
80		---	---	---	---					---	---	---	---				
81		---	---	---						---	---	---	---				
82		---	---	---	---					---	---	---	---				
83		---	---	---	---					---	---	---	---				
68		---	---	---	---					---	---	---	---				
84	NH_4^+	17.3	14.7	13.4	12.2	9.7				19.7	21.9	25.1	27.3	22.4			
85		19.9	(14.8)	12.2	10.8	10.6	(9.1)	(8.4)		23.1	[24.5]	21.2	23.0	27.0	[21.2]	[23]	
73	H_3S^+	17.0								17.8							
86,70,87		(21.2)[c]	(20.3)[c]							(24.5)	(21.8)						
88,70,19	H_2CN^+	(27.6)[c]								(23.8)							
146		27.4	21.4	17.2						24.2	25.3	26.2					
89	O_2^+	>16								---							
90	H_2O^+	>36								---							
91,19	HCO^+	(43.2)[c]								---							
85		---	(24.1)							---	[26]						
93,85.19	PH_4^+	(13)								---							
94	$Na^+ \cdot SO_2$	19.8								20.2							
95,28	Na^+CO_2	(20.7)[c]	(17.4)[c]	(12.4)[c]						(25.3)	(23.6)	([23])					
96,28,95		(22.9)[c]								(25.6)							
86,70,19	$H_3S^+ \cdot H_2S$	(19.1)[c]								(21.8)							
84	$NH_4^+ \cdot NH_3$	12.9	12.7	12.2						20.3	25.0	28.5					
84	$NH_4^+ \cdot 2NH_3$	12.4	11.7							24.6	27.8						
84	$NH_4^+ \cdot 3NH_3$	11.7								27.9							
97,60	$K^+ \cdot C_6H_6$	(18.1)[s]	(12.7)[c]	(11.8)[c]						(29.9)	(21.4)	(26.3)					
97,60	$K^+ \cdot 2C_6H_6$	(13.7)[s]	(12.2)[c]							(26.1)	(29.4)						

Ion	$-\Delta G^{\circ}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	7	8	(K) T	Method	Comments
Li^+	(27.2)	18.9	13.3	7.5	4.5	2.5			298	HPMS	(interpolated)
Na^+	17.6	13.2	9.3	6.3	3.9	2.9			298	HPMS	
	---	---	8.7	5.5	3.2				298	HPMS	
	---	---	---	5.9	3.7				298	HPMS	
	---	---	---	6.0	---				298	HPMS	
	19.9								298	MS	Flame Source (~1600 K)
K^+	11.5	8.9	6.3	4.4	3.2	2.3			298	HPMS	
	11.0	---							298	HPMS	
	0.4	---							840±50	MS	Knudsen Cell Source
	13.0								298	MS	Flame Source (~1600 K)
Rb^+	9.6	7.0	5.0	3.8	2.8				298	HPMS	
	10.0								298	MS	Flame Source (~1600 K)
Cs^+	7.9	5.9	4.2	3.0					298	HPMS	
	7.6	6.4	4.8						298	DTMS	
Ag^+	24.8	18.6	8.6	6.1	4.7	3.7			298	HPMS	
Bi^+	14.7	10.0	6.6	5.0	3.6	2.6			298	HPMS	
Cu^+	---	---	9.3	7.7	5.3				298	HPMS	
Pb^+	11.6	9.3	6.2	4.6	3.3	2.5			298	HPMS	
Sr^+	25.2	22.1	17.1	13.8	11.5	9.2	7.0	5.1	298	HPMS	
$SrOH^+$	23.3								298	MS	Flame Source (~1600 K)
$CaOH^+$	28.0								298	MS	Flame Source (~1600 K)
NO^+	11.6	8.5	5.4*						298,308*	PHPMS	
	---	8.5	6.0						296	FA	
	---	8.4	5.9						293	HPMS	
	---	---	6.2						295	FA	
	(12.7)[s]	8.5	6.0						296	SAMS	[s]NO^+–NO
	15.6								298	MS	Flame Source (~1600 K)
H_3O^+	24.3	13.0	9.3	---					298	PHPMS	
	25	13.6	8.5	5.5	3.9	2.8	2.2		298	HPMS	
	---	---	9.5	5.6	4.1	3.0			298	PHPMS	
	22.9	15.1	9.9	---					300	PHPMS	
	---	10.8	8.2	5.4					298	HPMS	
	7.7	9.3	8.4	4.8	3.4				300	HPMS	
	11.7	---	---	---					298	HPMS	
	11.2	9.7	8.6	---					298	HPMS	
	---	---	---	5.7	4.35				300	HPMS	Optimum of several values
	---	---	---	---					---	CI	Deuterated
	---	---	9.2	5.4					296	SAMS	
	---	---	9.4	5.3					298	FA	
	---	---	8.3	5.0					307	PHPMS	
	---	---	8.4	5.0					300	PHPMS	
	8.1	8.6	9.1	7.0					300	HPMS	Optimum of several values
	---	---	---	4.7					295	FA	
NH_4^+	11.4	8.2	5.9	4.1	3.0				298	PHPMS	
	13.0	4.6‡	5.9	3.9	2.6	3.2*	2.8@		298;414‡	HPMS	*266; @254
H_3S^+	11.7								298	PHPMS	
	(14.2)	(13.8)							300	HPMS	[c]H_2O/H_2S(s)+ΔPA
H_2CN^+	(20.5)								298	ICR	[c]H_3O^+–H_2O(s)+ΔPA
	20.2	13.9	9.4						298	HPMS	
O_2^+	---								---	FA	>O_2^+–SO_2
H_2O^+	---								---	PI	
HCO^+	---								298	---	[c]ΔH_f+PA; cf. Ref. 92
	---	9.0							582	HPMS	
PH_4^+	---								---	ICR	bracketed; see H_3O^+–PH_3
$Na^+ \cdot SO_2$	13.8								298	HPMS	
Na^+CO_2	(13.2)	(10.4)	(5.5)						298	HPMS	[c]H_2O/CO_2
	(15.3)								298	FA	[c]H_2O/CO_2
$H_3S^+ \cdot H_2S$	(12.9)								300	PHPMS	[c]H_2O/H_2S(s)+ΔPA
$NH_4^+ \cdot NH_3$	6.9	5.3	3.7						300	PHPMS	[s-cf. Ref. 109]
$NH_4^+ \cdot 2NH_3$	5.0	3.5							300	PHPMS	[s-cf. Ref. 109]
$NH_4^+ \cdot 3NH_3$	3.4								300	PHPMS	[s-cf. Ref. 109]
$K^+ \cdot C_6H_6$	(9.3)	(6.3)	(3.9)						298	HPMS	[s]$K^+ \cdot C_6H_6$–C_6H_6; [c]H_2O/C_6H_6(s)
$K^+ \cdot 2C_6H_6$	(5.9)	(3.4)							298	HPMS	[s]$K^+ \cdot 2C_6H_6$–C_6H_6; [c]H_2O/C_6H_6(s)

Table 2. Thermodynamic quantities for the gas-phase hydration of inorganic negative ions $M^-(H_2O)_{n-1} + H_2O \rightarrow M^-(H_2O)_n$

		$-\Delta H^o_{n-1,n}$ (kcal/mol)						$-\Delta S^o_{n-1,n}$ (cal/K mol)					
Ref.	Ion	1	2	3	4	5	6	1	2	3	4	5	6
98	F^-	23.3	16.6	13.7	13.5	13.2		17.4	18.7	20.4	26.9*	30.7	
99		---						---					
98	Cl^-	13.1	12.7	11.7	11.1			16.5	20.8	23.2	25.8		
100		14.9	12.6	11.5	10.9			19.7	20.5	22.4	24.8		
330		14.7	13.0	11.8				19.7	21.4	22.3			
101		---						---					
99		---						---					
295,4		(14.4)						[20.1]					
297		14.8						20.1					
98	Br^-	12.6	12.3	11.5	10.9			18.4	22.9	24.8	26.8		
99		---						---					
297		14.8						19.8					
98	I^-	10.2	9.8	9.4				16.3	19.0	21.3			
100		11.1	9.9	9.3				19.3	20.3	21.0			
99		---						---					
102	H^-	~17						---					
101,103	O^-	(<30)[c]						---					
103	OH^-	22.5	16.4	15.1	14.2	14.1		19.1	19.3	24.8	29.5	33.2	
104		25	17.9					20.8	21.2	---			
105		34.5	23	18				---	---				
101		---						---					
102		22.1						---					
298		27	18					---	---				
103	O_2^-	18.4	17.2	15.4	---			20.1	25.1	28.2			
99		---						---					
106		---						---					
101		---						---					
101	O_3^-	---						---					
104	NO_2^-	14.3	12.9	10.4	---			21	23.7	21.2			
107		15.2	13.6	11.7	11.6			23.8	26.4	25.8	29.0		
99		---						---					
108		---						---					
101		---						---					
104	NO_3^-	12.4	---	---				19.1					
107		14.6	14.3	13.8				25.0	30.3	33.2			
108		---						---					
101		---						---					
110	CO_3^-	14.1	13.6	13.1				25.2	29.6	32.5			
101		---						---					
111	CO_4^-	~14.6	~10.6					---					
101,103		---						---					
110	HCO_3^-	15.7	14.9	13.6	13.4			24.1	29.1	30.2	33.3		
104	CN^-	13.8						19.8					
101	SO_3^-	---						---					
101	SO_4^-	---						---					
112	HSO_4^-	11.9						19.8					
149	PO_3^-	13.0						22.5					
94	$Cl^- \cdot SO_2$	10.4	9.3					19.4	19.7				
101		---						---					
94	$Cl^- \cdot 2SO_2$	9.9						22.7					
113	$Cl^- \cdot HCl$	10.5	9.6					18.7	20.4				
113	$Cl^- \cdot 2HCl$	7.6						15.2					

Ion	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	(K) T	Method	Comments
F^-	18.1	11.0	7.6	5.5	4.1*		298	HPMS	* typographical error in ref.
	---	---	---	6.1	4.7		298	HPMS	
Cl^-	8.2	6.5	4.8*	3.4			298	HPMS	typographical error in ref.
	9.0	6.5	4.8	3.5			298	HPMS	
	8.8	6.6	5.1	---			298	HPMS	
	8.2	6.7	4.9	---			296	FA	
	---	---	5.4	4.0	3.0		298	HPMS	
	(8.4)[s]						298	ICR	[s] Cl^--t-C_4H_9OH
	8.8						298	MS	Flame Source (~1600 K)
Br^-	7.0	5.5	4.1	2.9			298	HPMS	
	---	5.8	4.5	3.3			298	HPMS	
	8.9						298	MS	Flame Source (~1600 K)
I^-	5.4	4.2	3.1	---			298	HPMS	
	5.3	3.9	3.0	---			298	HPMS	
	5.6	4.3	3.4	2.25			298	HPMS	
H^-	---						---	RET	Deuterated
O^-	---						---	FA	Based on $O^-(H_2O)+H_2O \rightarrow OH^-(H_2O)+OH$
OH^-	16.9	10.7	7.7	5.4	4.2		298	HPMS	Deuterated
	18.8	11.6	---	---			298	HPMS	
	---	---	---	---			---	CID	Deuterated
	---	---	---	5.6			298	FA	
	---	---	---				---	RET	Deuterated
	---	---					---	CID	
O_2^-	12.4	9.7	7.0	3.4			298	HPMS	
	---	---	6.25	4.55			298	HPMS	
	---	8.4	7.1	---			300.5	SA-MS	
	---	---	5.3	---			296	FA	
O_3^-	---	6.2	4.5				296	FA	
NO_2^-	8.0	5.8	4.1				298	HPMS	
	8.1	5.8	4.0	3.0			298	HPMS	
	---	6.2	4.6	3.5			298	HPMS	
	8.4	5.8					300	SAMS	
	8.0	5.9					296	FA	
NO_3^-	6.7	---	---				298	HPMS	
	7.1	5.3	3.9				298	HPMS	
	7.0	---	---				300	SAMS	
	6.8	5.0					296	FA	
CO_3^-	6.6	4.8	3.4				298	HPMS	
	6.7	4.3	---				296	FA	
CO_4^-	---	---	---				---	HPMS	
	(7.7)[c]						296	FA	[c] O_2^- in CO_2/H_2O(s)
HCO_3^-	8.5	6.2	4.6	3.5			298	HPMS	
CN^-	7.9						298	HPMS	
SO_3^-	5.9						296	FA	
SO_4^-	5.1	1.6					296	FA	
HSO_4^-	6.0						298	FA	
PO_3^-	6.3						298	HPMS	
$Cl^-\cdot SO_2$	4.7	3.5					296	HPMS	
	(5.5)[c]						296	FA	[c] H_2O/SO_2(s)
$Cl^-\cdot 2SO_2$	3.2						296	HPMS	
$Cl^-\cdot HCl$	4.9	3.5					298	HPMS	Deuterated
$Cl^-\cdot 2HCl$	3.1						298	HPMS	Deuterated

Table 3. Thermodynamic quantities for the gas-phase hydration of organic ions.

Ref.	Formula	Compound	$-\Delta H^{\circ}_{n-1,n}$ (kcal/mol) 1	2	3	4	5	6	7	8	$-\Delta S^{\circ}_{n-1,n}$ (cal/K mol) 1	2	3	4	5	6	7	8
91,19	CH_3^+	CH_3^+	(66.6)[c]	(25)[i]							---							
85			---	25.4	21.0	14.8	11.6	9.1	9.4	(8.9)	---	23.0	28.9	25.9	22.1	18.5	22.2	[22]
326			---	---	19.8	14.1	11.6	9.8	8.9		---	---	27.3	25.1	23.0	20.7	20.2	
115,70	CH_3O^+	H_2COH^+	(26.8)[c]	(18.5)[c]	(17.0)[c]						(23.9)	(22.0)	(25.5)					
85,(70,19)			(27.7)[c]	21.5	17.6	12.9	11.1	9.5	10.0		(21.9)	27.0	25.5	23.2	22.6	20.8	25.7	
88,70,19			(26.5)[c]								(22.1)							
116,70,19			---								---							
117	$CH_3O_2^+$	prot. formic acid	(24.1)								[26]							
85	CH_4NO^+	$(H_2NCHO)H^+$	21.2	14.0	11.8	9.7	9.9				27.2	22.8	21.0	20.2	25.6			
260,19	CH_5^+	CH_5^+	(42.5)[c]								(25.5)							
---	CH_5O^+	$CH_3OH_2^+$	---								---							
93,19	CH_5S^+	$CH_3SH_2^+$	(13.5)								---							
118			(16.9)								[25]							
119	CH_6N^+	$CH_3NH_3^+$	18.8	14.6	12.4						26.3	26.7	26.4					
85			16.8	14.6	12.3	10.3	(9.0)	(8.5)			21.8	24.2	24.1	22.0	[22.1]	[21.2]		
299,70,19	$C_2HO_2F_3$	CF_3COOH	(28.3)								[23.3]							
120	$C_2H_3O^+$	CH_3CO^+	24.6								33.1							
121			---	21.9							---							
85			---	20.1	17.8	12.9	10.8	(10.3)			---	21.0	26.4	23.2	20.4	[22.1]		
299,70,19	$C_2H_3OF_3^+$	$CF_3CH_2OH_2^+$	(30.5)								[23.8]							
85	$C_2H_4N^+$	CH_3CNH^+	24.8	17.5	15.6	11.2	10.4	10.1			28.4	25.1	24.8	21.8	23.4	25.5		
4;(91,19)	$C_2H_5^+$	$CH_3CH_2^+$	(38.5)[c]	24	19.2	14.2	12.5	---	13.1		---	26	28	26	26	---	28	
326			---	---	18.7	13.4	11.3	9.7			---	---	26.9	24.7	22.8	20.9		
119	$C_2H_5NF_3^+$	$CF_3CH_2NH_3^+$	21.1	17.3	14.2						30.0	29.9	29.2					
85	$C_2H_5O^+$	CH_3CHOH^+	25.0	16.8	17.0	11.3	9.4	9.3	9.8		27.6	25.2	27.9	21.4	18.8	21.7	25.8	
93,19	$C_2H_5OF_2^+$	$CF_2HCH_2OH_2^+$	(25)								---							
---	$C_2H_5O_2^+$	prot. acetic acid	---								---							
85	$C_2H_5O_2^+$	$(CH_3OCHO)H^+$	21.5	16.2	13.6	(11.0)					25.0	26.5	21.4	[21.6]				
---	$C_2H_7O^+$	$CH_3CH_2OH_2^+$	---								---							
122	$C_2H_7O^+$	$(CH_3)_2OH^+$	22.6	15.3	13.8	10.2					26.5	26.3	25.4	19.0				
85			24.0								29.0							
93,19	$C_2H_7S^+$	$(CH_3)_2SH^+$	(12)								---							
118			14.4								25.4							
119	$C_2H_8N^+$	$CH_3CH_2NH_3^+$	17.5	14.7	13.2						25.9	29.7	30.8					
85	$C_2H_8N^+$	$(CH_3)_2NH_2^+$	15.0	13.5	11.3	10.5	9.4	(8.4)			22.9	24.7	24.4	25.2	24.4	[21.2]		
123	$C_3H_5O^+$	$CH_3CH_2CO^+$	23.7								35.1							
92			---	---	16.4	12.7					---	---	24	24				
326	$C_3H_7^+$	$CH_3CH_2CH_2^+$	---	---	17.9	13.0	11.0	9.5	8.8		---	---	26.3	24.4	22.9	20.7	20.8	
77	$C_3H_7^+$	$(CH_3)_2CH^+$	17.6	13.5	14.9	---					27.7	12.7	21.5	---				
91,19,124			(23.6)[c]	---	---	---					---	---	---	---				
326			---	---	16.4	12.5	10.5	9.6	8.8	~7.9	---	---	24.1	23.6	21.5	21.9	21.3	~20
85	$C_3H_7O^+$	$(CH_3)_2COH^+$	20.5	13.6	12.7	10.3	10.3				26.0	23.2	21.9	20.2	23.5			
118	$C_3H_7O^+$	$CH_3CH^+OCH_3$	11.2								18.8							
---	$C_3H_7O_2^+$	prot. propionic acid	---								---							
---	$C_3H_9O^+$	$n\text{-}C_3H_7OH_2^+$	---								---							
---	$C_3H_9O^+$	$i\text{-}C_3H_7OH_2^+$	---								---							
300	$C_3H_9Sn^+$	$(CH_3)_3Sn^+$	(25.7)								[27.6]							
85	$C_3H_{10}N^+$	$nC_3H_7NH_3^+$	15.1	11.6	10.3	9.9					21.5	21.3	23.1	24.5				
125;85	$C_3H_{10}N^+$	$(CH_3)_3NH^+$	14.5	11.4	10.0	(8.4)					24.1	24.8	24.9	[21.6]				
118	$C_4H_5O^+$	furanH$^+$	20.8								43.4							
118	$C_4H_7O_2^+$	$(CH_3COOCH{=}CH_2)H^+$	(19.2)								[28.5]							
114	$C_4H_9^+$	$(CH_3)_3C^+$	11.2	---	17.7	14					22	---	29	28.7				
91,19,124			(10.6)[c]								---							
117	$C_4H_9O^+$	$c\text{-}C_4H_8OH^+$	21.8								28.8							
117	$C_4H_9O_2^+$	1,4-dioxaneH$^+$	20.9								25.8							

Formula	Compound	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	7	8	T(K)	Method	Comments
CH_3^+	CH_3^+	---								298	---	[c]ΔH_f's+PA; [i]interpolated; see Ref. 114
		---	18.5	12.4	7.1	5.0	3.6	2.8	3.0*	298, *269	HPMS	
		---	---	11.7	6.6	4.7	3.6	2.9		298	HPMS	
CH_3O^+	H_2COH^+	(19.7)	(11.9)	(9.4)						298	FA	[c]H_3O^+-H_2O/H_2CO(s)
		(21.2)	13.4	10.0	6.0	4.4	3.3	2.3		298	HPMS	[c]H_3O^+-H_2O+ΔPA
		(19.9)								298	ICR	[c]H_3O^+-H_2O+ΔPA
		(20.0)[c]	(11.7)[c]	(9.2)[c]						299	FA	[c]H_2O^+-H_2O/H_2CO(s)
$CH_3O_2^+$	prot. formic acid	9.0								582	HPMS	
CH_4NO^+	$(H_2NCHO)H^+$	13.1	7.2	5.5	3.7	2.3				298	HPMS	
CH_5^+	CH_5^+	(34.9)								298	---	[c]H_3O^+-CH_4+ΔPA
CH_5O^+	$CH_3OH_2^+$	---								---	---	see CH_3^+
CH_5S^+	$CH_3SH_2^+$	---								---	ICR	bracketed (±2 kcal)
		5.2								467	HPMS	
CH_6N^+	$CH_3NH_3^+$	11.0	6.7	4.5						298	PHPMS	
		10.3	7.4	3.7	3.5±	3.1*				298	HPMS	±269,*259
$C_2HO_2F_3$	CF_3COOH	(21.4)[c]								309	ICR	[c]H_3O^+-H_2O+ΔPA
$C_2H_3O^+$	CH_3CO^+	14.7								298	HPMS	converts to $CH_3C(OH)_2^+$
		---								---	HPMS	from Figure; quoted in Ref. 93
		---	13.8	9.9	6.0	4.7	4.1*			298,*280	HPMS	
$C_2H_3OF_3^+$	$CF_3CH_2OH_2^+$	(23.4)[c]								298	ICR	[c]H_3O^+-H_2O+ΔPA
$C_2H_4N^+$	CH_3CNH^+	16.3	10.0	8.2	4.7	3.4	2.5			298	HPMS	
$C_2H_5^+$	$CH_3CH_2^+$	---	16.3	10.9	6.5	4.8	---	4.8		298	HPMS	[c]ΔH_f's + PA (cf. Ref. 114)
		---	---	10.7	6.0	4.5	3.5			298	HPMS	
$C_2H_5NF_3^+$	$CF_3CH_2NH_3^+$	12.1	8.4	5.5						298	PHPMS	
$C_2H_5O^+$	CH_3CHOH^+	16.8	9.3	8.7	4.9	3.8	2.8	2.1		298	HPMS	
$C_2H_5OF_2^+$	$CF_2HCH_2OH_2^+$	---								---	ICR	bracketed (± 2 kcal)
$C_2H_5O_2^+$	prot. acetic acid	---								---	---	see CH_3CO^+
$C_2H_5O_2^+$	$(CH_3OCHO)H^+$	14.0	8.3	7.2	3.8*					258,*334	HPMS	
$C_2H_7O^+$	$CH_3CH_2OH_2^+$	---								---	---	see $C_2H_5^+$
$C_2H_7O^+$	$(CH_3)_2OH^+$	14.6	7.5	6.2	4.5					300	PHPMS	
		15.4								298	HPMS	
$C_2H_7S^+$	$(CH_3)_2SH^+$	---								---	ICR	bracketed (± 2 kcal)
		6.8								298	HPMS	
$C_2H_8N^+$	$CH_3CH_2NH_3^+$	9.8	5.8	4.0						298	PHPMS	
$C_2H_8N^+$	$(CH_3)_2NH_2^+$	8.2	6.1	4.0	3.0	2.1	3.0*			298,*255	HPMS	
$C_3H_5O^+$	$CH_3CH_2CO^+$	13.2								298	PHPMS	
		---	---	9.2	5.4					298	PHPMS	
$C_3H_7^+$	$CH_3CH_2CH_2^+$	---	---	10.1	5.7	4.2	3.3	2.6		298	HPMS	
$C_3H_7^+$	$(CH_3)_2CH^+$	9.2	9.7	8.5	---					300	HPMS	
		---	---	---	---					298	---	[c]ΔH_f's + PA (as in Ref. 114)
		---	---	9.2	5.5	4.1	3.1	2.5	1.9			
$C_3H_7O^+$	$(CH_3)_2COH^+$	12.8	6.7	6.2	4.3	3.3				298	HPMS	
$C_3H_7O^+$	$CH_3CH^+OCH_3$	5.6								298	HPMS	
$C_3H_7O_2^+$	prot. propionic acid	---								---	---	see $C_3H_5O^+$
$C_3H_9O^+$	$n\text{-}C_3H_7OH_2^+$	---								---	---	see $C_3H_7^+$
$C_3H_9O^+$	$i\text{-}C_3H_7OH_2^+$	---								---	---	see $C_3H_7^+$
$C_3H_9Sn^+$	$(CH_3)_3Sn^+$	((11.2)[s]								525	PHPMS	[s]$(CH_3)_3Sn^+$-CH_3OH
$C_3H_{10}N^+$	$nC_3H_7NH_3^+$	8.7	5.3	3.4	2.5					298	HPMS	
$C_3H_{10}N^+$	$(CH_3)_3NH^+$	7.3	4.0	2.6	3.0*					298,*254	HPMS	
$C_4H_5O^+$	$furanH^+$	7.9								298	HPMS	
$C_4H_7O_2^+$	$(CH_3COOCH{=}CH_2)H^+$	5.4								492	HPMS	
$C_4H_9^+$	$(CH_3)_3C^+$	4.6	---	9.1	5.4					298	PHPMS	
		---								298	---	[c]ΔH_f's + PA (as in Ref. 114)
$C_4H_9O^+$	$c\text{-}C_4H_8OH^+$	13.2								298	HPMS	tetrahydrofuranH$^+$
$C_4H_9O_2^+$	1,4-dioxaneH$^+$	13.2								298	HPMS	

Table 3. (continued) Thermodynamic quantities for the gas-phase hydration of organic ions.

Ref.	Formula	Compound	$-\Delta H^{\circ}_{n-1,n}$ (kcal/mol) 1	2	3	4	5	6	7	8	$-\Delta S^{\circ}_{n-1,n}$ (cal/K mol) 1	2	3	4	5	6	7	8
118	$C_4H_9O_2^+$	$H^+(CH_3COOCH_2CH_3)$	20.3								28.5							
85	$C_4H_{10}NO^+$	$CH_3(N(CH_3)_2)COH^+$	16.5	12.3	9.3	(9.0)					26.3	26.4	19.2	[21.6]				
118	$C_4H_{10}O^+$	$(CH_3)_2CH^+(OCH_3)$	10.8								23.3							
---	$C_4H_{11}O^+$	$(CH_3)_3COH_2^+$	---								---							
117	$C_4H_{11}O^+$	$(CH_3CH_2)_2OH^+$	20.9								30.0							
117	$C_4H_{11}O_2^+$	$CH_3OH^+(CH_2)_2OCH_3$	15.1								21.3							
324	$C_4H_{12}N^+$	$N(CH_3)_4^+$	9.0	(9.4)							21.5	[22]						
121	$C_5H_5NCl^+$	4-ClpyridineH$^+$	---								---							
121	$C_5H_5N_2O_2^+$	4-NO_2pyridineH$^+$	---								---							
121 125	$C_5H_6N^+$	pyridineH$^+$	15.0 16.1	9.6	8.3						25.5 27.0	19.6	19.6					
126	$C_5H_9NO_2^+$	prolineH$^+$	18.9								36.8							
85	$C_5H_9O^+$	$(c\text{-}C_3H_5)(CH_3)COH^+$	18.2	11.8	10.2	(10.0)	(9.7)				26.8	20.8	19.3	[21.6]	[22.1]			
117	$C_5H_{11}O^+$	$c\text{-}C_5H_{10}OH^+$	19.5								25.2							
126	$C_5H_{12}NO_2^+$	valineH$^+$	19.3								36.3							
117	$C_5H_{13}O_2^+$	$CH_3OH^+(CH_2)_3OCH_3$	(9)								[22]							
121	$C_6H_5N_2^+$	4-CNpyridineH$^+$	16.0	10.4	8.9	8.2					25.7	20.2	20.2	19.7				
121	$C_6H_5N_2^+$	3-CNpyridineH$^+$	---								---							
127	$C_6H_6NO_3^+$	o-NO_2phenolH$^+$	---								---							
127	$C_6H_6NO_3^+$	m-NO_2phenolH$^+$	---								---							
127	$C_6H_6NO_3^+$	p-NO_2phenolH$^+$	---								---							
127	$C_6H_6OCl^+$	o-ClphenolH$^+$	---								---							
127	$C_6H_6OCl^+$	m-ClphenolH$^+$	---								---							
127	$C_6H_6OCl^+$	p-ClphenolH$^+$	---								---							
93,70,19	$C_6H_7^+$	benzeneH$^+$	(<17)								---							
128	$C_6H_7NF^+$	m-FanilineH$^+$	(14.8)								[22]							
128	$C_6H_7NCl^+$	m-ClanilineH$^+$	(14.8)								[22]							
127	$C_6H_7O_2^+$	o-OHphenolH$^+$	---								---							
127	$C_6H_7O_2^+$	m-OHphenolH$^+$	---								---							
127	$C_6H_7O_2^+$	p-OHphenolH$^+$	---								---							
121	$C_6H_8N^+$	4-CH_3pyridineH$^+$	14.7								26.6							
128	$C_6H_8N^+$	anilineH$^+$	(15.1)								[22]							
121	$C_6H_8NO^+$	4-CH_3OpyridineH$^+$	---								---							
128	$C_6H_8NO^+$	m-OHanilineH$^+$	(12.5)								[22]							
128	$C_6H_9N_2^+$	o-NH_2anilineH$^+$	(13.9)								[22]							
128	$C_6H_9N_2^+$	m-NH_2anilineH$^+$	(9.9)								[22]							
128	$C_6H_9N_2^+$	p-NH_2anilineH$^+$	(14.7)								[22]							
117	$C_6H_{11}O^+$	$(c\text{-}C_3H_5)_2OH^+$	16.6								26.0							
129	$C_6H_{12}NO_3^+$	$(CH_3CONHCH(CH_3)\text{-}CO_2CH_3)H^+$	13.0	12.4	9.5						21.2	26.0	21.5					
117	$C_6H_{15}O^+$	$(n\text{-}C_3H_7)_2OH^+$	21.3								33.8							
117	$C_6H_{15}O^+$	$(i\text{-}C_3H_7)_2OH^+$	17.8								29.4							
118	$C_6H_{15}S^+$	$(n\text{-}C_3H_7)_2SH^+$	12.2								25.7							
125	$C_6H_{16}N^+$	$(CH_3CH_2)_3NH^+$	13.2								27.3							
123;121	$C_7H_5O^+$	$C_6H_5CO^+$	25.8	18.7*							42.9							
127	$C_7H_6NO^+$	p-CNphenolH$^+$	---								---							
128	$C_7H_7NF_3^+$	m-CF_3anilineH$^+$	(16.1)								[22]							
128	$C_7H_7N_2^+$	m-CNanilineH$^+$	(17.3)								[22]							

Formula	Compound	$-\Delta G^{\circ}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	7	8	T(K)	Method	Comments
$C_4H_9O_2^+$	$H^+(CH_3COOCH_2CH_3)$	11.8								298	HPMS	prot. ethyl acetate
$C_4H_{10}NO^+$	$CH_3(N(CH_3)_2)COH^+$	8.7	4.4	3.6	3.2*					298,*268	HPMS	
$C_4H_{10}O^+$	$(CH_3)_2CH^+(OCH_3)$	3.9								298	HPMS	
$C_4H_{11}O^+$	$(CH_3)_3COH_2^+$	---								---	---	see $(CH_3)_3C^+$
$C_4H_{11}O^+$	$(CH_3CH_2)_2OH^+$	12.0								298	HPMS	
$C_4H_{11}O_2^+$	$CH_3OH^+(CH_2)_2OCH_3$	8.8								298	HPMS	
$C_4H_{12}N^+$	$N(CH_3)_4^+$	2.6	3.6*							298,*259	HPMS	
$C_5H_5NCl^+$	4-ClpyridineH$^+$	4.9								400	PHPMS	
$C_5H_5N_2O_2^+$	4-NO_2pyridineH$^+$	5.9								400	PHPMS	
$C_5H_6N^+$	pyridineH$^+$	4.8 5.3	1.8	0.5						400 400	PHPMS PHPMS	
$C_5H_9NO_2^+$	prolineH$^+$	11.9								300	HPMS	
$C_5H_9O^+$	$(c\text{-}C_3H_5)(CH_3)COH^+$	10.2	5.6	4.4	4.0*	3.5*				298,*284	HPMS	*281
$C_5H_{11}O^+$	$c\text{-}C_5H_{10}OH^+$	12.0								298	HPMS	
$C_5H_{12}NO_2^+$	valineH$^+$	8.4								300	HPMS	
$C_5H_{13}O_2^+$	$CH_3OH^+(CH_2)_3OCH_3$	1.9								324	HPMS	
$C_6H_5N_2^+$	4-CNpyridineH$^+$	5.7	2.3	0.8	0.4					400	PHPMS	
$C_6H_5N_2^+$	3-CNpyridineH$^+$	6.0								400	PHPMS	
$C_6H_6NO_3^+$	o-NO_2phenolH$^+$	6.7								427	PHPMS	
$C_6H_6NO_3^+$	m-NO_2phenolH$^+$	8.1								427	PHPMS	
$C_6H_6NO_3^+$	p-NO_2phenolH$^+$	6.8								427	PHPMS	
$C_6H_6OCl^+$	o-ClphenolH$^+$	2.9								436	PHPMS	
$C_6H_6OCl^+$	m-ClphenolH$^+$	4.8								443	PHPMS	
$C_6H_6OCl^+$	p-ClphenolH$^+$	6.2								453	PHPMS	
$C_6H_7^+$	benzeneH$^+$	---								---	ICR	from H_3O^+-C_6H_6 < H_3O^+-H_2O
$C_6H_7NF^+$	m-FanilineH$^+$	5.3								433	PHPMS	
$C_6H_7NCl^+$	m-ClanilineH$^+$	5.3								433	PHPMS	
$C_6H_7O_2^+$	o-OHphenolH$^+$	2.9								454	PHPMS	
$C_6H_7O_2^+$	m-OHphenolH$^+$	4.5								454	PHPMS	
$C_6H_7O_2^+$	p-OHphenolH$^+$	4.4								454	PHPMS	
$C_6H_8N^+$	4-CH_3pyridineH$^+$	4.1								400	PHPMS	
$C_6H_8N^+$	anilineH$^+$	5.6								433	PHPMS	
$C_6H_8NO^+$	4-CH_3OpyridineH$^+$	3.4								400	PHPMS	
$C_6H_8NO^+$	m-OHanilineH$^+$	3.0								433	PHPMS	
$C_6H_9N_2^+$	o-NH_2anilineH$^+$	4.4								433	PHMPS	
$C_6H_9N_2^+$	m-NH_2anilineH$^+$	0.4								433	PHPMS	ring protonated
$C_6H_9N_2^+$	p-NH_2anilineH$^+$	5.2								433	PHMPS	
$C_6H_{11}O^+$	$(c\text{-}C_3H_5)_2OH^+$	8.9								298	HPMS	
$C_6H_{12}NO_3^+$	$(CH_3CONHCH(CH_3)\text{-}CO_2CH_3)H^+$	6.7	4.7	3.1						298	HPMS	N-acetyl alanine methyl ester
$C_6H_{15}O^+$	$(n\text{-}C_3H_7)_2OH^+$	11.2								298	HPMS	
$C_6H_{15}O^+$	$(i\text{-}C_3H_7)_2OH^+$	9.0								298	HPMS	
$C_6H_{15}S^+$	$(n\text{-}C_3H_7)_2SH^+$	4.5								298	HPMS	
$C_6H_{16}N^+$	$(CH_3CH_2)_3NH^+$	5.1								298	PHMPS	
$C_7H_5O^+$	$C_6H_5CO^+$	13.0								298	PHMPS	*from Figure in Ref. 121
$C_7H_6NO^+$	p-CNphenolH$^+$	7.7								426	PHMPS	
$C_7H_7NF_3^+$	m-CF_3anilineH$^+$	6.6								433	PHPMS	
$7H_7N_2^+$	m-CNanilineH$^+$	7.8								433	PHPMS	

Table 3. (continued) Thermodynamic quantities for the gas-phase hydration of organic ions.

Ref.	Formula	Compound	$-\Delta H^{\circ}_{n-1,n}$ (kcal/mol) 1	2	3	4	5	6	7	8	$-\Delta S^{\circ}_{n-1,n}$ (cal/K mol) 1	2	3	4	5	6	7	8
---	$C_7H_7O_2^+$	prot. benzoic acid	---								---							
127	$C_7H_7O_3^+$	prot. o-OH benzoic acid	---								---							
127	$C_7H_9O^+$	o-CH_3phenolH$^+$	---								---							
127	$C_7H_9O^+$	m-CH_3phenolH$^+$	---								---							
127	$C_7H_9O^+$	p-CH_3phenolH$^+$	---								---							
125	$C_7H_{10}N^+$	2,6$(CH_3)_2$ pyridineH$^+$	13.2								25.9							
128	$C_7H_{10}N^+$	m-CH_3anilineH$^+$	(13.5)								[22]							
128	$C_7H_{10}NO^+$	m-CH_3OanilineH$^+$	(10.3)								[22]							
128	$C_7H_{10}NS^+$	m-CH_3SanilineH$^+$	(10.6)								[22]							
121	$C_7H_{11}N_2^+$	4-$(CH_3)_2N$ pyridineH$^+$	12.0								24.8							
85	$C_7H_{11}O^+$	$(c\text{-}C_3H_5)_2COH^+$	16.5	11.2	8.9	(9.1)					24.0	22.3	17.1	[21.6]				
74	$C_7H_{15}O_2^+$	H$^+$(t-$C_5H_{11}OOCCH_3$)	13.8								12							
85	$C_8H_9O^+$	$(C_6H_5)(CH_3)COH^+$	19.5	12.7	(12.1)	(9.1)					29.1	21.1	[22]	[21.6]				
127	$C_8H_{11}O^+$	o-C_2H_5phenolH$^+$	---								---							
127	$C_8H_{11}O^+$	m-C_2H_5phenolH$^+$	---								---							
127	$C_8H_{11}O^+$	p-C_2H_5phenolH$^+$	---								---							
125	$C_8H_{12}N^+$	2-i-C_3H_7 pyridineH$^+$	14.2								28.8							
128	$C_8H_{12}N^+$	m-C_2H_5anilineH$^+$	(13.2)								[22]							
130	$C_8H_{12}N^+$	$C_6H_5N(CH_3)_2H^+$	10.9								21							
324	$C_8H_{20}N^+$	$N(C_2H_5)_4^+$	(7.0)								[20]							
74	$C_9H_{11}O_2^+$	H$^+$($C_6H_5CH_2OOCCH_3$)	13.7								12							
129	$C_9H_{12}NO^+$	$(C_6H_5)(N(CH_3)_2)COH^+$	15.1								26.3							
125	$C_9H_{14}N^+$	2,6$(C_2H_5)_2$ pyridineH$^+$	[13]								(28.6)							
125	$C_9H_{14}N^+$	2-t-C_4H_9 pyridineH$^+$	14.2								30.8							
125	$C_9H_{22}N^+$	$(n\text{-}C_3H_7)_3NH^+$	12.5								30.2							
301	$C_{10}H_{21}O_5^+$	15-crown-5 etherH$^+$	21.6								33.0							
125	$C_{11}H_{18}N^+$	2,6$(i\text{-}C_3H_7)_2$ pyridineH$^+$	12.8								32.1							
301	$C_{12}H_{25}O_6^+$	18-crown-6-etherH$^+$	26.4								34.6							
117	$C_{12}H_{27}O^+$	$(n\text{-}C_6H_{13})_2OH^+$	18.2								31.8							
125	$C_{12}H_{28}N^+$	$(n\text{-}C_4H_9)_3NH^+$	13.6								36.4							
125	$C_{13}H_{22}N^+$	2,6$(t\text{-}C_4H_9)_2$ pyridineH$^+$	12.5								41							
118,(131)		$CH_3OH_2^+ \cdot CH_3OH$	---	---	11.2	10.4	(9.4)				---	---	23.0	23.5	[22]			
118,(131)		$CH_3OH_2^+ \cdot 2CH_3OH$	---	11.8	9.2	(9.3)					---	25.5	20.2	[22]				
118		$CH_3OH_2^+ \cdot 3CH_3OH$	12.1	8.6	(9.1)						27.0	19.0	[22]					
118		$CH_3OH_2^+ \cdot 4CH_3OH$	10.0								23.8							
118		$CH_3CNH^+ \cdot CH_3CN$	15.9	15.3	10.3	(9.7)					24.6	25.2	22.3	[22.1]				
118		$CH_3CNH^+ \cdot 2CH_3CN$	---	9.7							---	[22]						
122		$(CH_3)_2OH^+ \cdot (CH_3)_2O$	16.3	13.6	11.6						38.8	24.6	26.8					
122,(131)		$(CH_3)_2OH^+ \cdot 2(CH_3)_2O$	(23.0)[c]	11.4							(37.8)	30.3						
302,132		CH_3O^-	(19.9)	---	---						[22]	---	---					
132,104			---	---	---						---	---	---					
132,104,302,11		$CH_3O^- \cdot CH_3OH$	---								---							

Formula	Compound	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	7	8	T(K)	Method	Comments
$C_7H_7O_2^+$	prot. benzoic acid	---								---	---	see $C_7H_5O^+$
$C_7H_7O_3^+$	prot. o-OH benzoic acid	5.5								452	PHPMS	
$C_7H_9O^+$	o-CH_3phenolH$^+$	4.4								447	PHPMS	
$C_7H_9O^+$	m-CH_3phenolH$^+$	4.2								454	PHPMS	
$C_7H_9O^+$	p-CH_3phenolH$^+$	4.6								447	PHPMS	
$C_7H_{10}N^+$	2,6$(CH_3)_2$ pyridineH$^+$	5.5								298	PHPMS	
$C_7H_{10}N^+$	m-CH_3anilineH$^+$	4.0								433	PHPMS	ring to N protonation on hydration
$C_7H_{10}NO^+$	m-CH_3OanilineH$^+$	0.8								433	PHPMS	ring protonated
$C_7H_{10}NS^+$	m-CH_3SanilineH$^+$	1.1								433	PHPMS	ring to N protonation on hydration
$C_7H_{11}N_2^+$	4-$(CH_3)_2N$ pyridineH$^+$	2.1								400	PHPMS	
$C_7H_{11}O^+$	$(c\text{-}C_3H_5)_2COH^+$	8.5	3.9	3.8	3.3*					298,*269	HPMS	
$C_7H_{15}O_2^+$	$H^+(t\text{-}C_5H_{11}OOCCH_3)_10$									298	HPMS	prot. t-amyl acetate
$C_8H_9O^+$	$(C_6H_5)(CH_3)COH^+$	9.3	4.6	3.9*	3.0*					298,*375	HPMS	‡284
$C_8H_{11}O^+$	o-C_2H_5phenolH$^+$	3.6								455	PHPMS	
$C_8H_{11}O^+$	m-C_2H_5phenolH$^+$	3.9								453	PHPMS	
$C_8H_{11}O^+$	p-C_2H_5phenolH$^+$	4.2								455	PHPMS	
$C_8H_{12}N^+$	2-i-C_3H_7 pyridineH$^+$	5.6								298	PHMPS	
$C_8H_{12}N^+$	m-C_2H_5anilineH$^+$	3.7								433	PHMPS	ring to N protonation on hydration
$C_8H_{12}N^+$	$C_6H_5N(CH_3)_2H^+$	4.6								298	---	
$C_8H_{20}N^+$	$N(C_2H_5)_4^+$	2.4								233	HPMS	
$C_9H_{11}O_2^+$	$H^+(C_6H_5CH_2OOCCH_3)_10$									298	HPMS	prot. benzyl acetate
$C_9H_{12}NO^+$	$(C_6H_5)(N(CH_3)_2)COH^+$	7.3								298	HPMS	
$C_9H_{14}N^+$	2,6$(C_2H_5)_2$ pyridineH$^+$	2.3								394	PHPMS	
$C_9H_{14}N^+$	2-t-C_4H_9 pyridineH$^+$	5.0								298	PHPMS	
$C_9H_{22}N^+$	$(n\text{-}C_3H_7)_3NH^+$	3.5								298	PHPMS	
$C_{10}H_{21}O_5^+$	15-crown-5 etherH$^+$	11.8								298	HPMS	
$C_{11}H_{18}N^+$	2,6$(i\text{-}C_3H_7)_2$ pyridineH$^+$	3.2								298	PHPMS	
$C_{12}H_{25}O_6^+$	18-crown-6-etherH$^+$	16.1								298	HPMS	
$C_{12}H_{27}O^+$	$(n\text{-}C_6H_{13})_2OH^+$	8.7								298	HPMS	
$C_{12}H_{28}N^+$	$(n\text{-}C_4H_9)_3NH^+$	2.8								298	PHPMS	
$C_{13}H_{22}N^+$	2,6$(t\text{-}C_4H_9)_2$ pyridineH$^+$	0.3								298	PHPMS	
	$CH_3OH_2^+ \cdot CH_3OH$	(7.3)[c]	(2.4)[c]	0.8	-0.2	3.5*				452,*269	HPMS	[c] H^+-CH_3OH/H_2O
	$CH_3OH_2^+ \cdot 2CH_3OH$	(3.1)[c]	0.3	0.1	3.3*					452,*274	HPMS	[c] H^+-CH_3OH/H_2O
	$CH_3OH_2^+ \cdot 3CH_3OH$	4.0	2.9	3.1*						300,*274	HPMS	
	$CH_3OH_2^+ \cdot 4CH_3OH$	2.9								300	HPMS	
	$CH_3CNH^+ \cdot CH_3CN$	8.5	7.7	3.6	2.9*					300,*318	HPMS	
	$CH_3CNH^+ \cdot 2CH_3CN$	---	2.8							316	HPMS	
	$(CH_3)_2OH^+ \cdot (CH_3)_2O$	(4.7)	6.3	3.6						300	PHPMS	
	$(CH_3)_2OH^+ \cdot 2(CH_3)_2O$	(11.7)	2.4							300	PHPMS	[c] H^+-$(CH_3)_2O/H_2O$
	CH_3O^-	(13.3)[c]	(8.3)[c]	---						296	HPMS	[c] OH^--H_2O/CH_3OH(s)
		---	---	(6.7)[c]						296	FA	[c] OH^--H_2O/CH_3OH(s)
	$CH_3O^- \cdot CH_3OH$	(8.3)[c]								296	FA	[c] OH^--H_2O/CH_3OH(s)

Table 4. Thermodynamic quantities for the gas-phase association of the rare gases to ions.

Ref.	Neut.	Ion	(kcal/mol) $-\Delta H^{o}_{n-1,n}$ 1	2	3	(cal/K mol) $-\Delta S^{o}_{n-1,n}$ 1	2	3	(kcal/mol) $-\Delta G^{o}_{n-1,n}$ (T) 1	2	3	(K) T	Method	Comments
150	He	He^+	54.5			---			---			---	ES	
151			58.8			---			---			---	S	
152			---	4.2‡		---	18.4‡		---	-1.6		300	DT	‡corrected for neglect of ln T term
153			---	---		---	---		---	-1.9		300	SAMS	
154			---	---	---	---	---	---	---	---	0.6	77	DTMS	
150		Ne^+	16.0			---			---			---	ES	
150		Ar^+	0.60			---			---			---	ES	
155		Li^+	---			---			-3.7			309*	DTMS	*low E/N
156			3.16									---	M	
304			1.09									---	M	
305			1.71									---	M	
306			1.69									---	M	
307			1.64									---	S	
156		Na^+	1.38			---			---			---	M	
304			0.93									---	M	
306			0.79									---	M	
307			1.19									---	S	
156		K^+	0.53			---			---			---	M	
308			0.57									---	M	
306			0.53									---	M	
307			0.58									---	S	
304		Cs^+	0.32			---			---			---	M	
307			0.36									---	S	
150	Ne	Ne^+	31.4			---			---			---	PI	
151			30.0									---	S	
150		Ar^+	1.8			---			---			---	PI	
150		Kr^+	1.27			---			---			---	PI	
150		Xe^+	0.95			---			---			---	PI	
156		Li^+	3.34			---			---			---	M	
306			2.84									---	M	
307			2.63									---	S	
156		Na^+	1.45			---			---			---	M	
306			1.52									---	M	
307			1.76									---	S	
156	Ne (cont'd)	K^+	0.95									---	M	
308			0.99									---	M	
306			0.92										M	
307			1.09										S	
156		Rb^+	0.78									---	M	
306			0.77										M	
156		Cs^+	0.65									---	M	
307			0.56										S	
157	Ar	Ar^+	28.8			---			---			---	S	
158;23;159			(27.8)[a]	5.1	---	(12.8)	20.5	---	(24.0)	3.5	2.0	(298);77	PHPMS	[a]N_2^+-Ar+Δ(IP)
160			28.4									---	PI	cf. Refs. therein
150			29.3									---	PI	
161			30.7									---	PF	
151			30.9									---	S	
150		Kr^+	12.2			---			---			---	PI	
162			13.6									---	PI	
150		Xe^+	4.1			---			---			---	PI	
162			3.2									---	PI	
163			6.0			19.4			0.2			298	SIFT	
164		Li^+	4.1			~7			2.6			215	DTMS	
165			---						1.9			319*	DTMS	*low E/N
156			12.7						---			---	M	
305			6.46						---			---	M	
307			7.22						---			---	S	
164		Na^+	4.4			---			---			---	DTMS	
156			4.87									---	M	
306			4.39									---	M	
307			3.70									---	S	
156		K^+	2.74			---			---			---	M	
304			2.79									---	M	
309			3.16									---	M	
308			2.63									---	M	
305			1.97									---	M	
306			2.94									---	M	
307			2.87									---	S	
156		Rb^+	2.84			---			---			---	M	
305			2.03									---	M	
306			1.98									---	M	

Table 4. (continued) Thermodynamic quantities for the gas-phase association of the rare gases to ions.

Ref.	Neut.	Ion	(kcal/mol) $-\Delta H^{o}_{n-1,n}$ 1	2	3	(cal/K mol) $-\Delta S^{o}_{n-1,n}$ 1	2	3	(kcal/mol) $-\Delta G^{o}_{n-1,n}$ (T) 1	2	3	(K) T	Method	Comments
156	Ar	Cs^+	2.28			---			---			---	M	
305	(cont'd)		1.95									---	M	
306			1.96									---	M	
307			1.46									---	S	
323		Hg^+	5.3			---			---			---	PI	
158		N_2^+	(25.4)[s]			(13.7)			(21.3)			298	PHPMS	$^{s}N_2^+-N_2$
166		CO_2^+	6.0			---			---			---	PI	
305		Br^-	1.36			---			---			---	M	
150	Kr	Kr^+	26.5			---			---			---	PI	
160			26.5									---	PI	cf. Refs. therein
167			26.3									---	PF	
151			27.9									---	S	
150		Xe^+	8.9			---			---			---	PI	
162			8.5									---	PI	
156		Li^+	16.4			---			---			---	M	
306			9.2									---	M	
307			10.6									---	S	
164		Na^+	5.8			18.5			1.6			225	DTMS	
156			6.57									---	M	
306			5.08									---	M	
307			4.84									---	S	
156		K^+	3.71			---			---			---	M	
305			3.21									---	M	
306			2.94									---	M	
307			2.89									---	S	
156		Rb^+	3.34			---			---			---	M	
305			2.64									---	M	
306			2.67									---	M	
156		Cs^+	3.07			---			---			---	M	
305			2.79									---	M	
306			2.72									---	M	
307			2.33									---	S	
310		O_2^+	7.6			---			---			---	PF	
305		Br^-	2.01			---			---			---	M	
157	Xe	Xe^+	22.4			---			---			---	S	
168			---	6.75‡		---	18.7‡		---	1.2		298	DTMS	‡corrected for $\int nT$ term
169			22.8									---	PI	
170			23.8									---	PI	
151			22.8									---	S	
156		Li^+	20.8			---			---			---	M	
306			12.6									---	M	
307			12.3									---	S	
156		Na^+	9.52			---			---			---	M	
306			5.94									---	M	
307			5.97									---	S	
						---			---					
156		K^+	5.33									---	M	
305			4.31									---	M	
306			4.84									---	M	
307			3.78									---	S	
156		Rb^+	3.62			---			---			---	M	
305			2.84									---	M	
306			4.26									---	M	
156		Cs^+	3.55			---			---			---	M	
304			2.44									---	M	
305			2.51									---	M	
306			2.62									---	M	
307			2.75									---	M	
						---			---				S	
171		F^-	6.5									---	S	
172		Cl^-	3.1			---			---			---	M	
305			3.11			---			---			---	M	
305		Br^-	3.35			---			---			---	M	

Table 5. Thermodynamic quantities for the gas-phase association of diatomics to ions.

			$-\Delta H^{\circ}_{n-1,n}$ (kcal/mol)					$-\Delta S^{\circ}_{n-1,n}$ (cal/K mol)				
Ref.	Neut.	Ion	1	2	3	4	5	1	2	3	4	5
173	H_2	H_3^+	9.6	4.1	3.8	2.4		24.6	19.8	20.2	19.3	
174			9.7	1.8				25.5	10.8			
175			5.1					9.6				
176			5.8					12.5				
177			8.6‡					23.5‡				
178			6.6	3.1				14.5	16.9			
179			5.6					11.5				
178			7.1	3.4				17.0	16.1			
180		HN_2^+	7.2	1.8				22.6	17			
180		HO_2^+	12.5					22				
180		$H(O_2)_2^+$	4.0					17				
181		HCO^+	3.9					20.5				
182		Li^+	6.5					---				
91,19		CH_3^+	(44.4)[c]					---				
57		$C_2H_5^+$	4.0	T<140 K				19.6				
			11.8	T>170 K				25				
57		$i\text{-}C_3H_7^+$	(<2.5)					[20]				
102		OH^-	~7					---				
183	N_2	N^+	60					---				
184			59					---				
91			59.4					---				
91		O^+	55.3					---				
185		Li^+	---					---				
186		Na^+	---					---				
96			8.0	5.3				18.6	18			
186		K^+	---					---				
187		$Ca^{+2}\cdot N_2$	---	---	---	---	---	---	---	---	---	---
188		N_2^+	22.8					19.5				
158			24.4					16.2				
189			20.1					11				
190			11.5					-1				
191			20.8					---				
22		O_2^+	5.69					18.9				
192			5.2	4.3	3.5			15.8	13.8	12.1		
193			---					---				
194		O_4^+	2.94	---				10.1	---			
21		NO^+	5.16					18.9				
195			4.45‡					15.7‡				
192			4.4	3.9	---	---		13.3	12.6	---	---	
196			---					---				
180		HN_2^+	16.0	4.0	3.8	3.5	(3.2)	24	18	20	20	[20]
197			14.5					20.4				
198		H_2CN^+	7.6	5.1	3.2	3.1	3.2	22.2	19.9	13.1	13.8	15.2
19,180		H_3^+	(24.1)[c]					(24.3)				
199		CH_5^+	6.8					19.7				
199		C_2H_5	6.9	4.6				18.2	10.9			
200	O_2	O^+	48	6.9	0.9			---	---	---		
201			49.9					---				
202			42.9					---				
203		O_2^+	9.5					20				
24			10.8	6.87	2.54	2.46	1.84	25.0	31.8	19.8	23.9	17.0
204			9.6					20.6				
200			9.7					---				
205			6.0					---				
206			---					---				
207			---					---				

Neut.	Ion	$\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	T (K)	Method	Comments
H_2	H_3^+	2.3	-1.8	-2.3	-3.4		300	PHPMS	
		2.0	-1.4				300	HPMS	
		2.2					300	HPMS	
		2.1					300	DT	
		1.6					300	DTMS	‡corrected for neglect of ℓnT term
		2.2	-2.0				300	HPMS	
		2.2					300	HPMS	deuterated
		2.0	-1.4				300	HPMS	deuterated
	HN_2^+	0.4	-3.3				298	PHPMS	
	HO_2^+	6.0					298	PHPMS	
	$H(O_2)_2^+$	-1.1					298	PNPMS	
	HCO^+	-2.3					300	PHPMS	
	Li^+	---					---	EI	(±4.6 kcal/mol)
	CH_3^+	---					298	---	from ΔH_f+PA's; cf. Ref. 57
	$C_2H_5^+$	1.3					140	HPMS	
		7.3					180		
	$i\text{-}C_3H_7^+$	<0.9					170	HPMS	
	OH^-	---					---	RET	
N_2	N^+	---					---	EI	
		---					---	EI	
		---					298	---	ΔH_f's
	O^+	---					0	---	ΔH_f's + IP (N_2O)
	Li^+	5.6	4.4				318*	DTMS	*low E/N
	Na^+	1.95					310*	DTMS	*low E/N
		2.2	-0.3				310	FA	
	K^+	1.0					310*	DTMS	*low E/N
	$Ca^{+2}\cdot N_2$	---	---	---	---	4.6	296	FA	
	N_2^+	17.1					298	HPMS	
		19.6					298	PHPMS	
		16.8					298	DTMS	
		11.8					298	DT	
		---					---	PI	
	O_2^+	0.1					296	PHPMS	
		0.5	0.2	-0.1	0.7‡	0.7*	296,*184	HPMS	‡204
		0.0					296	FA	
	O_4^+	0.6	0.5				230	HPMS	
	NO^+	1.3					204	PHPMS	
		1.25					204	DTMS	‡corrected for neglect of ln T term
		1.7	1.3	0.9	0.4		204	HPMS	
		~0.5					200	FA	
	HN_2^+	8.8	-1.4	-2.2	1.35*		298,*92	PHPMS	
		8.4					298	PHPMS	
	H_2CN^+	0.9	-0.9	-0.7	-1.0	-1.4	300	HPMS	
	H_3^+	(16.8)					298	---	$^cHN_2^+$-H_2 + ΔPA
	CH_5^+	0.9					298	HPMS	
	C_2H_5	1.5	1.3				298	HPMS	n=2, deuterated
O_2	O^+	---	---	---			---	PI	
		---					---	PF	
		---					---	PF	
	O_2^+	3.5					298	PHPMS	
		3.36	2.60	-3.36	-4.66	-3.23	298	PHPMS	
		3.5					298	PHPMS	
		---					---	PI	
		---					---	PI	
		3.3					---	DTMS	
		3.8					300	DTMS	

Table 5. (continued) Thermodynamic quantities for the gas-phase association of diatomics to ions.

			$-\Delta H^{o}_{n-1,n}$ (kcal/mol)					$-\Delta S^{o}_{n-1,n}$ (cal/K mol)				
Ref.	Neut.	Ion	1	2	3	4	5	1	2	3	4	5
193	O_2	O_2^+	---					---				
89	(cont'd)		---					---				
196		NO^+	---					---				
180		HO_2^+	20.0	6.6	(3.2)			27	22	[20]		
180		H_3^+	(12.5)[c]	(11.5)[c]				(19.6)	(22)			
155		Li^+	---					---				
208		Na^+	---					---				
187		Ca^+	---					---				
187		Ca^{+2}	---					---				
291		O^-	(<32)[c]					---				
209			42					---				
210			38					---				
211			(39.0)[c]					---				
212		O_2^-	13.55					32				
213			---					---				
214	CO	CO^+	28					---				
215			---					---				
197			(>25.4)					[20]				
191			22.4					---				
180		HCO^+	12.8	6.6	6.3	6.2	5.8	24	24	26	29	32
197			11.7					20.9				
216			10.8					22.5				
19,181		H_3^+	(44.5)[c]					(23.3)				
217		Na^+	12.6	7.5				20.4	15.1			
191	NO	NO^+	13.8	7.4	3.7	3.5	2.3	---				
218			13.6					---				
69			---					---				
219	HF	H_2F^+	25	14.8				---				
41,98		F^-	(38.5)					(21.9)				
295,4		Cl^-	(21.8)					[22.5]				
219	HCl	HCl^+	20					---				
96		Na^+	12.2					20.4				
332		$C_6H_6^+$	7.3					---				
220		Cl^-	23.7	15.2	11.7	10.3		23.5	24.4	23.4	26.7	
113,100			(20.4)[c]					(22.8)				
295,4			(23.1)					[23.5]				
113,(220)		$Cl^-\cdot H_2O$	16.0	(12.3)[c]				21.8	(20.9)			
113,100		$Cl^-\cdot 2H_2O$	(13.0)[c]					(21.7)				
112		HSO_4^-	(15.7)[s]					(15.1)				
221		I^-	14.2					22.7				
219	HBr	HBr^+	23					---				
222		Br^-	(>17.5)[c]					[22]				
222		$NO_3^-\cdot HNO_3$	(16.0)[s]					(22.9)				
222		NO_3^-	(>21)[s]					[23]				

Neut.	Ion	$\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	T (K)	Method	Comments
O_2 (cont'd)	O_2^+	3.4					296	FA	
		5.9					200	FA	
	NO^+	<-0.4					200	FA	
	HO_2^+	12.0	0.0	1.1*			298,*105	PHPMS	
	H_3^+	(6.7)	(4.9)				298	PHPMS	$^{c}HO_2^+-H_2$ + ΔPA; $^{c}O_2/H_2$ system
	Li^+	4.2					319[x]	DTMS	[x]low E/N
	Na^+	0.2					310[x]	DTMS	[x]low E/N
	Ca^+	6.0					296	FA	
	Ca^{+2}	---	---	---	---	4.6	296	FA	
	O^-	---					---	PF	[c]based on $D(O_2^- - O)$
		---					---	CID	
		---					---	PF	
		---					---	---	[c] from EA(O_3), D(O-O_2), and EA(O)
	O_2^-	4.0					298	PHPMS	
		3.5					300	DTMS	
CO	CO^+	---					---	EI	from IP's and ΔH_f's (error ±7 kcal/mol)
		4.92					340	HPMS	reported but equilibrium uncertain
		>11.5					695	PHPMS	
		---					---	PI	
	HCO^+	5.7	-0.6	-1.4	-2.5	-3.8	298	PHPMS	
		5.4					300	PHPMS	
		4.1					298	PHPMS	
	H_3^+	(37.5)					298	---	$^{c}HCO^+-H_2$ + ΔPA
	Na^+	6.5	3.0				298	HPMS	
NO	NO^+	---					---	PI	
		---					---	PI	
		7.0	1.9				296	SAMS	
HF	H_2F^+	---					---	PI	
	F^-	(32.0)[s]					298	ICR	$^{s}F^- - H_2O$
	Cl^-	(15.1)[s]					298	ICR	$^{s}Cl^- - t\text{-}C_4H_9OH$
HCl	HCl^+	---					---	PI	
	Na^+	6.1					298	FA	
	$C_6H_6^+$	---					---	PI	benzene$^+$
	Cl^-	16.7	7.9	4.7	2.4		298	PHPMS	
		(13.6)					298	HPMS	$^{c}HCl/H_2O$
		(16.0)[e]					298	ICR	$^{s}Cl^- - t\text{-}C_4H_9OH$
	$Cl^- \cdot H_2O$	9.5	(6.1)				298	HPMS	$^{c}HCl/H_2O$; deuterated mixture
	$Cl^- \cdot 2H_2O$	(6.5)					298	HPMS	$^{c}HCl/H_2O$; mixed clusters deuterated
	HSO_4^-	(11.2)					298	FA	$^{s}HSO_4^- - H_2O$
	I^-	7.4					298	HPMS	
HBr	HBr^+	---					---	PI	
	Br^-	(>9.4)					367	FA	$^{c}Br^-/NO_3^- - HNO_3/HBr(s)$
	$NO_3^- \cdot HNO_3$	(9.2)					298	FA	$^{s}NO_3^- \cdot HNO_3 - HNO_3$
	NO_3^-	>12.7)					367	FA	$^{s}NO_3^- - HNO_3$

Table 5. (continued) Thermodynamic quantities for the gas-phase association of diatomics to ions.

			$-\Delta H^{o}_{n-1,n}$ (kcal/mol)					$-\Delta S^{o}_{n-1,n}$ (cal/K mol)				
Ref.	Neut.	Ion	1	2	3	4	5	1	2	3	4	5
223,91	Cl_2	Cl^-	(17.0)					---				
224	I_2	I^-	(24.0)					---				
320	NaF	Na^+	62.7	47				---	---			
320		ScF_2^+	---	83	72	67		---	---	---	---	
30	NaCl	Na^+	42.4					17.6				
322	KF	F^-	46.4					---				
30	KCl	K^+	41.2					19.6				
30	KBr	K^+	40.8					22.8				
319			41.5					---				

Neut.	Ion	$\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	T (K)	Method	Comments
Cl_2	Cl^-	---					298	SAMS	based on $Cl^-+SO_2Cl_2 \rightarrow Cl_3^-+SO_2$
I_2	I^-	---					---	---	ΔH_f's
NaF	Na^+	---	---				---	MS	Knudsen cell
	ScF_2^+	---					---	MS	Knudsen cell
NaCl	Na^+	28.3					800	MS	Knudsen cell
KF	F^-	---					1100	MS	Knudsen cell
KCl	K^+	25.5					800	MS	Knudsen cell
KBr	K^+	22.6					800	MS	Knudsen cell
		---					800	MS	Knudsen cell

Table 6. Thermodynamic quantities for the gas-phase association of triatomics (except H_2O) to ions.

			$-\Delta H^o_{n-1,n}$ (kcal/mol)						$-\Delta S^o_{n-1,n}$ (cal/K mol)					
Ref.	Neut.	Ion	1	2	3	4	5	6	1	2	3	4	5	6
95	CO_2	Na^+	15.9	11.0	9.7	(8.4)			20.1	21.7	24.0	[25]		
96			13.7						19.8					
208			---	---					---	---				
9		K^+	8.5						15.2					
225			---						---					
62		Cs^+	6.2						14.3					
95		$Na^+ \cdot H_2O$	12.6						22.5					
95		$Na^+ \cdot 2H_2O$	10.3						23.9					
95		$Na^+ \cdot 3H_2O$	(7.2)						[25]					
187		$Ca^{+2} \cdot CO_2$	---						---					
187		$Ca^{+2} \cdot CaCO_3$	---						---					
166		CO_2^+	13.6						---					
226			16.2	6.0					21.1	24.0				
227			15.8						22.8					
228			17						---					
229			11.8	3.3	2.8				---					
328			15.6	7.4	6.0				19.1	23.4	21.9			
230		O_2^+	<10.6						---					
231,24			(10.5)[s]						(20.7)					
226			(>21.4)	7.5					[20]	15				
207			---						---					
328			11.0	8.5	6.6	4.8			21.7	21.1	21.3	17.8		
196		NO^+	<13.8						---					
327		HCO^+	12.6	7.2	6.9				21.4	19.7	22.7			
226		HCO_2^+	20.1						24.2					
216			19.1						27.1					
327			18.0	6.9					22.2	23.0				
226		H_3O^+	14.4						20.7					
327			15.3	12.4	10.5				24.6	26.5	26.9			
187		NH_4^+	---						---					
232		$CH_3NH_3^+$	13.2						21.4					
232		$C_2H_5NH_3^+$	11.2						20.8					
148		F^-	---						---					
221		Cl^-	8.0						19.6					
327			7.6	7.2	6.8				18.2	20.8	22.4			
221		I^-	5.6						18.2					
233		O^-	52.1											
234			42*											
235			57.7											
236,210			(>51)[s]											
221			---	7.1					---	21.8				
298		OH^-	88						---					
237		O_2^-	18.4						21					
101,103			---						---					
89,212			---						---					
101,103		$O_2^- \cdot H_2O$	---						---					
221		NO_2^-	9.3						24.2					
221		SO_3^-	6.5						20.7					
238	OCS	OCS^+	17.2	1.6					---	---				
238		CS_2^+	5.8						---					

Neut.	Ion	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	T (K)	Method	Comments
CO_2	Na^+	9.7	4.3	2.3	0.65			310	HPMS	
		7.6						310	FA	
		6.6	4.8					310[x]	DTMS	[x]low E/N
	K^+	3.8						310	HPMS	
		3.7						310[x]	DTMS	[x]low E/N
	Cs^+	1.9						298	DTMS	
	$Na^+ \cdot H_2O$	5.9						298	HPMS	
	$Na^+ \cdot 2H_2O$	3.2						298	HPMS	
	$Na^+ \cdot 3H_2O$	-0.25						298	HPMS	
	$Ca^{+2} \cdot CO_2$	---	---	---	---	8.0		296	FA	
	$Ca^{+2} \cdot CaCO_3$	---	---	---	---	7.6		296	FA	
	CO_2^+	---						---	PI	
		9.9	1.2					298	PHPMS	
		9.0						298	PHPMS	
		---						---	EI	(±5 kcal/mol)
		---						---	PI	
		9.9	4.3	0.5				298	HPMS	
	O_2^+	---						---	PF	
		(4.3)						298	FA	[s]$O_2^+-O_2$
		>9.4	3.0*					600,*298	PHPMS	
		4.4						298	DTMS	
		4.5	2.2	0.3	0.5			298	HPMS	
	NO^+	---						---	FA	< $NO^+ \cdot NO$
	HCO^+	6.2	1.3	0.1				298	HPMS	
	HCO_2^+	12.9						298	PHPMS	
		11.0						298	PHPMS	
		11.4	0.0					298	HPMS	
	H_3O^+	8.2						298	PHPMS	
		8.0	4.5	2.5				298	HPMS	
	NH_4^+	2.25						296	FA	
	$CH_3NH_3^+$	6.8						298	PHPMS	
	$C_2H_5NH_3^+$	5.0						298	PHPMS	
	F^-	>11.6						298	FA	
	Cl^-	2.2						298	HPMS	
		2.2	1.0	0.1				298	HPMS	
	I^-	0.2						298	HPMS	
	O^-							---	PF	
								---	PF	*not lowest state
								---	CID	
								---	FA	[s] $O^- - O_2$
		---	0.6					298	HPMS	
	OH^-	---						---	CID	
	O_2^-	12.1						298	DT	
		(12.9)[s]						296	FA	[s] $O_2^- - H_2O$
		(10.0)[s]						298	FA	[s] $O_2^- - O_2$
	$O_2^- \cdot H_2O$	(8.2)[s]						296	FA	[s] $O_2^- \cdot H_2O - H_2O$
	NO_2^-	2.1						298	HPMS	
	SO_3^-	0.3						298	HPMS	
OCS	OCS^+	---	---					---	PI	
	CS_2^+	---						---	PI	

Table 6. (continued) Thermodynamic quantities for the gas-phase association of triatomics (except H_2O) to ions.

			$-\Delta H^\circ_{n-1,n}$ (kcal/mol)						$-\Delta S^\circ_{n-1,n}$ (cal/K mol)					
Ref.	Neut.	Ion	1	2	3	4	5	6	1	2	3	4	5	6
239	CS_2	S^+	39.7						---					
226		S_2^+	21.9						17.1					
239			28.8						---					
239		CS^+	36.0						---					
226		CS_2^+	21.9						21.9					
240			17.5	4.4	3.9	2.6			---					
226		HCS_2^+	11.1						26.4					
241		$C_6H_6^+$	12.2						24					
89	N_2O	O_2^+	---						---					
229		N_2O^+	13.1						---					
235	ONO	O^-	41.5						---					
235	O_2N	O^-	110						---					
242	O_3	NO^+	<13.8						---					
231,24		O_2^+	(14.5)[s]						(20.5)					
292		Na^+	12.5						---					
40,28	HCN	Li^+	(36.4)						(25.8)					
147		H_2CN^+	30.0	13.8	11.8	9.2			32	23	25	26		
146			26.1	14.4					23	21.2				
146		NH_4^+	20.5	17.5	13.7	11.1	8.5	7.4	20.2	25.6	23.4	22.1	20.5	19.9
118		$CH_3NH_3^+$	20.8						22.9					
118		$(CH_3)_3NH^+$	16.8						23.0					
118		$(C_3H_7)_3NH^+$	13.8						29.0					
147		$(CH_3)_2CH^+$	30.8						32					
147		$t\text{-}C_4H_9^+$	16.3						25					
88,70		H_3O^+	(32.5)						(24.3)					
146,(19)			(32.3)	18.8	13.2				(24.9)	20.4	16.1			
243,115,70		H_2COH^+	---						---					
41,98		F^-	(39.5)						(22.2)					
295.4		Cl^-	(21.0)						[23.7]					
244	H_2S	H_2S^+	17.0	3.2	1.2	1.4	2.6		---	---				
245			21.2	4.2					---	---				
86		H_3S^+	15.4	9.1	8.4	6.7	(6.1)		24.4	20.9	24.5	24.7	[24]	
73			12.8	7.2	5.4	3.3			18.7	17.3	14	10		
245			10.6	---					---	---				
312			10.8	6.0	4.4	2.5			---	---	---	---		
86,(70)		H_3O^+	(24.9)[s]	13.3					(25.5)	21.7				
73,19			(20.7)[c]						(17.3)					
86,70		$H_3O^+ \cdot H_2O$	(13.6)[s]						(23.0)					
145,19		CH_5^+	(42.1)[c]						(22.7)					
91,19		CH_3^+	(82.4)[c]											
118		NH_4^+	12.0						18.5					
118		$CH_3NH_3^+$	(11.3)						[22]					

Neut.	Ion	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	T (K)	Method	Comments
CS_2	S^+	---						---	PI	
	S_2^+	16.8						298	PHPMS	
		---						---	PI	
	CS^+	---						---	PI	
	CS_2^+	15.4						298	PHPMS	
		---						---	PI	
	HCS_2^+	3.2						298	PHPMS	
	$C_6H_6^+$	5.0						298	PHPMS	
N_2O	O_2^+	(8.9)[s]						200	FA	[s] O_2^+-O_2
	N_2O^+	---						---	PI	
ONO	O^-	---						---	CID	
O_2N	O^-	---						---	CID	
O_3	NO^+	---						---	FA	$<NO^+ \cdot CO_2$
	O_2^+	(8.4)						298	FA	$^{s}O_2^+$-O_2
	Na^+	---						---	FA	
HCN	Li^+	(28.7)[s]						298	ICR	$^{s}Li^+$-H_2O
	H_2CN^+	20.5	6.9	4.4	1.5			298	PHPMS	
		19.3	8.1					298	HPMS	
	NH_4^+	14.5	9.9	6.7	4.5	2.4	1.5	298	HPMS	
	$CH_3NH_3^+$	14.0						298	HPMS	
	$(CH_3)_3NH^+$	9.9						298	HPMS	
	$(C_3H_7)_3NH^+$	5.2						298	HPMS	
	$(CH_3)_2CH^+$	21.3						298	PHPMS	
	$t\text{-}C_4H_9^+$	8.8						298	PHPMS	
	H_3O^+	(25.3)[s]						298	ICR	$^{s}H_3O^+$-H_2O
		(25.0)[c]	12.7	8.4				298	HPMS	$^{c}H_2CN^+$-H_2O+ΔPA
	H_2COH^+	(20.6)[s]						298	FA	$^{s}H_2COH^+$-H_2CO
	F^-	(32.9)[s]						298	ICR	$^{s}F^-$-H_2O
	Cl^-	(13.9)[s]						298	ICR	$^{s}Cl^-$-$t\text{-}C_4H_9OH$
H_2S	H_2S^+	---						---	PI	
		---						---	PI	
	H_3S^+	8.1	2.8	1.0	-0.7	1.66*		298,*185	PHPMS	
		7.2	2.0	1.2	0.5			300	PHPMS	
		---	---					---	PI	
		---	---	---	---			---	PI	
	H_3O^+	(17.2)	6.8					300	PHPMS	$^{s}H_3O^+$-H_2O
		(15.5)						300	---	$^{c}H_3S^+$-H_2O + ΔPA
	$H_3O^+ \cdot H_2O$	(6.7)						300	PHPMS	$^{s}H_3O^+ \cdot H_2O$-H_2O
	CH_5^+	(35.3)						298	---	$^{c}H_3S^+$-CH_4 + ΔPA
	CH_3^+							298	---	$^{c}\Delta H_f$'s + PA's
	NH_4^+	6.5						298	HPMS	
	$CH_3NH_3^+$	5.4						270	HPMS	

Table 6. (continued) Thermodynamic quantities for the gas-phase association of triatomics (except H_2O) to ions.

			$-\Delta H^o_{n-1,n}$ (kcal/mol)						$-\Delta S^o_{n-1,n}$ (cal/K mol)					
Ref.	Neut.	Ion	1	2	3	4	5	6	1	2	3	4	5	6
41,98	H_2S (cont'd)	F^-	(34.6)						(18.7)					
96	SO_2	Na^+	18.9						20.3					
217			---	16.6	14.3	(12.3)			---	25.5	26.9	[27]		
62		Cs^+	10.8						18.9					
94		$Na^+ \cdot H_2O$	14.1						17.4					
246,69		NO^+	---						---					
89,24		O_2^+	---						---					
247		SO^+	13.8						---					
247		SO_2^+	15.2						---					
333		$C_4H_6^+$	3.7						---					
333		$C_4H_8^+$	2.4						---					
223		F^-	>59						---					
41,98			(43.8)						(23.0)					
221		Cl^-	21.8	12.3	10 0	8.6			23.2	22.7	23.1	23.2		
101			---						---					
112,100			(22.2)[s]						(24.1)					
311,4			(20.9)						[20.8]					
221		I^-	12.9	10.1	9.2				20.2	21.6	24.7			
101,233		O^-	(>60)[s]						---					
221			---	13.3					---	18.9				
221,101		CO_3^-	(>14)						[20]					
94,(100)		$Cl^- \cdot H_2O$	17.4	(11.8)[c]					20.2	(26.0)				
101			---						---					
94,100		$Cl^- \cdot 2H_2O$	(14.1)[c]						(19.4)					
221		NO_2^-	25.9	9.0	6.6				36.8	16.8	13.4			
248			---	9.8					---	21.5				
112,107			(24.3)[s]						(31.6)					
248		NO_3^-	18.2	8.8					31.6	14.1				
101,107			---	---					---					
112,107			(17.2)[s]						(25.2)					
221;249		SO_2^-	24.0	8.3					33.8	16.0				
101		SO_4^-	---						---					
149		HSO_4^-	13.7						26.1					

Neut.	Ion	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	T (K)	Method	Comments
	F^-	(29.0)[s]						298	ICR	[s]F^--H_2O
SO_2	Na^+	12.8						298	FA	
		---	9.0	6.3	3.2*			298,*328	HPMS	
	Cs^+	5.2						298	DTMS	
	$Na^+ \cdot H_2O$	8.9						298	HPMS	
	NO^+	(7.8)[s]						296	SAMS	[s]NO^+-NO
	O_2^+	(9.6)[s]						298	FA	[s]O_2^+-O_2
	SO^+	---						---	PI	
	SO_2^+	---						---	PI	
	$C_4H_6^+$	---						---	PI	1,3-butadiene$^+$
	$C_4H_8^+$	---						---	PI	trans-2-butene$^+$
	F^-	---						---	SAMS	$Cl^- + SO_2ClF \rightarrow SO_2F^- + Cl_2$
		(36.9)[s]						298	ICR	
	Cl^-	14.9	5.5	3.1	1.7			298	HPMS	
		(14.2)[s]						296	FA	[s]Cl^--H_2O
		(15.0)						298	FA	[s]$Cl^- \cdot H_2O$
		(14.7)[s]						298	ICR	[s]Cl^--t-C_4H_9OH
	I^-	6.9	3.7	1.8				298	HPMS	
	O^-	---						---	FA	[s]O^--CO_2
		---	7.7					298	HPMS	
	CO_3^-	(>8.0)[s]						296	HPMS	[s]O^-CO_2
	$Cl^- \cdot H_2O$	11.4	(4.1)					296	HPMS	[c]H_2O/SO_2
		(11.5)[s]						296	FA	[s]$Cl^- \cdot H_2O$-H_2O
	$Cl^- \cdot 2H_2O$	(8.4)						296	HPMS	[c]H_2O/SO_2
	NO_2^-	14.9	4.0	2.6				298	HPMS	
		---	3.4					298	HPMS	
		(14.9)						298	FA	[s]NO_2^--H_2O
SO_2	NO_3^-	8.8	4.6					298	HPMS	
		(10.6)[s]						298	FA	[s]NO_3^--H_2O
		(9.7)						298	FA	[>]NO_3^--H_2O
	SO_2^-	13.9	3.5					298	HPMS	
	SO_4^-	(6.7)[s]						296	FA	[s]SO_4^--H_2O
	HSO_4^-	5.9						298	HPMS	

Table 7. Thermodynamic quantities for the gas-phase association of inorganic polyatomics to ions.

			$-\Delta H^{o}_{n-1,n}$ (kcal/mol)						$-\Delta S^{o}_{n-1,n}$ (cal/K mol)					
Ref.	Neut.	Ion	1	2	3	4	5	6	1	2	3	4	5	6
40,28	NH_3	Li^+	(39.1)	---					(23.5)	---				
20			---	33.1	21.0	16.5	11.1	9.3	---	29.7	25.3	32.6	28.0	25.3
20		Na^+	29.1	22.9	17.1	14.7	10.7	9.7	25.7	25.1	24.0	29.0	29.8	29.7
133		K^+	20.1	16.3	13.5	11.6			23.0	22.8	27.7	25.4		
134			17.8	---					28.0					
133		Rb^+	18.7	15.2	13.1	11.4	10.2		24.3	23.6	25.1	38.0		
63		Ag^+	---	36.9	14.6	13.0	12.8		---	32.7	24.6	30.0	34.1	
133		Bi^+	35.5	23.2	13.4				35.7	33.0	26.0			
63		Cu^+	---	---	14.0	12.8	12.8		---	---	23.8	28.7	33.1	
90		NH_3^+	18.1						---					
51			23.1	9.2					---	---				
84		NH_4^+	24.8	15.7*	13.8	12.5			25.9	22.9	25.7	29.4		
135			27	17	16.5	14.5	7.5		32	26.8	34	36	25	
136			---	---	17.8	15.9			---	---	38	40.5		
137			25.4	17.3	14.2	11.8			24.3	23.9	25.3	27.1		
138			---	16.9	15.1	13.5	9.6		---	24.8	29.7	31.6	32	
139			---	---	13.2	10.6			---	---	24.1	21.1		
140			21.5	16.2	13.5	11.7	7.0	6.5	20	23.7	25.2	27.9	21.5	21.9
141			---	---	---	12.9			---	---	---	---		
51			13.8	10.4					---	---				
50			13.8	6.4					---	---				
109			---						---					
142			---						---					
143			---						---					
91,19		CH_3^+	(103.1)[c]						---					
144		$CH_3NH_3^+$	21.4						26					
118,19		CH_3CNH^+	(43.2)						(26.2)					
144		$(CH_3)_2NH_2^+$	20.6						28.2					
117		$(CH_3)_3NH^+$	17.3						23.9					
117		$(C_2H_5)_3NH^+$	16.3						29.6					
117		$C_5H_5NH^+$	17.3						22.5					
126		$C_5H_{12}O_2N^+$	20.9						28.8					
126		$C_5H_9O_2N^+$	20.6						28.9					
91,19		$C_2H_5^+$	(70.1)[c]						---					
145,19		CH_5^+	(75.6)[c]						(23.5)					
60,(19)		H_3O^+	(54.8)[c]	18.4	17.1	15.0			(22.7)	23.0	31.8	34.3		
60,(70,19)		$H_3O^+ \cdot H_2O$	(37.9)[c]	18.2	15.7				(20.3)	30.3	33.9			
60,(70,19)		$H_3O^+ \cdot 2H_2O$	(31.8)[c]	17.3					(23.7)	35.1				
60,70,19		$H_3O^+ \cdot 3H_2O$	(26.5)[c]						(22.7)					
60,72,19		$H_3O^+ \cdot 4H_2O$	(23.5)[c]						(22.7)					
146,19,84		H_2CN^+	(53)[c]	(22.0)[c]					(23)	(25.9)				
148		F^-	<23						---					
149		Cl^-	8.2						15.4					
295,4			(10.5)						[19.9]					
149		Br^-	7.7						19.1					
149		I^-	7.4						20.9					
300		$(CH_3)_3Sn^+$	(36.9)						[29.1]					

Neut.	Ion	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	T(K)	Method	Comments
NH_3	Li^+	(32.1)[s]	---					298	ICR	[s]Li^+-H_2O interpolated value in Ref. 28
		---	24.2	13.5	6.8	2.8	1.8	298	HPMS	
	Na^+	21.4	15.4	9.9	6.1	1.8	0.8	298	HPMS	
	K^+	13.2	9.5	6.6	4.0			298	HPMS	
		11.8						298	HPMS	
	Rb^+	11.5	8.2	5.6	3.4	1.3		298	HPMS	
	Ag^+	---	27.3	7.3	4.1	2.6		298	HPMS	
	Bi^+	34.9	13.4	5.7				298	HPMS	
	Cu^+	---	---	6.9	4.2	2.9		298	HPMS	
	NH_3^+	---						---	PI	
		---	---					---	EI	(error ±4.6 kcal/mole)
	NH_4^+	17.1	8.9	6.1	3.7			298	PHPMS	*typographical error in ref.
		17.5	9.0	6.4	3.8	0.05		298	HPMS	
		---	---	6.4	3.8	0.5		298	HPMS	
		18.1	10.2	6.7	3.7			298	HPMS	
		---	9.5	6.3	4.1	0.7		298	DTMS	
		---	---	6.0	4.3			298	HPMS	Optimum value
		15.5	9.4	6.0	3.4	0.4	0.0	298	HPMS	
		---	---	---	---			---	HPMS	
		---	---					---	EI	(error ±4.6 kcal/mole)
		---	---					---	PI	
		---	>9.7	6.5	3.4			296	FA	
		---	10.1	6.4	---			296	SAMS	
		6.3	5.5					400	HPMS	
	CH_3^+	---						298	---	[c] ΔH_f's and PA's
	$CH_3NH_3^+$	7.1						550	PHPMS	
	CH_3CNH^+	(35.4)[s]						298	HPMS	[s] from proton transfer
	$(CH_3)_2NH_2^+$	5.1						550	PHPMS	
	$(CH_3)_3NH^+$	4.2						550	HPMS	
	$(C_2H_5)_3NH^+$	0.0						550	HPMS	
	$C_5H_5NH^+$	4.9						550	HPMS	pyridineH^+
	$C_5H_{12}O_2N^+$	12.6						300	HPMS	valineH^+
	$C_5H_9O_2N^+$	11.9						300	HPMS	prolineH^+
	$C_2H_5^+$	---						298	----	[c]ΔH_f's and PA; cf. Ref. 114
	CH_5^+	(68.5)						298	----	[c]$NH_4^+-CH_4+\Delta PA$
	H_3O^+	(48.0)	11.6	7.6	4.7			300	HPMS	[c]$NH_3/H_2O+\Delta PA$
	$H_3O^+ \cdot H_2O$	(31.8)	9.2	5.6				300	HPMS	[c]NH_3/H_2O [[s]cf. Ref. 109]
	$H_3O^+ \cdot 2H_2O$	(24.7)	6.5					300	HPMS	[c]NH_3/H_2O [[s]cf. Ref. 109]
	$H_3O^+ \cdot 3H_2O$	(19.4)						300	HPMS	[c]NH_3/H_2O [[s]cf. Ref. 109]
	$H_3O^+ \cdot 4H_2O$	(16.7)						300	HPMS	[c]NH_3/H_2O
	H_2CN^+	(46.3)	(14.3)					298	HPMS	[c]HCN/NH_3
	F^-	---						---	FA	$< F^- - H_2O$
	Cl^-	3.6						298	HPMS	
		(4.5)[s]						298	ICR	[s]$Cl^- - t\text{-}C_4H_9OH$
	Br^-	2.0						298	HPMS	
	I^-	1.2						298	HPMS	
	$(CH_3)_3Sn^+$	(21.6)[s]						525	PHPMS	[s]$(CH_3)_3Sn^+-CH_3OH$

Table 7. (continued) Thermodynamic quantities for the gas-phase association of inorganic polyatomics to ions.

			$-\Delta H^{o}_{n-1,n}$ (kcal/mol)						$-\Delta S^{o}_{n-1,n}$ (cal/K mol)					
Ref.	Neut.	Ion	1	2	3	4	5	6	1	2	3	4	5	6
107	HNO_2	NO_2^-	32.5	21.3					---	---				
			(31)[s]	21.6					---	---	---			
107	HNO_3	NO_3^-	---	17.7	16.0				---	---	---			
222			(>23)	18.3	16.1				[24]	22.1	28.9			
230			---	16.0	13.9	9.3	7.4	4.6	---	23.1	26.7	19.9	18.6	7.3
251			---	---	---				---	---	---			
222		Br^-	(>20)[c]	(18.1)[c]					[18.5]	(23.6)				
96		Na^+	20.6						20.3					
112,100	H_2O_2	Cl^-	(22.1)[s]						(21.4)					
112,107		NO_2^-	(20.2)[s]						(20.0)					
112,107		NO_3^-	(19.2)[s]						(21.3)					
112		HSO_4^-	(15.9)[s]						(17.3)					
252	PH_3	PH_4^+	11.5	9.2	7.3	6.5	5.5		25.9	22.3	18.4	15.0	13.2	
252		$P_2H_5^+$	9						20					
252		$P_3H_6^+$	10.8						34					
93		H_3O^+	(34.5)						---					
41,98	PF_3	F^-	(40.2)						(23.5)					
311,4		Cl^-	(15.5)						(21.0)					
322	AlF_3	F^-	117.2	48.8*					---					
321			114	56					---					
320	ScF_3	Na^+	33						---					
321		F^-	112						---					
319	K_2SO_4	K^+	38						---					
41,98	SF_4	F^-	(43.8)						(25.6)					
41,98	COF_2	F^-	(42.6)						(29.0)					
41,98	SOF_2	F^-	(37.4)						(24.1)					
41,98	SO_2F_2	F^-	(35.8)						(27.5)					
253	CeI_3	I^-	67						28					
259	CCl_4	Cl^-	14.2						27.8					
314,98	SiF_4	F^-	---						---					

Neut.	Ion	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	T(K)	Method	Comments
HNO_2	NO_2^-	---	---					---	HPMS	
		---	---	---				---	HPS	$^{S}NO_2^- - SO_2$
HNO_3	NO_3^-	---	---					---	HPMS	
		>14.5	11.7	7.4				298	FA	
		---	9.0	5.9	3.2	1.9	2.4	298	HPMS	
		---	---	6.9				298	FA	
	Br^-	(>13.4)	(11.1)*					367,*298	FA	$^{C}Br^-/NO_3^- - HNO_3/HBr(s)$
	Na^+	14.6						298	FA	
H_2O_2	Cl^-	(15.7)						298	FA	$^{S}Cl^- - H_2O$
	NO_2^-	(14.2)						298	FA	$^{S}NO_2^- - H_2O$
	NO_3^-	(12.9)						298	FA	$^{S}NO_2^- - H_2O$
	HSO_4^-	(10.7)						298	FA	$^{S}NO_3^- - H_2O$
PH_3	PH_4^+	3.7	2.5	1.8	1.7	1.6		298	DTMS	
	$P_2H_5^+$	4.3	3.66	3.33				298	DTMS	
	$P_3H_6^+$	3.5	3.27					298	DTMS	
	H_3O^+	---						---	ICR	bracketed (±2 kcal) by HCN and HCOOH (Refs. 88,117)
PF_3	F^-	(32.6)^{S}						298	ICR	$^{S}F^- - H_2O$
	Cl^-	(9.2)^{S}						298	ICR	$^{S}Cl^- - t\text{-}C_4H_9OH$
AlF_3	F^-	---						1100,850	MS	Knudsen cell
		---						---	MS	Knudsen cell
ScF_3	Na^+	---						---	MS	Knudsen cell
	F^-	---						---	MS	Knudsen cell
K_2SO_4	K^+	---						1200	MS	Knudsen cell
SF_4	F^-	(36.2)^{S}						298	ICR	$^{S}F^- - H_2O$
COF_2	F^-	(33.9)^{S}						298	ICR	$^{S}F^- - H_2O$
SOF_2	F^-	(30.2)^{S}						298	ICR	$^{S}F^- - H_2O$
SO_2F_2	F^-	(27.6)^{S}						298	ICR	$^{S}F^- - H_2O$
CeI_3	I^-	39						1000	MS	Heated collision chamber
CCl_4	Cl^-	5.9						298	HPMS	
SiF_4	F^-	(51)						298	ICR	$^{S}F^- - H_2O$

Table 8. Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
295,4	$CHFCl_2$	$CHFCl_2$	Cl^-	(17.6)	[23.1]	(10.7)	298	ICR	s Cl^--t-C_4H_9OH
295,4	CHF_2Cl	CHF_2Cl	Cl^-	(17.2)	[23.0]	(10.3)	298	ICR	s Cl^--t-C_4H_9OH
41,98	CHF_3	CHF_3	F^-	(27.1)	[24.1]	(19.6)	298	ICR	s F^--H_2O
295,4			Cl^-	(16.7)	[22.9]	(9.8)	298	ICR	s Cl^--t-C_4H_9OH
254	$CHCl_3$	$CHCl_3$	Cl^-	15.2	14.8	10.8	298	HPMS	
259				19.1	24.3	11.8	298	HPMS	
295,4				(18.1)	[23.2]	(11.2)	298	ICR	s Cl^--t-C_4H_9OH
40,28	CH_2O	formaldehyde	Li^+	(36.0)	[26]	(28.2)	298	ICR	s Li^+-H_2O
85,70			H_3O^+	(32.9)	(21.6)	(26.4)	298	HPMS	s H_3O^+-H_2O
115,70				(32.0)	(21.7)	(25.5)	298	FA	s H_3O^+-H_2O
88,70				---	---	(25.2)	298	ICR	s H_3O^+-H_2O
116,70				---	---	(25.3)	299	FA	s H_3O^+-H_2O
315,70				(32.2)	[23.8]	(25.1)	298	ICR	s H_3O^+-H_2O
85,70			$H_3O^+ \cdot H_2O$	(22.8)	(24.3)	(15.6)	298	HPMS	s H_3O^+-H_2O
115,70				(18.9)	(18.4)	(13.1)	298	FA	s $H_3O^+ \cdot H_2O$-H_2O
116,70				---	---	(12.7)	299	FA	s $H_3O^+ \cdot H_2O$-H_2O
85,70			$H_3O^+ \cdot 2H_2O$	(20.9)	(28.1)	(12.5)	298	HPMS	c H_2O/H_2CO
115,70				(16.4)	(23.2)	(9.5)	298	FA	s $H_3O^+ \cdot 2H_2O$-H_2O
166,70				---	---	(9.3)	298	FA	s $H_3O^+ \cdot 2H_2O$-H_2O
85,70			$H_3O^+ \cdot 3H_3O$	(16.3)	(24.0)	(9.2)	298	HPMS	c H_2O/H_2CO
85,72			$H_3O^+ \cdot 4H_2O$	(14.7)	(23.2)	(7.8)	298	HPMS	c H_2O/H_2CO
85,72			$H_3O^+ \cdot 5H_2O$	(12.6)	(19.0)	(6.9)	298	HPMS	c H_2O/H_2CO
85,72			$H_3O^+ \cdot 6H_2O$	(11.9)	(18.6)	(6.3)	298	HPMS	c H_2O/H_2CO
243,147			H_2CN^+	---	---	(21.8)	298	FA	s $H_2CN^+ \cdot HCN$
115,70			H_2COH^+	(27.6)	(24.6)	(20.3)	298	FA	c $H_2O/H_2CO(s)$
315,70,19				(27.7)	[26.5]	(19.8)	298	ICR	c $H_2O/H_2CO(s)$
117	CH_2O_2	formic acid	$CH_3NH_3^+$	19.0	24.2	11.8	298	HPMS	
299,131,19			$CH_3OH_2^+$	(32.0)	[27.7]	(23.8)	298	ICR	s $(CH_3)_2OH^+$-$(CH_2)_2O$
41,98			F^-	(45.3)	[24.2]	(38.1)	298	ICR	s F^--H_2O
255			Cl^-	27.4	24.5	20.1	300	HPMS	
254				37.2	39.6	25.4	298	HPMS	
256				---	---	---	---	HPMS	cf. Table 9
295,4				(25.6)	[24.1]	(18.4)	298	ICR	s Cl^--t-C_4H_9OH
296			I^-	18.9	20.7	12.7	300	HPMS	
256			$HCOO^-$	---	---	---	---	---	cf. Table 9
39,28	CH_2F_2	CH_2F_2	Li^+	(26.5)	---	---	---	ICR	s $Li^+ \cdot H_2O$; from Figure
39,28	CH_2Cl_2	CH_2Cl_2	Li^+	(29)	---	---	---	ICR	s $Li^+ \cdot H_2O$; from Figure
259			Cl^-	15.5	22.0	8.9	298	HPMS	
295,4				(15.8)	[22.1]	(9.2)	298	ICR	s Cl^--t-C_4H_9OH
117	CH_3NO	$HCONH_2$	$CH_3NH_3^+$	30.0	30.0	21.1	298	HPMS	
39,28	CH_3NO	CH_3NO_2	Li^+	(39.5)	---	---	---	ICR	s Li^+H_2O; from Figure
117			$CH_3NH_3^+$	20.5	23.0	13.6	298	HPMS	
126			valineH^+	19.8	27.8	12.6	300	HPMS	
126			prolineH^+	17.5	21.6	11.0	300	HPMS	
118			aniline$^+$	(14.0)	[17]	8.2	343	HPMS	
118			1-CH_3-naphthalene$^+$	11.6	24	4.4	298	HPMS	
39,28	CH_3F	CH_3F	Li^+	(31)	---	---	---	ICR	s $Li^+ \cdot H_2O$; from Figure
117			$CH_3NH_3^+$	11.8	23.3	4.9	298	HPMS	
295,4			Cl^-	(11.5)	[20.3]	(5.4)	298	ICR	s Cl^--t-C_4H_9OH
39,28	CH_3Cl	CH_3Cl	Li^+	(25)	---	---	---	ICR	s $Li^+ \cdot H_2O$; from Figure
257			CH_2Cl^+	6.9	-3.5	7.9	298	HPMS	cf. Table 9
257			CH_3^+	---	---	---	---	HPMS	cf. Table 9

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^o_{0,1}$	(cal/K mol) $-\Delta S^o_{0,1}$	(kcal/mol) $-\Delta G^o_{0,1}(T)$	(K) T	Method	Remarks
257	CH_3Cl	CH_3Cl (conc'd)	CH_4Cl^+	---	---	---	---	HPMS	cf. Table 9
117			$CH_3NH_3^+$	10.7	20.6	4.6	298	HPMS	
258			$C_2H_5^+$	30.7	30.7	21.6	298	HPMS	
258			$(CH_3)_2CH^+$	22.9	44.5	9.6	298	HPMS	
324			$N(CH_3)_4^+$	6.5	17.9	1.2	298	HPMS	
259			Cl^-	8.6	15.3	4.1	298	HPMS	[s] Cl^--t-C_4H_9OH
295,4				(12.2)	[20.5]	(6.2)	298	ICR	[s] Cl^--t-C_4H_9OH
117	CH_3Br	CH_3Br	$CH_3NH_3^+$	11.2	21.0	4.9	298	HPMS	
293			Cl^-	10.9	12.8	7.1	298	HPMS	
293			Br^-	9.2	14.0	5.0	298	HPMS	
118	CH_3I	CH_3I	aniline$^-$	(9.3)	[17]	4.3	299	HPMS	
293			Cl^-	9.8	7.3	7.6	298	HPMS	
293			I^-	9.0	16.4	4.1	298	HPMS	
314,98	CH_3SiF_3	CH_3SiF_3	F^-	---	---	(43.0)	298	ICR	[s] F^--H_2O
217	CH_4	methane	Na^+	7.2	14.1	3.0	298	HPMS	
260			H_3O^+	8.0	20.4	1.9	300	HPMS	cf. Table 9
145			NH_4^+	3.59	15.5	-1.06	300	HPMS	
145			H_3S^+	3.87	18.1	-1.55	300	HPMS	
145			CF_3^+	4.55	18.8	-1.08	300	HPMS	
91.19			CH_3^+	(39.8)	---	---	298	---	[c] ΔH_f's + PA's
261			CH_5^+	7.4	20.8	1.2	298	HPMS	cf. Table 9
262				4.14	12.4	0.45	298	HPMS	cf. Table 9
262			$C_2H_5^+$	2.39	8.6	-0.16	298	HPMS	
263				6.6	23.4	-0.4	298	HPMS	
57			$(CH_3)_2CH^+$	3.4	20	-2.6	298	HPMS	
40,28	CH_4O	methanol	Li^+	(38.1)	[26.2]	(30.3)	298	ICR	[s] $Li^+ \cdot H_2O$
91,19			NO^+	(30.2)	---	---	298	---	[c] ΔH_f's + PA's
118,19			H_3O^+	(40.8)	(24.0)	(33.6)	300	HPMS	[c] CH_3OH/H_2O; cf. Table 9
118,70,19			$H_3O^+ \cdot H_2O$	(30.2)	(28.6)	(21.6)	300	HPMS	[c] CH_3OH/H_2O; cf. Table 9
118,70,19			$H_3O^+ \cdot 2H_2O$	(25.5)	(32.8)	(15.6)	300	HPMS	[c] CH_3OH/H_2O; cf. Table 9
118,70,19			$H_3O^+ \cdot 3H_2O$	(19.6)	(28.8)	(10.9)	300	HPMS	[c] CH_3OH/H_2O; cf. Table 9
118,72,19			$H_3O^+ \cdot 4H_2O$	(16.0)	(24.4)	(8.7)	300	HPMS	[c] CH_3OH/H_2O; cf. Table 9
118,72,19			$H_3O^+ \cdot 5H_2O$	(14.0)	(22.2)	(7.3)	300	HPMS	[c] CH_3OH/H_2O
299,131,19			$HC(OH)_2^+$	(35.1)	[25.6]	(27.5)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
131			$CH_3OH_2^+$	33.1	30.5	24.0	298	HPMS	cf. Table 9
299,131,19				(33.7)	[28.5]	(25.2)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
117			$CH_3NH_3^+$	19.0	24.2	11.8	298	HPMS	
299,131,19			CH_3CHOH^+	(30.3)	[26.9]	(22.3)	298	ICR	[s] $(CH)_2OH^+$-$(CH_3)_2O$
299,131,19			$C_2H_5OH_2^+$	(29.6)	[26.6]	(21.7)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
122			$(CH_3)_2OH^+$	26.3	27.1	18.2	300	HPMS	cf. Table 9
122			$(CH_3)_2OH^+ \cdot (CH_3)_2O$	18.1	30.6	9.0	300	HPMS	cf. Table 9
122,131			$(CH_3)_2OH^+ \cdot 2(CH_3)_2O$	---	---	(6.8)	300	HPMS	[c] $(CH_3)_2O/CH_3OH$
118			$CH_3CH^+OCH_3$	13.1	21.4	6.7	298	HPMS	
300			$(CH_3)_3Sn^+$	32.6	32	15.8	525	HPMS	
324			$N(CH_3)_4^+$	9.8	23.2	2.9	298	HPMS	cf. Table 9
301			$C_8H_{17}O_4^+$	19.5	34.0	9.4	298	HPMS	12-crown-4etherH$^+$
301			$C_{10}H_{21}O_5^+$	20.0	28.0	11.7	298	HPMS	15-crown-5etherH$^+$

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kacl/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
301	CH_4O	methanol (cont'd)	$C_{12}H_{25}O_6^+$	20.0	29.5	11.2	298	HPMS	18-crown-6etherH$^+$
41,98			F^-	(29.6)	[22.6]	(22.8)	298	ICR	s F^--H_2O
264,265			Cl^-	---	---	(9.4)	298	ICR	s Cl^--CH_3CN
266				14.2	14.8	9.8	298	HPMS	cf. Table 9
295,4				(16.8)	[22.9]	(9.9)	298	ICR	s Cl^--t-C_4H_9OH
330				17.4	24.1	10.2	298	HPMS	cf. Table 9
296			I^-	11.3	17.8	6.0	300	HPMS	
266			O_2^-	19.1	21.9	12.5	298	HPMS	cf. Table 9
302,11,132			OH^-	---	---	(25)	296	HPMS	s OH^-/CH_3O^-; cf. Table 9
132,104			$OH^-\cdot H_2O$	---	---	(14.5)	296	FA	s $OH^-\cdot H_2O$-H_2O
132,103			$OH^-\cdot 2H_2O$	---	---	(9.6)	296	FA	s $OH^-\cdot 2H_2O$-H_2O
302			CH_3O^-	21.8	21.8	15.3	298	HPMS	
268,302,11			$C_2H_5O^-$	---	---	(13.4)	298	ICR	c CH_3O^--CH_2OH/C_2H_5OH(s)
267,302,11				---	---	(13.4)	296	FA	c CH_3O^--CH_3OH/C_2H_5OH(s)
303,302				(20.2)	[22]	(13.6)	298	ICR	s CH_3O^--CH_3OH
303,302			$n\text{-}C_3H_7O^-$	(19.8)	[22]	(13.2)	298	ICR	s $CH_3O^-\cdot CH_3OH$
303,302			$t\text{-}C_4H_9O^-$	(18.9)	[22]	(12.3)	298	ICR	s $CH_3O^-\cdot CH_3OH$
303,302			$t\text{-}C_5H_{11}O^-$	(18.6)	[22]	(12.0)	298	ICR	s $CH_3O^-\cdot CH_3OH$
303,302			$C_6H_{11}S_2^-$	(14.8)	[22]	(8.2)	298	ICR	5,5$(CH_3)_2$-1,3-dithianide
303,302			$C_6H_5C{\equiv}C^-$	(13.3)	[22]	(7.7)	298	ICR	s CH_3O^--CH_3OH
93	CH_4S	CH_3SH	H_3O^+	(34.3)	---	---	---	ICR	bracketed ± 2 kcal by H$^+$ HCOOH (Refs. 88,117)
118			$CH_3NH_3^+$	14.5	24.7	7.1	298	HPMS	
118			$CH_3NH_3^+\cdot CH_3CN$	9.9	20.0	3.9	298	HPMS	
118			$CH_3NH_3^+\cdot 2CH_3CN$	(7.8)	[20]	2.4	269	HPMS	
41,98			F^-	(34.2)	[23.2]	(27.3)	298	ICR	s F^--H_2O
40,28	CH_5N	CH_3NH_2	Li^+	(41.1)	[26]	(33.3)	298	ICR	s Li^+-H_2O
134,61			K^+	(19.1)	(21.8)	(12.7)	298	HPMS	s K^+-H_2O
144			NH_4^+	(32)	[26]	(17.9)	550	HPMS	from proton transfer
144			$CH_3NH_3^+$	21.7	23.6	8.7	550	HPMS	
63				---	---	---	---	HPMS	cf. Table 9
144			$(CH_3)_2NH_2^+$	22.4	29.2	6.3	550	HPMS	
300			$(CH_3)_3Sn^+$	(42.1)	[30.7]	(26.0)	525	HPMS	s $(CH_3)_3Sn^+$-CH_3OH
324			$N(CH_3)_4^+$	8.7	17.4	3.5	298	HPMS	
129			$C_6H_{12}NO_3^+$	28.6	19.9	22.7	298	HPMS	N-acetylalanine methyl esterH$^+$
314,98	C_2OF_4	CF_3COF	F^-	---	---	(37.2)	298	ICR	s F^--H_2O
299,70	$C_2HO_2F_3$	CF_3COOH	H_3O^+	(30.8)	[24.7]	(23.4)	298	ICR	s H_3O^+-H_2O
299.70.19			$CF_3C(OH)_2^+$	(29.3)	[28.5]	(20.8)	298	ICR	s H_3O^+-H_2O
41,98	C_2HF_3	$F_2C{=}CHF$	F^-	(26.3)	[25.6]	(18.7)	298	ICR	s F^--H_2O
41,98	C_2HF_5	CF_3CHF_2	F^-	(30.4)	[26.6]	(22.5)	298	ICR	s F^--H_2O
295,4			Cl^-	(18.8)	[23.3]	(11.8)	298	ICR	s Cl^--t-C_4H_9OH
269	C_2H_2	acetylene	$C_2H_2^+$	22.6	---	---	---	PI	
41,98	C_2H_2O	$H_2C{=}CO$	F^-	(35.3)	[26.5]	(27.4)	298	ICR	s F^--H_2O
41,98	$C_2H_2OF_4$	$(CHF_2)_2O$	F^-	(36.0)	[27.2]	(27.9)	298	ICR	s F^--H_2O
39,28	C_2H_3N	CH_3CN	Li^+	(43)	---	---	---	ICR	s Li^+-H_2O; from Figure
61			Na^+	---	---	---	---	HPMS	cf. Table 9
61			K^+	24.4	21.5	18.0	298	HPMS	cf. Table 9

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^o_{0,1}$	(cal/K mol) $-\Delta S^o_{0,1}$	(kcal/mol) $-\Delta G^o_{0,1}(T)$	(K) T	Method	Remarks
61	C_2H_3N	CH_3CN (cont'd)	Rb^+	20.7	18.1	15.3	298	HPMS	cf. Table 9
61			Cs^+	19.2	18.6	13.7	298	HPMS	cf. Table 9
118			NH_4^+	27.6	24.2	20.4	298	HPMS	cf. Table 9
118,19			H_3O^+	(46.7)	(29.3)	(37.9)	300	HPMS	[c] H_2O/CH_3CN; cf. Table 9
118,70			$H_3O^+ \cdot H_2O$	(32.6)	(30.1)	(23.6)	300	HPMS	[c] H_2O/CH_3CN; cf. Table 9
118,70			$H_3O^+ \cdot 2H_2O$	(28.7)	(33.2)	(18.8)	300	HPMS	[c] H_2O/CH_3CN; cf. Table 9
118,70			$H_3O^+ \cdot 3H_2O$	(22.4)	(27.7)	(14.1)	300	HPMS	[c] CH_3CN/H_2O; cf. Table 9
118,72			$H_3O^+ \cdot 4H_2O$	(20.1)	(27.7)	(11.9)	300	HPMS	[c] CH_3CN/H_2O; cf. Table 9
118,72			$H_3O^+ \cdot 5H_2O$	(18.6)	(28.2)	(10.2)	300	HPMS	[c] CH_3CN/H_2O; cf. Table 9
117			$CH_3NH_3^+$	24.5	25.8	16.8	298	HPMS	cf. Table 9
118			$CH_3NH_3^+ \cdot CH_3SH$	(19.9)	(21.1)	(13.6)	298	HPMS	[c] CH_3CN/CH_3SH
147			CH_3CNH^+	30.2	29	21.6	298	HPMS	cf. Table 9
270			$CH_3NHCHOH^+$	---	---	(16.2)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270,131			$(CH_3)_2OH^+$	---	---	(23.0)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
270			$(CH_3)_2COH^+$	---	---	(20.8)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$C_2H_5OCHOH^+$	---	---	(21.5)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(CH_3)(CH_3O)COH^+$	---	---	(20.1)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$n\text{-}C_3H_7OH_2^+$	---	---	(23.6)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
300			$(CH_3)_3Sn^+$	(37.5)	[31.4]	(21.0)	525	HPMS	[s] $(CH_3)_3Sn^+$-CH_3OH
270			$(c\text{-}C_3H_5)CNH^+$	---	---	(20.8)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			cyclobutanoneH$^+$	---	---	(22.1)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(CH_3)(c\text{-}C_3H_5)COH^+$	---		(17.5)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$c\text{-}C_4H_8OH^+$	---	---	(20.7)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN;
270			$(CH_3)(C_2H_5O)COH^+$	---	---	(18.9)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(CH_3O)(c\text{-}C_3H_5)COH^+$	---	---	(17.7)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			1,4-dioxane H$^+$	---	---	(22.9)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(C_2H_5)_2OH^+$	---	---	(19.6)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			cyclopentanoneH$^+$	---	---	(20.1)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$2\text{-}CH_3\text{-}c\text{-}C_4H_7OH^+$	---	---	(19.0)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$c\text{-}C_5H_{10}OH^+$	---	---	(20.3)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(C_2H_5)(i\text{-}C_3H_7)OH^+$	---	---	(18.4)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
118			aniline$^+$	17.2	17.0	11.6	323	HPMS	
270			cyclohexanoneH$^+$	---	---	(19.4)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$2,2\text{-}(CH_3)_2\text{-}c\text{-}C_4H_6OH^+$	---	---	(18.2)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(CH_3)(t\text{-}C_4H_9)COH^+$	---	---	(18.1)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(n\text{-}C_3H_7)_2OH^+$	---	---	(18.7)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(i\text{-}C_3H_7)_2OH^+$	---	---	(17.9)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$C_6H_5CHOH^+$	---	---	(18.7)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(c\text{-}C_3H_5)_2COH^+$	---	---	(14.3)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(i\text{-}C_3H_7)_2COH^+$	---	---	(16.7)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(CH_3)(C_6H_5)COH^+$	---	---	(16.3)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(CH_3O)(C_6H_5)COH^+$	---	---	(16.5)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$(CH_3)(c\text{-}C_6H_{11})COH^+$	---	---	(18.8)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
270			$p\text{-}(CH_3C_6H_4)(CH_3)COH^+$	---	---	(15.5)	298	ICR	[s] $(CH_3)_2OH^+$-CH_3CN
118			$1\text{-}CH_3\text{-naphthalene}^+$	(12.0)	[24]	4.6	303	HPMS	
265			F^-	16.0	13.4	12.0	298	HPMS	cf. Table 9

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
265	C_2H_3N	CH_3CN (cont'd)	Cl^-	13.4	14.3	9.2	298	HPMS	cf. Table 9
295,4				(15.8)	[21.4]	(9.4)	298	ICR	s Cl^--t-C_4H_9OH
330				13.6	15.7	8.9	298	HPMS	cf. Table 9
265			Br^-	12.9	16.5	8.0	298	HPMS	cf. Table 9
265			I^-	11.9	18.2	6.4	298	HPMS	cf. Table 9
266			O_2^-	16.4	17.4	11.2	298	HPMS	cf. Table 9
267			$CH_3C(O)CH_2^-$	---	---	9.4	295	FA	
299,70	$C_2H_3OF_3$	CF_3CH_2OH	H_3O^+	(33.0)	[24.6]	(25.7)	298	ICR	s H_3O^+-H_2O
117			$CH_3NH_3^+$	19.1	28.5	10.6	298	HPMS	
299,70,19			$CF_3CH_2OH_2^+$	(23.2)	[28.9]	(31.8)	298	ICR	s H_3O^+-H_2O
41,98			F^-	(37.8)	[26.5]	(29.9)	298	ICR	s F^--H_2O
295,4			Cl^-	(24.0)	[25]	(16.5)	298	ICR	s Cl^--t-C_4H_9OH
311,98	$C_2H_3O_2Cl$	$ClCOOCH_3$	Cl^-	(14.1)	[21.0]	(7.8)	298	ICR	s Cl^--t-C_4H_9OH
41,98	$C_2H_3F_3$	CF_2HCH_2F	F^-	(26.5)	[25.9]	(18.8)	298	ICR	s F^--H_2O
295,4			Cl^-	(18.9)	[25]	(11.4)	298	ICR	s Cl^--t-C_4H_9OH
325	C_2H_4	ethylene	NH_4^+	(10)	[20]	3.7	294	HPMS	
271			$C_2H_4^+$	15.8	---	---	---	PI	
272				18.2	---	---	---	PI	cf. Table 9
272			$C_3H_5^+$	16.7	---	---	---	PI	
272			$C_4H_7^+$	8.7	---	---	---	PI	
41,98	$C_2H_4NF_3$	$CF_3CH_2NH_2$	F^-	(28.1)	(26.0)	(20.3)	298	ICR	s F^--H_2O
295,4			Cl^-	(18.0)	[24]	(10.8)	298	ICR	s Cl^--t-C_4H_9OH
39,28	C_2H_4O	CH_3CHO (acetaldehyde)	Li^+	(41.3)	---	---	---	ICR	s Li^+-H_2O; value given in Ref. 93
273			NO^+	(35.9)	---	---	---	ICR	s NO^+-C_2H_5OH
299,131,19			$CH_3OH_2^+$	(34.7)	[27.5]	(26.5)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			CH_3CHOH^+	(31.9)	[28.9]	(23.3)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$CH_3C(OH)_2^+$	(29.0)	[26.2]	(21.2)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$C_2H_5OH_2^+$	(31.2)	[26.9]	(23.2)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
295,4			Cl^-	(14.4)	[21.7]	(7.9)	298	ICR	s Cl^--t-C_4H_9OH
117	$C_2H_4O_2$	CH_3COOH (acetic acid)	$CH_3NH_3^+$	22.0	24.3	14.8	298	HPMS	
299,131,19			CH_3CHOH^+	(32.5)	[27.7]	(24.2)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$CH_3C(OH)_2^+$	(29.5)	[27.9]	(21.2)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$C_2H_5OH_2^+$	(31.4)	[27.6]	(23.2)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131			$(CH_3)_2OH^+$	(29.3)	[28.4]	(20.8)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
129			$(N(CH_3)_2)(CH_3)COH^+$	18.4	24.7	11.0	298	HPMS	
129			$C_6H_{12}NO_3^+$	18.1	27.2	10.0	298	HPMS	N-acetylalanine methyl esterH^+
117			$(c\text{-}C_3H_5)_2COH^+$	22.4	34.9	12.0	298	HPMS	
41,98			F^-	(44.1)	[25.6]	(36.5)	298	ICR	s F^--H_2O
254			Cl^-	21.6	19.3	15.8	298	HPMS	
295,4				(23.9)	[24.0]	(16.7)	298	ICR	s Cl^--t-C_4H_9OH
296			I^-	16.9	21.3	10.5	300	HPMS	
39,28	$C_2H_4O_2$	$HCOOCH_3$	Li^+	(41.5)	---	---	---	ICR	s Li^+-H_2O; from Figure
117			$CH_3NH_3^+$	(21.4)	[24]	10.3	459	HPMS	
295,4	$C_2H_4F_2$	CH_3CF_2H	Cl^-	(14.9)	[22.7]	(8.1)	298	ICR	s Cl^--t-C_4H_9OH

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
274	$C_2H_5NO_2$	glycine	glycineH$^+$	31	33	21.2	298	HPMS	
275,221	$C_2H_5NO_3$	$C_2H_5ONO_2$	NO_2^-	(20.9)	(35.3)	(10.4)	298	HPMS	[s] NO_2^--SO_2; cf. Table 9
248			$NO_2^-\cdot SO_2$	7.4	10.4	4.2	298	HPMS	
275			NO_3^-	17.2	32.2	7.6	298	HPMS	cf. Table 9
41,98	C_2H_5OF	CH_2FCH_2OH	F^-	(34.8)	[26.3]	(27.0)	298	ICR	[s] F^--H_2O
295,4			Cl^-	(20.5)	[25]	(13.0)	298	ICR	[s] Cl^--t-C_4H_9OH
295,4	C_2H_5OCl	CH_2ClCH_2OH	Cl^-	(21.5)	[25]	(14.0)	298	ICR	[s] Cl^--t-C_4H_9OH
39,28	C_2H_5F	C_2H_5F	Li^+	(33.5)	---	---	---	ICR	[s] Li^+-H_2O; from Figure
276	C_2H_5Cl	C_2H_5Cl	$C_2H_5^+$	---	---	---	---	HPMS	cf. Table 9
294	C_2H_5Br	C_2H_5Br	Br^-	11.6	19.2	5.9	298	HPMS	
277	C_2H_6	ethane	$C_2H_4^+$	15.3	21	9.0	298	HPMS	
91,19	C_2H_6O	C_2H_5OH (ethanol)	NO^+	(35.2)	---	---	298	---	[c] ΔH_f's + PA's
299,131,19			$CH_3OH_2^+$	(36.0)	[27.5]	(27.8)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
117			$CH_3NH_3^+$	(21.3)	[25]	8.9	496	HPMS	
114			$C_2H_5^+$	(54)	---	---	298	---	[c] ΔH_f's + PA's
299,131,19			CH_3CHOH^+	(32.9)	[30.6]	(23.8)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$CH_3C(OH)_2^+$	(29.5)	[26.0]	(21.7)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$C_2H_5OH_2^+$	(32.0)	[28.5]	(23.5)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
316,131,19				(32.2)	[28.5]	(23.7)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
300			$(CH_3)_3Sn^+$	(34.8)	[32.2]	(17.9)	525	HPMS	[s] $(CH_3)_3Sn^+$-CH_3OH
299,131,19			n-$C_3H_7OH_2^+$	(30.5)	[28.6]	(22.0)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
316,131,19			i-$C_3H_7OH_2^+$	(30.7)	[28.2]	(22.3)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			n-$C_4H_9OH_2^+$	(30.2)	[28.6]	(21.7)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
41,48			F^-	(31.5)	(24.9)	(24.1)	298	ICR	[s] F^--H_2O
278,264			Cl^-	---	---	(9.95)	295	ICR	[s] Cl^--CH_3OH
295,4				(17.3)	[23.1]	(10.4)	298	ICR	[s] Cl^--t-C_4H_9OH
296			I^-	12.1	18.9	6.4	300	HPMS	
267;268,302			CH_3O^-	---	---	(16.5)	298	FA,ICR	[s] CH_3O^--CH_3OH
267,302,11			$C_2H_5O^-$	---	---	(13.9)	296	FA	[c] CH_3O^--CH_3OH/C_2H_5OH(s)
268,302,11				---	---	(13.8)	298	ICR	[c] CH_3O^--CH_3OH/C_2H_5OH(s)
303,302				(20.6)	[22]	(14.0)	298	ICR	[s] CH_3O^--CH_3OH
303,302			n-$C_3H_7O^-$	(20.3)	[22]	(13.7)	298	ICR	[s] CH_3O^--CH_3OH
303,302			t-$C_4H_9O^-$	(19.5)	[22]	(12.9)	298	ICR	[s] CH_3O^--CH_3OH
303,302			t-$C_5H_{11}O^-$	(19.2)	[22]	(12.6)	298	ICR	[s] CH_3O^--CH_3OH
40,28	C_2H_6O	$(CH_3)_2O$	Li^+	(39.5)	[27.5]	(31.3)	298	ICR	[s] Li^+-H_2O
134			K+	20.8	24.8	13.4	298	HPMS	
279				22.2	26.8	14.2	298	HPMS	
122,19			H_3O^+	(48.2)	(27.7)	(39.9)	300	HPMS	[c] $(CH_3)_2OH^+$-H_2O + ΔPA
122,70				(45.4)	(24.5)	(37.9)	300	HPMS	[c] $H_2O/(CH_3)_2O$(s); cf. Table 9
122,70			$H_3O^+\cdot H_2O$	(29.1)	(26.5)	(21.1)	300	HPMS	[c] $H_2O/(CH_3)_2O$(s); cf. Table 9
122,70			$H_3O^+\cdot 2H_2O$	(23.4)	(30.2)	(14.3)	300	HPMS	[s] $H_3O^+\cdot 2H_2O$-H_2O; cf. Table 9
122			$H_3O^+\cdot 3H_2O$	(17.9)	(28.4)	(9.3)	300	HPMS	[s] $H_2O^+\cdot 3H_2O$-H_2O
122			$CH_3OH_2^+$	35.0	24.7	27.6	300	HPMS	cf. Table 9
122			$CH_3OH_2^+\cdot CH_3OH$	21.9	25.2	14.4	300	HPMS	cf. Table 9
122			$CH_3OH_2^+\cdot 2CH_3OH$	17.2	28.6	8.7	300	HPMS	cf. Table 9

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
122	C_2H_6O	$(CH_3)_2O$ (cont'd)	$CH_3OH_2^+ \cdot 3CH_3OH$	15.3	31.5	5.9	300	HPMS	
117			$CH_3NH_3^+$	21.5	29.3	12.8	298	HPMS	
299,131,19			$CH_3C(OH)_2^+$	(31.1)	[26.0]	(23.4)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
117			$(CH_3)_2OH^+$	29.5	27.0	21.5	298	HPMS	
131				30.7	29.6	21.9	300	HPMS	cf. Table 9
299,131,19			$(HCOOC_2H_5)H^+$	(30.2)	[28.8]	(21.6)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
324			$(CH_3)_2OCH_3^+$	13.0	28.4	4.5	298	HPMS	
299,131,19			$n\text{-}C_3H_7OH_2^+$	(31.9)	[28.6]	(23.4)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
316,131,19			$i\text{-}C_3H_7OH_2^+$	(31.9)	[28.2]	(23.5)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$1,4\text{-dioxaneH}^+$	(29.9)	[29.1]	(21.2)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
318	C_2H_6OS	$(CH_3)_2SO$	K^+	35	31	25	300	HPMS	cf. Table 9
280			$(CH_3)_2SOH^+$	(30.8)	(22.9)	(24.0)	298	HPMS	s $(CH_3)_2SOH^+$-$(CH_3)_2CO$; cf. Table 9
280			$(CH_3)_2COH^+$	(41.1)	(29.6)	(32.3)	298	HPMS	s $(CH_3)_2COH^+$-$(CH_3)_2CO$
317			Cl^-	18.6	20.4	12.5	300	HPMS	cf. Table 9
317			Br^-	17.3	21.4	10.9	300	HPMS	cf. Table 9
317			I^-	15.7	21.7	9.2	300	HPMS	cf. Table 9
39,28	C_2H_6S	$(CH_3)_2S$	Li^+	(32.8)	---	---	---	ICR	s Li^+-H_2O (value given in Ref. 93)
118	C_2H_6S	C_2H_5SH	$CH_3NH_3^+$	15.5	21.8	9.0	298	HPMS	
40,28	C_2H_7N	$(CH_3)_2NH$	Li^+	(42.2)	[27]	(34.1)	298	ICR	s Li^+-H_2O
134			K^+	19.5	21.4	13.1	298	HPMS	
144			NH_4^+	(38.9)	[28.2]	(23.4)	550	HPMS	from proton transfer
144			$CH_3NH_3^+$	(27.5)	(24.9)	(13.8)	550	HPMS	from proton transfer
144			$(CH_3)_2NH_2^+$	20.8	25.7	6.6	550	HPMS	
144			$(CH_3)_3NH^+$	20.5	28.5	4.8	550	HPMS	
300			$(CH_3)_3Sn^+$	(44.2)	[30.3]	(28.3)	525	HPMS	s $(CH_3)_3Sn^+$-CH_3OH
281	C_2H_7N	$C_2H_5NH_2$	$C_2H_5NH_3^+$	---	---	---	---	HPMS	cf. Table 9
300			$(CH_3)_3Sn^+$	(44.1)	[31.8]	(27.4)	525	HPMS	s $(CH_3)_3Sn^+$-CH_3OH
279	$C_2H_8N_2$	$H_2NCH_2CH_2NH_2$	K^+	25.7	22.3	19.0	298	HPMS	cf. Table 9
282			$H_2NCH_2CH_2NH_3^+$	---	---	---	---	HPMS	cf. Table 9
41,98	C_3F_5N	C_2F_5CN	F^-	(30.1)	[22.8]	(23.3)	298	ICR	s F^--H_2O
311,4	C_3HOF_5	$(CF_2H)(CF_3)CO$	Cl^-	(23.4)	[23.9]	(16.3)	298	ICR	s Cl^--t-C_4H_5OH
295,4	$C_3H_2OF_6$	$(CF_3)_2HCOH$	Cl^-	(>26.5)	[25]	(>19)	298	ICR	s Cl^--t-C_4H_9OH
39,28	C_3H_4	$CH_3C{\equiv}CH$	Li^+	(28.5)	---	---	---	ICR	s Li^+-H_2O; from Figure
41,98	C_3H_5OF	$CH_2F(c\text{-}C_2H_3O)$	F^-	(25.5)	[23.7]	(18.4)	298	ICR	s F^--H_2O
39,28	C_3H_6	$CH_3CH{=}CH_2$	Li^+	(23)	---	---	---	ICR	s $Li^+ \cdot H_2O$; from Figure
39,28	C_3H_6O	$(CH_3)_2CO$ (acetone)	Li^+	(44.5)	---	---	---	ICR	s $Li^+ \cdot H_2O$; from Figure
318			K^+	26	24	19	300	HPMS	cf. Table 9
273			NO^+	(41.0)	---	---	---	ICR	s $NO^+ \cdot C_2H_5OH$
117			$CH_3NH_3^+$	24.0	23.2	17.1	298	HPMS	
283			CH_3CO^+	12.5	---	---	---	PI	

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
280	C_3H_6O	$(CH_3)_2CO$ (acetone)	$(CH_3)_2SOH^+$	24.1	24.5	16.8	298	HPMS	
283		(cont'd)	$(CH_3)_2CO^+$	>12.4	---	---	---	PI	
299,131,19			$(CH_3)_2COH^+$	(31.5)	[30.9]	(22.3)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
280				30.1	30.4	21.0	298	HPMS	
329				---	---	---	---	HPMS	cf. Table 9
299,131,19			$(CH_3COOCH_3)H^+$	(30.0)	[29.0]	(21.4)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$c\text{-}C_4H_8OH^+$	(31.0)	[30.6]	(21.9)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(CH_3)(C_2H_5)COH^+$	(29.4)	[29.1]	(20.7)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			1,4-dioxaneH$^+$	(32.6)	[29.4]	(23.9)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(C_2H_5)_2OH^+$	(29.3)	[29.2]	(20.6)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(C_2H_5)_2COH^+$	(28.5)	[29.0]	(19.9)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
300			$(CH_3)_3Sn^+$	(37.4)	[30.9]	(21.2)	298	HPMS	s $(CH_3)_3Sn^+$-CH_3OH
324			$N(CH_3)_4^+$	14.6	24.7	7.2	298	HPMS	cf. Table 9
324			$N(C_2H_5)_4^+$	12.4	26.7	4.4	298	HPMS	
255			Cl^-	13.7	19.6	7.9	300	HPMS	
295,4				(14.1)	[19.6]	(8.2)	298	ICR	s Cl^--t-C_4H_9OH
284,104			$OH^-\cdot H_2O$	---	---	(15.0)	295	FA	s $OH^-\cdot H_2O$-H_2O
267			$CH_3C(O)CH_2^-$	---	---	8.3	295	FA	
273	C_3H_6O	C_2H_5CHO	NO^+	(38.1)	---	---	---	ICR	s NO^+-C_2H_5OH
118	C_3H_6O	CH_2=CHOCH$_3$	$(CH_2$=CHOCH$_3)H^+$	---	---	<6.8	520	HPMS	
295,4	$C_3H_6OF_2$	$(CH_2F)_2HCOH$	Cl^-	(23.6)	[25]	(16.1)	298	ICR	s Cl^--t-C_4H_9OH
39,28	$C_3H_6O_2$	CH_3COOCH_3	Li^+	(43.5)	---	---	---	ICR	s Li^+-H_2O; from Figure
273			NO^+	(39.8)	---	---	---	ICR	s $NO^+\cdot C_2H_5OH$
299,131,19			$(CH_3)_2COH^+$	(31.4)	[29.9]	(22.5)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(CH_3COOCH_3)H^+$	(29.7)	[30.9]	(20.5)	298	ICR	s$(CH_3)_2OH^+$-$(CH_3)_2O$ + APA
117			$CH_3NH_3^+$	23.5	24.8	16.1	298	HPMS	
300			$(CH_3)_3Sn^+$	(38.4)	[32.6]	(21.3)	525	HPMS	s $(CH_3)_3Sn^+$-CH_3OH
299,131	$C_3H_6O_2$	$HCOOC_2H_5$	$(CH_3)_2OH^+$	(31.2)	[28.8]	(22.6)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$C_2H_5C(OH)_2^+$	(30.0)	[30.9]	(20.8)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			1,4-dioxaneH$^+$	(30.5)	[29.9]	(21.6)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
296	$C_3H_6O_2$	C_2H_5COOH	I^-	16.6	20.4	10.5	300	HPMS	
129	C_3H_7NO	$CH_3CONHCH_3$	$(CH_3CONHCH_3)H^+$	29.8	23.6	22.8	298	HPMS	
39,28	C_3H_7NO	$(CH_3)_2NCHO$	Li^+	(50)	---	---	---	ICR	s Li^+-H_2O; from Figure
318			K^+	31	26	23	300	HPMS	cf. Table 9
39,28	C_3H_7F	$(CH_3)_2CHF$	Li^+	(35.5)	---	---	---	ICR	s Li^+-H_2O; from Figure
39,28	C_3H_7Cl	$(CH_3)_2CHCl$	Li^+	(30)	---	---	---	ICR	s Li^+-H_2O; from Figure
294	C_3H_7Br	n-C_3H_7Br	Br^-	11.6	19.8	5.7	298	HPMS	
39,28	C_3H_7Br	$(CH_3)_2CHBr$	Li^+	(30.5)	---	---	---	ICR	s Li^+-H_2O; from Figure
294			Br^-	12.2	19.9	6.3	298	HPMS	
39,28	C_3H_7I	$(CH_3)_2CHI$	Li^+	(29.5)	---	---	---	ICR	s Li^+-H_2O; from Figure
316,131,19	C_3H_8O	i-C_3H_7OH	$C_2H_5OH_2^+$	(33.6)	[27.2]	(25.5)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
316,131			$(CH_3)_2OH^+$	(31.0)	[28.2]	(22.6)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
316,131,19	C_3H_8O	i-C_3H_7OH (cont'd)	i-$C_3H_7OH_2^+$	(31.9)	[29.6]	(23.1)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
316,131,19			t-$C_4H_9OH_2^+$	(30.5)	[28.2]	(22.1)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
316,131,19			s-$C_4H_9OH_2^+$	(32.0)	[27.5]	(23.8)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
41,98			F^-	(32.3)	[25.6]	(24.7)	298	ICR	[s] F^--H_2O
295,4			Cl^-	(17.6)	[23.2]	(10.7)	298	ICR	[s] Cl^--t-C_4H_9OH
296			I^-	12.2	19.1	6.5	300	HPMS	
117	C_3H_8O	n-C_3H_7OH	$CH_3NH_3^+$	22.0	25.6	14.4	298	HPMS	
299,131			$(CH_3)_2OH^+$	(30.3)	[28.4]	(21.8)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$C_2H_5OH_2^+$	(32.8)	[27.4]	(24.6)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			n-$C_3H_7OH_2^+$	(31.6)	[30.2]	(22.6)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
329				---	---	---	---	HPMS	cf. Table 9
299,131,19			n-$C_4H_9OH_2^+$	(31.7)	[29.2]	(23.0)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
300			$(CH_3)_3Sn^+$	(35.5)	[32]	(18.7)	525	HPMS	[s] $(CH_3)_3Sn^+$-CH_3OH
41,98			F^-	(32.3)	[25.4]	(24.7)	298	ICR	[s] F^--H_2O
295,4			Cl^-	(17.7)	[23.2]	(10.8)	298	ICR	[s] Cl^--t-C_4H_9OH
303,302	C_3H_8O	n-C_3H_7OH (cont'd)	$H_2C{=}C(CH_3)O^-$	(14.5)	[22]	(7.9)	298	ICR	[s] CH_3O^--CH_3OH
303,302			n-$C_3H_7O^-$	(21.0)	[22]	(14.4)	298	ICR	[s] CH_3O^--CH_3OH
303,302			t-$C_4H_9O^-$	(20.2)	[22]	(13.6)	298	ICR	[s] CH_3O^--CH_3OH
303,302			t-$C_5H_{11}O^-$	(19.8)	[22]	(13.2)	298	ICR	[s] CH_3O^--CH_3OH
303,302			$C_6H_5C{\equiv}C^-$	(15.4)	[22]	(8.8)	298	ICR	[s] CH_3O^--CH_3OH
118	C_3H_8S	n-C_3H_7SH	$CH_3NH_3^+$	17.5	24.9	10.1	298	HPMS	
300			$(CH_3)_3Sn^+$	(34.2)	[32.2]	(17.3)	525	HPMS	[s] $(CH_3)_3Sn^+$-CH_3OH
324	C_3H_8S	$C_2H_5SCH_3$	$CH_3NH_3^+$	(19.8)	[25]	11.3	438	HPMS	
40,28	C_3H_9N	$(CH_3)_3N$	Li^+	(42.1)	[28]	(33.7)	298	ICR	[s] Li^+-H_2O
134,61			K^+	(20.0)	(23.4)	(13.0)	298	HPMS	[s] K^+-H_2O
144			$(CH_3)_2NH_2^+$	23.3	25.3	9.4	550	HPMS	
144			$(CH_3)_3NH^+$	22.5	32.0	4.9	550	HPMS	
324			$N(CH_3)_4^+$	9.9	20.6	3.8	298	HPMS	
300			$(CH_3)_3Sn^+$	(45.6)	[32]	(28.8)	525	HPMS	[s] $(CH_2)_3Sn^+$-CH_3OH
134	C_3H_9N	n-$C_3H_7NH_2$	K^+	21.8	25.5	14.2	298	HPMS	
281			n-$C_3H_7NH_3^+$	---	---	---	---	HPMS	cf. Table 9
281	C_3H_9N	i-$C_3H_7NH_2$	i-$C_3H_7NH_3^+$	---	---	---	---	HPMS	cf. Table 9
282	$C_3H_{10}N$	1,2$(NH_2)_2C_3H_6$	(1,2$(NH_2)_2C_3H_6)H^+$	---	---	---	---	HPMS	cf. Table 9
282	$C_3H_{10}N$	1,3$(NH_2)_2C_3H_6$	(1,3$(NH_2)_2C_3H_6)H^+$	---	---	---	---	HPMS	cf. Table 9
129	$C_4H_4N_2$	pyrimidine	$C_5H_{10}NO_3^+$	28.6	26.7	20.6	298	HPMS	N-acetylglycine methyl esterH^+
118	C_4H_4O	furan	furan H^+	22.5	40.7	10.4	298	HPMS	
295,4	$C_4H_4OF_6$	$(CF_3)_2CH_3COH$	Cl^-	(>26.5)	[25]	(>19)	298	ICR	[s] Cl^--t-C_4H_9OH
325	C_4H_5N	pyrrole	$CH_3NH_3^+$	18.6	21.0	12.3	298	HPMS	
41,98			F^-	(34.2)	[25.5]	(26.6)	298	ICR	[s] F^--H_2O
255			Cl^-	---	---	11.6	421	HPMS	

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(Kcal/mol) $-\Delta H^{\circ}_{0,1}$	(cal/K mol) $-\Delta S^{\circ}_{0,1}$	(kcal/mol) $-\Delta G^{\circ}_{0,1}(T)$	(K) T	Method	Remarks
285	$C_4H_5N_3O$	cytosine	cytosine H^+	38.3	37	27.3	298	HPMS	
117	$C_4H_5O_2F_3$	$CF_3COOC_2H_5$	$CH_3NH_3^+$	(21.4)	[26]	9.4	450	HPMS	
118	$C_4H_6O_2$	$CH_3COOCH=CH_2$	$(CH_3COOCH=CH_2)H^+$	(27.3)	[34.5]	10.4	492	HPMS	
117	C_4H_7N	n-C_3H_7CN	$CH_3NH_3^+$	(28.1)	[28]	10.0	581	HPMS	
39,28	C_4H_8	$(CH_3)_2C=CH_2$	Li^+	(28)	---	---	---	ICR	s Li^+-H_2O; from Figure
273	C_4H_8O	$(CH_3)(C_2H_5)CO$	NO^+	(42.2)	---	---	---	ICR	s $NO^+-C_2H_5OH$
117			$CH_3NH_3^+$	(25.2)	[25]	11.4	553	HPMS	
299,131,19			$(CH_3)_2COH^+$	(32.7)	[29.8]	(23.8)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			$(CH_3)(C_2H_5)COH^+$	(30.4)	[30.9]	(21.2)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			$(C_2H_5)_2COH^+$	(29.5)	[29.4]	(20.7)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
300			$(CH_3)_3Sn^+$	(39.3)	[32.8]	(22.1)	525	HPMS	s $(CH_3)_3Sn^+-CH_3OH$
295,4			Cl^-	(14.0)	[21.0]	(8.5)	298	ICR	s Cl^--t-C_4H_9OH
117	C_4H_8O	c-C_4H_8O (tetrahydrofuran)	c-$C_4H_8OH^+$	32.6	32.2	23.0	298	HPMS	tetrahydrofuranH$^+$
299,131,19				(32.5)	[32.2]	(22.9)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			$(CH_3)_2COH^+$	(33.4)	[29.9]	(24.5)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			$(C_2H_5)_2COH^+$	(30.1)	[29.4]	(21.3)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			$(C_2H_5)_2OH^+$	(30.4)	[29.5]	(21.6)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
273	C_4H_8O	n-C_3H_7CHO	NO^+	(39.2)	---	---	---	ICR	s $NO^+-C_2H_5OH$
299,131	$C_4H_8O_2$	1,4 dioxane	$(CH_3)_2OH^+$	(31.7)	[28.9]	(23.1)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			$(CH_3)_2COH^+$	(30.0)	[30.2]	(21.0)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			1,4 dioxaneH$^+$	(30.9)	[31.5]	(21.5)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			$(HCOOC_2H_5)H^+$	(30.9)	[29.7]	(22.0)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
273	$C_4H_8O_2$	$CH_3COOC_2H_5$	NO^+	(41.5)	---	---	---	ICR	s $NO^+-C_2H_5OH$
118			$(CH_3COOC_2H_5)H^+$	30.0	34.5	19.7	298	HPMS	
300			$(CH_3)_3Sn^+$	(40.2)	[33]	(22.9)	525	HPMS	s $(CH_3)_3Sn^+-CH_3OH$
296	$C_4H_8O_2$	i-C_3H_7COOH	I^-	16.7	20.5	10.6	300	HPMS	
318	C_4H_9NO	$(N(CH_3)_2)(CH_3)CO$	K^+	31	23	24	300	HPMS	cf. Table 9
129			$(CH_3)_3NH^+$	27.2	24.1	20.0	298	HPMS	
324			$N(CH_3)_4^+$	18.0	21.6	11.6	298	HPMS	
129			$(N(CH_3)_2)(CH_3)COH^+$	31.3	27.4	23.1	298	HPMS	
41,98	C_4H_9F	$(CH_3)_3CF$	F^-	(22.3)	[23.6]	(15.3)	298	ICR	s F^-H_2O
295,4			Cl^-	(13.3)	[20.8]	(7.1)	298	ICR	s Cl^--t-C_4H_9OH
295,4	C_4H_9Cl	$(CH_3)_3CCl$	Cl^-	(14.3)	[21.2]	(8.0)	298	ICR	s Cl^--t-C_4H_9OH
294	C_4H_9Br	$(CH_3)_3CBr$	Br^-	12.4	19.3	6.7	298	HPMS	
294	C_4H_9Br	$(CH_3)_2CHCH_2Br$	Br^-	12.9	21.8	6.4	298	HPMS	
134	$C_4H_{10}O$	$(C_2H_5)_2O$	K^+	22.3	24.7	14.9	298	HPMS	
273			NO^+	(41.3)	---	---	---	ICR	s $NO^+-C_2H_5OH$
286			$CH_3NH_3^+$	22.0	25.0	14.6	298	HPMS	
286			$(CH_3)_3NH^+$	19.5	29.4	10.7	298	HPMS	
299,131,19			$(CH_3)_2COH^+$	(32.9)	[29.7]	(24.0)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$
299,131,19			c-$C_4H_8OH^+$	(31.9)	[30.9]	(22.7)	298	ICR	s $(CH_3)_2OH^+-(CH_3)_2O$

Table 8. (continued) *Thermodynamic quantities for the association of organic compounds to gaseous ions.*

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
117	$C_4H_{10}O$	$(C_2H_5)_2O$ (cont'd)	$(C_2H_5)_2OH^+$	29.8	33.2	19.9	298	HPMS	
299,131,19				(30.3)	[30.9]	(21.1)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(C_2H_5)_2COH^+$	(29.5)	[29.5]	(20.7)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(n\text{-}C_3H_7)_2OH^+$	(29.3)	[30.0]	(20.4)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(i\text{-}C_3H_7)_2OH$	(26.0)	[30.8]	(16.8)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
286			pyridine H^+	22.5	32.9	12.7	298	HPMS	
286			$c\text{-}C_6H_{11}NH_3^+$	21.9	31.9	12.4	298	HPMS	
117	$C_4H_{10}O$	$n\text{-}C_4H_9OH$	$CH_3NH_3^+$	(23.5)	[26]	10.6	495	HPMS	
300			$(CH_3)_3Sn^+$	(36.5)	[32.4]	(19.5)	525	HPMS	[s] $(CH_3)_3Sn^+$-CH_3OH
299,131,19			$n\text{-}C_4H_9OH_2^+$	(31.5)	[30.9]	(22.3)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$C_2H_5OH_2^+$	(33.1)	[27.7]	(24.8)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$n\text{-}C_3H_7OH_2^+$	(31.3)	[29.2]	(22.6)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
41,98			F^-	(32.2)	(25.9)	(24.5)	298	ICR	[s] F^--H_2O
295,4			Cl^-	(17.6)	[23.2]	(10.7)	298	ICR	[s] Cl^--t-C_4H_9OH
316,131,19	$C_4H_{10}O$	$s\text{-}C_4H_9OH$	$i\text{-}C_3H_7OH_2^+$	(32.8)	[28.2]	(24.4)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
316,131,19			$s\text{-}C_4H_9OH_2^+$	(32.6)	[28.2]	(24.6)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
117	$C_4H_{10}O$	$t\text{-}C_4H_9OH$	$CH_3NH_3^+$	(22.9)	[26]	10.0	495	HPMS	
300			$(CH_3)_3Sn^+$	(36.6)	[32.4]	(19.6)	525	HPMS	[s] $(CH_3)_3Sn^+$-CH_3OH
316,131,19			$i\text{-}C_3H_7OH_2^+$	(33.0)	[28.2]	(24.6)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
316,131,19			$t\text{-}C_4H_9OH_2^+$	(31.6)	[29.6]	(22.8)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
41,98			F^-	(33.3)	(26.1)	(25.5)	298	ICR	[s] F^--H_2O
4			Cl^-	19.2	27	11.1	298	HPMS	
254				14.2	10.3	11.1	298	HPMS	
296			I^-	12.1	18.7	6.5	300	HPMS	
303,302			$t\text{-}C_4H_9O^-$	(20.4)	[22]	(13.8)	298	ICR	[s] CH_3O^--CH_3OH
303,302			$t\text{-}C_5H_{11}O^-$	(20.3)	[22]	(13.7)	298	ICR	[s] CH_3O^--CH_3OH
217	$C_4H_{10}O_2$	$CH_3O(CH_2)_2OCH_3$	Na^+	47.2	34.6	36.9	298	HPMS	cf. Table 9
279			K^+	30.8	26.8	22.8	298	HPMS	
286			$CH_3NH_3^+$	30.1	30.1	21.1	298	HPMS	
286			$(CH_3)_3NH^+$	26.7	34.8	16.3	298	HPMS	
286			pyridineH^+	25.4	31.4	16.0	298	HPMS	
286			$c\text{-}C_6H_{11}NH_3^+$	29.4	35.5	18.8	298	HPMS	
30	$C_4H_{11}N$	$(C_2H_5)_2NH$	$(CH_3)_3Sn^+$	(46.4)	[33]	(29.1)	525	HPMS	[s] CH_3O^--CH_3OH
117	C_5H_4NF	2-F-pyridine	$(C_2H_5)_3NH^+$	20.8	31.0	11.6	298	HPMS	
19,28	C_5H_5N	pyridine	Li^+	(44)	---	---	---	ICR	[s] Li^+-H_2O; from Figure
134			K^+	20.7	18.6	15.2	298	HPMS	
63			Ag^+	---	---	---	---	HPMS	cf. Table 9
63			pyridineH^+	26.3	32.1	16.7	298	HPMS	cf. Table 9
285				23.7	28	15.4	298	HPMS	
125				24.6	28.2	16.2	298	HPMS	
117			$(C_2H_5)_3NH^+$	(20.4)	[28]	9.0	408	HPMS	
285	$C_5H_5N_5$	adenine	adenineH^+	30.3	39	21.7	298	HPMS	
255	C_5H_6	cyclopentadiene	Cl^-	---	---	<2.5	300	HPMS	

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^o_{0,1}$	(cal/K mol) $-\Delta S^o_{0,1}$	(kcal/mol) $-\Delta G^o_{0,1}(T)$	(K) T	Method	Remarks
285	$C_5H_6N_2O_2$	thymine	thymineH$^+$	30.1	37	19.1	298	HPMS	
255	C_5H_8	1,4-pentadiene	Cl^-	---	---	3.7	300	HPMS	
274	$C_5H_8NO_2$	proline	prolineH$^+$	29	32	19.5	298	HPMS	
126				20	---	---	---	HPMS	
126			valineH$^+$	23.4	---	---	---	HPMS	
255	$C_5H_8O_2$	$(CH_3CO)_2CH_2$ (acetylacetone)	Cl^-	---	---	11.0	421	HPMS	
129	$C_5H_9NO_3$	$CH_3C(O)NHCH_2COOCH_3$	pyrimidineH$^+$	34.5	38.4	23.1	298	HPMS	N-acetylglycine methyl ester
324			$N(CH_3)_4^+$	20.1	29.4	11.3	298	HPMS	
41,98	$C_5H_{10}O$	$(CH_3)_3CCHO$	F^-	(24.6)	[26.2]	(16.8)	298	ICR	[s] F^--H_2O
295,4			Cl^-	(15.0)	[21.9]	(8.4)	298	ICR	[s] Cl^--t-C_4H_9OH
273	$C_5H_{10}O$	$(C_2H_5)_2CO$	NO^+	(42.9)	---	---	---	ICR	[s] NO^+-C_2H_5OH
299,131,19			$(C_2H_5)_2COH^+$	(30.2)	[31.2]	(20.9)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(CH_3)(C_2H_5)COH^+$	(31.1)	[29.9]	(22.2)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(CH_3)_2COH^+$	(33.4)	[30.1]	(24.4)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			$(C_2H_5)_2OH^+$	(30.8)	[29.7]	(22.0)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
299,131,19			c-$C_4H_8OH^+$	(32.6)	[31.0]	(23.4)	298	ICR	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
117			$CH_3NH_3^+$	(25.9)	[26]	11.8	549	HPMS	
300			$(CH_3)_3Sn^+$	(39.5)	[31.6]	(22.9)	525	HPMS	[s] $(CH_3)_2OH^+$-$(CH_3)_2O$
295,4			Cl^-	(14.1)	[19.6]	(8.2)	298	ICR	[s] Cl^--t-C_4H_9OH
117	$C_5H_{10}O$	c-$C_5H_{10}O$	c-$C_5H_{10}OH^+$	32.6	32.2	23.0	298	HPMS	
296	$C_5H_{10}O_2$	t-C_4H_9COOH	I^-	15.4	21.7	8.9	300	HPMS	
117	$C_5H_{10}O_2$	HCOOn-C_4H_9	$CH_3NH_3^+$	(24.5)	[26]	12.5	461	HPMS	
117	$C_5H_{10}O_2$	CH_3COOi-C_3H_7	$CH_3NH_3^+$	30.0	35.2	19.5	298	HPMS	
300			$(CH_3)_3Sn^+$	(41.8)	[33.5]	(24.2)	525	HPMS	[s] $(CH_3)_3Sn^+$-CH_3OH
273	$C_5H_{10}O_2$	CH_3COOn-C_3H_7	NO^+	(42.0)	---	---	---	ICR	[s] NO^+-C_2H_5OH
300			$(CH_3)_3Sn^+$	(40.2)	[32.8]	(23.0)	---	HPMS	[s] $(CH_3)_3Sn^+$-CH_3OH
126	$C_5H_{11}NO_2$	valine	prolineH$^+$	21.0	---	---	---	HPMS	
126			valineH$^+$	20.7	---	---	---	HPMS	
294	$C_5H_{11}Br$	t-$C_5H_{11}Br$	Br^-	14.4	25.2	6.9	298	HPMS	
303,302	$C_5H_{12}O$	t-$C_5H_{11}OH$	t-$C_5H_{11}O^-$	(21.5)	[22]	(14.9)	298	ICR	[s] CH_3O^--CH_3OH
303,302			t-$C_4H_9CH(CH_3)O^-$	(21.3)	[22]	(14.7)	298	ICR	[s] CH_3O^--CH_3OH
303,302			$C_6H_5{\equiv}C^-$	(17.1)	[22]	(10.5)	298	ICR	[s] CH_3O^--CH_3OH
286	$C_5H_{12}O_2$	$CH_3O(CH_2)_3OCH_3$	$CH_3NH_3^+$	31.2	32.0	21.7	298	HPMS	
286			$(CH_3)_3NH^+$	25.5	33.1	15.6	298	HPMS	
286	$C_5H_{12}O_2$	$CH_3O(CH_2)_3OCH_3$	2-F-pyridineH$^+$	26.2	31.6	16.8	298	HPMS	
286			pyridineH$^+$	26.5	35.8	15.8	298	HPMS	
286			c-$C_6H_{11}NH_3^+$	28.4	35.0	18.0	298	HPMS	

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
241	C_6F_6	C_6F_6	benzene$^+$	(12.1)	[27]	4.0	300	HPMS	
118			aniline$^+$	(11.0)	[25]	3.5	298	HPMS	
241	C_6HF_5	C_6HF_5	benzene$^+$	(11.2)	[27]	3.1	300	HPMS	
241	$C_6H_2F_4$	1,2,3,5-$C_6H_2F_4$	benzene$^+$	(11.2)	[27]	3.1	300	HPMS	
241	$C_6H_2F_4$	1,2,4,5-$C_6H_2F_4$	benzene$^+$	12.0	27	3.9	300	HPMS	
241	$C_6H_3F_3$	1,3,5-$C_6H_3F_3$	benzene$^+$	12.4	28	3.9	300	HPMS	
241	$C_6H_4F_2$	1,2-$C_6H_4F_2$	benzene$^+$	(15.2)	[27]	6.3	330	HPMS	
295,4			Cl^-	(14.3)	[21.6]	(7.8)	298	ICR	s Cl^--t-C_4H_9OH
241	$C_6H_4F_2$	1,3-$C_6H_4F_2$	benzene$^+$	13.9	26	6.2	300	HPMS	
241			1,3-$C_6H_4F_2^+$	(13.2)	[27]	5.2	298	HPMS	
255			Cl^-	---	---	7.7	300	HPMS	
295,4				(14.6)	[22.6]	(7.8)	298	ICR	s Cl^--t-C_4H_9OH
325	$C_6H_4F_2$	1,4-$C_6H_4F_2$	NH_4^+	(13)	[20]	5.1	395	HPMS	
295,4			Cl^-	(13.8)	[21.6]	(7.3)	298	ICR	s Cl^--t-C_4H_9OH
273	$C_6H_5NO_2$	$C_6H_5NO_2$	NO^+	(39.3)	---	---	---	ICR	s NO^+-C_2H_5OH
118			aniline$^+$	(19.5)	[27]	10.7	324	HPMS	
118			1-CH_3-naphthalene$^+$	13.2	27	5.2	298	HPMS	
255			Cl^-	---	---	7.1	300	HPMS	
287,255	C_6H_5OF	p-F-phenol	Cl^-	(26.9)	(25.3)	(19.3)	300	HPMS	s Cl^--phenol
287,255	C_6H_5OCl	p-Cl-phenol	Cl^-	(28.9)	(26.3)	(21.0)	300	HPMS	s Cl^--phenol
273	C_6H_5F	C_6H_5F	NO^+	(37.8)	---	---	---	ICR	s NO^+-C_2H_5OH
325			NH_4^+	14.4	18.0	9.0	298	HPMS	
241			$C_6H_5F^+$	(14.1)	[27]	5.3	356	HPMS	
241			benzene$^+$	17.0	30	8.1	300	HPMS	
118			aniline$^+$	11.8	26.7	3.8	298	HPMS	
255			Cl^-	---	---	5.9	300	HPMS	
273	C_6H_5Cl	C_6H_5Cl	NO^+	(38.5)	---	---	---	ICR	s NO^+-C_2H_5OH
118			aniline$^+$	(12.0)	[27]	4.0	297	HPMS	
241			mesitylene$^+$	(11.4)	[27]	2.9	300	HPMS	
255			Cl^-	---	---	6.5	300	HPMS	
295,4				(13.6)	[22.4]	(6.9)	298	ICR	s Cl^--t-C_4H_9OH
118	C_6H_5Br	C_6H_5Br	aniline$^+$	(14.1)	[27]	5.3	325	HPMS	
255			Cl^-	---	---	6.8	298	HPMS	
118	C_6H_5I	C_6H_5I	aniline$^+$	(13.6)	[27]	4.8	324	HPMS	
255			Cl^-	---	---	7.2	300	HPMS	
40,28	C_6H_6	benzene	Li^+	(37.9)	[27.5]	(29.7)	298	ICR	s Li^+-H_2O
97			K^+	19.2	24.6	11.9	298	HPMS	cf. Table 9
97,60			$K^+ \cdot H_2O$	(16.8)	(27.1)	(8.7)	298	HPMS	s $K^+ \cdot H_2O$-H_2O; cf. Table 9
97,60			$K^+ \cdot 2H_2O$	(13.4)	(24.3)	(6.1)	298	HPMS	s $K^+ \cdot 2H_2O$-H_2O; cf. Table 9
97,60			$K^+ \cdot 3H_2O$	(12.6)	(27.6)	(3.7)	298	HPMS	s $K^+ \cdot 3H_2O$-H_2O

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
273	C_6H_6	benzene (cont'd)	NO^+	(41.1)	---	---	---	ICR	[s] $NO^+-C_2H_5OH$
325			NH_4^+	19.3	23.3	12.4	298	HPMS	cf. Table 9
325			$CH_3NH_3^+$	18.8	25.1	11.3	298	HPMS	
288			$C_2H_5^+$	(46.5)	(31.5)	(37)	298	---	[c] ΔH_f's + PA's
325			$C_2H_5OH_2^+$	(21)	[25]	8.7	491	HPMS	
289			$C_3H_3^+$	9.0	9	6	300	HPMS	
288			$(CH_3)_2CH^+$	(33.8)	(34)	(23.7)	298	---	[c] ΔH_f's + PA's
325			$(CH_3)_3NH^+$	15.9	27.7	7.6	298	HPMS	
289			$c-C_4H_4S^+$	13	23	7	300	HPMS	thiophene$^+$
288			$(CH_3)_3C^+$	22	49	7.4	298	HPMS	
324			$N(CH_3)_4^+$	(9.4)	[20]	3.5	296	HPMS	
241			$C_6H_5Cl^+$	14.0	26	6.2	300	HPMS	
289			benzene$^+$	15	23	8	300	HPMS	
241				17.0	27	8.9	300	HPMS	
241			benzeneH$^+$	11.0	24	3.9	300	HPMS	
118			aniline$^+$	113.2	26.3	5.3	298	HPMS	
241			toluene$^+$	12.4	26	4.6	300	HPMS	
118			$C_6H_5NHCH_3^+$	(12.2)	[26]	4.5	298	HPMS	
118			$C_6H_5N(CH_3)_2^+$	(9.8)	[26]	2.0	298	HPMS	
241			mesitylene$^+$	10.6	26	2.8	300	HPMS	
118			$p-CH_3C_6H_4N(CH_3)_2^+$	(9.8)	[22]	2.6	329	HPMS	
118			$p-CH_3$-naphthalene$^+$	8.9	24	1.7	298	HPMS	
97			Cl^-	(10.4)	[22]	3.8	300	HPMS	
295,4				(9.9)	[17.1]	(4.8)	298	ICR	[s] Cl^--t-C_4H_9OH
331				9.5	19.9	3.6	298	HPMS	
41,98	C_6H_6O	phenol	F^-	(41.4)	[26.3]	(33.5)	298	ICR	[s] F^-H_2O
254			Cl^-	19.4	15.5	14.8	298	HPMS	
4				27.4	25	20.0	298	HPMS	
255				25.0	26.0	17.2	300	HPMS	
125	C_6H_7N	2-CH_3-pyridine	2-CH_3-pyridineH$^+$	23.0	27.8	14.7	298	HPMS	
134	C_6H_7N	aniline	K^+	22.8	23.7	15.8	298	HPMS	
118			aniline$^+$	17.4	24.6	9.5	322	HPMS	
118			$C_6H_5NHCH_3^+$	17.4	20.2	9.0	298	HPMS	
118			$C_6H_5N(CH_3)_2^+$	(14.5)	[27]	6.5	298	HPMS	
118			$p-CH_3C_6H_4N(CH_3)_2^+$	(13.5)	[27]	5.9	283	HPMS	
41,98			F^-	(31.2)	[26.2]	(23.4)	298	ICR	[s] F^-H_2O
325	C_6H_{10}	cyclohexene	$CH_3NH_3^+$	11.6	16.9	6.6	298	HPMS	
129	$C_6H_{11}NO_3$	$CH_3C(O)NHCH-(CH_3)COOCH_3$	$CH_3NH_3^+$	40.1	35.1	29.6	298	HPMS	N-acetylalanine methyl ester
129			$(CH_3)_3NH^+$	29.7	27.6	21.5	298	HPMS	
129			$C_6H_{12}NO_3^+$	30.1	31.5	20.7	298	HPMS	
39,28	C_6H_{12}	cyclohexane	Li^+	(24)	---	---	---	ICR	[s] Li^+-H_2O; from Figure
325			NH_4^+	(<9)	[20]	<2.8	317	HPMS	
241			benzene$^+$	(11.2)	[27]	3.2	295	HPMS	
117	$C_6H_{12}O$	c-$C_6H_{12}O$	c-$C_6H_{12}OH^+$	33.2	34.7	22.9	298	HPMS	
117	$C_6H_{12}O$	$(n-C_3H_7)(C_2H_5)CO$	$CH_3NH_3^+$	27.0	27.0	19.0	298	HPMS	
300	$C_6H_{12}O_2$	$CH_3COO(n-C_4H_9)$	$(CH_3)_3Sn^+$	(41.7)	[33.5]	(24.1)	525	HPMS	[s] $(CH_3)_3Sn^+-CH_3OH$
300	$C_6H_{14}O$	$n-C_6H_{13}OH$	$(CH_3)_3Sn^+$	(37.5)	[33.3]	(20.0)	525	HPMS	[s] $(CH_3)_3Sn^+-CH_3OH$

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
117	$C_6H_{14}O$	$(n\text{-}C_3H_7)_2O$	$CH_3NH_3^+$	24.0	26.7	16.0	298	HPMS	
299,131,19			$(C_2H_5)_2OH^+$	(31.4)	[29.9]	(22.5)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
117			pyridineH$^+$	(23.5)	[31]	8.0	500	HPMS	
117			c-$C_6H_{11}NH_3^+$	25.4	31.2	16.1	298	HPMS	
117			$(n\text{-}C_3H_7)_2OH^+$	30.2	37.4	19.1	298	HPMS	
299,131,19				(29.9)	[31.9]	(20.4)	298	ICR	s $(CH_3)_2OH^+$-$(CH_3)_2O$
117	$C_6H_{14}O$	$(i\text{-}C_3H_7)_2O$	$(i\text{-}C_3H_7)_2OH^+$	27.0	39.1	15.3	298	HPMS	
299,131,19				(26.6)	[32.6]	(16.9)	298	ICR	s $(CH_3)OH^+$-$(CH_3)_2O$
299,131,19			$(C_2H_5)_2OH^+$	(31.3)	[29.8]	(22.4)	298	ICR	s $(CH_3)OH^+$-$(CH_3)_2O$
303,302	$C_6H_{14}O$	t-$C_4H_9CH(CH_3)OH$	t-$C_4H_9CH(CH_3)O^-$	(21.4)	[22]	(14.8)	298	ICR	s $(CH_3)OH^+$-$(CH_3)_2O$
303,302			$C_6H_5CH_2O^-$	(21.6)	[22]	(15.0)	298	ICR	s $(CH_3)OH^+$-$(CH_3)_2O$
286	$C_6H_{14}O_3$	$CH_3(OCH_2CH_2)_2$-OCH_3	$(CH_3)_3NH^+$	32.8	40.0	20.9	298	HPMS	
286			1,2-diazineH$^+$	32.4	36.1	21.6	298	HPMS	
324			$N(CH_3)_4^+$	20.6	28.7	12.0	298	HPMS	
286			2-F-pyridineH$^+$	34.7	38.6	23.2	298	HPMS	
286			pyridineH$^+$	31.5	36.5	20.6	298	HPMS	
286			c-$C_6H_{11}NH_3^+$	39.7	44.6	26.4	298	HPMS	
125	$C_6H_{15}N$	$(C_2H_5)_3N$	$(C_2H_5)_3NH^+$	23.8	41.0	11.6	298	HPMS	
300			$(CH_3)_3Sn^+$	(45.7)	[33.9]	(27.9)	525	HPMS	s $(CH_3)_3Sn^+$-CH_3OH
311,4	$C_6H_{15}B$	$(C_2H_5)_3B$	Cl^-	(23.8)	[22]	(17.2)	298	ICR	s Cl^--t-C_4H_9OH
273	C_7H_5N	C_6H_5CN	NO^+	(41.1)	---	---	---	ICR	s NO^+-C_2H_5OH
117			$CH_3NH_3^+$	29.4	31.2	20.1	298	HPMS	
118			aniline$^+$	(21.8)	[27]	12.3	338	HPMS	
118			1-CH_3-naphthalene$^+$	(15.4)	[27]	6.9	301	HPMS	
287,255	C_7H_5NO	p-CNphenol	Cl^-	(33.6)	(26)	(25.8)	300	HPMS	s Cl^--p-F phenol
287,255				(34.6)	(28)	(26.2)	300	HPMS	s Cl^--p-Cl phenol
273	$C_7H_5F_3$	$C_6H_5CF_3$	NO^+	(35)	---	---	---	ICR	s NO^+-C_2H_5OH
118			aniline$^+$	(12.1)	[27]	4.0	300	HPMS	
273	C_7H_6O	C_6H_5CHO	NO^+	(43.7)	---	---	---	ICR	s NO^+-C_2H_5OH
255	$C_7H_7NO_2$	p-NO_2toluene	Cl^-	---	---	7.5	300	HPMS	
41,98	C_7H_7F	$C_6H_5CH_2F$	F^-	(24.4)	[26.6]	(16.5)	298	ICR	s F^--H_2O
273	C_7H_8	toluene	NO^+	(44.2)	---	---	---	ICR	s NO^+-C_2H_5OH
324			$N(CH_3)_4^+$	9.5	20.3	3.5	298	HPMS	
118			aniline$^+$	14.0	26.8	5.5	320	HPMS	
241			toluene$^+$	16.0	29	7.3	300	HPMS	
241			mesitylene$^+$	12.0	27	4.0	300	HPMS	
255			Cl^-	---	---	4.0	300	HPMS	
302	C_7H_8O	$C_6H_5CH_2OH$	$C_6H_5CH_2O^-$	23.8	23.2	16.9	298	HPMS	
303,302				(22.3)	[22]	(15.7)	298	ICR	s $CH_3O^-CH_3OH$
287,255	C_7H_8O	p-CH_3phenol (p-cresol)	Cl^-	(24.6)	(26.7)	(16.6)	300	HPMS	s Cl^--phenol
303,302			$C_6H_5C{\equiv}C^-$	(19.5)	[22]	(14.9)	298	ICR	s $CH_3O^-CH_3OH$
118	C_7H_8O	$C_6H_5OCH_3$ (anisole)	aniline$^+$	(16.8)	[27]	7.6	346	HPMS	

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^{\circ}_{0,1}$	(cal/K mol) $-\Delta S^{\circ}_{0,1}$	(kcal/mol) $-\Delta G^{\circ}_{0,1}(T)$	(K) T	Method	Remarks
255	C_7H_8O	$C_6H_5OCH_3$ (anisole) (cont'd)	Cl^-	---	---	7.3	300	HPMS	
125	C_7H_9N	2,6-$(CH_3)_2$-pyridine	2,6-$(CH_3)_2$-pyridineH^+	23.3	33.2	13.4	298	HPMS	
118	C_7H_9	$C_6H_5NHCH_3$	$C_6H_5NHCH_3^+$	(12.3)	[26]	4.6	298	HPMS	
273	$C_7H_{14}O$	$(i\text{-}C_3H_7)_2CO$	NO^+	(44.6)	---	---	---	ICR	[s] NO^+-C_2H_5OH
74	$C_7H_{14}O_2$	$CH_3COO\text{-}t\text{-}C_5H_{11}$ (t-amyl acetate)	t-amyl acetateH^+	9.1	-2	9.8	300	HPMS	
255	C_8H_8O	$(CH_3)(C_6H_5)CO$ (acetophenone)	Cl^-	---	---	7.1	421	HPMS	
273	C_8H_{10}	$C_6H_5C_2H_5$	NO^+	(44.5)	---	---	---	ICR	[e] NO^+-C_2H_5OH
255			Cl^-	---	---	5.0	300	HPMS	
118	C_8H_{10}	p-xylene	aniline$^+$	(14.5)	[27]	5.8	322	HPMS	
241			p-xylene$^+$	15.6	32	5.9	300	HPMS	
241			mesitylene$^+$	14.9	28	6.6	300	HPMS	
255			Cl^-	---	---	3.9	300	HPMS	
241	C_8H_{10}	m-xylene	mesitylene$^+$	(14.3)	[27]	6.2	300	HPMS	
255			Cl^-	---	---	4.4	300	HPMS	
300	C_8H_{10}	o-xylene	$(CH_3)_3Sn^+$	(29.9)	[31.8]	(13.2)	525	HPMS	[g] $(CH_3)_3Sn^+$-CH_3OH
125	$C_8H_{11}N$	2-i-C_3H_7pyridine	2-i-C_3H_7pyridineH^+	23.0	32.7	13.3	298	HPMS	
118	$C_8H_{11}N$	$C_6H_5N(CH_3)_2$	$C_6H_5N(CH_3)_2^+$	(10.0)	[26]	2.2	298	HPMS	
117	$C_8H_{16}O_2$	$n\text{-}C_4H_9COOnC_3H_7$	$CH_3NH_3^+$	30.0	34.8	19.6	298	HPMS	
286	$C_8H_{16}O_4$	12-crown-4-ether (cont'd)	$(CH_3)_3NH^+$	35.8	41.5	23.4	298	HPMS	
286			1,2-diazineH^+	37.0	40.8	24.8	298	HPMS	
286			pyridineH^+	36.1	40.0	24.2	298	HPMS	
286			c-$C_6H_{11}NH_3^+$	37.2	34.8	26.8	298	HPMS	
286	$C_8H_{18}O$	$(n\text{-}C_4H_9)_2O$	$CH_3NH_3^+$	25.0	28.0	16.6	298	HPMS	
324			$N(CH_3)_4^+$	(12.9)	[25]	4.6	330	HPMS	
117			$(n\text{-}C_4H_9)_2OH^+$	30.5	38.7	19.0	298	HPMS	
286	$C_8H_{18}O_4$	$CH_3(OCH_2CH_2)_3OCH_3$	$(CH_3)_3NH^+$	34.6	40.0	22.7	298	HPMS	
286			1,2-diazineH^+	37.0	41.4	24.7	298	HPMS	
324			$N(CH_3)_4^+$	24.2	33.8	14.1	298	HPMS	
286			pyridineH^+	34.7	38.3	23.3	298	HPMS	
286			c-$C_6H_{11}NH_3^+$	43.3	43.8	30.2	298	HPMS	
300	$C_8H_{19}N$	$(n\text{-}C_4H_9)_2NH$	$(CH_3)_3Sn^+$	(48.8)	[33.7]	(31.1)	525	HPMS	[g] $(CH_3)_3Sn^+$-CH_3OH
255	C_9H_{10}	$(CH_3)(C_6H_5CH_2)CO$ (phenylacetone)	Cl^-	---	---	8.3	421	HPMS	
74	$C_9H_{10}O_2$	$CH_3COOCH_2C_6H_5$ (benzyl acetate)	$C_3H_3^+$	10	-7	~10	300	HPMS	
74			benzyl acetateH^+	5.4	-14	9.7	300	HPMS	
273	C_9H_{12}	$i\text{-}C_3H_7C_6H_5$ (cumene)	NO^+	(45.1)	---	---	---	ICR	[s] NO^+-C_2H_5OH
255			Cl^-	---	---	5.5	300	HPMS	
273	C_9H_{12}	$n\text{-}C_3H_7C_6H_5$	NO^+	(45.1)	---	---	---	ICR	[s] NO^+-C_6H_5OH
255			Cl^-	---	---	5.0	300	HPMS	

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^\circ_{0,1}$	(cal/K mol) $-\Delta S^\circ_{0,1}$	(kcal/mol) $-\Delta G^\circ_{0,1}(T)$	(K) T	Method	Remarks
325	C_9H_{12}	mesitylene	NH_4^+	21.8	21.2	15.5	298	HPMS	
300			$(CH_3)_3Sn^+$	(32.0)	[31.8]	(15.3)	525	HPMS	[s] $(CH_3)_3Sn^+-CH_3OH$
118			aniline$^+$	15.3	25.6	7.7	298	HPMS	
241			mesitylene$^+$	17.2	30	8.0	300	HPMS	
290			mesityleneH$^+$	(12.4)	[28]	4.6	272	HPMS	
118			1-CH_3-naphthalene$^+$	(13.0)	[27]	5.0	296	HPMS	
255			Cl^-	---	---	4.5	300	HPMS	
125	$C_9H_{13}N$	2-t-C_4H_9-pyridine	2-t-C_4H_9-pyridineH$^+$	23.0	39.4	11.3	298	HPMS	
125	$C_9H_{13}N$	2,6$(C_2H_5)_2$-pyridine	2-6-$(C_2H_5)_2$-pyridineH$^+$	22.8	37.4	11.7	298	HPMS	
118	$C_9H_{13}N$	p-$CH_3C_6H_4N(CH_3)_2$	p-$CH_3C_6H_4N(CH_3)_2^+$	(16.2)	[24]	8.3	329	HPMS	
125	$C_9H_{21}N$	$(n-C_3H_7)_3N$	$(n-C_3H_7)_3NH^+$	---	---	7.4	293	HPMS	
118	$C_{10}H_7Br$	1-Br-naphthalene	aniline$^+$	15.7	28.9	7.0	298	HPMS	
118	$C_{10}H_8$	naphthalene	aniline$^+$	(15.7)	[26]	7.3	324	HPMS	
290			naphthalene$^+$	17.8	29	9.2	298	HPMS	
290			naphthalene H$^+$	14.1	30	5.2	298	HPMS	
290			biphenylene$^+$	(12.6)	[28]	5.1	298	HPMS	
290			biphenylene H$^+$	(13.9)	[28]	6.4	298	HPMS	
118	$C_{10}H_8$	azulene	aniline$^+$	(14.3)	[27]	5.8	315	HPMS	
			azulene$^+$	16.8	26	9.1	298	HPMS	
118	$C_{10}H_{14}$	n-$C_4H_9C_6H_5$	aniline$^+$	(14.6)	[27]	5.5	330	HPMS	
118	$C_{10}H_{20}O_5$	15-crown-5-ether	$(CH_2)_3NH^+$	34.9	35.6	24.3	298	HPMS	
286			pyridine H$^+$	41.0	42.6	28.3	298	HPMS	
286			c-$C_6H_{11}NH_3^+$	42.3	36.5	31.4	298	HPMS	
118	$C_{11}H_{10}$	1-CH_3-naphthalene	aniline$^+$	15.8	25.1	8.4	298	HPMS	
118			1-CH_3-naphthalene$^+$	(17.9)	[27]	9.9	296	HPMS	
125	$C_{11}H_{17}N$	2,6-$(i-C_3H_7)_2$-pyridine	2,6-$(i-C_3H_7)_2$ pyridineH$^+$	23.6	48.4	9.2	298	HPMS	
290	$C_{12}H_8$	biphenylene	azulene$^+$	(15.9)	[28]	7.2	309	HPMS	
290			biphenylene$^+$	16.0	29	7.3	300	HPMS	
290			biphenyleneH$^+$	(13.6)	[28]	5.9	277	HPMS	
118	$C_{12}H_8$	acenaphthylene	aniline$^+$	(17.5)	[27]	8.7	325	HPMS	
118	$C_{12}H_{10}$	acenaphthene	aniline$^+$	18.3	28.6	9.0	325	HPMS	
290			biphenylene$^+$	(14.2)	[28]	6.3	283	HPMS	
290			acenaphthene	(17.0)	[28]	8.1	283	HPMS	
290			acenaphtheneH$^+$	(14.8)	[28]	5.6	330	HPMS	
290	$C_{12}H_{10}$	biphenyl	azulene$^+$	(13.5)	[28]	5.2	297	HPMS	
290			biphenylene$^+$	(13.4)	[28]	5.5	279	HPMS	
118	$C_{12}H_{18}$	$C_6(CH_3)_6$	aniline$^+$	17.1	24.1	9.3	325	HPMS	
286	$C_{12}H_{24}O_6$	18-crown-6-ether	$(CH_3)_3NH^+$	(41)	[40]	18	569	HPMS	
286			1,2-diazineH$^+$	(42)	[44]	16	600	HPMS	

Table 8. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions.

Reference	Neutral Formula	Compound	Ion	(kcal/mol) $-\Delta H^{\circ}_{0,1}$	(cal/K mol) $-\Delta S^{\circ}_{0,1}$	(kcal/mol) $-\Delta G^{\circ}_{0,1}(T)$	(K) T	Method	Remarks
286	$C_{12}H_{24}O_6$	18-crown-6-ether (cont'd)	pyridineH^+	(40)	[44]	16	550	HPMS	
286			c-$C_6H_{11}NH_3^+$	(46)	[38]	23	670	HPMS	
117	$C_{12}H_{26}O$	$(n\text{-}C_6H_{13})_2O$	$CH_3NH_3^+$	27.2	31.4	17.8	298	HPMS	
117			$(n\text{-}C_6H_3)_2OH^+$	29	36	18.3	298	HPMS	
125	$C_{12}H_{27}N$	$(n\text{-}C_4H_9)_3N$	$(n\text{-}C_4H_9)_3NH^+$	24.4	56.5	7.6	298	HPMS	
300			$(CH_3)_3Sn^+$	(48.0)	[34.3]	(30.0)	525	HPMS	[s] $(CH_3)_3Sn^+\text{-}CH_3OH$
290	$C_{13}H_{10}$	fluorene	azulene$^+$	(14.6)	[28]	6.0	307	HPMS	
290			biphenylene$^+$	(13.3)	[28]	5.4	283	HPMS	
290	$C_{13}H_{10}$	fluorene	fluorene$^+$	(16.5)	[28]	7.2	331	HPMS	
290			fluoreneH$^+$	(14.4)	[28]	6.1	298	HPMS	
255	$C_{13}H_{12}$	$(C_6H_5)_2CH_2$	Cl^-	---	---	7.4	300	HPMS	
125	$C_{13}H_{21}N$	2,6-$(t\text{-}C_4H_9)_2$-pyridine	2,6-$(t\text{-}C_4H_9)_2$-pyridineH^+	---	---	<4.5	313	HPMS	
290	$C_{14}H_{10}$	anthracene	anthracene$^+$	16.4	26	8.7	298	HPMS	
290			anthraceneH$^+$	(16.0)	[28]	6.1	352	HPMS	
290	$C_{14}H_{10}$	phenanthrene	phenanthrene$^+$	(17.8)	[28]	8.8	320	HPMS	
290			phenanthreneH$^+$	(15.7)	[28]	6.7	320	HPMS	
290	$C_{14}H_{18}$	octhracene	octhracene$^+$	(16.5)	[28]	7.8	304	HPMS	
290			octhraceneH$^+$	(14.2)	[28]	6.1	298	HPMS	
290	$C_{16}H_{10}$	pyrene	pyrene$^+$	(19.1)	[28]	8.2	390	HPMS	
290			pyreneH$^+$	16.5	29	7.9	298	HPMS	
290	$C_{18}H_{12}$	chrysene	chrysene$^+$	(18.2)	[28]	6.3	418	HPMS	
290			cryseneH$^+$	(17.8)	[28]	5.6	418	HPMS	
255	$C_{19}H_{16}$	$(C_6H_5)_3CH$	Cl^-	---	---	4.1	300	HPMS	
290	$C_{20}H_{12}$	perylene	perylene$^+$	(19.7)	[28]	8.3	406	HPMS	
290			perylene H$^+$	(19.1)	[28]	7.2	424	HPMS	
290	$C_{22}H_{12}$	1,12-benzoperylene$^+$	1,12-benzoperylene$^+$	21.6	27	13.6	298	HPMS	
290			1,12-benzoperyleneH$^+$	(21.4)	[28]	10.6	385	HPMS	
290	$C_{24}H_{12}$	coronene	coronene$^+$	(23.8)	[28]	10.4	476	HPMS	

Table 9. Thermodynamic quantities for the association of organic compounds to gaseous ions. The higher order clustering reactions.

Ref.	Neutral	Ion	$-\Delta H^{\circ}_{n-1,n}$ (kcal/mol) 1	2	3	4	5	6	7	$-\Delta S^{\circ}_{n-1,n}$ (cal/K mol) 1	2	3	4	5	6	7
256	HCOOH	Cl^-	---	34.1	22.2	14.1	10.1			---	55	35	20	11.5		
256		$HCOO^-$	---	26.1	20.0	14.2	10.1			---	34	30	21.5	12		
257	CH_3Cl	CH_2Cl^+	6.9	5.7						-3.5	8					
257		CH_3^+	---	6.0	5.1					---	15	14				
257		CH_4Cl^+	---	4.2						---	2					
260	CH_4	H_3O^+	8.0	3.4						20.4	8.1					
261		CH_5^+	7.4	5.9	4.1	3.9				20.8	24.4	26.1	26.6			
262			4.1	1.5						12.4	7.2					
118,(131)	CH_3OH	H_3O^+	(40.8)[c]	(22.9)	16.4	(13.5)	(11.4)[c]			(24.0)	[25]	26.5	[28]	(25.5)		
118		$H_3O^+ \cdot H_2O$	(30.2)[c]	18.0	---	---				(28.6)	26.3					
118		$H_3O^+ \cdot 2H_2O$	(25.5)[c]	(14.4)[c]	---	---				(32.8)	(23.4)	---	---			
118		$H_3O^+ \cdot 3H_2O$	(19.6)[c]	(13.2)[c]	---					(28.8)	(23.6)	---				
118		$H_3O^+ \cdot 4H_2O$	(16.0)[c]	(13.5)[c]						(24.4)	[26.6]					
131		$CH_3OH_2^+$	33.1	26.3	16.1	13.5	12.5	11.9	12.0	30.5	28.2	28.9	28.7	31.1	32.9	35.7
117		$CH_3NH_3^+$	19.0							24.2						
122		$(CH_3)_2OH^+$	26.3	18.8	15.9	13.7				27.1	28.9	31.2	30.8			
122		$(CH_3)_2OH^+ \cdot (CH_3)_2O$	18.1	15.1	12.2					30.6	30.6	26.5				
324		$N(CH_3)_4^+$	9.8	9.2						23.2	24.0					
266		Cl^-	14.2	13.0	12.3	11.2	10.5			14.8	19.4	23.6	26.4	25.5		
330			17.4	14.1	11.8					24.1	24.2	22.9				
266		O_2^-	19.1	15.5	13.5					21.9	24.8	27.9				
132,104,302		OH^-	---	---						---	---					
63	CH_3NH_2	$CH_3NH_3^+$	---	19.2	17.0					---	39.9	41.6				
61	CH_3CN	Na^+	---	24.4	20.6	14.9	12.7			---	22.7	27.5	27.9	41.2		
61		K^+	24.4	20.6	18.2	13.6	11.5			21.5	24.2	28.3	27.5	33.7		
61		Rb^+	20.7	17.7	15.7	12.5	11.1			18.1	20.9	24.8	25.7	32.5		
61		Cs^+	19.2	16.7	14.3	12.1	10.9			18.6	21.6	24.0	27.0	32.9		
118		NH_4^+	27.6	21.2	14.2	11.7				24.2	25.4	19.5	22.2			
118		H_3O^+	(46.7)[c]	23.4	20.6					(29.3)	24.7	27.3				
118		$H_3O^+ \cdot H_2O$	(32.6)[c]	(21.2)[c]	(15.0)[c]					(30.1)	(24.8)	[24.1]				
118		$H_3O^+ \cdot 2H_2O$	(28.7)[c]	(15.9)[c]						(33.2)	(22.3)					
118		$H_3O^+ \cdot 3H_2O$	(22.4)[c]	(14.4)						(27.7)	[22]					
85		$CH_3NH_3^+$	24.5	17.9	13.4					25.8	21.8	21.0				
147		CH_3CNH^+	30.2	9.3						29	19					
265		F^-	16.0	12.9	11.7	10.4	5.3			13.4	14.8	17.9	19.6	7.4		
265		Cl^-	13.4	12.2	10.6	6.2				14.3	18.9	20.1	10.8			
330			13.6	11.9	11.6	11.3	10.9	10.4		15.7	17.2	22.6	26.6	30.4		
265		Br^-	12.9	11.8	10.0	5.5				16.5	20.4	21.7	10.9			
265		I^-	11.9	10.5	9.3					18.2	20.8	22.1				
266		O_2^-	16.4	14.2	11.9	9.5				17.4	22.0	24.7	22.4			

Neutral	Ion	$-\Delta G^{\circ}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	7	T(K)	Method	Comments
HCOOH	Cl^-	---	17.7	11.8	8.1	6.7			298	HPMS	cf. Table 8
	$HCOO^-$	---	16	11	7.8	6.5			298	HPMS	
CH_3Cl	CH_2Cl^+	7.9	3.3						298	HPMS	
	CH_3^+	---	1.5	0.9					298	HPMS	
	CH_4Cl^+	---	3.6						298	HPMS	
CH_4	H_3O^+	1.9	1.2						300	HPMS	
	CH_5^+	1.2	-1.4	-3.7	-4.1				298	HPMS	
		0.45	-0.69						298	HPMS	
CH_3OH	H_3O^+	(33.6)	11.6*	8.4	-0.2*	(3.8)			300,*452	HPMS	$^cH_2O/CH_3OH$
	$H_3O^+ \cdot H_2O$	(21.6)	10.1	(2.3)*	(-0.5)*				300,*452	HPMS	$^cH_2O/CH_3OH$
	$H_3O^+ \cdot 2H_2O$	(15.6)	(7.4)	(1.6)*	(-1.4)*				300,*452	HPMS	$^cH_2O/CH_3OH$
	$H_3O^+ \cdot 3H_2O$	(10.9)	(6.1)	(1.2)*					300,*452	HPMS	$^cH_2O/CH_3OH$
	$H_3O^+ \cdot 4H_2O$	(8.7)	(6.3)*						300,*269	HPMS	$^cH_2O/CH_3OH$
	$CH_3OH_2^+$	24.0	12.9	7.5	4.9	3.2	2.1	1.4	298	HPMS	
	$CH_3NH_3^+$	11.8							298	HPMS	
	$(CH_3)_2OH^+$	18.2	10.2	6.6	4.5				300	HPMS	
	$(CH_3)_2OH^+ \cdot (CH_3)_2O$	9.0	6.0	4.3					300	HPMS	
	$N(CH_3)_4^+$	2.9	2.0						298	HPMS	
	Cl^-	9.8	7.2	5.2	3.3	2.9			298	HPMS	
		10.2	6.9	5.0					298	HPMS	cf. Table 8
	O_2^-	12.5	8.1	5.2					298	HPMS	
	OH^-	(25)[s]	(10.3)[c]						296	FA	$^cOH^- - H_2O/CH_3OH(s)$
CH_3NH_2	$CH_3NH_3^+$	---	7.3	4.7					298	HPMS	cf. Table 8
CH_3CN	Na^+	---	17.6	12.3	6.6	0.4			298	HPMS	
	K^+	18.0	13.4	9.8	5.4	1.4			298	HPMS	
	Rb^+	15.3	11.4	8.3	4.8	1.4			298	HPMS	
	Cs^+	13.7	10.2	7.2	4.0	1.1			298	HPMS	
	NH_4^+	20.4	13.6	8.4	5.1				298	HPMS	
	H_3O^+	(37.9)	16.0	12.4					300	HPMS	$^cCH_3CN/H_2O$
	$H_3O^+ \cdot H_2O$	(23.6)	(13.7)	(7.5)*					300,*316	HPMS	$^cCH_3CN/H_2O$
	$H_3O^+ \cdot 2H_2O$	(18.8)	(9.1)						300	HPMS	$^cCH_3CN/H_2O$
	$H_3O^+ \cdot 3H_2O$	(14.1)	7.4*						300,*318	HPMS	$^cCH_3CN/H_2O$
	$CH_3NH_3^+$	16.8	11.4	7.1					298	HPMS	
	CH_3CNH^+	21.6	3.6						298	HPMS	
	F^-	12.0	8.5	6.4	4.5	3.1			298	HPMS	
	Cl^-	9.2	6.6	4.6	3.0				298	HPMS	
		8.9	6.8	4.9	3.0	2.0	1.3		298	HPMS	cf. Table 8
	Br^-	8.0	5.8	3.6	2.2				298	HPMS	
	I^-	6.4	4.3	2.7					298	HPMS	
	O_2^-	11.2	7.7	4.5	2.8				298	HPMS	

Table 9. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions. The higher order clustering reactions.

			$-\Delta H^{\circ}_{n-1,n}$ (kcal/mol)							$-\Delta S^{\circ}_{n-1,n}$ (cal/K mol)						
Ref.	Neutral	Ion	1	2	3	4	5	6	7	1	2	3	4	5	6	7
272	C_2H_4	$C_2H_4^+$	18.2	4.2						---	---					
275,(221)	$C_2H_5ONO_2$	NO_2^-	(20.9)[s]	8.5	7.3					(35.3)	12.8	14.1				
275		NO_3^-	17.2	7.2						32.2	8.7					
276	C_2H_5Cl	$C_2H_5^+$	---	5.2	4.8					---	8.7	7.7				
122	$(CH_3)_2O$	H_3O^+	(45.4)[c]	18.5	16.8					(24.5)	26.3	26.6				
122		$H_3O^+ \cdot H_2O$	(29.1)[c]	16.4	15.8					(26.5)	22.8	36.5				
122,(70)	$(CH_3)_2O$	$H_3O^+ \cdot 2H_2O$	(23.4)[s]	16.9						(30.2)	32.9					
122		$CH_3OH_2^+$	35.0	20.2	---					24.7	29.8	---				
122		$CH_3OH_2^+ \cdot CH_3OH$	21.9	16.6						25.2	31.8					
122		$CH_3OH_2^+ \cdot 2CH_3OH$	17.2	12.5						28.6	25.6					
131		$(CH_3)_2OH^+$	30.7	10.1						29.6	27.9					
318	$(CH_3)_2SO$	K^+	35	29	20	16	15.8	15.5		31	34	28	30	37	40	
280		$(CH_3)_2SOH^+$	(30.8)[s]	21.3						(22.9)	10.9					
317		Cl^-	18.6	16.0	14.9	14.6	13.8			20.4	23.8	29.8	37.2	40.2		
317		Br^-	17.3	14.5	13.6					21.4	22.4	27.5				
317		I^-	15.7	12.8	11.6					21.7	22.0	25.1				
281	$C_2H_5NH_2$	$C_2H_5NH_3^+$	---	19.5	17.3					---	41.6	42.6				
279	$H_2NCH_2-CH_2NH_2$	K^+	25.7	22.2	12.9					22.3	32.0	26.3				
282		$H_2NCH_2-CH_2NH_3^+$	---	---	17.5					---	---	46.7				
318	$(CH_3)_2CO$	K^+	26	21	16					24	26	24				
329		$(CH_3)_2COH^+$	---	12.2	8.5					---	23.0	17.0				
324		$N(CH_3)_4^+$	14.6	13.0	(11.7)					24.7	29.2	[25]				
318	$(CH_3)_2NCHO$	K^+	31	21	15	13				26	20	18	24			
329	$n-C_3H_7OH$	$n-C_3H_7OH_2^+$	---	18.9	14.2	11.7				---	23.0	23.8	23.0			
281	$n-C_3H_7NH_2$	$n-C_3H_7NH_3^+$	---	19.5	17.1					---	41.6	42.3				
281	$i-C_3H_7NH_2$	$-C_3H_7NH_3^+$	---	19.8	16.2					---	42.6	39.3				
282	$1,2(NH_3)_2-C_3H_6$	$(1,2(NH_2)_2-C_3H_6)H^+$	---	---	19.5					---	---	54.7				
282	$1,3(NH_2)_2-C_3H_6$	$(1,3(NH_2)_2-C_3H_6)H^+$	---	---	19.7					---	---	57.0				
318	$(N(CH_3)_2)-(CH_3)CO$	K^+	31	24	18					23	24	24				
217	$CH_3O(CH_2))_2-OCH_3$	Na^+	47.2	35.1	23.2					34.6	40.5	42.2				
63	$c-C_5H_5N$	Ag^+	---	---	16.7	17.9				---	---	28.0	40.3			
63		$c-C_5H_5NH^+$	26.3	12.6	13.6					32.1	29.7	37.9				

Neutral	Ion	$-\Delta G^{\circ}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	7	T(K)	Method	Comments
C_2H_4	$C_2H_4^+$	---	---						---	PI	cf. Table 8
$C_2H_5ONO_2$	NO_2^-	(10.4)	4.7	3.1					298	HPMS	[s]$NO_2^- - SO_2$
	NO_3^-	7.6	4.6						298	HPMS	
C_2H_5Cl	$C_2H_5^+$	---	2.6	2.5					298	HPMS	
$(CH_3)_2O$	H_3O^+	(37.9)	10.7	8.9					300	HPMS	[c]$H_2O/(CH_3)_2O$(s); cf. Table 8
	$H_3O^+ \cdot H_2O$	(21.1)	9.6	4.9					300	HPMS	[c]$H_2O/(CH_3)_2O$(s)
$(CH_3)_2O$	$H_3O^+ \cdot 2H_2O$	(14.3)	7.1						300	HPMS	[s]$H_3O^+ \cdot 2H_2O - H_2O$
	$CH_3OH_2^+$	27.6	11.3	(-0.3)[s]					300	HPMS	[s]$H^+CH_3OH \cdot 2(CH_3)_2O - CH_3OH$
	$CH_3OH_2^+ \cdot CH_3OH$	14.4	7.1						300	HPMS	
	$CH_3OH_2^+ \cdot 2CH_3OH$	8.7	4.8						300	HPMS	
	$(CH_3)_2OH^+$	21.9	1.9						300	HPMS	cf. Table 8
$(CH_3)_2SO$	K^+	25	19	11	7	5	3		300	HPMS	
	$(CH_3)_2SOH^+$	(24.0)	18.1						298	HPMS	[s]$(CH_3)_2SOH^+ - (CH_3)_2CO$
	Cl^-	12.5	8.9	6.0	3.5	1.8			300	HPMS	
	Br^-	10.9	7.8	5.3					300	HPMS	
	I^-	9.2	6.2	4.1					300	HPMS	
$C_2H_5NH_2$	$C_2H_5NH_3^+$	---	7.1	4.6					298	HPMS	
$H_2NCH_2-CH_2NH_2$	K^+	19.0	12.7	5.1					298	HPMS	
	$H_2NCH_2-CH_2NH_3^+$	---	---	3.6					298	HPMS	
$(CH_3)_2CO$	K^+	19	13	9					300	HPMS	
	$(CH_3)_2COH^+$	---	5.3	3.4					298	HPMS	cf. Table 8
	$N(CH_3)_4^+$	7.7	4.8	4.7					281	HPMS	
$(CH_3)_2NCHO$	K^+	23	15	9.6	5.8				300	HPMS	
$n-C_3H_7OH$	$n-C_3H_7OH_2^+$	---	12.0	7.1	4.8				298	HPMS	cf. Table 8
$n-C_3H_7NH_2$	$n-C_3H_7NH_3^+$	---	7.1	4.5					298	HPMS	
$i-C_3H_7NH_2$	$i-C_3H_7NH_3^+$	---	7.1	4.5					298	HPMS	
$1,2(NH_3)_2-C_3H_6$	$(1,2(NH_2)_2-C_3H_6)H^+$	---	---	3.2					298	HPMS	
$1,3(NH_2)_2-C_3H_6$	$(1,3(NH_2)_2-C_3H_6)H^+$	---	---	2.7					298	HPMS	
$(N(CH_3)_2)-(CH_3)CO$	K^+	24	16.5	11					300	HPMS	
$CH_3O(CH_2))_2OCH_3$	Na^+	36.9	23.0	10.6					298	HPMS	
$c-C_5H_5N$	Ag^+	---	---	8.4	5.9				298	HPMS	pyridine
	$c-C_5H_5NH^+$	16.7	3.7	2.3					298	HPMS	cf. Table 8

Table 9. (continued) Thermodynamic quantities for the association of organic compounds to gaseous ions. The higher order clustering reactions.

			$-\Delta H^{\circ}_{n-1,n}$ (kcal/mol)							$-\Delta S^{\circ}_{n-1,n}$ (cal/K mol)						
Ref.	Neutral	Ion	1	2	3	4	5	6	7	1	2	3	4	5	6	7
97	C_6H_6	K^+	19.2	18.8	14.5	12.6				24.6	33.9	32.7	41.4			
97,60		$K^+ \cdot H_2O$	(16.8)[s]	(14.4)[c]						(27.1)	(30.1)					
97,60		$K^+ \cdot 2H_2O$	(13.4)[s]	(12.8)[c]						(24.3)	(33.7)					
118		NH_4^+	19.3	17.0	14.2					23.3	30.5	32.8				

Neutral	Ion	$-\Delta G^{o}_{n-1,n}$ (T) (kcal/mol) 1	2	3	4	5	6	7	T(K)	Method	Comments
C_6H_6	K^+	11.9	8.8	4.7	0.3				298	HPMS	benzene
	$K^+ \cdot H_2O$	(8.7)	(5.4)						298	HPMS	$^{s}K^+ \cdot H_2O\text{-}H_2O$; $^{c}H_2O/C_6H_6(s)$
	$K^+ \cdot 2H_2O$	(6.1)	(2.7)						298	HPMS	$^{s}K^+ \cdot 2H_2O\text{-}H_2O$; $^{c}H_2O/C_6H_6(s)$
	NH_4^+	12.4	7.9	4.4					298	HPMS	

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