Electrochemical Data

D. Dobos

AKADÉMIAI KIADÓ, BUDAPEST

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Electrochemical Data

A handbook for electrochemists in industry and universities

Electrochemistry holds an important position in science, not only in academic research but also in many industrial processes. This book contains a wide range of tabulated electrochemical data. Extensive coverage is given to conductivities, transport numbers, relative permittivities, activity coefficients and electrode potentials, in addition to many other electrochemical properties of aqueous and non-aqueous systems. SI units are used throughout although where considered useful, the data are also given in the more traditional units.

The book will be an invaluable reference source for researchers and those in industry who are working in fields where electrochemical processes are involved.

1828

AKADÉMIAI KIADÓ • BUDAPEST

ELECTROCHEMICAL DATA

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A HANDBOOK FOR ELECTROCHEMISTS IN INDUSTRY AND UNIVERSITIES

BY

D. DOBOS

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CONTENTS

FOREWORD

Dezső Dobos' book "Electrochemical Data" was first published in Hungarian by the Technical Publishing House, Budapest.

In writing this book the author's purpose was to provide a comprehensive source of rapid information for chemists, physical chemists and electrochemists engaged in industrial practice, dealing with a variety of problems that may emerge during their day-to-day work.

Based on the success of the Hungarian edition, the Publishing House of the Hungarian Academy of Sciences decided to publish an English version of the book. The author began the translation and preparation of the English manuscript, and much of the work had been completed when it was interrupted forever by his tragic and untimely death.

As a tribute to the author's memory I decided to complete the work in accordance with his original conception and according to the notes he left behind.

Since the publication of the Hungarian edition, the International System of Units (SI) has been generally adopted and recommended by many countries for use in science and technology. Therefore, in the English edition the data are given in SI units. In those tables where the maintenance of the old units was appropriate, the data are presented both in the traditional and in SI units.

My thanks are due to my colleague, Dr. A. Marton, for performing the calculations and also for his assistance in the correction of the manuscript.

It is hoped that the English edition of the book will greatly contribute to the successful work of many chemists and electrochemists in academic and industrial environments: this was the true and selfless intention of the author.

Prof. J. Inczédy

I

LIST OF SYMBOLS, FUNDAMENTAL PHYSICAL CONSTANTS, CONVERSION TABLE TO SI UNITS, INTERNATIONAL ATOMIC WEIGHTS, ELECTROCHEMICAL EQUATIONS AND FORMULAE

LIST OF SYMBOLS

LATIN CHARACTERS

A	ampere
a	activity
a.c.	alternating current
(aq)	aqueous
atm.	atmosphere
b.p.	boiling point
C	coulomb
°C	degree Celsius
c	concentration in general
(cryst)	crystalline state
D	diffusion coefficient
DME	dropping mercury electrode
d.c.	direct current
dil.	dilute
E	potential
E^0	standard electrode potential
$E_{1/2}$	polarographic half-wave potential
E_d	diffusion potential
EMF	electromotive force of galvanic cell
e	electron
equiv.	gramme equivalent
F	Faraday constant
ΔG	Gibbs free energy change
(g)	gaseous state
ΔH	enthalpy change
Hz	hertz
I	current, ionic strength
J	joule
J	current density
K	kelvin
K	equilibrium constant
K	solubility product
K_w	ionic product of water

k	rate constant, constant in general
l	litre
(l)	liquid state
ln	natural logarithm
log	decimal logarithm
M	molar concentration (number of moles of solute per litre of solution)
m	metre
m	molal concentration (number of moles of solute per 1000 g of solvent)
m.p.	melting point
N	newton
N	normality (number of equivalents of solute per litre of solution)
NCE	normal calomel electrode
p	pressure
pK	$-\log K$
R	resistance, gas constant
S	entropy
SCE	saturated calomel electrode
SHE	standard hydrogen electrode
s	second
(s)	solid state
T	absolute temperature
t	temperature
t_+	cation transport number
t_-	anion transport number
u	ionic mobility
V	volt
w.%	weight per cent
z	valency, number of charges involved in the electrochemical reaction

GREEK CHARACTERS

α	degree of electrolytic dissociation, temperature coefficient
γ	mean ionic activity coefficient
δ	dielectric loss angle
ε	relative permittivity
ξ	electrokinetic potential
η	overvoltage
κ	specific conductance or conductivity
Λ	equivalent conductivity of electrolyte
Λ_0	equivalent conductivity of electrolyte at zero concentration
Λ_m	molar conductivity of electrolyte
λ	ionic equivalent conductivity

λ_0	limiting ionic equivalent conductivity
ρ	specific resistance or resistivity
τ	time
ϕ	dilution
Ω	ohm

SYMBOLS USED AS SUBSCRIPT

a	anion, anode
ac	acid
b	base
c	cation, cathode
d	dissociation
i	ion
w	water

Other symbols are introduced as required in the text.

FUNDAMENTAL PHYSICAL CONSTANTS

Constant	Value in SI units
Avogadro number	6.022×10^{23} mol^{-1}
Boltzmann constant	1.381×10^{-23} J K^{-1}
Electron charge	1.602×10^{-19} C
Electron rest mass	9.110×10^{-31} kg
Faraday constant	9.649×10^{4} C mol^{-1}
Gas constant	8.314 J K^{-1} mol^{-1}
Molar volume of ideal gas at 101 325 Nm^{-2} (= 1 atm.) and 273.15 K	2.241×10^{-2} m^{3} mol^{-1}
Neutron rest mass	1.674×10^{-27} kg
Planck constant	6.626×10^{-34} J s
Proton charge	1.602×10^{-19} C
Proton rest mass	1.673×10^{-27} kg
Velocity of light in vacuum	2.997×10^{8} m s^{-1}

$\ln x = 2.303 \log x$, $RTF^{-1} \ln 10 = 0.05916$ V at 298.15 K.

CONVERSION TABLE TO SI UNITS

Physical quantity	Old unit	Value in SI units
Length	centimetre	10^{-2} m
	Ångstrom	10^{-10} m
Area	square centimetre	10^{-4} m^2
Volume	millilitre	10^{-6} m^3
	litre	10^{-3} m^3
Mass	gramme	10^{-3} kg
Force	dyne	10^{-5} N
	kilogramme force	9.806 N
Pressure	atmosphere	1.013×10^5 N m^{-2}
	torr = mm Hg	133.3 N m^{-2}
	bar	105 N m^{-2}
Energy	thermochemical calorie	4.184 J
	electronvolt	1.602×10^{-19} J
	electronvolt per mole	2.660 kJ mol^{-1}
	erg	10^{-7} J
	kilowatt hour	3.6×10^6 J
Entropy	eu = cal$\times$g$^{-1}\times$°C^{-1}	4184 J kg^{-1} K^{-1}
Frequency	cycle per second	1 Hz
Dipole moment	debye	3.334×10^{-30} C m
Relative permittivity	dielectric constant	1
Temperature	°C	0°C = 273.15 K

PREFIXES FOR FRACTIONS AND MULTIPLES OF SI UNITS

Prefix	Symbol	Factor	Prefix	Symbol	Factor
pico	p	10^{-12}	deci*	d	10^{-1}
nano	n	10^{-9}	kilo	k	10^{-3}
micro	μ	10^{-6}	mega	M	10^6
milli	m	10^{-3}	giga	G	10^9
centi*	c	10^{-2}	terra	T	10^{12}

* In the SI the fractions of units are normally to be restricted to steps of a thousandth and the multiples to steps of a thousand.

INTERNATIONAL ATOMIC WEIGHTS

(Arranged alphabetically according to the symbols; base ^{12}C = 12.0000)

Symbol	Element	Atomic number	Atomic weight	Symbol	Element	Atomic number	Atomic weight
Ac	Actinium	89	227	He	Helium	2	4.0026
Ag	Silver	47	107.868	Hf	Hafnium	72	178.49
Al	Aluminium	13	26.9815	Hg	Mercury	80	200.59
Am	Americium	95	243	Ho	Holmium	67	164.930
Ar	Argon	18	39.948	I	Iodine	53	126.9044
As	Arsenic	33	74.9216	In	Indium	49	114.82
At	Astatine	85	210	Ir	Iridium	77	192.2
Au	Gold	79	196.967	K	Potassium	19	39.102
B	Boron	5	10.811	Kr	Krypton	36	83.80
Ba	Barium	56	137.34	La	Lanthanum	57	138.91
Be	Beryllium	4	9.0122	Li	Lithium	3	6.939
Bi	Bismuth	83	208.980	Lu	Lutetium	71	174.97
Bk	Berkelium	97	247	Lw	Lawrencium	103	256
Br	Bromine	35	79.904	Md	Mendelevium	101	257
C	Carbon	6	12.01115	Mg	Magnesium	12	24.305
Ca	Calcium	20	40.08	Mn	Manganese	25	54.9380
Cd	Cadmium	48	112.40	Mo	Molybdenum	42	95.94
Ce	Cerium	58	140.12	N	Nitrogen	7	14.0067
Cf	Californium	98	252	Na	Sodium	11	22.9898
Cl	Chlorine	17	35.453	Nb	Niobium	41	92.906
Cm	Curium	96	247	Nd	Neodymium	60	144.24
Co	Cobalt	27	58.9332	Ne	Neon	10	20.179
Cr	Chromium	24	51.996	Ni	Nickel	28	58.71
Cs	Caesium	55	132.905	No	Nobelium	102	255
Cu	Copper	29	63.546	Np	Neptunium	93	237
Dy	Dysprosium	66	162.50	O	Oxygen	8	15.9994
Er	Erbium	68	167.26	Os	Osmium	76	190.2
Es	Einsteinium	99	254	P	Phosphorus	15	30.9738
Eu	Europium	63	151.96	Pa	Protactinium	91	231
F	Fluorine	9	18.9984	Pb	Lead	82	207.19
Fe	Iron	26	55.847	Pd	Palladium	46	106.4
Fm	Fermium	100	257	Pm	Promethium	61	147
Fr	Francium	87	223	Po	Polonium	84	210
Ga	Gallium	31	69.72	Pr	Praseodymium	59	140.907
Gd	Gadolinium	64	157.25	Pt	Platinum	78	195.09
Ge	Germanium	32	72.59	Pu	Plutonium	94	244
H	Hydrogen	1	1.00797	Ra	Radium	88	226

(continued)

Symbol	Element	Atomic number	Atomic weight	Symbol	Element	Atomic number	Atomic weight
Rb	Rubidium	37	85.47	Tc	Technetium	43	99
Re	Rhenium	75	186.2	Te	Tellurium	52	127.60
Rh	Rhodium	45	102.905	Th	Thorium	90	232.08
Rn	Radon	86	222	Ti	Titanium	22	47.90
Ru	Ruthenium	44	101.07	Tl	Thallium	81	204.37
S	Sulphur	16	32.064	Tm	Thulium	69	168.934
Sb	Antimony	51	121.75	U	Uranium	92	238.03
Sc	Scandium	21	44.956	V	Vanadium	23	50.942
Se	Selenium	34	78.96	W	Tungsten	74	183.85
Si	Silicon	14	28.086	Xe	Xenon	54	131.30
Sm	Samarium	62	150.35	Y	Yttrium	39	88.905
Sn	Tin	50	118.69	Yb	Ytterbium	70	173.04
Sr	Strontium	38	87.62	Zn	Zinc	30	65.37
Ta	Tantalum	73	180.948	Zr	Zirconium	40	91.22
Tb	Terbium	65	158.924				

ELECTROCHEMICAL EQUATIONS AND FORMULAE*

Resistance

$$R = \frac{E}{I} \qquad [\Omega]$$

E the potential, [V]
I the current, [A]

Resistivity (Specific resistance)

$$\rho = \frac{1}{\kappa} \qquad [\Omega\,\mathrm{m}]$$

κ the conductivity of the electrolyte, $[\Omega^{-1}\,\mathrm{m}^{-1}]$

Resistance of an electrolyte solution

$$R = \frac{1}{\kappa} \cdot \frac{l}{S} \qquad [\Omega]$$

l the mean distance between the electrodes, [m]
S the surface area of the electrode (mean cross-sectional area of the solution), $[\mathrm{m}^2]$

Cell constant

$$C = \frac{l}{S} \qquad [\mathrm{m}^{-1}]$$

$$C = R\kappa \qquad [\mathrm{m}^{-1}]$$

* The meaning and the dimension of the symbols are explained at their first occurrence and these are used systematically throughout this chapter.

R is the resistance of a particular electrolyte of known conductivity κ, measured in the cell.

The conductivity (specific conductance) of any other electrolyte is thus readily calculated:

$$\kappa = \frac{C}{R}$$

Equivalent conductivity

$$\Lambda = \kappa\phi = \frac{\kappa}{C} \qquad [\Omega^{-1}\,\mathrm{m}^2\,\mathrm{equiv.}^{-1}]$$

ϕ the dilution *i.e.* reciprocal concentration
c the concentration, [equiv. l^{-1}]

Kohlrausch rule

$$\Lambda_0 = \Lambda + k\sqrt{c}$$

Λ_0 the equivalent conductivity of the electrolyte at infinite dilution,
Λ the equivalent conductivity of the electrolyte at a particular concentration,
k an empirical constant

Degree of electrolytic dissociation

$$\alpha = \frac{\Lambda}{\Lambda_0}$$

Ionic equivalent conductivity and ionic mobility

$$\lambda_+ = Fu_+\,; \quad \lambda_- = Fu_- \qquad [\Omega^{-1}\,\mathrm{m}^2\,\mathrm{equiv.}^{-1}]$$

F the Faraday constant, 96490 C equiv.$^{-1}$
u the ionic mobility, [$\mathrm{m}^2\,\mathrm{s}^{-1}\,\mathrm{V}^{-1}$]

Equivalent conductivity and ionic mobility

$$\Lambda = \alpha F(u_+ + u_-) = \alpha(\lambda_+ + \lambda_-)$$

$$\Lambda_0 = \lambda_{0+} + \lambda_{0-}$$

λ_{0+}, λ_{0-} the ionic equivalent conductivity at infinite dilution

Hittorf transport numbers

$$t_+ = \frac{\lambda_+}{\lambda_+ + \lambda_-}; \quad t_- = \frac{\lambda_-}{\lambda_+ + \lambda_-}$$

$$t_+ + t_- = 1$$

$$\frac{t_+}{t_-} = \frac{u_+}{u_-} = \frac{\lambda_+}{\lambda_-}$$

$$\lambda_+ = t_+ \Lambda; \quad \lambda_- = t_- \Lambda$$

Ostwald dilution law

$$K_d = \frac{\alpha^2 c}{1 - \alpha}$$

K_d the dissociation constant of the weak electrolyte

In general for an electrolyte which yields n ions:

$$K_d = \frac{c^{(n-1)} \Lambda^n}{\Lambda_0^{(n-1)} (\Lambda_0 - \Lambda)}$$

For a *binary* electrolyte:

$$K_d = \frac{c \Lambda^2}{\Lambda_0 (\Lambda_0 - \Lambda)}$$

Ionic strength

$$I = \frac{1}{2} \sum m_i z_i^2 \qquad [\text{mol kg}^{-1}]$$

m_i the molar concentration of the ion i, [mol kg^{-1}]
z_i charge number of the ion i

Activity

$$a = \gamma m \qquad [\text{mol kg}^{-1}]$$

γ mean activity coefficient

Mean activity coefficient at 25°C:

$$\log \gamma = A \mid z_+ z_- \mid \sqrt{I}$$

A the Debye–Hückel constant for aqueous solution at 25°C, 0.5115 $mol^{-1/2}\ kg^{1/2}$

In general:

$$\gamma = \sqrt[(x+y)]{\gamma_+^x\ \gamma_-^y}$$

γ_+ and γ_- individual ionic activity coefficients
z_+ and z_- charge number of the respective ion

In *binary* electrolyte solution:

$$a = \sqrt{a_+\ a_-}\ ; \quad \gamma = \sqrt{\gamma_+\ \gamma_-}$$

Mean activity coefficients of *ternary* electrolytes (*e.g.* $BaCl_2$, K_2SO_4, *etc.*):

$$\gamma = \sqrt[3]{\gamma_+\ \gamma_-^2} \quad \text{or} \quad \gamma = \sqrt[3]{\gamma_+^2\ \gamma_-}$$

In *quaternary* electrolyte solutions (*e.g.* $LaCl_3$, $K_3[Fe(CN)_6]$, *etc.*):

$$\gamma = \sqrt[4]{\gamma_+\ \gamma_-^3} \quad \text{or} \quad \gamma = \sqrt[4]{\gamma_+^3\ \gamma_-}$$

Law of mass action for strong electrolytes

$$K_d = \frac{a_+\ a_-}{a'}$$

a' the activity of the undissociated substance

pH

$$\text{pH} = -\log a_{H^+}$$

Calculation of the approximate pH values of solution

Strong acid: $\text{pH} = -\log\ [\text{acid}]$*

Strong base: $\text{pH} = 14 + \log\ [\text{base}]$*

* pK_{ac} acid exponent
pK_b base exponent
[acid], [base] and [salt] molar concentration of the acid, base and salt.

Weak acid: $$\mathrm{pH} = \frac{1}{2}\,\mathrm{p}K^*_{\mathrm{ac}} - \frac{1}{2}\log\,[\mathrm{acid}]$$

Weak base: $$\mathrm{pH} = 14 - \frac{1}{2}\,\mathrm{p}K^*_{\mathrm{b}} + \frac{1}{2}\log\,[\mathrm{base}]$$

Salt formed by a weak acid and a strong base:

$$\mathrm{pH} = 7 + \frac{1}{2}\,\mathrm{p}K_{\mathrm{ac}} + \frac{1}{2}\log\,[\mathrm{salt}]^*$$

Salt formed by a weak base and a strong acid:

$$\mathrm{pH} = 7 - \frac{1}{2}\,\mathrm{p}K_{\mathrm{b}} - \frac{1}{2}\log\,[\mathrm{salt}]$$

Salt formed by a weak acid and a weak base:

$$\mathrm{pH} = 7 + \frac{1}{2}\,\mathrm{p}K_{\mathrm{ac}} - \frac{1}{2}\,\mathrm{p}K_{\mathrm{b}}$$

Acid salts of a dibasic acid:

$$\mathrm{pH} = \frac{1}{2}\,\mathrm{p}K_{\mathrm{ac}_1} + \frac{1}{2}\,\mathrm{p}K_{\mathrm{ac}_2} - \frac{1}{2}\log\,[\mathrm{salt}] + \frac{1}{2}\log\,(K_{\mathrm{ac}_1} + [\mathrm{salt}])$$

Basic salts:

$$\mathrm{pH} = 14 - \frac{1}{2}\,pK_{\mathrm{b}_1} - \frac{1}{2}\,\mathrm{p}K_{\mathrm{b}_2}$$

Buffer solution consisting of a mixture of a weak acid and its salt:

$$\mathrm{pH} = \mathrm{p}K_{\mathrm{ac}} + \log\frac{[\mathrm{salt}]}{[\mathrm{acid}]}$$

Buffer solution consisting of a mixture of a weak base and its salt:

$$\mathrm{pH} = 14 - \mathrm{p}K_{\mathrm{b}} + \log\frac{[\mathrm{base}]}{[\mathrm{salt}]}$$

Nernst equation

$$E = E^0 + \frac{RT}{zF}\ln a \qquad [\mathrm{V}]$$

E^0 standard electrode potential, [V]
R gas constant, 8.314 $\mathrm{J\,K^{-1}\,mol^{-1}}$
T temperature, K

Which with decimal logarithms and at 20°C becomes:

$$E = E^0 + \frac{0.0581}{z} \log a$$

Redox potential

$$E = E^0_{ox,red} + \frac{RT}{zF} \ln \frac{a_{ox}}{a_{red}} \qquad [V]$$

z number of electrons transferred in the redox reaction
$E^0_{ox,red}$ standard redox potential, [V]

Which with decimal logarithms and at 20°C becomes:

$$E = E^0_{ox,red} + \frac{0.0581}{z} \log \frac{a_{ox}}{a_{red}}$$

rH

$$rH = -\log p_{H_2}$$

p_{H_2} pressure of the hydrogen gas, [atm.]

Redox potential and rH

$$E = 0.029\, rH - 0.058\, pH$$

Potential of a gas electrode

Hydrogen electrode:

$$E = E^0 + \frac{RT}{F} \ln \frac{a_{H^+}}{\sqrt{p_{H_2}}}$$

By definition, the standard potential of the SHE is equal to zero (arbitrary zero potential). This equation, at 20°C, therefore becomes:

$$E = 0.0581 \log \frac{a_{H^+}}{\sqrt{p_{H_2}}}$$

Chlorine electrode: (at 20°C)

$$E = E^0 + 0.0581 \log \frac{\sqrt{p_{Cl_2}}}{a_{Cl^-}}$$

p_{Cl_2} pressure of the chlorine gas

Oxygen electrode: (at 20°C)

$$E = E^0 + 0.0581 \log \frac{\sqrt[4]{p_{O_2}}}{a_{OH^-}}$$

p_{O_2} pressure of the oxygen gas

Diffusion potential

$$E_d = \frac{\lambda_- - \lambda_+}{\lambda_+ + \lambda_-} \frac{RT}{F} \ln \frac{a_1}{a_2}$$

At 20°C:

$$E_d = \frac{\lambda_- - \lambda_+}{\lambda_+ + \lambda_-} 0.0581 \log \frac{\gamma_1 c_1}{\gamma_2 c_2}$$

Electromotive force of galvanic cells

$$EMF = E_1^0 - E_2^0 + \frac{RT}{F}\left(\frac{\ln a_1}{z_1} - \frac{\ln a_2}{z_2}\right)$$

which with decimal logarithms and at 20°C becomes:

$$EMF = E_1^0 - E_2^0 + 0.0581\left(\frac{\log a_1}{z_1} - \frac{\log a_2}{z_2}\right)$$

Subscripts 1 and 2 refer to the positive and negative electrodes.

Concentration cells

The *EMF* of concentration cells *with transference* at 20°C:

$$EMF = \frac{0.0581}{z} \log \frac{a_1}{a_2} + E_d$$

The *EMF* of concentration cells *without transference* at 20°C:

$$EMF = \frac{0.0581}{z} \log \frac{a_1}{a_2} \qquad a_1 > a_2$$

For example:

$$- Na_{(1)}Hg \mid NaCl(aq) \mid Na_{(2)}Hg +$$

$$[Na_{(1)}] > [Na_{(2)}] \qquad E_d = \text{zero}$$

$$\overbrace{\qquad\qquad}^{E_d}$$

$$-\mathrm{Ag} \mid \mathrm{AgNO_{3(2)}} \mathrel{\vdots} \mathrm{AgNO_{3(1)}} \mid \mathrm{Ag} +$$

$$[\mathrm{AgNO_{3(2)}}] < [\mathrm{AgNO_{3(1)}}] \qquad EMF = E_2 - E_1 + E_d$$

because $u_+ < u_-$

$$\overbrace{\qquad\qquad}^{E_d}$$

$$-\mathrm{Pt, H_2} \mid \mathrm{HCl_{(2)}} \mathrel{\vdots} \mathrm{HCl_{(1)}} \mid \mathrm{Pt, H_2} +$$

$$[\mathrm{HCl_{(2)}}] < [\mathrm{HCl_{(1)}}] \qquad EMF = E_2 - E_1 - E_d$$

because $u_+ > u_-$

Gibbs–Helmholtz equation

$$\Delta H = -zF\left(EMF - T\frac{\mathrm{d}EMF}{\mathrm{d}T}\right) \qquad [\mathrm{kJ\ mol^{-1}}]$$

ΔH enthalpy change of the cell reaction
T temperature, K

Gibbs free energy for the cell reaction

$$\Delta G = -zF\,EMF \qquad [\mathrm{kJ\ mol^{-1}}]$$

ΔG free energy change for the cell reaction

Terminal voltage of a galvanic cell

$$E_t = EMF\frac{R_e}{R_e + R_i} \qquad [\mathrm{V}]$$

R_e the external resistance and the resistance of the connecting wires, $[\Omega]$
R_i the internal resistance of the galvanic cell, $[\Omega]$

Ilkovic equation in polarography

$$I_d = 0.627\, zFcD^{1/2} m^{2/3} \tau^{1/6}$$

I_d diffusion current, $[\mu\mathrm{A}]$
z the number of electrons in the electron transfer reaction
c concentration, $[\mathrm{mmol\ l^{-1}}]$
D diffusion coefficient of the electroactive species, $[\mathrm{cm^2\,s^{-1}}]$
m the average rate of flow of mercury from the capillary, $[\mathrm{mg\,s^{-1}}]$
τ drop time (drop life), [s]

Heyrovsky–Ilkovic equation for the polarographic wave

$$E = E_{1/2} + \frac{RT}{zF} \ln \left(\frac{I_d - I}{I} \right)$$

E the applied cathode potential, [V]
$E_{1/2}$ the half-wave potential, [V]
I current at the potential E, [μA]

Ohm's law for electrolysis

$$I = \frac{E_t - E_d}{R}$$

I electrolysis current, [A]
R total resistance of the system being electrolyzed [Ω]
E_d decomposition potential of the electrolyte solution, [V]
E_t terminal voltage between the electrodes, [V]

Faraday law

$$m = \frac{\mathrm{M}}{zF} I\tau$$

m amount of substance deposited or decomposed, [g]
M the formula weight of the substance, [g]
z the number of electrons involved in the reaction
I electrolysis current, [A]
τ time of electrolysis, [s]

Potential required for electrolysis

$$E = E_d + E_p + \eta + IR \qquad [\mathrm{V}]$$

E_d decomposition potential, [V]
E_p excess potential caused by concentration polarization, [V]
η overvoltage, [V]
IR ohmic potential drop caused by the external resistance of the electrolyzing system (bath solution + electrodes + wires), [V]

Tafel equation

$$\eta = a + b \log J$$

a, b current density-independent constants characteristic of the metal, [V]

J current density, [$A\,m^{-2}$]

Current efficiency of electrolysis

$$\eta_{curr.} = \frac{\text{useful (effective) current quantity}}{\text{total current quantity}}$$

Voltage efficiency of electrolysis

$$\eta_{volt.} = \frac{E_d}{E_t}$$

Energy efficiency of electrolysis

$$\eta_{en.} = \frac{E_d}{E_t} \eta_{curr.}$$

II

CONDUCTIVITIES, IONIC MOBILITIES, TRANSPORT NUMBERS, DIFFUSION COEFFICIENTS, THERMODYNAMIC DATA FOR IONS IN ELECTROLYTE SOLUTIONS, RELAXATION TIMES, RELATIVE PERMITTIVITIES

Table 1

Specific and equivalent conductivities of solutions of inorganic electrolytes at 18°C*

Electrolyte	Concentration w. %	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 equiv.$^{-1}$	Temperature coefficient α**
$AlCl_3$	2.180	3.25	0.00650	—
	4.280	5.62	0.00562	—
	8.267	8.84	0.00442	—
	12.001	10.41	0.00347	—
	15.512	10.864	0.002716	—
$AgNO_3$	5	2.56	0.00834	0.0218
	10	4.76	0.00743	0.0217
	20	8.72	0.00620	0.0212
	40	15.65	0.00450	0.0205
	60	21.01	0.00311	0.0209
$BaCl_2$	5	3.89	0.00777	0.0214
	10	7.33	0.00698	0.0206
	15	10.51	0.00636	0.0198
	24	15.34	0.00530	0.0192
$Ba(NO_3)_2$	4.2	2.09	0.00630	0.0235
	8.4	3.52	0.00512	0.0245
$Ba(OH)_2$	1.25	2.50	0.01694	0.0187
	2.50	4.79	0.01602	0.0185
$CaCl_2$	5	6.43	0.00686	0.0213
	10	11.41	0.00583	0.0206
	20	17.28	0.00406	0.0200
	25	17.81	0.003212	0.0204
	30	16.58	0.002387	0.0216
	35	13.66	0.001613	0.0236

* See examples at the end of this table

** The temperature coefficient $\alpha = \frac{1}{\kappa} \cdot \frac{d\kappa}{dt}$ is obtained from conductivities measured at 18°C and 26°C. In the case of KHS and K_2S the bases of the conversion are the values obtained at 10°C and 26°C.

Table 1

Electrolyte	Concentration, w. %	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 equiv.$^{-1}$	Temperature coefficient, α
$Ca(NO_3)_2$	6.25	4.91	0.00615	0.0218
	12.5	8.04	0.00479	0.0217
	25	10.48	0.00282	0.0218
	37.5	8.76	0.001415	0.0253
	50	4.69	0.000510	0.0335
$CdBr_2$	0.0324	0.0231	0.00967	—
	0.0748	0.0470	0.00851	—
	0.154	0.0844	0.00747	—
	0.506	0.213	0.00570	—
	1	0.357	0.00482	0.0232
	5	1.09	0.00284	0.0226
	10	1.64	0.00204	0.0232
	20	2.36	0.00143	0.0239
	30	2.73	0.000930	0.0258
	35	2.77	0.000766	0.0270
	40	2.71	0.000618	0.0281
	43	2.61	0.000534	0.0288
$CdCl_2$	0.0503	0.0495	0.00900	—
	0.200	0.156	0.00712	—
	0.599	0.364	0.00552	—
	1	0.551	0.00501	0.0222
	5	1.67	0.00292	0.0218
	10	2.41	0.00202	0.0217
	15	2.82	0.00150	—
	20	2.99	0.001139	0.0228
	25	2.98	0.000864	0.0239
	30	2.82	0.000647	0.0252
	40	2.21	0.000340	0.0290
	50	1.37	0.000149	0.0353
CdI_2	1	0.212	0.00385	0.0286
	5	0.609	0.00214	0.0260
	10	1.039	0.00175	0.0248
	15	1.46	0.00156	—
	20	1.86	0.00142	0.0240
	30	2.54	0.00117	0.0244
	40	3.03	0.000935	0.0253
	45	3.14	0.000811	0.0259
$Cd(NO_3)_2$	1	0.694	0.00816	0.0226
	5	2.89	0.00655	0.0221
	10	5.13	0.00557	0.0215
	20	8.27	0.00410	0.0212
	25	9.19	0.00347	0.0213
	30	9.56	0.00287	0.0214
	35	9.48	0.002317	0.0220

(continued)

Electrolyte	Concentration, w.%	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 $equiv.^{-1}$	Temperature coefficient, α
$Cd(NO_3)_2$	40	9.03	0.001835	0.0228
	48	7.55	0.001162	0.0252
$CdSO_4$	0.0289	0.0247	0.00888	—
	0.0999	0.0692	0.00720	—
	0.495	0.2393	0.00499	—
	1	0.416	0.00429	0.0210
	5	1.46	0.00290	0.0206
	10	2.47	0.00233	0.0206
	25	4.30	0.001382	0.0223
	30	4.36	0.001102	0.0236
	35	4.24	0.000865	0.0251
	36	4.21	0.000825	0.0255
$CoCl_2$	2	2.33	0.00543	—
	10	8.90	0.00387	—
	15.2	11.79	0.00318	—
	24.2	12.58	0.00190	—
$CuCl_2$	1.35	1.87	0.00936	—
	9.0	7.16	0.00493	—
	18.2	9.24	0.00316	—
	28.75	8.97	0.00155	—
	35.2	6.99	0.00092	—
$Cu(NO_3)_2$ (15°C)	5	3.65	0 00656	0.0221
	10	6.35	0.00547	0.0215
	15	8.58	0.00471	0.0206
	20	10.18	0.00400	0.0205
	25	10.89	0.00328	0.0216
	35	10.62	0.00207	0.0237
$CuSO_4$	2.5	1.09	0.00340	0.0213
	5	1.89	0.00287	0.0216
	10	3.20	0.00231	0.0218
	15	4.21	0.001919	0.0231
	17.5	4.58	0.001741	
$FeCl_3$	2.644	3.32	0.00665	—
	5.176	5.29	0.00529	—
	9.949	7.52	0.00376	—
	14.366	8.43	0.00281	—
	18.502	8.20	0.00205	—
	22.362	7.95	0.00159	—
	25.984	7.44	0.00124	—
$FeSO_4$	3.67	1.54	0.00308	0.0218
	7.10	2.58	0.00258	0.0218
	13.36	3.90	0.00195	0.0223
	18.97	4.61	0.001537	0.0231

Table 1

Electrolyte	Concentration, w. %	κ, $\Omega^{-1}\,m^{-1}$	Λ, $\Omega^{-1}\,m^2\,equiv.^{-1}$	Temperature coefficient α
HBr (15°C)	5	19.08	0.02995	0.0152
	10	35.49	0.02693	0.0152
	15	49.40	0.02415	0.0150
HCl	5	39.48	0.02810	0.0158
	10	63.02	0.02191	0.0156
	20	76.15	0.01262	0.0154
	30	66.20	0.00698	0.0152
	40	51.52	0.00391	—
HF	0.004	0.025	0.01318	—
	0.007	0.038	0.01002	—
	0.015	0.050	0.00659	—
	0.030	0.080	0.00527	—
	0.060	0.123	0.00405	—
	0.121	0.210	0.00346	—
	0.242	0.363	0.00299	—
	0.484	0.673	0.00277	—
	1.50	1.98	0.00262	0.0720
	2.48	3.15	0.00251	—
	4.80	5.93	0.00243	0.0666
	7.75	9.63	0.00242	—
	15.85	18.53	0.00221	—
	24.5	28.32	0.00213	0.0583
	29.8	34.11	0.00207	—
HI (15°C)	5	13.32	0.03289	0.0157
HNO_3	6.2	31.23	0.03071	0.0147
	12.4	54.18	0.02570	0.0142
	24.8	76.76	0.01693	—
	31.0	78.19	0.01331	0.0139
	37.2	75.45	0.01034	—
	49.6	63.41	0.00611	0.0157
	62.0	49.64	0.00364	0.0157
H_2SO_4	5	20.85	0.01980	0.0121
	10	39.15	0.01799	0.0128
	15	54.32	0.01609	0.0136
	20	65.27	0.01402	0.0145
	25	71.71	0.01192	0.0154
	30	73.88	0.00989	0.0162
	35	72.43	0.00804	0.0170
	40	68.00	0.00638	0.0178
	50	54.05	0.00379	0.0193
	60	37.26	0.002027	0.0213
	65	29.05	0.001440	0.0230

(continued)

Electrolyte	Concentration, w. %	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 $equiv.^{-1}$	Temperature coefficient, α
H_2SO_4	70	21.57	0.000936	0.0256
	75	15.22	0.000595	0.0291
	80	11.05	0.000391	0.0349
	85	9.80	0.0003172	0.0357
	86	9.92	0.0003161	0.0339
	87	10.10	0.0003169	—
	88	10.33	0.0003193	0.0320
	89	10.55	0.0003212	—
	90	10.75	0.0003224	0.0295
	91	10.93	0.0003236	—
	92	11.02	0.0003220	0.0280
	93	10.96	0.0003160	—
	94	10.71	0.0003049	0.0280
	95	10.25	0.0002881	—
	96	9.44	0.0002624	0.0286
	97	8.00	0.0002199	0.0286
	99.4	0.85	0.0000228	0.0400
	100.14	1.87	—	0.0030
H_3BO_3	0.776	0.00022	0.005835	0.0231
	1.92	0.0011	0.0011752	0.0143
	2.88	0.0021	0.0014904	0.0119
	3.612	0.0031	0.0017504	0.0075
H_3PO_4 (15°C)	10	5.66	0.001754	0.0104
	20	11.29	0.001656	0.0114
	30	16.54	0.001527	—
	35	18.58	0.001427	—
	40	20.70	0.001311	0.0150
	45	20.87	0.001173	0.0161
	50	20.73	0.001017	0.0174
	70	14.36	0.000442	0.0252
	80	9.79	0.000247	0.0309
	85	7.80	0.0001749	0.0350
	87	7.09	0.0001566	0.0372
$HgBr_2$	0.223	0.0016	0.000129	0.0380
	0.422	0.0026	0.000110	0.0320
$HgCl_2$	0.229	0.0044	0.000259	0.0440
	1.013	0.0114	0.000151	0.0372
	5.08	0.0421	0.000107	0.0249
KBr	5	4.65	0.01069	0.0206
	10	9.28	0.01029	0.0194
	20	19.07	0.00981	0.0177
	30	29.23	0.00924	0.0164
	36	35.07	0.00879	0.0154

Table 1

Electrolyte	Concentration, w. %	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 $equiv.^{-1}$	Temperature coefficient, α
KCN	3.25	5.27	0.01042	0.0207
(15°C)	6.5	10.26	0.00997	0.0193
KCl	5	6.90	0.00999	0.0201
	10	13.59	0.00952	0.0188
	15	20.20	0.00915	0.0179
	20	26 77	0 00889	0.0168
	21	28 10	0 00875	0.0166
$KClO_3$ (15°C)	5	3.67	0.00872	0.0211
KF	5	6.52	0 00729	0.0213
	10	12.09	0.00649	0.0216
	20	20.80	0.00515	0.0218
	30	25.61	0.00391	0.0227
	40	25.22	0.00266	0.0250
$KHCO_3$	5	3.71	0.007190	0.0205
(15°C)	10	6.88	0 006454	0.0197
KHS	4.09	5.35	0.009240	0.0219
	7.86	10.39	0.009130	0.0207
	15.08	19.28	0.008478	0.0191
	33.43	37.49	0.006486	0.0178
	51.22	40.03	0.004267	0.0189
$KHSO_4$	5	8.21	0 002161	0.0085
	10	15.28	0.001941	0.0086
	20	27.69	0.001637	0.0088
	27	34.19	0.001424	0.0093
KH_2PO_4	5	2.38	0.006263	0.0220
	10	4.00	0.005095	0.0222
	15	5.84	0.002630	0.0227
KI	5	3.38	0.01083	0.0205
	10	6.80	0.01049	0.0200
	20	14.55	0.01034	0.0184
	30	23.03	0.01001	0.0166
	40	31.68	0.00941	0.0151
	55	42.26	0.00782	0.0140
KNO_3	5	4.54	0.00892	0.0208
	10	8.39	0.00798	0.0205
	15	11.86	0 00729	0.0202
	20	15.05	0.00672	0.0197
	22	16.25	0.00651	0.0194

(continued)

Electrolyte	Concentration, w. %	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 $equiv.^{-1}$	Temperature coefficient, α
KOH	4.2	14.64	0.01884	0.0187
(15°C)	8.4	27.23	0.01689	0.0186
	16.8	45.58	0.01315	0.0193
	25.2	54.03	0.00968	0.0209
	29.4	54.34	0.00806	0.0221
	33.6	52.21	0.00654	0.0236
	42.0	42.12	0.00394	0.0283
K_2CO_3	5	5.61	0.00742	0.0221
(15°C)	10	10.38	0.00657	0.0212
	20	18.06	0.00524	0.0210
	30	22.22	0.00394	0.0219
	40	21.68	0.002645	0.0246
	50	14.69	0.001316	0.0318
K_2S	3.18	8.45	0.01397	0.0193
	4.98	12.84	0.01365	0.0191
	9.93	23.43	0.01203	0.0189
	15.06	33.34	0.01082	0.0189
	19.96	40.20	0.00947	
	24.64	44.01	0.00808	0.0201
	29.97	45.63	0.00662	0.0204
	38.08	41.06	0.00441	0.0236
	47.26	25.79	0.00206	0.0324
K_2SO_4	5	4.58	0.00768	0.0216
	10	8.60	0.00694	0.0203
LiCl	2.5	4.10	0.00687	—
	5	7.33	0.00606	—
	10	12.18	0.00490	—
	20	16.76	0.00319	—
	30	13.99	0.001678	—
	40	8.44	0.000714	—
LiI	5	2.96	0.00765	0.0218
	10	5.73	0.00714	0.0215
	20	10.94	0.00629	0.0206
	25	13.46	0.00594	0.0202
LiOH	1.25	7.81	0.01482	0.0191
	2.5	14.16	0.01325	0.0196
	5.0	23.96	0.01092	0.0203
	7.5	29.99	0.00890	0.0221
Li_2CO_3	0.20	0.343	0.00635	—
	0.63	0.885	0.00519	—

Table 1

Electrolyte	Concentration, w. %	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 $equiv.^{-1}$	Temperature coefficient α
Li_2SO_4 (15°C)	5	4.00	0.00422	0.0236
	10	6.10	0.00309	0.0239
$MgCl_2$	5	6.83	0.00624	0.0222
	10	11.28	0.00495	0.0220
	20	14.02	0.002837	0.0237
	30	10.61	0.001318	0.0283
	34	7.68	0.000814	0.0318
$Mg(NO_3)_2$	5	4.38	0.00627	0.0216
	10	7.70	0.00531	0.0212
	17	11.02	0.00423	0.0208
$MgSO_4$ (15°C)	5	2.63	0.00301	0.0226
	10	4.14	0.002255	0.0241
	15	4.80	0.001660	0.0252
	20	4.76	0.001174	0.0269
	25	4.15	0.000777	0.0288
$MnCl_2$ (15°C)	5	5.26	0.00633	0.0210
	10	8.44	0.00488	0.0206
	15	10.55	0.00389	0.0202
	20	11.34	0.00300	0.0203
	25	10.90	0.00220	0.0203
	28	10.16	0.001780	—
$MnSO_4$	4.978	1.90	0.00276	0.0221
	10.443	3.72	0.001829	0.0216
	25.21	4.25	0.000998	0.0242
	35.35	3.00	0.000452	0.0294
NaCl	5	6.72	0.00760	0.0217
	10	12.11	0.00662	0.0214
	15	16.42	0.00578	0.0212
	20	19.57	0.00499	0.0216
	25	21.35	0.00420	0.0227
	26	21.51	0.00404	—
NaI	5	2.98	0.00861	0.0221
	10	5.81	0.00816	0.0215
	20	11.44	0.00731	0.0203
	40	21.11	0.00559	0.0197
$NaNO_3$	5	4.36	0.00718	0.0221
	10	7.82	0.00623	0.0217
	20	13.03	0.00485	0.0215
	30	16.06	0.00371	0.0220

(continued)

Electrolyte	Concentration, w.%	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 $equiv.^{-1}$	Temperature coefficient, α
NaOH	1	4.65	0.01845	—
	2	8.87	0 01737	—
	4	16.28	0.01563	—
	6	22.42	0.01405	—
	8	27.29	0.01256	—
	10	30.93	0.01117	—
	15	34.90	0.00800	—
	20	32.84	0.005395	—
	25	27.17	0.003422	—
	27.5	23.86	0.002669	—
	30	20.74	0.002083	—
	32.5	17.98	0.001635	—
	35	15.60	0.001293	—
	37.5	13.61	0.001034	—
	40	12.06	0.000844	—
	45	9.77	0.000588	—
	50	8.20	0.000430	—
Na_2CO_3	5	4.51	0.00455	0.0252
	10	7.05	0.00339	0.0271
	15	8.36	0.002551	0.0294
Na_2S	2.02	6.12	0.01157	0.0206
	5.03	13.21	0.00972	0.0213
	9.64	20.17	0.00737	0.0226
	14.02	23.59	0.00567	0.0247
	16.12	22.43	0.00460	0.0268
	18.15	21.84	0.00387	0.0295
Na_2SO_4	5	4.09	0.00556	0.0236
	10	6.87	0.00447	0.0249
	15	8.86	0.00367	0.0256
NH_3 (15°C)	0.10	0.0251	0.000425	0.0246
	0.40	0.0492	0.0002103	—
	0.80	0.0657	0.0001408	—
	1.60	0.0867	0.0000929	0.0238
	4.01	0.1095	0.0000475	0.0250
	8.03	0.1038	0.0000228	0.0262
	16.15	0.0632	0 00000713	0.0301
	30.50	0.0193	0.00000121	—
NH_4Cl	5	9.18	0.00968	0.0198
	10	17.76	0.00924	0.0186
	15	25.86	0.00884	0.0171
	20	33.65	0 00850	0.0161
	25	40.25	0.00805	0.0154

Table 1

Electrolyte	Concentration, w.%	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 equiv.$^{-1}$	Temperature coefficient, α
NH_4I	10	7.72	0.01051	0.0201
	20	15.99	0.01017	0.0192
	50	42.00	0.00845	0.0153
NH_4NO_3 (15°C)	5	5.90	0.00926	0.0203
	10	11.17	0.00859	0.0194
	30	28.41	0.00671	0.0168
	50	36.33	0.00474	0.0156
$(NH_4)_2SO_4$ (15°C)	5	5.52	0.00710	0.0215
	10	10.10	0.00631	0.0203
	20	17.79	0.00527	0.0193
	30	22.92	0.00431	0.0191
	31	23.21	0.00420	—
$NiSO_4$	3.73	1.53	0.00306	0.0231
	7.20	2.54	0.00254	0.0227
	13.46	3.85	0.001925	0.0241
	19.01	4.52	0.001507	0.0250
$Pb(NO_3)_2$	5	1.91	0.00604	0.0238
	10	3.22	0 00487	0.0251
	15	4.29	0.00414	0.0251
	20	5.21	0.00358	0.0250
	25	6.00	0.00313	0.0252
	30	6.68	0.00276	0.0257
$SnCl_4$	3.176	10.84	0.02168	—
	6.202	12.17	0.01217	—
	11.865	13.38	0.00669	—
	17.067	14.37	0.00479	—
	21.874	13.08	0.00327	—
$SrCl_2$	5	4.83	0.00733	0.0214
	10	8.86	0.00643	0.0208
	15	12.31	0.00568	—
	22	15.83	0.00465	—
$Sr(NO_3)_2$	5	3.09	0.00628	0.0225
	10	5.27	0.00514	0.0225
	15	6.90	0.00430	0.0227
	20	8.02	0.00359	0.0228
	25	8.66	0.002966	0.0226
	35	8.61	0.001923	0.0241
$ThCl_4$	4.147	3.05	0.00610	—
	7.964	5.40	0.00540	—
	14.770	8.86	0.00443	—
	20.677	10.89	0.00363	—
	27.516	11.92	0.00298	—

(continued)

Electrolyte	Concentration w.%	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 equiv.$^{-1}$	Temperature coefficient α**
$ZnCl_2$ (15°C)	2.5	2.76	0.00736	0.0213
	5	4.83	0.00628	0.0192
	10	7.27	0.00453	0.0165
	20	9.12	0.00261	0.0156
	30	9.26	0.001619	0.0172
	40	8.45	0.001012	0.0198
	60	3.69	0.000240	0.0307
$ZnSO_4$	5	1.91	0.00293	0.0225
	10	3.21	0.002342	0.0223
	15	4.15	0.001913	0.0228
	25	4.80	0.001188	0.0258
	30	4.44	0.000866	0.0273

Examples:

1. Calculate the specific resistance of a 10 w.% $AgNO_3$ solution at 18°C.

$$\rho = \frac{1}{\kappa} = \frac{1}{4.76} = 0.21\ \Omega\text{m}$$

2. Calculate the specific and equivalent conductivity of a 10 w.% $AgNO_3$ solution at 20°C.

$$\kappa_{20^\circ} = \kappa_{18^\circ}\,[1 + \alpha(t - 18)] = 4.76\,[1 + 0.0217\,(20 - 18)] = 4.76\,(1 + 0.0434) = 4.97\ \Omega^{-1}\,\text{m}^{-1}$$

$$\phi = \frac{\Lambda_{18^\circ}}{\kappa_{18^\circ}} = \frac{0.00743}{4.76} = 0.00156\ \text{m}^3\ \text{equiv.}^{-1}$$

$$\Lambda_{20^\circ} = \kappa_{20^\circ}\,\phi = 4.97 \times 0.00156 = 0.00775\ \Omega^{-1}\,\text{m}^2\ \text{equiv.}^{-1}$$

Table 2

Equivalent conductivities of $AgNO_3$, Ag_2SO_4, $AlCl_3$ and $Al_2(SO_4)_3$ solutions

Concentration, N	$AgNO_3$ 18°C	Ag_2SO_4 18°C	$AlCl_3$ 25°C	$Al_2(SO_4)_3$ 25°C
	Λ, Ω^{-1} m^2 equiv.$^{-1}$			
0.0005	0.01139	—	—	—
0.001	0.01132	0.01163	0.01380	0.01072
0.0039	—	—	0.01238	0.00831
0.005	0.01100	0.01084	—	—
0.01	0.01078	0.01029	0.01069	0.00606
0.05	0.00995	—	—	—
0.1	0.00943	—	—	—
0.5	0.00778	—	—	—
1.0	0.00678	—	—	—

Table 3

Equivalent conductivities of $Ba(CH_3COO)_2$, $BaBrO_3$, $BaCl_2$ and $Ba(NO_3)_2$ solutions

Concentration, N	Ba acetate 18°C	$BaBrO_3$ 25°C	$BaCl_2$ 18°C	$Ba(NO_3)_2$ 18°C
	Λ, Ω^{-1} m² equiv.⁻¹			
0.0005	0.00861	—	0.01170	0.01333
0.001	0.00850	0.01136	0.01156	0.01117
0.005	0.00804	—	—	0.01053
0.01	0.00771	0.01027	0.01067	0.01010
0.05	0.00657	—	0.00960	0.00868
0.1	0.00602	—	0.00908	0.00789
0.5	0.00438	—	0.00773	0.00566
1.0	0.00343	—	0.00701	—

Table 4

Equivalent conductivities of $Ca(CH_3COO)_2$, $CaCl_2$, $Ca(NO_3)_2$ and $CaSO_4$ solutions at 18°C

Concentration, N	$Ca(CH_3COO)_2$	$CaCl_2$	$Ca(NO_3)_2$	$CaSO_4$
	Λ, Ω^{-1} m² equiv.⁻¹			
0.0005	0.00807	0.01133	0.01099	0.01093
0.001	0.00796	0.01120	0.01085	0.01043
0.005	0.00750	0.01067	0.01030	0.00863
0.01	0.00719	0.01034	0.00995	0.00774
0.5	0.00603	0.00933	0.00884	—
0.1	0.00540	0.00882	0.00825	—
0.5	0.00363	0.00749	0.00657	—
1.0	0.00263	0.00675	0.00559	—

Table 5

Equivalent conductivities of $CdBr_2$, $CdCl_2$, CdI_2, $Cd(NO_3)_2$ and $CdSO_4$ solutions at 18°C

Concentration, N	$CdBr_2$	$CdCl_2$	CdI_2	$Cd(NO_3)_2$	$CdSO_4$
	Λ, Ω^{-1} m² equiv.⁻¹				
0.001	—	—	—	—	0.00977
0.0039	—	—	—	0.0100	—
0.005	0.00865	0.0091	0.00767	0.0100	0.00797
0.01	0.00763	0.0083	0.00656	0.0096	0.00703
0.05	0.00532	0.0059	0.00401	0.00864	0.00496
0.1	0.00446	0.0050	0.00310	0.00808	0.00422
0.5	0.00253	0.00308	0.00183	0.00639	0.00287
1.0	0.00183	0.00224	0.00154	0.00545	0.00236

Table 6

Equivalent conductivities of $CoCl_2$, CsCl, $CuCl_2$, $Cu(NO_3)_2$ and $CuSO_4$ solutions

Concentration, N	$CoCl_2$ 25°C	CsCl 18°C	$CuCl_2$ 25°C	$Cu(NO_3)_2$ 25°C	$CuSO_4$ 18°C
	Λ, Ω^{-1} m^2. equiv.$^{-1}$				
0.0005	—	0.01314	—	—	0.01035
0.001	—	0.01307	—	0.01295	0.00985
0.0039	0.0118	—	0.01195	0.01192	—
0.005	—	0.01275	—	—	0.00810
0.01	—	0.01252	—	—	0.00717
0.1	—	0.01135	—	—	0.00438

Table 7

Equivalent conductivities of K acetate, KBr, KCNS, KCl and $KClO_3$ solutions at 18°C

Concentration, N	K acetate	KBr	KCNS	KCl	$KClO_3$
	Λ, Ω^{-1} m^2 equiv.$^{-1}$				
0.0005	0.00989	0.01301	0.01194	0.01281	0.01177
0.001	0.00983	0.01294	0.01186	0.01273	0.01169
0.005	0.00957	0.01264	0.01158	0.01244	0.01136
0.01	0.00940	0.01244	0.01139	0.01224	0.01116
0.05	0.00877	0.01178	0.01077	0.01158	0.01037
0.1	0.00838	0.01142	0.01043	0.01120	0.00992
0.5	0.00716	0.01054	0.00957	0.01024	0.00853
1.0	0.00634	—	0.00916	0.00983	—

Table 8

Equivalent conductivities of $KClO_4$, KF, $KHCO_3$, KI and KIO_3 solutions

Concentration, N	$KClO_4$ 25°C	KF 18°C	$KHCO_3$ 25°C	KI 18°C	KIO_3 18°C
	Λ, Ω^{-1} m^2 equiv.$^{-1}$				
0.0005	0.01388	0.01096	0.01161	0.01290	0.00967
0.001	0.01379	0.01089	0.01153	0.01282	0.00960
0.005	0.01342	0.01062	0.01122	0.01253	0.00932
0.01	0.01315	0.01043	0.01101	0.01234	0.00912
0.05	0.01216	0.00977	—	0.01173	0.00841
0,1	0.01152	0.00940	—	0.01140	0.00797
0.5	—	0.00826	—	0.01062	—
1.0	—	0.00760	—	0.01036	—

Table 9

Equivalent conductivities of KNO_3, K_2CO_3, $K_2C_2O_4$, K_2SO_4 and $K_4[Fe(CN)_6]$ solutions

Concentration, N	KNO_3 18°C	K_2CO_3 18°C	$K_2C_2O_4$ 18°C	K_2SO_4 18°C	$K_4[Fe(CN)_6]$ 25°C
	Λ, Ω^{-1} m^2 $equiv.^{-1}$				
0.0005	0.01244	—	0.01238	0.01285	—
0.001	0.01236	0.01330	0.01224	0.01269	0.01672
0.005	0.01205	0.01216	0.01167	0.01203	0.01461
0.01	0.01182	0.01155	0.01125	0.01158	0.01348
0.05	0.01099	0.01007	0.01008	0.01019	0.01077
0.1	0.01048	0.00941	0.00949	0.00949	0.00979
0.5	0.00892	0.00778	0.00804	0.00785	—
1.0	0.00805	0.00707	0.00737	0.00716	—

Table 10

Equivalent conductivities of $LaCl_3$, LiCl, $LiIO_3$, $LiNO_3$ and Li_2SO_4 solutions

Concentration, N	$LaCl_3$ 25°C	LiCl 18°C	$LiIO_3$ 18°C	$LiNO_3$ 18°C	Li_2SO_4 18°C
	Λ, Ω^{-1} m^2 $equiv.^{-1}$				
0.0005	0.01396	0.00972	0.00659	0.00935	0.00979
0.001	0.01370	0.00965	0.00653	0.00929	0.00964
0.005	0.01275	0.00939	0.00629	0.00903	—
0.01	0.01218	0.00921	0.00612	0.00886	0.00869
0.05	0.01062	0.00861	0.00553	0.00827	0.00747
0.1	0.00991	0.00824	0.00515	0.00792	0.00682
0.5	—	0.00707	0.00390	0.00680	0.00505
1.0	—	0.00634	0.00312	0.00608	0.00414

Table 11

Equivalent conductivities of $MgCl_2$, $Mg(NO_3)_2$, $MgSO_4$ and $MnCl_2$ solutions

Concentration, N	$MgCl_2$ 18°C	$Mg(NO_3)_2$ 18°C	$MgSO_4$ 18°C	$MnCl_2$ 25°C
	Λ, Ω^{-1} m^2 $equiv.^{-1}$			
0.0005	0.01077	—	0.01042	—
0.001	0.01064	0.01026	0.00998	—
0.005	0.01013	0.00977	0.00845	—
0.01	0.00981	0.00947	0.00762	—
0.0172	—	—	—	0.0108
0.05	0.00885	0.00853	0.00569	—
0.1	0.00834	0.00805	0.00497	—
0.25	—	—	—	0.00835
0.5	0.00696	—	0.00354	—
1.0	0.00615	—	0.00289	—

Table 12

Equivalent conductivities of NH_4Cl, NH_4NO_3, $(NH_4)_2SO_4$, NaCl and $NaClO_4$ solutions

Concentration, N	NH_4Cl 18°C	NH_4NO_3 18°C	$(NH_4)_2SO_4$ 25°C	NaCl 18°C	$NaClO_4$ 25°C
	Λ, Ω^{-1} m^2 equiv.$^{-1}$				
0.0005	0.01281	—	—	0.01072	0.01156
0.001	0.01273	0.01245	—	0.01065	0.01149
0.004	—	—	0.0138	—	—
0.005	0.01242	—	—	0.01038	0.01117
0.01	0.01221	0.01180	—	0.01020	0.01096
0.02	—	—	0.01272	—	0.01069
0.05	0.01152	—	—	0.00957	0.01024
0.1	0.01107	0.01066	—	0.00920	0.00984
0.25	—	—	0.00957	—	—
0.5	0.01014	—	—	0.00509	—
1.0	0.00970	0.00888	—	0.00473	—

Table 13

Equivalent conductivities of Na acetate, NaF, NaI, $NaIO_3$ and $NaNO_3$ soutions

Concentration, N	Na acetate 18°C	NaF 18°C	NaI 25°C	$NaIO_3$ 18°C	$NaNO_3$ 18°C
	Λ, Ω^{-1} m^2 equiv.$^{-1}$				
0.0005	0.00758	0.00885	0.01254	0.00758	0.01035
0.001	0.00752	0.00878	0.01242	0.00752	0.01029
0.005	0.00724	0.00852	0.01212	0.00726	0.01001
0.01	0.00702	0.00835	0.01192	0.00709	0.00982
0.05	0.00642	0.00770	0.01128	0.00644	0.00914
0.1	0.00611	0.00731	0.01088	0.00605	0.00872
0.5	0.00494	0.00600	—	—	0.00741
1.0	0.00412	0.00519	—	—	0.00659

Table 14

Equivalent conductivities of Na_2CO_3, Na_2HPO_4, Na_2SO_4 and Na_2SiO_3 solutions at 18°C

Concentration, N	Na_2CO_3	Na_2HPO_4	Na_2SO_4	Na_2SiO_3
	Λ, Ω^{-1} m^2 $equiv.^{-1}$			
0.0005	—	—	0.01083	—
0.001	0.0112	0.00584	0.01067	0.0144
0.005	0.01025	—	0.01008	0.0139
0.01	0.00962	0.0054	0.00968	0.0136
0.05	0.00803	—	0.00839	0.0124
0.1	0.00729	0.0044	0.00784	0.0116
0.5	0.00545	—	0.00597	0.0088
1.0	0.00455	0.0028	0.00508	0.0072

Table 15

Equivalent conductivities of $NiSO_4$, $Pb(NO_3)_2$, RbCl, $SrCl_2$ and $Sr(NO_3)_2$ solutions at 18°C

Concentration, N	$NiSO_4$	$Pb(NO_3)_2$	RbCl	$SrCl_2$	$Sr(NO_3)_2$
	Λ, Ω^{-1} m^2 $equiv.^{-1}$				
0.0005	—	0.01180	(0.01312)	0.01160	0.01097
0.001	0.00963	0.01161	0.01303	0.01145	0.01083
0.005	0.00795	0.01086	(0.01274)	0.01089	0.01027
0.01	0.00708	0.01035	0.01253	0.01054	0.00990
0.05	0.00510	0.00863	(0.01178)	0.00944	0.00873
0.1	0.00438	0.00773	0.01139	0.00902	0.00809
0.5	0.00304	0.00532	—	0.00757	0.00627
1.0	0.00251	0.00420	0.01019	0.00685	0.00521

Table 16

Equivalent conductivities of TlCl, TlF, $TlNO_3$, $ZnCl_2$ and $ZnSO_4$ solutions at 18°C

Concentration, N	TlCl	TlF	$TlNO_3$	$ZnCl_2$	$ZnSO_4$
	Λ, Ω^{-1} m^2 $equiv.^{-1}$				
0.0005	0.01292	0.01145	0.01256	0.0108	0.01035
0.001	0.01282	0.01133	0.01247	0.0107	0.00984
0.005	0.01237	0.01082	0.01211	0.0101	0.00821
0.01	0.01202	0.01054	0.01184	0.0098	0.00732
0.05	—	0.00974	0.01079	0.0087	0.00530
0.1	—	0.00926	0.01012	0.0082	0.00456
0.5	—	0.00788	—	0.0065	0.00323
1.0	—	0.00775	—	0.0055	0.00266

Table 17

Equivalent conductivities of some acids in aqueous solution at 18°C

Concentration, N	CH_3CO_2H	HCl	HNO_3	H_2SO_4	H_3PO_4
	Λ, Ω^{-1} m^2 $equiv.^{-1}$				
0.0001	0.0107	—	—	—	—
0.0002	0.0080	—	—	—	—
0.0005	0.0057	—	—	0.0368	—
0.001	0.0041	0.0377	0.0375	0.0361	0.0106
0.002	0.00302	0.0376	0.0374	0.0351	0.0102
0.005	0.00200	0.0373	0.0371	0.0330	0.0093
0.01	0.00143	0.0370	0.0368	0.0308	0.0085
0.02	0.00104	0.0367	0.0364	0.0286	0.0074
0.03	0.000835	0.0364	0.0361	0.0272	0.0067
0.05	0.000648	0.0360	0.0357	0.0253	—
0.1	0.000460	0.0351	0.0350	0.0225	—
0.2	0.000324	0.0342	0.0340	0.0214	—
0.3	0.000265	0.0336	0.0334	0.0210	—
0.5	0.000201	0.0327	0.0324	0.0205	—
1.0	0.000132	0.0301	0.0310	0.0198	0.0022
3.0	0.000054	0.0215	0.0220	0.01668	0.00177
5.0	0.0000285	0.01522	0.0156	0.01350	0.00171
10.0	0.0000049	0.00644	0.00654	0.00700	0.00155

Table 18

Equivalent conductivities of some inorganic bases in aqueous solution at 18°C

Concentration, N	$Ba(OH)_2$	$Ca(OH)_2$	KOH	NH_4OH	NaOH
	Λ, Ω^{-1} m^2 $equiv.^{-1}$				
0.0001	—	—	—	0.0066	—
0.0002	—	—	—	0.0053	—
0.0005	0.0219	—	—	0.0038	—
0.001	—	—	0.0234	0.00280	0.0208
0.002	0.0215	—	0.0233	0.00206	0.0206
0.005	—	0.0233	0.0230	0.00132	0.0203
0.01	0.0207	0.0226	0.0228	0.00096	0.0200
0.02	—	0.0214	0.0225	0.00071	0.0197
0.03	—	—	0.0222	0.00058	0.0194
0.05	0.0191	—	0.0219	0.00046	0.0190
0.1	0.0180	—	0.0213	0.00033	0.0183
0.2	—	—	0.0206	0.000230	0.0178
0.3	—	—	0.0203	0.000183	0.0176
0.5	—	—	0.0197	0.000135	0.0172
1.0	—	—	0.0184	0.000089	0.0160
3.0	—	—	0.01406	0.000036	0.01080
5.0	—	—	0.01058	0.000020	0.00690
10.0	—	—	0.00448	0.000005	0.00202

Table 19

Conductivities of saturated solutions of slightly soluble electrolytes

Electrolyte	t, °C	$\kappa \cdot 10^4$, Ω^{-1} m^{-1}	Electrolyte	t, °C	$\kappa \cdot 10^4$, Ω^{-1} m^{-1}
AgBr	20	0.057	MgC_2O_4	18	199.3
$AgBrO_3$	20	663.24	MgF_2	18	224
AgCN	20	19.0	$Mg(OH)_2$	18	80.0
$Ag_2C_2O_4$	18	25.475	$Mn(OH)_2$	18	9.5
AgCl	18	1.259	$PbBr_2$	20	3692
Ag_2CrO_4	18	18.581	$Pb(BrO_3)_4$	19.94	4630.4
$AgIO_3$	18	11.89	$Pb(CNS)_2$	20	5346
AgOH	20	29.2	PbF_2	18	430.5
Ag_3PO_4	19.5	6.1	PbI_2	20.1	338.4
$BaCO_3$	18	25.475	$Pb(IO_3)_2$	18	5.96
$BaC_2O_4 \cdot 2\,H_2O$	18	78.32	$Pb(OH)_2$	20	25.5
$BaCrO_4$	18	3.197	$PbSO_4$	18	32.6
BaF_2	18	1528.5	SrC_2O_4	18	53.95
$BaSO_4$	18	2.398	SrF_2	18	171.8
$CaCO_3$	18	28.84	$SrSO_4$	18	126.9
$CaC_2O_4 \cdot H_2O$	18	9.586	TlBr	18	192.0
CaF_2	18	39.96	$TlBrO_3$	19.94	1079
$CaSO_4 \cdot 2\,H_2O$	18	1878.1	TlCl	18	1513
$CdC_2O_4 \cdot 3\,H_2O$	18	27.0	TlI	18	22.25
CuI	18	2.128	$TlIO_3$	20	154
$MgCO_3$	17.8	791.2	TlSCN	20	1399

Table 20

Conductivity of very pure water at various temperatures

t, °C	−2	0	2	4	10	18	26	34	50
$\kappa \cdot 10^6$, Ω^{-1} m^{-1}	1.47	1.58	1.80	2.12	2.85	4.41	6.70	9.62	18.9

Table 21

Conductivities of potassium chloride solutions at various temperatures

t, °C	Concentration			
	0.01 N	0.02 N	0.1 N	1.0 N
	κ, Ω^{-1} m^{-1}			
0	0.0776	0.1521	0.715	6.541
1	0.0800	0.1566	0.736	6.713
2	0.0824	0.1612	0.757	6.886
3	0.0848	0.1659	0.779	7.061
4	0.0872	0.1705	0.800	7.237
5	0.0896	0.1752	0.822	7.414
6	0.0921	0.1800	0.844	7.593
7	0.0945	0.1848	0.866	7.773
8	0.0970	0.1896	0.888	7.954
9	0.0995	0.1945	0.911	8.136
10	0.1020	0.1994	0.933	8.319
11	0.1045	0.2043	0.956	8.504
12	0.1070	0.2093	0.979	8.389
13	0.1095	0.2142	1.002	8.876
14	0.1121	0.2193	1.025	9.063
15	0.1147	0.2243	1.048	9.252
16	0.1173	0.2294	1.072	9.441
17	0.1199	0.2345	1.095	9.631
18	0.1225	0.2397	1.119	9.822
19	0.1251	0.2449	1.143	10.014
20	0.1278	0.2501	1.167	10.207
21	0.1305	0.2553	1.191	10.400
22	0.1332	0.2606	1.215	10.554
23	0.1359	0.2659	1.239	10.789
24	0.1386	0.2712	1.264	10.984
25	0.1413	0.2765	1.288	11.180
26	0.1441	0.2819	1.313	11.377
27	0.1468	0.2873	1.337	11.574
28	0.1496	0.2927	1.362	—
29	0.1524	0.2981	1.287	—
30	0.1552	0.3036	1.412	—
31	0.1581	0.3091	1.437	—
32	0.1609	0.3146	1.462	—
33	0.1638	0.3201	1.488	—
34	0.1667	0.3256	1.513	—
35	—	0.3312	1.539	—
36	—	0.3368	1.564	—

Table 22

Conductivities of saturated $CaSO_4$, 30 w.% H_2SO_4, 17.4 w.% $MgSO_4$ and saturated NaCl solutions at various temperatures

t, °C	Saturated $CaSO_4$	30 w.% H_2SO_4	17.4 w.% $MgSO_4$	Saturated NaCl
	κ, Ω^{-1} m^{-1}			
0	—	51.84	2.877	13.45
1	—	53.04	2.979	13.86
2	—	54.25	3.083	14.27
3	—	55.47	3.188	14.69
4	—	56.69	3.294	15.12
5	—	57.92	3.402	15.55
6	—	59.15	3.512	15.99
7	—	60.38	3.623	16.43
8	—	61.61	3.735	16.88
9	—	62.85	3.849	17.34
10	0.1488	64.08	3.963	17.79
11	0.1537	65.32	4.079	18.26
12	0.1586	66.56	4.197	18.72
13	0.1636	67.80	4.315	19.19
14	0.1685	69.04	4.434	19.67
15	0.1734	70.28	4.555	20.15
16	0.1782	71.51	4.676	20.63
17	0.1831	72.75	4.799	21.12
18	0.1880	73.98	4.922	21.61
19	0.1928	75.22	5.046	22.10
20	0.1976	76.45	5.171	22.60
21	0.2024	77.68	5.297	23.10
22	0.2071	78.90	5.424	23.60
23	0.2118	80.13	5.551	24.11
24	0.2164	81.35	5.679	24.62
25	0.2211	82.57	5.808	25.13
26	0.2258	83.78	5.937	25.65
27	0.2304	84.99	6.067	26.16
28	0.2350	86.20	6.197	26.69
29	0.2395	87.40	6.328	27.21
30	0.2441	88.60	6.459	27.74
31	—	89.80	6.591	28.27
32	—	90.99	6.723	28.80
33	—	92.17	6.855	29.33
34	—	93.35	6.988	29.87
35	—	94.53	7.121	30.41
36	—	95.70	7.254	30.95

Table 23

Conductivities of inorganic pure liquids

Substance	t, °C	κ, Ω^{-1} m^{-1}
Ammonia	−33	$<1\times10^{-6}$
	−79	1.3×10^{-5}
Arsenic tribromide	35	1.5×10^{-4}
Arsenic trichloride	25	1.2×10^{-4}
Bromine	17	1×10^{-11}
Carbon disulphide	1	7.8×10^{-16}
Carbon tetrachloride	18	4.0×10^{-16}
Chlorine	−70	$<1\times10^{-14}$
Cyanogen	–	7×10^{-7}
Gallium	30	3.68×10^{6}
Germanium tetrabromide	30	7.8×10^{-3}
Hydrogen bromide	−80	8×10^{-7}
Hydrogen chloride	−96	1×10^{-6}
Hydrogen cyanide	0	3.3×10^{-4}
	18	4.5×10^{-5}
Hydrogen iodide	−35.5	2×10^{-5}
Hydrogen sulphide	−60	1×10^{-9}
Hydroxylamine	34	8.3×10^{-3}
Mercury	0	1.063×10^{6}
Nitric acid	25	1.5
Phosgene	25	7×10^{-7}
Phosphorus oxychloride	25	2.2×10^{-4}
Selenium oxybromide	42−45	6×10^{-3}
Selenium oxychloride	25	2×10^{-3}
Sulphonyl chloride ($SOCl_2$)	25	2×10^{-4}
Sulphur	115	1×10^{-10}
	130	5×10^{-9}
	440	1.2×10^{-5}
Sulphur dioxide	−15	9×10^{-6}
	0	1×10^{-5}
	35	1.5×10^{-6}
Sulphuric acid (of high purity)	25	1
Sulphuryl chloride (SO_2Cl_2)	25	3×10^{-6}
Water (conductivity)	18	4.4×10^{-6}

Table 24

Equivalent conductivities of some salts in liquid SO_2 at 0°C

Compound	ϕ, l · equiv.$^{-1}$								
	8	16	32	64	128	256	512	1024	2048
	Λ, Ω^{-1} m^2 equiv.$^{-1}$								
KBr	—	0.00308	0.00308	0.00344	—	—	—	—	—
KCNS	—	0.00175	0.00188	0.00220	—	—	—	—	—
KI	0.00356	0.00370	0.00413	0.00483	0.00577	0.00704	0.00867	0.01055	0.01260
NaI	—	0.00299	0.00316	0.00357	—	—	—	—	—
NH_4CNS	0.00092	0.00085	0.00088	0.00100	—	—	—	—	—
NH_4I	—	0.00358	0.00387	0.00443	—	—	—	—	—
RbI	—	—	0.00454	0.00530	0.00630	—	—	—	—
$N(CH_3)H_3Cl$	0.00074	0.00081	0.00095	0.00121	0.00159	0.00212	0.00285	0.00381	0.00521
$N(CH_3)_2H_2Cl$	0.00090	0.00097	0.00111	0.00133	0.00164	0.00215	0.00277	0.00370	0.00485
$N(CH_3)_3HCl$	0.00102	0.00106	0.00118	0.00144	0.00183	0.00243	0.00318	0.00421	0.00527
$N(CH_3)_4Cl$	0.00786	0.00812	0.00843	0.00920	0.01035	0.01200	0.01357	0.01512	0.01671
$N(CH_3)_4Br$	0.00799	0.00804	0.00834	0.00945	0.01059	0.01151	0.01339	0.01486	0.01631
$N(CH_3)_4I$	0.00831	0.00857	0.00906	0.00979	0.01115	0.01255	0.01474	0.01573	—
$N(C_2H_5)H_3Cl$	0.00033	0.00040	0.00049	0.00061	0.00078	0.00103	0.00105	0.00114	0.00122
$N(C_2H_5)_2H_2Cl$	0.00109	0.00112	0.00124	0.00150	0.00189	0.00247	0.00314	0.00434	0.00599
$N(C_2H_5)_3HCl$	0.00160	0.00166	0.00185	0.00221	0.00278	0.00363	0.00464	0.00585	0.00715
$N(C_2H_5)_4I$	0.00902	0.00930	0.00980	0.01058	0.01165	0.01279	0.01415	0.01547	—
$N(C_7H_5)H_3Cl$	0.00056	0.00063	0.00079	0.00102	0.00133	0.00175	0.00235	0.00317	0.00404
$S(CH_3)_3I$	0.00736	0.00748	0.00783	0.00860	0.01006	0.01152	0.01322	0.01461	—

Table 25

Equivalent conductivities of some compounds in methanol at 25°C

Compound	ϕ, l · equiv.$^{-1}$						
	10	20	40	80	160	320	∞
	Λ, Ω^{-1} m^2 equiv.$^{-1}$						
Dichloroacetic acid	0.000044	0.000062	0.000086	0.000123	0.000172	—	0.0200
Hydriodic acid	0.01315	0.01438	0.01542	0.01643	0.01725	0.01804	0.02122
Hydrobromic acid	0.01246	0.01368	0.01474	0.0158	0.0167	0.0175	0.02066
Hydrochloric acid	0.01167	0.01301	0.01423	0.01534	0.01634	0.01714	0.02043
Picric acid	0.000932	0.001281	0.001748	0.002385	0.003212	0.004325	0.02011
Salicylic acid	0.000007	0.000010	0.000014	0.000020	—	—	0.01984
Sodium bromide	0.00583	0.00660	0.00730	0.00790	0.00842	0.00889	0.01067
Sodium chloride	—	0.00616	0.00688	0.00752	0.00807	0.00854	0.01041
Sodium iodide	0.00630	0.00726	0.00794	0.00852	0.00904	0.00947	0.01118
Sodium picrate	—	0.00345	0.00626	0.00695	0.00753	0.00804	0.01013
Sodium salicylate	—	0.00514	0.00593	0.00667	0.00727	0.00778	0.00984
Sodium trichloroacetate	—	0.0531	0.00603	0.00669	0.00726	0.00814	0.00962
Sodium trichlorobutyrate	0.00428	0.00509	0.00583	0.00645	0.00703	0.00754	0.00951
Trichloroacetic acid	0.000241	0.000333	0.000466	0.000648	0.000904	0.00126	0.01962
Trichlorobutyric acid	0.000063	0.000088	0.000124	0.000175	—	—	0.0193

Table 26

Equivalent conductivities of some compounds in ethanol at 25°C

Compound	ϕ, l · equiv.$^{-1}$						
	10	20	40	80	160	320	∞
	Λ, Ω^{-1} m^2 equiv.$^{-1}$						
Ammonium chloride	—	0.001873	0.002216	0.002590	0.002965	0.003318	0.00477
Lithium chloride	0.00145	0.00177	0.00210	0.00243	0.00272	0.00298	0.00394
Salicylic acid	0.0000013	0.0000020	—	—	—	—	0.00860
Sodium benzoate	—	0.000944	0.001220	0.001552	0.001928	0.002342	0.00439
Sodium dichloroacetate	0.000985	0.001264	0.001586	0.001953	0.002354	0.002752	0.00520
Sodium formate	—	—	0.001568	0.001948	0.002344	0.002760	0.00490
Sodium salicylate	0.000957	0.001221	0.001527	0.001878	0.002267	0.002658	0.00445
Sodium trichloroacetate	0.001107	0.001395	0.001730	0.002098	0.002503	0.002894	0.00460
Sodium trichlorobutyrate	—	—	0.001514	0.001873	0.002263	0.002627	0.00450
Trichloroacetic acid	0.0000347	0.0000479	0.0000664	—	—	—	0.00880

Table 27

Equivalent conductivities of some inorganic electrolytes in acetone at 25°C

Dissolved salt	ϕ, l · equiv.$^{-1}$							
	32	64	128	256	512	1024	2048	∞
	Λ, Ω^{-1} m^2 equiv.$^{-1}$							
KI	—	—	0.00673	0.00855	0.01041	0.01208	0.01360	0.01325
LiCl	—	—	0.01155	0.01305	0.01415	0.01496	0.01536	0.0153
NaI	—	—	—	0.01263	0.01335	0.01399	0.01385	0.01399
NH_4I	0.00061	0.00088	0.00121	0.00171	0.00232	0.00334	—	0.00773

Table 28

Conductivities of pure solids and molten inorganic salts at various temperatures

Compound	m.p. °C	t, °C	κ, Ω^{-1} m^{-1}
AgBr	434	200	0.052
		350	8
		425	276
		450	293
		500	302
		550	310
		600	318
		700	334
		800	360
AgCl	455	250	0.03
		450	11
		456	376
		550	405
		600	446
		640	449
		650	452
		660	458
		680	462
		700	465
		720	469
		740	472
		760	475
		780	478
		800	481
		900	514
$AgClO_3$	230	250	47
AgF	435	500	410
		550	480
		600	530
		650	590
AgI	552	150	133
		300	197
		450	241
		500	252
		550	246
		600	243
		800	230
$AgNO_3$	212	230	74
		250	83
		260	88
		300	105
		330	117
		350	125
$AlBr_3$	97.5	201	1.0×10^{-4}
		243	1.8×10^{-4}
		270	2.6×10^{-4}
$AlCl_3$	194	189	4×10^{-4}
		200	5.6×10^{-5}
		227	8.6×10^{-5}
		245	1.1×10^{-4}
AlI_3	191	209	2.6×10^{-4}
		246	5.2×10^{-4}
		270	7.4×10^{-4}
$BaBr_2$	850	900	131
		950	144
		1000	158
		1050	170
$BaCl_2$	962	900	171
		950	189
		1000	205
		1050	219
		1100	231
BaI_2	740	720	70
		750	78
		800	91
		900	131
		1000	136
$BeCl_2$	440	450	0.32
		460	0.57
		470	0.83
$BiCl_3$	230	266	44
		315	51
		350	56
		400	58
BiI_3	439	500	31
		600	30
		700	28
$CaBr_2$	760	800	157
		900	188
		1000	219
$CaCl_2$	772	800	200
		850	220

Table 28

Compound	m.p. °C	t, °C	κ, Ω^{-1} m^{-1}
$CaCl_2$	772	900	235
		950	250
		970	260
		1000	266
		1050	276
CaI_2	784	800	117
		900	139
		1000	157
$CdBr_2$	580	571	106
		597	112
		617	115
		700	133
$CdCl_2$	568	576	193
		668	212
		775	230
		801	237
CdI_2	388	388	19
		419	25
		443	30
		466	35
		500	42
		600	64
$CeCl_3$	848	850	96
		950	117
CeI_3	761	800	45
		850	50
CsBr	636	650	84
		750	108
		850	132
CsCl	646	660	114
		711	126
		775	139
		831	148
CsF	703	750	351
		800	374
		850	393
		900	408
CsI	626	650	69
		750	90
		850	109
$CsNO_3$	414	447	60
		494	66
		556	74
CuBr	504	500	252
γ-CuBr		137	0.33×10^{-3}
		358	7.5
β-CuBr		400	148
		450	200
α-CuBr		480	354
CuBr melt		550	267
CuCl	422	45	0.53×10^{-5}
		213	0.15×10^{-1}
		366	6.15
		404	23.7
		450	330
		550	360
$CuCl_2$	498	440	20.8
		460	22.5
		480	34.1
		490	39.4
$HgBr_2$	237	128	7.6×10^{-5}
		132	1.5×10^{-3}
Hg_2Cl_2	302	529	100
		544	103
$HgCl_2$	277	294	8.2×10^{-3}
		311	1×10^{-2}
HgI_2	259	92	1×10^{-6}
		167	1×10^{-5}
		260	0.85
		320	0.66
$InBr_3$	436	445	17
		460	17
		480	17
		533	16
		540	16
InCl	225	242	97
		272	114
		310	138
		351	166
$InCl_2$	235	356	47
		383	53

(continued)

Compound	m.p. °C	t, °C	κ, Ω^{-1} m^{-1}
$InCl_2$	235	392	54
		466	67
		474	69
		496	71
		507	72
$InCl_3$	586	594	42
		625	39
		633	38
		673	35
		694	33
InI_3	200	221	5.4
		250	6.6
		251	6.6
		303	8.1
		319	8.5
		372	9.6
KBr	730	750	165
		760	166
		800	175
		810	177
		850	185
		860	186
		900	195
		950	205
KCl	790	440	4.4×10^{-5}
		540	1.91×10^{-4}
		640	1.01×10^{-3}
		740	9.8×10^{-3}
		800	219
		850	236
		900	250
		1000	265
KF	880	863	295
		881	311
		903	329
		916	342
		972	392
$KHSO_4$	200	300	14.1
KI	723	692	123
		743	132
		780	138
		813	148
KNO_3	333	340	63.4
		350	66.6
		380	76.0
		400	82.0
		410	85.0
		420	88.2
		450	97.0
		500	10.7
KOH	360	400	252
		450	281
		500	310
		550	340
		600	369
K_2CO_3	891	900	194
		950	212
		1000	226
$K_2Cr_2O_7$	398	400	21
		450	28
		500	39
K_2SO_4	1069	1100	184
		1150	194
K_3AlF_6	1010	1020	225
		1040	233
		1060	241
$LaBr_3$	~780	800	83
		900	125
$LaCl_3$	907	872	114
		895	123
		1005	155
LaI_3	~761	800	46
		850	53
LiBr	547	600	497
		650	523
		700	548
		750	573
LiCl	614	620	587
		681	614
		746	640
		786	653
		801	659

Compound	m.p. °C	t, °C	κ, Ω^{-1} m^{-1}
LiF	870	900	884
		950	904
		1000	920
LiI	446	500	354
		550	390
		600	401
		650	408
$LiNO_3$	261	250	79
		300	107
		320	118
		350	132
		400	160
		440	180
Li_3AlF_6	800	800	345
		850	360
		900	380
$MgBr_2$	700	750	77
		850	95
		950	114
$MgCl_2$	712	730	105
		750	109
		774	113
		800	118
		900	139
		1000	158
MgI_2	650	700	50
		800	67
		900	86
$MnCl_2$	650	850	144
		950	171
MnF_2	856	950	490
		1000	510
$MoCl_5$	194	216	1.8×10^{-4}
		234	4.1×10^{-4}
		258	7.5×10^{-4}
NaBr	755	420	0.6×10^{-4}
		500	3.1×10^{-4}
		540	7.4×10^{-4}
		600	3.15×10^{-3}
		640	6.91×10^{-3}
		700	1.74×10^{-2}
NaBr(cont.)	755	740	2.76×10^{-2}
		800	306
		850	323
		900	330
NaCl	801	590	8.7×10^{-4}
		650	3.05×10^{-3}
		700	8.72×10^{-3}
		750	2.46×10^{-2}
		790	5.7×10^{-2}
		850	375
		900	391
		950	406
		1000	416
		1100	440
NaF	992	988	305
		1000	315
		1010	324
		1020	332
		1030	340
		1040	348
		1050	358
		1100	397
NaI	651	700	256
		750	263
		800	270
		850	276
		900	283
		950	290
$NaNO_2$	271	300	134
		350	161
		400	189
		450	226
$NaNO_3$	308	240	7.6×10^{-5}
		260	1.65×10^{-4}
		275	3.2×10^{-4}
		290	5.8×10^{-4}
		305	1.15×10^{-3}
		320	102.5
		350	117.3
		380	130.5
		400	138.4
		420	145.8
		440	152.8
		480	165.8
		500	171.6

(continued)

Compound	m.p. °C	t, °C	κ, Ω^{-1} m^{-1}
NaOH	319	320	212
		350	238
		400	282
		450	327
NH_4HSO_4	147	190	14.2
$NaHSO_4$	~310	310	25.6
$NaPO_3$	627	600	30
		700	55
		800	80
		900	105
		1000	130
		1100	154
Na_2CO_3	851	850	292
		900	310
Na_2MoO_4	687	843	141
		925	157
		1026	178
		1123	194
		1217	209
		1306	223
		1408	240
Na_2SO_4	884	900	223
		950	237
		1000	250
		1050	264
		1100	277
Na_2WO_4	692	753	109
		958	152
		1066	172
		1362	225
		1501	245
Na_3AlF_6 (natural cryolite)	1000	1000	216
		1050	242
		1100	270
$NbCl_5$	194	194	2×10^{-5}
$NdCl_3$	784	775	69
		827	84
		873	97
		900	104
$PbBr_2$	373	400	58

Compound	m.p. °C	t, °C	κ, Ω^{-1} m^{-1}
$PbBr_2$(cont.)	373	450	84
		500	103
$PbCl_2$	501	94	2.5×10^{-4}
		123	6.35×10^{-4}
		140	1.14×10^{-3}
		151	1.57×10^{-3}
		169	2.54×10^{-3}
		193	4.57×10^{-3}
		217	8.83×10^{-3}
		232	1.25×10^{-2}
		249	1.72×10^{-2}
		263	2.34×10^{-2}
		273	2.86×10^{-2}
		289	4.23×10^{-2}
		323	6.57×10^{-2}
		347	9.32×10^{-2}
		363	1.11×10^{-1}
		390	1.61×10^{-1}
		403	1.93×10^{-1}
		424	2.52×10^{-1}
		438	2.91×10^{-1}
		453	3.62×10^{-1}
		466	4.34×10^{-1}
		479	6.1×10^{-1}
		483	9.2×10^{-1}
		500	169
		600	192
PbI_2	402	155	1.82×10^{-6}
		209	6.92×10^{-6}
		280	3.63×10^{-5}
		307	1×10^{-4}
		350	3.3×10^{-4}
		370	1.1×10^{-3}
		450	49
		500	60
$PrCl_3$	823	824	90
		902	120
		965	140
RbBr	682	700	113
		800	137
		900	151
RbCl	715	733	149
		780	162
		873	181
		915	187

Table 28 (continued)

Compound	m.p. °C	t, °C	κ, Ω^{-1} m^{-1}
RbI	642	700	96
		750	104
		800	112
		850	119
$RbNO_3$	310	319	44
		380	58
		450	71
		490	80
$SbCl_3$	73.4	100	7.35×10^{-2}
		120	8.09×10^{-2}
		140	8.78×10^{-2}
		160	9.51×10^{-2}
		180	10.26×10^{-2}
		200	10.73×10^{-2}
		210	11.28×10^{-2}
$ScCl_3$	939	960	56
		1000	66
$SnCl_2$	247	263	89
		300	112
		320	120
		350	141
		410	172
$SrBr_2$	643	700	98
		800	130
		900	160
$SrCl_2$	869	900	198
		1000	229
		1050	243
		1100	256
SrI_2	402	600	64
		700	87
		800	110
		900	132
$TaCl_5$	221	221	3×10^{-5}
$TeCl_2$	~210	200	4.2
		250	8.9
		290	13.4
$TeCl_4$	224	250	13
		290	18
		320	21

Compound	m.p. °C	t, °C	κ, Ω^{-1} m^{-1}
$ThCl_4$	820	843	74
		890	84
		950	90
TlBr	460	250	0.4×10^{-2}
		447	0.47
		460	81
		550	102
		600	113
TlCl	430	250	0.5×10^{-2}
		421	0.61
		431	109
		500	133
		600	170
TlI	440	250	0.01
		429	0.48
		439	53
		550	75
		600	84
UCl_4	590	570	34
		598	42
		620	48
UO_2Cl_2	~580	600	5.1
		650	7.0
WCl_5	248	250	0.67×10^{-4}
		270	1.22×10^{-4}
		290	1.7×10^{-4}
		300	1.8×10^{-4}
WCl_6	275	280	1.9×10^{-4}
		300	2.6×10^{-4}
		380	4.1×10^{-4}
		430	6.9×10^{-4}
YCl_3	680	720	41
		800	54
		875	73
$ZnBr_2$	394	400	1.8
		500	8.5
		600	21.9
$ZnCl_2$	283	319	0.03
		340	0.28
		460	5.1
		650	31
		700	45

Table 29

Equivalent conductivities of molten inorganic salts at their melting points

Electrolyte	m.p., °C	Λ, Ω^{-1} m^2 equiv.$^{-1}$	Electrolyte	m.p., °C	Λ, Ω^{-1} m^2 equiv.$^{-1}$
AgBr	434	0.01042	LiBr	547	0.01770
AgCl	455	0.01242	LiCl	614	0.01830
AgI	552	0.00858	LiF	870	0.02430
$AlCl_3$	194	1.5×10^{-9}	$MgCl_2$	712	0.00288
$BaCl_2$	962	0.00770	NaBr	755	0.01320
$BeCl_2$	440	8.6×10^{-6}	NaCl	800	0.01335
$CaCl_2$	772	0.00640	NaF	992	0.00668
$CdBr_2$	567	0.00412	NaI	651	0.01360
$CdCl_2$	568	0.00585	$PbBr_2$	373	0.00270
CdI_2	388	0.000635	$PbCl_2$	501	0.00530
CsCl	646	0.00667	RbCl	715	0.00940
CuCl	422	0.00940	$ScCl_3$	939	0.0015
$InBr_2$	436	0.00064	$SrCl_2$	873	0.00557
$InCl_2$	586	0.00147	$ThCl_4$	820	0.0016
InI_2	216	0.00023	TlBr	460	0.00317
KBr	730	0.01240	TlCl	430	0.00466
KCl	790	0.01035	TlI	440	0.00248
KF	880	0.0130	YCl_3	680	0.00095
KI	723	0.01040			

Table 30

Conductivity of the system KI–AlI_3 at 200°C

KI, mol%	κ, Ω^{-1} m^{-1}
0	0.000234
0.83	0.0220
1.58	0.05516
3.11	0.2024
3.68	0.2677
5.12	0.4592
7.78	0.8421
14.78	2.223
21.38	3.907
23.91	4.303
25.47	4.767
27.01	5.161
31.88	6.546
37.03	7.945
41.33	9.847
44.17	11.160
46.50	12.110

Table 31

Conductivity of the system HgI_2–AlI_3 at 200°C

HgI_2, mol%	κ, Ω^{-1} m^{-1}
0	0.000234
0.66	0.000558
2.63	0.003133
5.34	0.02298
7.27	0.06592
12.90	0.4004
16.12	0.7299
22.32	1.485
28.37	2.366
30.69	2.731
31.35	2.812
34.69	3.351
37.74	3.988
47.64	6.346
48.77	6.606
53.70	8.452
66.25	14.900
75.20	29.900

Table 32

Conductivity of the system CdI_2–AlI_3 at 200°C

CdI_2, mol%	κ, Ω^{-1} m^{-1}
0	0.000234
2.48	0.00336
3.39	0.00715
4.41	0.02048
7.01	0.09880
9.35	0.1646
10.49	0.2736
16.34	0.6141
17.71	0.6786
20.97	0.8119
27.72	0.8854
25.05	0.9435
27.24	0.9994

Table 33

Conductivity of the system SbI_3–AlI_3 at 200°C

SbI_3, mol %	κ, Ω^{-1} m^{-1}
0	0.000234
2.35	0.00295
2.99	0.09987
11.27	0.2212
12.01	0.2477
14.86	0.4094
19.45	0.6604
22.66	0.8287
24.94	0.9340
27.55	1.027
41.83	1.837
47.34	2.047
55.71	2.427
59.50	2.483
72.81	2.631
92.95	0.7524
100	0.021

Table 34

Conductivity of the system $AlBr_3$–$SbBr_3$ at 99.5°C

$SbBr_3$, mol %	κ, Ω^{-1} m^{-1}
1.09	0.000006
3.60	0.000531
5.68	0.008543
6.37	0.01377
7.31	0.02674
8.75	0.04835
9.85	0.07148
14.15	0.1647
19.33	0.2884
22.31	0.3601
25.58	0.4267
29.91	0.5348
35.10	0.6331
40.00	0.7303
45.59	0.8248
47.98	0.8607
49.52	0.8982
55.28	0.9894
60.19	1.1646
65.29	1.3212
71.70	1.4617
76.17	1.6582
81.06	1.7808
86.47	1.7250
88.56	1.5832
92.86	1.1741
97.58	0.4724
99.02	0.2086

Table 35

Conductivity of the system $BaCl_2$–$NaCl$ at various temperatures

$BaCl_2$, mol %	900°C	1000°C	1100°C
	κ, Ω^{-1} m^{-1}		
0	377.5	401	424.5
13	311	334	352.0
23.95	275	302	322.5
35.4	259	284.5	305.0
48.0	234	265.5	293.5
67.5	221	255	282.5
83.5	194	226.5	254.5
100		204.5	234.5

Table 36

Conductivity of the system CuI–AlI_3 at 200°C

CuI, mol %	κ, Ω^{-1} m^{-1}
0	0.000234
1.80	0.0127
3.22	0.06657
6.83	0.2004
12.03	0.2707
14.57	0.4779
26.03	0.5567

Table 37

Conductivity of the system KNO_3–$NaNO_3$ at various temperatures

KNO_3, mol%	350°C	400°C	450°C
	κ, $\Omega^{-1}\,m^{-1}$		
0	117.3	138.4	156.2
20	103.17	122.7	138.9
50	86.8	104.5	120.5
80	73.6	90.53	105.9
100	67.1	82.4	97.1

Table 38

Conductivity of the system $AgNO_3$–$TlNO_3$ at 250°C

$AgNO_3$, mol%	κ, $\Omega^{-1}\,m^{-1}$
0	43.6
15	46.5
34.41	51.2
61.02	58.0
82.4	69.5
100	81.2

Table 39

Conductivity of the system $Na_2B_4O_7$–NaCl at various temperatures

NaCl, mol%	750°C	800°C	850°C
	κ, $\Omega^{-1}\,m^{-1}$		
0	18	26	36
2.3	21	31	42
8.2	33	43	57
15.8		64	83
22.0		83	106

Table 40

Conductivity of the system KCl–NaCl at 850°C

NaCl, mol%	κ, $\Omega^{-1}\,m^{-1}$
0	242
7.9	244.1
29.82	255.9
56.05	286.2
70.07	302.2
79.68	315.9
91.98	344.8
100	357.5

Table 41

Conductivity of the system NaCl–$CaCl_2$ at various temperatures

NaCl, mol%	850°C κ, $\Omega^{-1}\,m^{-1}$	NaCl, mol%	950°C κ, $\Omega^{-1}\,m^{-1}$
0	222	0	258
10.0	219	17.6	237.5
32.16	230.7	55.45	257.6
50.0	240.4	65.44	282
65.44	263.5	85.07	323
73.95	283	100	389
85.07	301.6		
100	357.5		

Table 42

Conductivity of the system NaCl–$CaCl_2$ at various temperatures

$CaCl_2$, mol%	800°C	900°C	1000°C
	κ, $\Omega^{-1}\,m^{-1}$		
0	357	379	400
12.5	308	335	357
25	265	297	323
30.9	251	285.5	315
45	228	260.5	289
62	209	245	274.5
75.7	195	230.5	262.5
88.75	198	234	267
100	202	233	265

Table 43

Conductivity of the system $AgI-AlI_3$ at 200°C

AgI, mol%	κ, Ω^{-1} m^{-1}
2.14	0.03572
6.13	0.2286
10.95	0.6513
17.26	1.454
22.04	1.906
27.31	2.749
28.51	2.825
28.78	2.870

Table 44

Conductivity of the system AgBr–AgCl at 500°C

AgCl, mol%	κ, Ω^{-1} m^{-1}
0	292.4
30	313.0
50	324.6
70	340.9
100	365.3

Table 45

Conductivity of the system AlB_3–KBr at 99.5°C

KBr, mol%	κ, Ω^{-1} m^{-1}
11.02	1.633
12.65	1.853
15.44	2.195
16.84	2.362
18.46	2.546

Table 46

Conductivity of the system AgCl–AgI at various temperatures

AgCl, mol%	200°C	300°C	400°C	450°C	500°C	550°C	600°C
	κ, Ω^{-1} m^{-1}						
10	156	196	228	242	235	242	248
25	144	211	225	234	241	247	252
42	78	225	256	268	275	281	285
90	0.4	5	115	338	354	370	383

Table 47

Conductivity of the system AgBr–AgI at various temperatures

AgBr, mol%	200°C	300°C	400°C	500°C	600°C
	κ, Ω^{-1} m^{-1}				
5	150	187	216	242	246
10	150	188	220	—	242
20	156	194	225	236	245
30	162	200	233	239	247
40	67	204	240	244	—
60	28	160	238	257	270
70	8.3	68	243	260	272
80	1	22	242	261	274
90	0.2	6	220	277	290

Table 48

Conductivity of the system $AgNO_3$–AgI at various temperatures

$AgNO_3$, mol %	150°C	200°C	250°C	300°C
	κ, Ω^{-1} m^{-1}			
32.39	—	—	122.3	141.5
42.72	61.0	86.1	108.5	129.2
52.77	52.1	76.6	98.5	120.9
57.15	48.2	71.7	93.4	116.1
65.53	40.6	63.7	89.3	108.6
72.27	38.0	61.2	83.4	107.6
77.04	36.8	60.3	82.9	104.8
81.65	33.9	57.3	81.1	102.7
90.96	—	57.4	81.5	103.0
100	—	—	83.0	105.0

Table 49

Conductivity of the system KCl–$CaCl_2$ at various temperatures

KCl, mol %	800°C	900°C
	κ, Ω^{-1} m^{-1}	
0	200.6	240.5
14.18	177.2	209.0
27.10	162.0	189.3
33.15	155.4	183.5
44.47	147.7	169.9
50.35	147.8	170.2
59.78	149.2	176.6
77.61	170.8	197.5
85.65	195.1	219.5
100	230.1	252.2

Table 50

Conductivity of the system KCl–$CdCl_2$ at various temperatures

$CdCl_2$, mol %	800°C	900°C
	κ, Ω^{-1} m^{-1}	
0	230.1	252.2
4.31	216.3	231.5
9.21	204.1	216.0
14.81	191.1	206.1
17.95	185.2	200.0
28.9	173.5	188.2
33.3	178.5	180.0
37.8	166.2	177.6
43	170.3	180.0
48.7	177.1	186.8
55.0	184.1	194.0
62 0	192.9	209.0
78.5	211	215.1
100	225	240.1

Table 51

Conductivity of the system KCl–$MgCl_2$ at various temperatures

$MgCl_2$, mol %	500°C	600°C	700°C	800°C
	κ, Ω^{-1} m^{-1}			
0	—	—	—	224
7.93	—	—	—	197
16.59	—	—	155	180
26.38	—	109	134	155
34.98	75	101	123	142
44.41	—	101	123	141
51.31	—	100	121	138
61.98	—	99	121	149
92.43	—	—	110	131
100	—	—	—	118

Table 52

Conductivity of the system LiCl–KCl at various temperatures

LiCl, mol %	700°C	750°C	800°C
	κ, Ω^{-1} m^{-1}		
0	—	—	217
10	—	217	229
20	217	233	249
30	234	250	266
50	271	291	308
60	288	310	333
70	352	372	391
75	368	389	411
80	392	412	432
90	475	499	522
100	602	626	650

Table 53

Conductivity of the system KF–NaF at various temperatures

KF, w. %	900°C	950°C	1000°C	1050°C
	κ, Ω^{-1} m^{-1}			
0	—	401	—	463
20	—	388	357	435
40	313	374	343	420
60	301	361	327	401
80	283	347	313	380
100	271	355	301	—

Table 54

Conductivity of the system NaF–AlF_3 at various temperatures

AlF_3, mol%	750°C	800°C	900°C	950°C	1000°C	1025°C	1050°C
	κ, Ω^{-1} m^{-1}						
0	—	—	—	—	401	435	463
10	—	—	—	302	359	337	417
20	—	—	—	—	329	358	373
25	—	—	—	—	323	337	359
30	—	—	—	—	305	319	331
35	—	—	—	267	303	305	319
40	174	188	230	255	271	279	288
46.6	147	168	207	230	250	259	273

Table 55

Conductivity of the system K_3AlF_6–Na_3AlF_6 at various temperatures

Na_3AlF_6 w.%	950°C	1000°C	1025°C	1050°C
	κ, Ω^{-1} m^{-1}			
0	—	185	201	227
20	—	202	221	244
40	—	221	242	267
60	215	254	279	295
80	—	287	306	334
100	—	323	337	359

Table 56

Conductivity of the system Al_2O_3–Na_3AlF_6 at various temperatures

Al_2O_3, w.%	900°C	920°C	940°C	960°C	980°C	1000°C	1020°C	1040°C
	κ, Ω^{-1} m^{-1}							
0	—	—	—	—	216	223	230	237
5	—	—	—	199	205	212	219	226
10	—	—	183	189	196	202	208	215
15	—	167	173	179	185	191	197	202
20	152	157	163	169	175	180	186	191

Table 57

Conductivity of the system $Na_2B_4O_7$–NaF at various temperatures

NaF, w. %	750°C	800°C	850°C
	κ, Ω^{-1} m^{-1}		
0	18	26	36
19	20	28	38
73	29	39	52
136	—	55	72
257	—	92	118

Table 58

Conductivity of the system $PbBr_2$–$PbCl_2$ at 500°C

$PbCl_2$, mol %	κ, Ω^{-1} m^{-1}
0	103
10	105.9
25	110.8
50	120.1
75	131
90	140
100	147.2

Table 59

Conductivity of the system Na_2O–WO_3 at various temperatures

$Na_2O : WO_3$ molar ratio	750°C	800°C	850°C	900°C
	κ, Ω^{-1} m^{-1}			
1 : 1	109.1	119.2	129.4	140.0
1 : 2	106.6	117.6	127.8	137.8
1 : 2.4	105.9	115.5	126.6	135
1 : 2.6	102.4	111.7	—	133.6
1 : 4.5	92.8	109.1	120.8	132.6
1 : 6	—	107.7	119.9	132.4

Table 60

Specific and equivalent conductivities of aqueous solutions of organic compounds at 18°C

Compound	Concentration, w. %	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 $equiv.^{-1}$	Temperature coefficient, α*
Acetic acid	0.3	0.0318	0.000636	—
	1	0.0584	0.000350	—
	5	0.1225	0.0001464	0.0163
	10	0.1526	0.0000904	0.0169
	15	0.1619	0.0000636	0.0174
	20	0.1605	0.0000470	0.0179
	30	0.1401	0.00002698	0.0186
	40	0.1081	0.00001546	0.0196

* For application see the example on page 49

Compound	Concentration, w. %	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 equiv.$^{-1}$	Temperature coefficient, α
Acetic acid	50	0.0740	0.00000838	0.0194
	60	0.0456	0.00000428	0.0206
	70	0.0235	0.00000189	—
	75	0.0146	0.00000109	0.0210
	99.7	0.000004	2.3×10^{-10}	—
Butyric acid	1.00	0.0455	0.000399	—
	5.02	0.0863	0.000151	—
	10.07	0.0986	0.0000857	—
	15.03	0.0955	0.0000555	—
	20.01	0.0888	0.0000388	—
	30.04	0.0694	0.0000202	—
	50.04	0.0296	0.00000519	—
	70.01	0.0056	0.00000071	—
	89.97	0.00015	0.000000015	—
Chloroacetic acid (25°C)	1.017	0.4651	0.004290	—
	5.148	1.066	0.001915	—
	10.23	1.410	0.001251	—
	16.26	1.647	0.000900	—
	19.7	1.684	0.000758	—
	21.09	1.679	0.000695	—
	35.03	1.420	0.000337	—
	52.68	0.795	0.000118	—
	64.48	0.402	0.0000464	—
	73.84	0.181	0.0000177	—
	85.94	0.0406	0.0000033	—
Dichloroacetic acid (25°C)	1.299	2.109	0.02075	—
	5.381	5.373	0.01253	—
	10.38	7.512	0.008885	—
	16.01	8.751	0.006558	—
	23.33	8.943	0.004456	—
	38.22	7.390	0.002104	—
	55.77	3.910	0.0007051	—
	70.22	1.331	0.0001783	—
	86.42	0.1094	0.0001103	—
	95.15	0.0047	0.000000414	—
	97.07	0.00096	0.000000082	—
Formic acid	4.94	0.550	0.000503	—
	9.55	0.756	0.000355	—
	20.34	0.984	0.000212	—
	29.83	1.038	0.0001491	—
	39.95	0.984	0.0001033	—
	50.02	0.864	0.0000709	—

Compound	Concentration w.%	κ, Ω^{-1} m^{-1}	Λ, Ω^{-1} m^2 equiv.$^{-1}$	Temperature coefficient, α
Formic acid	70.06	0.523	0.0000294	—
	89.02	0.187	0.00000803	—
Oxalic acid	3.5	5.08	64.3	0.0141
	7.0	7.83	48.8	0.0143
Propionic acid	1.00	0.0479	0.0003549	—
	5.01	0.0925	0.0001364	—
	10.08	0.1113	0.0000809	—
	15.05	0.1099	0.0000533	—
Potassium acetate	4.67	3.47	0.00714	0.0223
	9.33	6.25	0.00628	0.0219
	28	12.56	0.00383	0.0231
	37.33	12.62	0.00276	0.0250
	46.67	11.22	0.001875	0.0275
	65.33	4.79	0.00525	0.0409
Potassium oxalate	5	4.88	0.00783	—
	10	9.15	0.00708	—
Sodium acetate	5	2.95	0.00473	0.0251
	10	4.81	0.00375	0.0259
	20	6.51	0.002420	0.0293
	30	6.00	0.001416	0.0350
	32	5.69	0.001247	0.0371
Tartaric acid (15°C)	5	0.599	0.000880	0.0185
	10	0.813	0.000584	0.0189
	20	0.995	0.000341	0.0186
	25	1.00	0.0002677	—
	30	0.964	0.0002099	0.0199
	40	0.785	0.0001221	0.0222
	50	0.532	0.0000630	0.0264
Trichloroacetic acid (25°C)	1.922	3.751	0.03152	—
	5.64	10.35	0.02906	—
	10.05	16.50	0.02546	—
	20.32	24.50	0.01775	—
	26.87	24.97	0.01323	—
	27.80	25.00	0.01274	—
	31.99	24.90	0.01081	—
	35.96	24.45	0.00926	—
	52.22	16.09	0.003873	—
	66.45	7.34	0.001304	—
	81.91	1.04	0.000136	—
	90.18	0.082	0.00000939	—
	94.34	0.006	0.000000641	—

Table 61

Molar conductivities of aqueous solutions of organic bases at 25°C

Compound	ϕ, l · mol^{-1}					
	8	16	32	64	128	256
	Molar conductivity, Ω^{-1} m^{-2} mol^{-1}					
Allylamine	0.00047	0.00067	0.00095	0.00132	0.00182	0.00251
Benzylamine	0.00029	0.00041	0.00059	0.00083	0.00117	0.00164
Dimethylamine	0.00204	0.00288	0.00397	0.00538	0.00718	0.00927
Dipropylamine	0.00178	0.00254	0.00354	0.00478	0.00642	0.00830
Ethylamine	0.00148	0.00210	0.00289	0.00392	0.00529	0.00702
Ethylenediamine	—	0.00082	0.00115	0.00160	0.00221	0.00301
Guanidine	—	0.01900	—	0.02120	—	0.02230
Isoamylamine	0.00131	0.00187	0.00260	0.00355	0.00477	0.00632
Isobutylamine	0.00105	0.00151	0.00210	0.00289	0.00391	0.00520
Isodibutylamine	—	—	—	0.00339	0.00454	0.00597
Methylamine	0.00151	0.00210	0.00289	0.00393	0.00530	0.00700
Methyldiethylamine	0.00094	0.00137	0.00192	0.00266	0.00366	0.00494
Piperazine	—	—	0.00098	0.00134	0.00185	0.00256
Piperidine	0.00230	0.00323	0.00442	0.00592	0.00778	0.00997
Propylamine	0.00132	0.00187	0.00256	0.00354	0.00478	0.00638
Triethylamine	0.00142	0.00205	0.00290	0.00395	0.00535	0.00710
Trimethylamine	0.00053	0.00077	0.00109	0.00154	0.00214	0.00294
Tripropylamine	—	—	—	—	0.00608	0.00755

Table 62

Conductivities of pure organic liquid compounds

Compound	Formula	t, °C	κ, Ω^{-1} m^{-1}
Acetaldehyde	C_2H_4O	0	1.2×10^{-4}
		15	1.7×10^{-4}
Acetamide	CH_3CONH_2	100	$<4.3\times10^{-3}$
Acetic acid	CH_3COOH	0	5×10^{-7}
		25	2.4×10^{-6}
Acetic anhydride	$(CH_3CO)_2O$	0	1×10^{-4}
		25	4.8×10^{-5}
Acetoacetic ester	$CH_3COCH_2COOCH_2CH_3$	25	4×10^{-6}
Acetone	CH_3COCH_3	−15	1.1×10^{-7}
		0	6×10^{-6}
		18	2×10^{-6}
		25	5.8×10^{-6}
Acetonitrile	CH_3CN	0	1×10^{-4}
		20	7×10^{-4}
		25	2×10^{-5}
Acetophenone	C_8H_8O	25	6.4×10^{-7}

Compound	Formula	t, °C	κ, $\Omega^{-1}\,m^{-1}$
Acetylacetone	$C_5H_8O_2$	0	2×10^{-5}
		25	3×10^{-5}
Acetyl bromide	CH_3COBr	0	2×10^{-4}
		25	2.4×10^{-4}
Acetyl chloride	CH_3COCl	0	3.5×10^{-5}
		25	4×10^{-5}
Acetylene dichloride	$CHCl:CHCl$	25	8.5×10^{-7}
Allyl alcohol	$CH_2:CHCH_2OH$	25	7×10^{-4}
Amyl acetate	$CH_3COOCH_2(CH_2)_3CH_3$	25	1.6×10^{-7}
Amyl nitrate	$CH_3(CH_2)_3CH_2ONO_2$	25	2.8×10^{-5}
Amyl nitrite	$CH_3(CH_2)_3CH_2ONO$	25	2×10^{-5}
Aniline	$C_6H_5NH_2$	25	2.4×10^{-6}
		35	8.2×10^{-6}
Anisole	$C_6H_5OCH_3$	25	1×10^{-11}
Anthracene	$C_{14}H_{10}$	230	3×10^{-8}
Benzaldehyde	C_6H_5CHO	18	1.7×10^{-5}
		20	4×10^{-5}
		25	1.5×10^{-5}
Benzene	C_6H_6	20	$<1.2\times10^{-16}$
Benzoic acid	C_6H_5COOH	125	3×10^{-7}
Benzonitrile	C_6H_5CN	25	5×10^{-6}
Benzyl alcohol	$C_6H_5CH_2OH$	25	1.8×10^{-4}
Benzylamine	$C_6H_5CH_2NH_2$	25	$<1.7\times10^{-6}$
Benzyl benzoate	$C_6H_5COOCH_2C_6H_5$	25	$<1\times10^{-7}$
Benzyl cyanide	$C_6H_5CH_2CN$	0	1×10^{-5}
Bromal	CBr_3CHO	25	8×10^{-6}
Bromobenzene	C_6H_5Br	25	1.2×10^{-9}
Bromoform	$CHBr_3$	25	$<2\times10^{-6}$
Butyl acetate	$CH_3COO(CH_2)_3CH_3$	25	1.6×10^{-6}
Butyl alcohol	$CH_3(CH_2)_3OH$	25	9.1×10^{-7}
tert-Butyl alcohol	$CH_3C(CH_3)_2OH$	25	2.9×10^{-5}
Butyl stearate	$C_{17}H_{35}COOC_4H_9$	30	2.1×10^{-11}
Capronitrile	$CH_3(CH_2)_4CN$	25	3.7×10^{-4}
Chloroacetic acid	$CH_2ClCOOH$	60	1.4×10^{-4}
m-Chloroaniline	$ClC_6H_4NH_2$	25	5×10^{-6}
Chlorobenzene	C_6H_5Cl	0	$<1\times10^{-7}$
Chloroform	$CHCl_3$	25	$<2\times10^{-6}$
Chlorohydrin	$C_3H_7O_2Cl$	25	5×10^{-5}
m-Cresol	$C_6H_4CH_3OH$	25	$<1.7\times10^{-6}$
o-Cresol		25	0.13×10^{-6}
p-Cresol		20	1.4×10^{-6}
p-Cymene	$CH_3C_6H_4CH(CH_3)_2$	25	2×10^{-6}
Dibutyl phthalate	$C_6H_4(COOC_4H_9)_2$	30	1.8×10^{-7}
Dibutyl sebacate	$C_4H_9OOC(CH_2)_8COOC_4H_9$	30	1.7×10^{-9}
Dichloroacetic acid	$CHCl_2COOH$	0	4×10^{-6}
		25	7×10^{-6}
1,1-Dichloroethane	$C_2H_4Cl_2$	25	$<1.7\times10^{-6}$

(continued)

Compound	Formula	t, °C	κ, Ω^{-1} m^{-1}
Dichlorohydrin	$C_3H_6OCl_2$	25	1.2×10^{-3}
D chloromethane	CH_2Cl_2	25	4.3×10^{-9}
Diethylamine	$(C_2H_5)_2NH$	−33.5	2.2×10^{-7}
Diethyl carbonate	$(C_2H_5)_2CO_3$	25	9.1×10^{-8}
Diethyl ether	$(C_2H_5)_2O$	25	$<4\times10^{-11}$
Diethyl oxalate	$(C_2H_5)_2(CO_2)_2$	20	7×10^{-5}
Diethyl sulphate	$(C_2H_5)_2SO_4$	25	2.6×10^{-5}
Dimethyl sulphate	$(CH_3O)_2SO_2$	0	1.6×10^{-5}
		25	3×10^{-5}
1,4-Dioxan	$C_4H_8O_2$	25	5×10^{-13}
Epichlorohydrin	C_3H_5ClO	25	3.4×10^{-6}
Ethanol	C_2H_5OH	0	1.5×10^{-5}
		18	6.4×10^{-6}
		25	1.3×10^{-7}
2-Ethoxyethanol	$C_2H_5OCH_2CH_2OH$	25	1.8×10^{-4}
Ethyl acetate	$C_2H_5COOCH_3$	25	3×10^{-7}
Ethylamine	$C_2H_5NH_2$	−33.5	4.6×10^{-6}
		0	4×10^{-5}
Ethyl benzoate	$C_2H_5COOC_6H_5$	19	$<2\times10^{-8}$
		25	$<1\times10^{-7}$
Ethyl bromide	C_2H_5Br	25	$<2\times10^{-6}$
Ethyl chloride	CH_3CH_2Cl	0	$<3\times10^{-7}$
Ethyl cyanoacetate	$CH_2(CN)COOC_2H_5$	25	1.9×10^{-5}
Ethylene bromide	$BrCH_2CH_2Br$	19	$<2\times10^{-8}$
Ethylene chloride	$ClCH_2CH_2Cl$	25	3×10^{-8}
Ethylene glycol See Glycol			
Ethyl ether	$(C_2H_5)_2O$	25	$<4\times10^{-11}$
Ethyl formate	C_2H_5HCOO	25	3×10^{-5}
Ethylidene chloride	CH_3CHCl_2	25	$<1.7\times10^{-6}$
Ethyl iodide	C_2H_5I	25	$<2\times10^{-6}$
Ethyl isothiocyanate	C_2H_5NCS	25	1.26×10^{-5}
Ethyl lactate	$CH_3CH(OH)COOC_2H_5$	25	1.0×10^{-4}
Ethyl mustard oil See Ethyl isothio-cyanate			
Ethyl nitrate	$C_2H_5ONO_2$	0	2.3×10^{-5}
		25	5.3×10^{-5}
Ethyl propionate	$C_2H_5COOCH_2CH_3$	17	8.3×10^{-2}
Ethyl thiocyanate	C_2H_5CSN	25	1.2×10^{-4}
Eugenol	$C_6H_3(C_3H_5)(OCH_3)OH$	25	$<1.7\times10^{-6}$
Formamide	$HCOHN_2$	20	2×10^{-4}
Formic acid	$HCOOH$	20	1.2×10^{-2}
Furfural	C_4H_3OCHO	25	1.5×10^{-4}
Glycerol	$CH_2OHCHOHCH_2OH$	25	6.4×10^{-6}
Glycol	$HOCH_2CH_2OH$	0	2.4×10^{-5}
		25	3×10^{-5}

Compound	Formula	t, °C	κ, Ω^{-1} m^{-1}
Guaiacol	$CH_3OC_6H_4OH$	25	2.8×10^{-5}
Heptane	C_7H_{16}	20	$<1.1\times10^{-11}$
Hexane	C_6H_{14}	18	1×10^{-16}
Isoamyl alcohol	$(CH_3)_2CHCH_2CH_2OH$	18	5×10^{-6}
		20	4×10^{-6}
		25	1.5×10^{-6}
Isobutyl acetate	$CH_3COOCH_2CH(CH_3)_2$	20	2.6×10^{-2}
Isobutyl alcohol	$(CH_3)_2CHCH_2OH$	18	1×10^{-5}
		25	8×10^{-6}
Isobutyl nitrate	$(CH_3)_2CHCH_2ONO_2$	25	$<2\times10^{-6}$
Isopropyl alcohol	$(CH_3)_2CHOH$	25	0.5×10^{-4}
Isovaleric acid	$(CH_3)_2CHCH_2COOH$	80	$<4\times10^{-11}$
Methanol	CH_3OH	18	4.4×10^{-5}
		25	2.2×10^{-5}
Methyl acetate	CH_3COOCH_3	25	3.4×10^{-4}
Methylamine	CH_3NH_2	20	$\sim7\times10^{-5}$
Methyl benzoate	$C_6H_5COOCH_3$	20	1.3×10^{-3}
Methyl ethyl ketone	$CH_3COC_2H_5$	25	1×10^{-5}
Methyl formate	CH_3HCOO	20	2×10^{-4}
Methyl iodide	CH_3I	25	$<2\times10^{-6}$
Methyl thiocyanate	CH_3SCN	25	1.5×10^{-4}
Naphthalene	$C_{10}H_8$	82	4.3×10^{-8}
Nitrobenzene	$C_6H_5NO_2$	0	5×10^{-7}
		20	$<2\times10^{-8}$
Nitroethane	$CH_3CH_2NO_2$	30	5×10^{-5}
Nitromethane	CH_3NO_2	0	4.4×10^{-5}
		25	6.6×10^{-5}
2-Nitropropane	$CH_3CH(NO_2)CH_3$	30	5×10^{-5}
m-Nitrotoluene	$C_6H_4CH_3NO_2$	25	$<2\times10^{-5}$
o-Nitrotoluene		25	$<2\times10^{-5}$
Nonane	C_9H_{20}	25	1.7×10^{-6}
Oleic acid	$CH_3(CH_2)_7CH:$ $CH(CH_2)_7COOH$	15	$<2\times10^{-8}$
Pentane	$CH_3(CH_2)_3CH_3$	20	$<2.1\times10^{-8}$
Petroleum			3×10^{-11}
Phenetole	$C_6H_5OC_2H_5$	25	$<1.7\times10^{-6}$
Phenol	C_6H_5OH	25	$<1.7\times10^{-6}$
Phenylacetonitrile	$C_6H_5CH_2CN$	25	$<0.5\times10^{-5}$
Phenyl ethyl ether See Phenetole			
Phenyl isothiocyanate	C_6H_5NCS	25	1.4×10^{-4}
Phenyl mustard oil See Phenyl isothiocyanate			
Picoline	$C_5H_4NCH_3$	25	5.5×10^{-5}
Pinene	$C_{10}H_{16}$	25	$<2.3\times10^{-8}$
Piperidine	$CH_2(CH_2)_4NH$	25	$<2\times10^{-5}$

(continued)

Compound	Formula	t, °C	κ, $\Omega^{-1}\,m^{-1}$
Propionaldehyde	CH_3CH_2CHO	25	0.95×10^{-4}
Propionic acid	CH_3CH_2COOH	25	$<1\times10^{-7}$
Propionitrile	CH_3CH_2CN	25	$<1\times10^{-5}$
Propyl acetate	$CH_3(CH_2)_2CH_3COO$	17	2.2×10^{-2}
Propyl alcohol	$CH_3CH_2CH_2OH$	20	9.2×10^{-7}
Propyl formate	$CH_3(CH_2)_2HCOO$	17	5.5×10^{-3}
Pyridine	C_5H_5N	25	4×10^{-6}
Quinoline	C_9H_7N	0	1.6×10^{-6}
		25	2.2×10^{-6}
		50	7.4×10^{-6}
Salicylaldehyde	$C_6H_4(OH)CHO$	25	1.6×10^{-5}
Stearic acid	$CH_3(CH_2)_{16}COOH$		$\sim2\times10^{-11}$
Terpinene	$C_{10}H_{16}$	25	1.7×10^{-6}
Toluene	$C_6H_5CH_3$	20	$<1.2\times10^{-12}$
o-Toluidine	$C_6H_4CH_3NH_2$	25	3.8×10^{-5}
p-Toluidine		100	6.2×10^{-6}
Trichloroacetic acid	CCl_3COOH	25	3×10^{-7}
		60	6.2×10^{-7}
Trimethylamine	$(CH_3)_3N$	−33.5	2.2×10^{-8}
Turpentine		20	$\sim2\times10^{-11}$
Xylene	$C_6H_4(CH_3)_2$	20	$<1.2\times10^{-13}$

Table 63

Resistivities and conductivities of water–ethanol mixtures

H_2O, w.%	ρ, Ω m	κ, $\Omega^{-1}\,m^{-1}$
5	3.0×10^{3}	3.3×10^{-4}
10	2.0×10^{3}	4.9×10^{-4}
15	1.6×10^{3}	6.2×10^{-4}
20	1.2×10^{3}	7.8×10^{-4}
25	1.1×10^{3}	9.3×10^{-4}
30	0.9×10^{3}	10.5×10^{-3}
35	7.6×10^{2}	1.3×10^{-3}
40	6.5×10^{2}	1.5×10^{-3}
45	5.9×10^{2}	1.7×10^{-3}
50	5.2×10^{2}	2.0×10^{-3}

Table 64

Resistivities and conductivities of water–glycol mixtures

H_2O, w.%	ρ, Ω m	κ, $\Omega^{-1}\,m^{-1}$
5	5.0×10^{3}	2.0×10^{-4}
10	2.3×10^{3}	4.3×10^{-4}
15	1.4×10^{3}	6.8×10^{-4}
20	1.0×10^{3}	9.5×10^{-4}
25	8.2×10^{2}	1.2×10^{-3}
30	6.7×10^{2}	1.5×10^{-3}
35	5.7×10^{2}	1.7×10^{-3}
40	5.0×10^{2}	2.0×10^{-3}
45	4.5×10^{2}	2.2×10^{-3}
50	4.1×10^{2}	2.4×10^{-3}

Table 65

Resistivities of aqueous solutions of inorganic and some organic compounds at 25°C

Solution	0.1 N	0.5 N	1.0 N
	ρ, Ω m		
$CaCl_2$	1.01	0.238	0.129
$CdCl_2$	1.85	0.58	0.401
$CdSO_4$	2.10	0.62	0.366
$CoCl_2$	0.75	0.253	0.141
$CoSO_4$	2.04	0.57	0.341
$CuSO_4$	1.91	0.56	0.341
$FeCl_2$	—	0.287	0.165
$FeSO_4$	1.80	0.53	0.336
$Fe(NH_4)_2(SO_4)_2$	—	—	0.120
H_3BO_3	—	2200.00	700.00
HCl	0.26	0.0554	0.0301
H_2CrO_4	0.27	0.0581	0.0318
HF	2.80	0.81	—
$HOOCCH_3$	19.00	8.70	6.70
H_2SO_4	0.40	0.0928	0.0581
$K[Ag(CN)_2]$	—	0.16	—
KCl	0.78	0.171	0.0894
KCN	0.70	0.153	0.0821
KOH	0.46	0.0948	0.0507
$MgSO_4$	1.71	0.495	0.299
$NaCl$	0.92	0.217	0.116
Na_2CO_3	1.17	0.313	0.191
NaF	1.21	0.294	0.185
Na_2HPO_4	1.99	0.524	0.315
$NaOH$	0.50	0.106	0.0577
Na_2SO_4	1.09	0.291	0.168
NH_4Cl	0.78	0.174	0.0934
NH_4OH	27.00	12.80	9.70
$(NH_4)_2SO_4$	0.94	0.23	0.128
$NiCl_2$	1.05	0.25	0.141
$NiSO_4$	1.95	0.53	0.338
$Ni(NH_4)_2(SO_4)_2$	0.71	0.195	—
$Pb(BF_4)_2$	—	—	0.092
$ZnCl_2$	1.01	0.226	0.134
$ZnSO_4$	1.84	0.53	0.332

Table 66

Resistivities of KOH solutions at various temperatures

KOH, w.%	Temperature, °C						
	50	55	60	65	70	75	80
	ρ, Ω m						
20	0.01250	0.01174	0.01099	0.01046	0.00988	0.00928	0.00882
22.5	0.01158	0.01096	0.01027	0.00968	0.00909	0.00863	0.00833
25	0.01104	0.01036	0.00970	0.00923	0.00865	0.00820	0.00790
27.7	0.01061	0.00999	0.00933	0.00901	0.00833	0.00788	0.00751
30	0.01042	0.00988	0.00922	0.00867	0.00827	0.00775	0.00737
32.5	0.01060	0.00988	0.00921	0.00864	0.00814	0.00769	0.00730
35	0.01075	0.01000	0.00929	0.00870	0.00818	0.00772	0.00731
37.5	0.01100	0.01020	0.00945	0.00883	0.00828	0.00779	0.00736
40	0.01153	0.01064	0.00980	0.00913	0.00852	0.00800	0.00754

Table 67

Resistivities of NaOH solutions at various temperatures

NaOH, w.%	Temperature, °C						
	50	55	60	65	70	75	80
	ρ, Ω m						
15	0.01575	0.01460	0.01333	0.01250	0.01172	0.01162	0.01046
17.5	0.01527	0.01408	0.01300	0.01209	0.01130	0.01062	0.01000
20	0.01508	0.01381	0.01272	0.01170	0.01088	0.01018	0.00956
22.5	0.01520	0.01385	0.01266	0.01164	0.01081	0.01007	0.00943
25	0.01583	0.01428	0.01290	0.01180	0.01088	0.01010	0.00941
27.5	0.01692	0.01566	0.01346	0.01220	0.01117	0.01030	0.00955
30	0.01780	0.01576	0.01392	0.01256	0.01166	0.01050	0.00969
32.5	0.01923	0.01650	0.01450	0.01300	0.01176	0.01075	0.00990
35	0.01950	0.01695	0.01506	0.01342	0.01200	0.01103	0.01011
37.5	0.02105	0.01800	0.01562	0.01385	0.01242	0.01127	0.01031
40	0.02232	0.01905	0.01640	0.01443	0.01287	0.01164	0.01058

Table 68

Resistivities of $ZnCl_2$ solutions

$ZnCl_2$, w.%	Density at 20°C g ml^{-1}	Bé°	$ZnCl_2$ in 1000 ml solution, g	Resistivity, Ω m		
				0°C	20°C	50°C
10	1.082	11.0	108.2	0.201	0.134	0.095
20	1.187	22.8	237.3	0.161	0.107	0.072
30	1.293	32.8	387.8	0.157	0.103	0.069
40	1.417	42.7	566.9	0.168	0.113	0.073
50	1.568	52.5	784.1	0.238	0.142	0.082

Table 69

Equivalent ionic conductivities in aqueous solutions at 18°C

The ionic conductivity at t°C, $\lambda_t = \lambda_{18}\,[1 + \alpha(t - 18)]$

Ion	Concentration, equiv. l^{-1}											α
	0	0.0001	0.0002	0.0005	0.001	0.002	0.005	0.01	0.02	0.05	0.1	
	λ, Ω^{-1} m^2 $equiv.^{-1}$											
H^+	0.0315	0.0315	0.0314	0.0312	0.0311	0.0310	0.0309	0.0307	0.0304	0.0301	0.0294	0.0154
Li^+	0.00334	0.00332	0.00330	0.00328	0.00325	0.00321	0.00315	0.00308	0.00300	0.00288	0.00275	0.0265
Na^+	0.00435	0.00432	0.00430	0.00428	0.00424	0.00420	0.00413	0.00405	0.00395	0.00379	0.00364	0.0244
K^+	0.00646	0.00641	0.00640	0.00637	0.00633	0.00628	0.00618	0.00607	0.00593	0.00572	0.00551	0.0217
Cs^+	0.0068	0.00674	0.00672	0.00669	0.00666	0.00660	0.00649	0.00637	0.0062	0.0060	0.0058	0.0212
$^1/_2\ Mg^{2+}$	0.0045	0.00445	0.0044	0.0043	0.0042	0.0041	0.0039	0.0037	0.0034	0.0031	0.0028	0.0256
$^1/_2\ Ca^{2+}$	0.0051	0.00504	0.00499	0.00490	0.00480	0.00466	0.00422	0.00419	0.00392	0.00352	0.00320	0.0247
$^1/_2\ Sr^{2+}$	0.0051	0.00504	0.00494	0.00490	0.00479	0.00465	0.00439	0.0041	0.0039	—	—	0.0247
$^1/_2\ Ba^{2+}$	0.0055	0.00540	0.00535	0.00526	0.00514	0.00467	0.0046	0.0044	7.0041	—	—	0.0239
Ag^+	0.00544	0.00537	0.00534	0.00531	0.00522	0.00522	0.00513	0.00502	0.0049	0.0046	0.0044	0.0229
Tl^+	0.00660	0.00653	0.00652	0.00648	0.00642	0.00634	0.00617	0.0060	0.0058	0.0054	0.0050	0.0215
OH^-	0.0174	0.0172	0.0172	0.0171	0.0171	0.0170	0.0168	0.0167	0.0165	0.0161	0.0157	0.0180
F^-	0.00466	0.00462	0.00461	0.00458	0.00455	0.00450	0.00442	0.00432	0.0042	0.0040	0.0038	0.0238
Cl^-	0.00655	0.00649	0.00648	0.00644	0.00640	0.00635	0.00625	0.00615	0.00602	0.00579	0.00558	0.0216
ClO_3^-	0.00550	0.00545	0.00543	0.00540	0.00536	0.00531	0.00520	0.00509	0.00493	0.00465	0.00400	0.0215
Br^-	0.00676	0.00670	0.00668	0.00665	0.00661	0.00653	0.00644	0.00637	0.00623	0.00606	0.00591	0.0215
I^-	0.00665	0.00656	0.00655	0.00653	0.00649	0.00644	0.00635	0.00627	0.00616	0.00601	0.00588	0.0213
IO_3^-	0.00339	0.00335	0.00334	0.00334	0.00328	0.00323	0.00314	0.00304	0.00291	0.00236	0.00242	0.0234
$^1/_2\ SO^{2-}$	0.00683	0.00666	0.00660	0.00650	0.00638	—	0.00587	0.00555	0.00515	0.0048	0.0040	0.0237
SCN^-	0.00566	0.00561	0.00560	0.00557	0.00554	0.00549	0.00540	0.00532	0.00521	0.00505	0.00491	0.0221
NO_3^-	0.00617	0.00613	0.00611	0.00608	0.00604	0.00598	0.00588	0.00576	0.00561	0.00533	0.00508	0.0205
$^1/_2\ CO_3^{2-}$	—	—	—	—	0.0060	0.0060	0.0060	0.055	0.0050	0.0043	0.0038	0.0270

Table 70

Limiting equivalent anionic conductivities in aqueous solutions

Ion	Temperature, °C			
	0	18	25	100
	λ_0, Ω^{-1} m^2 equiv.$^{-1}$			
OH^-	0.0105	0.0174	0.01976	0.0446
OD^-	—	—	0.0119	—
$AsO_4H_2^-$	—	—	0.0034	—
Br^-	0.00431	0.00676	0.00784	—
BrO_3^-	0.00310	0.00490	0.00558	0.0155
CN^-	—	—	0.0078	—
$CH_3CO_2^-$	0.0020	0.0034	0.0041	0.0130
$^1/_2\ CO_3^{2-}$	0.0036	0.00605	0.00693	—
CO_3H^-	—	—	0.00445	—
$^1/_2\ C_2O_4^{2-}$	0.0032	0.0063	—	—
$^1/_2(C_4H_4O_6)^{2-}$	—	0.0055	—	—
Cl^-	0.00414	0.00655	0.00763	0.0207
ClO_2^-	—	—	0.0052	—
ClO_3^-	0.0036	0.00550	0.00646	0.0172
ClO_4^-	0.00373	0.00591	0.00673	0.0179
$^1/_2\ CrO_4^{2-}$	0.0042	0.0072	0.0085	—
F^-	—	0.00466	0.00554	—
HCO_2^-	—	0.0047	—	—
I^-	0.00420	0.00665	0.00769	—
IO_3^-	0.00210	0.00339	0.00410	0.0127
IO_4^-	—	0.0049	0.00545	—
$^1/_2\ MoO_4^{2-}$	—	—	0.00745	—
MnO_4^-	0.0036	0.0053	0.00628	—
N_3^-	—	—	0.00695	—
NCO^-	—	0.00548	0.00646	—
NO_2^-	0.0044	0.0059	0.0072	—
NO_3^-	0.00402	0.00617	0.007142	0.0189
$PO_4H_2^-$	—	0.0028	0.0036	—
$^1/_2\ PO_4H^{2-}$	—	—	0.0057	—
ReO_4^-	—	0.00465	0.00549	—
SCN^-	0.00417	0.00566	0.00665	—
SH^-	0.0040	0.0057	0.0065	—
SO_3H^-	0.0027	—	0.0050	—
$^1/_2\ SO_3^{2-}$	—	—	0.0072	—
$^1/_2\ SO_4^{2-}$	0.0041	0.00683	0.00798	0.0256
$^1/_2\ S_2O_3^{2-}$	—	—	0.00874	—
$^1/_2\ S_2O_4^{2-}$	0.0034	—	0.00665	—
$^1/_2\ S_2O_6^{2-}$	—	—	0.0093	—
$^1/_2\ S_2O_8^{2-}$	—	—	0.0086	—
$^1/_2\ SeO_4^{2-}$	—	0.0065	0.00757	—
$^1/_2\ WO_4^{2-}$	0.0035	0.0059	0.00694	—

Table 71

Limiting equivalent cationic conductivities in aqueous solutions

Ion	Temperature, °C			
	0	18	25	100
	λ_0, Ω^{-1} m^2 equiv.$^{-1}$			
H^-	0.0225	0.0315	0.03497	0.0637
Li^+	0.00191	0.00334	0.003868	0.0120
Na^+	0.002585	0.00435	0.005010	0.0150
K^+	0.00403	0.00646	0.007350	0.0200
Rb^+	0.00435	0.00675	0.00775	—
Cs^+	0.0044	0.0068	0.00768	0.0200
NH^+	0.00403	0.0064	0.00737	0.01843
$^1/_2\ Be^{2+}$	—	—	0.0045	—
$^1/_2\ Mg^{2+}$	0.00285	0.0046	0.005306	0.0170
$^1/_2\ Ca^{2+}$	0.00308	0.0051	0.00595	0.0187
$^1/_2\ Sr^{2+}$	0.0031	0.0051	0.00595	—
$^1/_2\ Ba^{2+}$	0.00336	0.00543	0.00637	0.0200
$^1/_2\ Ra^{2+}$	0.0033	0.00566	0.00668	—
$^1/_3\ Al^{3+}$	0.0029	—	0.0063	—
$^1/_3\ Sc^{3+}$	—	—	0.00647	—
$^1/_3\ La^{3+}$	0.00350	0.00592	0.00697	0.0220
Ag^+	0.0033	0.005436	0.00619	0.0180
$^1/_3\ Ce^{3+}$	—	—	0.0067	—
$^1/_2\ Cd^{2+}$	0.0028	0.00451	0.0054	—
$^1/_2\ Co^{2+}$	0.0028	0.0045	0.0054	—
$^1/_3\ Cr^{3+}$	—	—	0.0067	—
$^1/_2\ Cu^{2+}$	0.0028	0.00453	0.00566	—
$^1/_2\ Fe^{2+}$	0.0028	0.00445	0.00535	—
$^1/_3\ Fe^{3+}$	—	—	0.0068	—
$^1/_2\ Mn^{2+}$	0.0027	0.00445	0.00535	—
$^1/_3\ Nd^{3+}$	—	—	0.00643	—
$^1/_2\ Ni^{2+}$	0.0028	0.0045	0.0054	—
$^1/_2\ Pb^{2+}$	0.00375	0.00605	0.0070	—
$^1/_3\ Pr^{3+}$	—	—	0.00654	—
$^1/_3\ Sm^{3+}$	—	—	0.00658	—
Tl^+	0.00433	0.0066	0.00749	—
$^1/_2\ Zn^{2+}$	0.0028	0.00450	0.00535	—
$^1/_2\ Hg_2^{2+}$	—	—	0.00686	—
$^1/_3\ Er^{3+}$	—	—	0.00659	—
$^1/_3\ Eu^{3+}$	—	—	0.00678	—
$^1/_3\ Yb^{3+}$	—	—	0.00652	—
$^1/_2\ Hg^{2+}$	—	—	0.00636	—

Table 72

Limiting equivalent ionic conductivities in organic solvents at 25°C

Ion	Solvent				
	Acetone	Ethanol	Methanol	Methyl ethyl ketone	Nitrobenzene
	λ_0, Ω^{-1} m² equiv.$^{-1}$				
H^+	0.0088	0.00595	0.0143	—	0.0023
Ag^+	0.0088	0.00175	0.00503	0.0066	0.00185
$^1/_2$ Ba^{2+}	0.0085	—	0.00600	—	—
$^1/_2$ Ca^{2+}	—	—	0.00600	—	—
$^1/_2$ Cd^{2+}	—	—	0.00574	0.0084	—
Cs^+	0.0088	0.00255	0.00623	—	—
K^+	0.0082	0.00220	0.00537	0.0065	0.00192
Li^+	0.0075	0.00149	0.00397	0.00503	—
$^1/_2$ Mg^{2+}	—	—	0.00576	—	—
$N(CH_3)_4^+$	0.01025	0.00283	0.00700	0.00791	—
$N(C_2H_5)_4^+$	0.00930	0.00284	0.00620	0.00753	0.00172
$N(C_3H_7)_4^+$	0.00737	—	0.00461	0.00603	0.00148
$N(C_4H_9)_4^+$	0.00702	—	0.00391	0.00545	—
$N(C_5H_{11})_4^+$	0.00628	—	0.00355	0.00502	0.00119
NH_4^+	0.0098	0.00193	0.00579	—	—
Na^+	0.0080	0.00187	0.00458	0.0056	0.00172
Rb^+	0.0086	0.00236	0.00574	—	—
$^1/_2$ Sr^{2+}	—	—	0.00590	—	—
Tl^+	—	—	0.00606	—	—
$^1/_2$ Zn^{2+}	—	—	0.00596	—	—
OH^-	—	0.00225	0.0053	—	—
Br^-	0.0113	0.00258	0.00555	0.00764	0.00196
Cl^-	0.0111	0.00243	0.00523	0.00654	0.00173
ClO_3^-	—	0.00293	0.00614	—	—
ClO_4^-	0.0117	0.00338	0.00709	0.00865	0.00199
F^-	0.0102	—	0.00402	—	—
I^-	0.0110	0.00287	0.00627	0.00823	0.00200
NO_2^-	—	0.00259	0.00550	—	—
NO_3^-	0.0120	0.00279	0.00608	0.00837	—
picrate$^-$	0.00845	0.0027	0.0049	0.00679	0.0015
SCN^-	0.0123	0.00292	0.00610	—	—

Table 73

Absolute ion mobilities at infinite dilution at 18°C

Cation	$u_c \times 10^8$, m s^{-1}/V m^{-1}	Anion	$u_a \times 10^8$, m s^{-1}/V m^{-1}
H^+	32.4	OH^-	17.8
Ag^+	5.6	acetate$^-$	3.7
Al^{3+}	4.1	benzoate$^-$	2.7
Ba^{2+}	5.7	Br^-	7.0
Be^{2+}	2.9	BrO_3^-	4.9
Ca^{2+}	5.3	CO_3^{2-}	7.2
Cd^{2+}	4.8	Cl^-	6.8
Co^{2+}	4.5	ClO_3^-	5.7
Cr^{3+}	4.7	ClO_4^-	6.7
Cs^+	7.1	CrO_4^{2-}	7.4
Cu^{2+}	4.6	$Cr_2O_7^{2-}$	4.7
Fe^{2+}	4.7	F^-	4.8
Fe^{3+}	6.3	formate$^-$	4.8
K^+	6.6	I^-	6.8
Li^+	3.4	IO_3^-	3.5
Mg^{2+}	4.8	IO_4^-	4.9
Mn^{2+}	4.6	MnO_4^-	5.5
NH_4^+	6.7	NO_3^-	6.4
Na^+	4.6	PO_4^{3-}	4.9
Ni^{2+}	4.6	SCN^-	5.9
Pb^{2+}	7.0	SO_4^{2-}	7.1
Ra^{2+}	6.0	$S_2O_8^{2-}$	7.2
Rb^+	6.8		
Sr^{2+}	5.5		
Tl^+	6.8		
Zn^{2+}	4.8		

Table 74

Anion transport numbers in aqueous $AgNO_3$, $BaBr_2$, $BaCl_2$, BaI_2 and $Ba(NO_3)_2$ solutions at 18°C

Concentration, N	$AgNO_3$	$BaBr_2$	$BaCl_2$	BaI_2	$Ba(NO_3)_2$
0.005	0.526	—	0.554	—	—
0.01	0.526	—	0.554	—	—
0.02	0.526	0.578	0.554	0.574	—
0 05	0.526	—	0.560	—	0.544
0.1	0.526	0.592	0.580	0.585	—
0.2	0.522	—	0.592	—	0.545
0.5	0.51	—	0.611	—	—
1.0	0.500	—	0.640	—	—
1.5	0.487	—	0.650	—	—
2.0	0.476	—	0.657	—	—

Table 75

Anion transport numbers in aqueous $CaBr_2$, $CaCl_2$ and CaI_2 solutions at 18°C

Concentration, N	$CaBr_2$	$CaCl_2$	CaI_2
0.005	—	0.562	—
0.01	—	0.565	—
0.02	0.591	0.578	0.584
0.05	—	0.589	—
0.1	0.604	0.60	0.600
0.2	—	0.60	—
0.5	—	0.675	—
1.0	—	0.686	—
1.5	—	0.695	—
2.0	—	0.700	—
3.0	—	0.710	—
5.0	—	0.737	—

Table 76

Anion transport numbers in aqueous $CdBr_2$, $CdCl_2$, CdI_2 and $CdSO_4$ solutions at 18°C

Concentration, N	$CdBr_2$	$CdCl_2$	CdI_2	$CdSO_4$
0.005	0.570	—	—	—
0.01	0.570	0.570	0.558	0.613
0.02	0.570	0.58	0.560	0.616
0.05	0.570	0.59	0.560	0.622
0.1	0.571	0.62	0.683	0.631
0.2	0.610	0.65	0.840	0.651
0.5	0.650	0.69	1.003	0.677
1.0	0.782	0.72	1.12	0.706
1.5	—	0.73	1.18	—
2.0	—	0.745	1.22	0.746
3.0	—	0.767	—	—
5.0	—	0.865	—	—

Table 77

Anion transport numbers in aqueous CsBr, CsCl, CsI and $CuSO_4$ solutions at 18°C

Concentration, N	CsBr	CsCl	CsI	$CuSO_4$
0.02	0.503	0.496	0.503	0.625
0.05	—	—	—	0.625
0.1	0.507	0.506	0.503	0.627
0.2	—	—	—	0.643
0.5	—	—	—	0.672
1.0	—	—	—	0.696
1.5	—	—	—	0.714
2.0	—	—	—	0.720

Table 78

Anion transport numbers in aqueous HCl, HNO_3 and H_2SO_4 solutions at 18°C

Concentration, N	HCl	HNO_3	H_2SO_4
0.005	0.168	0.166	—
0.01	0.167	0.165	0.175
0.02	0.166	0.165	0.175
0.05	0.165	0.160	0.175
0.1	0.164	—	0.172
0.2	0.163	—	0.175
0.5	0.160	—	0.175
1.0	0.155	—	0.175
3.0	—	—	0.192
5.0	—	—	0.203

Table 79

Anion transport numbers in aqueous KBr, KI and KNO_3 solutions at 25°C

Concentration, N	KBr	KI	KNO_3
0.01	0.5167	0.5116	0.4916
0.02	0.5168	0.5117	0.4913
0.05	0.5169	0.5118	0.4907
0.1	0.5167	0.5117	0.4897
0.2	0.5159	0.5113	0.4880
1.0	0.514	—	0.487
1.5	0.515	0.515	0.482
2.0	0.515	0.515	0.479
3.0	0.516	0.516	—

Table 80

Anion transport numbers in aqueous $KBrO_3$, KCl, $KClO_3$ and $KClO_4$ solutions at 18°C

Concentration, N	$KBrO_3$	KCl	$KClO_3$	$KClO_4$
0.005	—	0.504	—	—
0.01	—	0.504	—	—
0.02	0.433	0.504	0.466	—
0.05	—	0.505	—	—
0.1	0.430	0.506	0.464	0.477
0.2	—	0.506	—	—
0.5	—	0.510	—	—
1.0	—	0.515	—	—
1.5	—	0.515	—	—
2.0	—	0.515	—	—
3.0	—	0.516	—	—

Table 81

Anion transport numbers in aqueous KOH, K_2CO_3, K_2SO_4 and K acetate solutions at 18°C

Concentration, N	KOH	K_2CO_3	K_2SO_4	CH_3CO_2K
0.005	—	—	0.505	—
0.01	—	—	0.506	—
0.02	—	—	0.508	—
0.05	—	0.39	0.510	—
0.1	0.735	0.40	—	0.33
0.2	0.736	0.41	0.515	0.33
0.5	0.738	0.435	—	0.33
1.0	0.740	0.434	—	0.331
1.5	—	0.421	—	0.332
2.0	—	0.413	—	0.332
3.0	—	0.404	—	0.333
5.0	—	0.380	—	0.335

Table 82

Anion transport numbers in aqueous LiCl, LiOH, $MgBr_2$, $MgCl_2$, MgI_2 and $MgSO_4$ solutions at 18°C

Concentration, N	LiCl	LiOH	$MgBr_2$	$MgCl_2$	MgI_2	$MgSO_4$
0.005	0.670	—	—	—	—	0.612
0.01	0.670	—	—	—	—	0.615
0.02	0.672	—	0.615	—	0.612	0.619
0.05	0.684	—	0.632	0.632	—	0.627
0.1	0.687	0.85	0.650	0.648	0.650	0.64
0.2	0.700	0.85	—	0.68	—	0.65
0.5	0.730	0.861	—	0.69	—	0.69
1.0	0.740	0.87	—	0.709	—	0.75
1.5	0.741	0.890	—	0.718	—	0.75
2.0	0.745	—	—	0.729	—	0.76
3.0	0.752	—	—	0.747	—	0.76
5.0	0.763	—	—	0.776	—	—

Table 83

Anion transport numbers in aqueous NH_4Br, NH_4Cl and NH_4I solutions at 18°C

Concentration, N	NH_4Br	NH_4Cl	NH_4I
0.005	—	0.507	—
0.01	—	0.507	—
0.02	0.517	0.508	0.511
0.05	—	0.508	—
0.1	0.519	0.509	0.516
0.2	—	0.509	—
0.5	—	0.513	—
1.0	—	0.514	—
1.5	—	0.515	—
2.0	—	0.515	—
3.0	—	0.516	—

Table 84

Anion transport numbers in aqueous NaBr, NaCl, NaI and NaOH solutions at 18°C

Concentration, N	NaBr	NaCl	NaI	NaOH
0.005	0.605	0.603	—	—
0.01	0.605	0.604	—	—
0.02	0.605	0.605	—	—
0.05	0.606	0.608	0.619	0.81
0.1	—	0.611	0.624	0.82
0.2	—	0.620	—	0.82
0.5	—	0.623	—	0.82
1.0	—	0.637	—	0.825
1.5	—	0.640	—	—
2	—	0.642	—	—
3	—	0.646	—	—
5	—	0.650	—	—

Table 85

Anion transport numbers in aqueous Na_2CO_3, Na_2SO_4 and Na acetate solutions at 18°C

Concentration, N	Na_2CO_3	Na_2SO_4	CH_3CO_2Na
0.01	—	0.608	—
0.02	—	0.610	—
0.05	0.52	0.617	—
0.1	0.53	—	0.44
0.2	0.53	0.63	0.43
0.5	0.54	—	0.43
1.0	0.548	—	0.425
1.5	0.546	—	0.422
2	0.542	—	0.421
3	0.530	—	0.417

Table 86

Anion transport numbers in aqueous RbBr, RbCl, RbI and Tl_2SO_4 solutions at 18°C

Concentration, N	RbBr	RbCl	RbI	Tl_2SO_4
0.02	0.505	0.503	0.502	0.525
0.05	—	—	—	0.525
0.1	0.508	0.506	0.503	0.525

Table 87

Transport numbers in some solid electrolytes

Electrolyte	Temperature, °C	t_+	t_-
AgBr	20 – 300	1.00	—
AgCl	20 – 350	1.00	—
α-AgI	150 – 400	1.00	—
β-AgI	20 – 140	1.00	—
α-Ag_2S	200	10^{-3} – 10^{-24}	Electron conduction
α-Ag_2Se	200		
α-Ag_2Te	200		
$BaBr_2$	350 – 450	—	1.00

Electrolyte	Temperature, °C	t_+	t_-
$BaCl_2$	400–700	—	1.00
$BaFe_2$	500	—	1.00
γ-CuBr	27	—	Electron conduction 1.00
	52	0.005	0.995
	181	0.036	0.964
	223	0.14	0.86
	272	0.39	0.51
	308	0.92	0.08
	390	1.00	0.00
CuCl	18	—	1.00
	40	0.02	0.98
	178	0.05	0.95
	218	0.29	0.71
	254	0.90	0.10
	315	1.00	—
	366	1.00	—
CuI	400–500	1.00	—
Cu_2O	1000	—	$\sim 4 \times 10^{-4}$
Cu_2S	220	1.00	—
KBr	605	0.5	0.5
	660	0.4	0.6
KCl	435	0.96	0.04
	500	0.94	0.06
	550	0.92	0.08
	600	0.88	0.12
KI	610	0.9	0.1
NaCl	500	0.98	0.02
	550	0.94	0.06
	580	0.92	0.08
	620	0.88	0.12
NaF	500	1.00	—
	550	0.99	0.01
	600	0.92	0.08
	625	0.86	0.14
$PbBr_2$	200–360	—	1.00
$PbCl_2$	90	10^{-10}	—
	270	10^{-5}	—
	484	10^{-3}	—
PbF_2	200	—	1.00
PbI_2	155	0.004	0.996
	194	0.03	0.97
	255	0.39	0.61
	290	0.67	0.33
	338	0.79–0.85	0.21–0.15
	376	0.93–1.00	0.07–0.0

Table 88

Transport numbers in some pure molten electrolytes

Electrolyte	Temperature, °C	t_+	t_-
AgCl	650	0.85	0.15
$AgNO_3$	350	0.76	0.24
$BaCl_2$	1000	0.23	0.77
$CaCl_2$	900	0.42	0.58
$CdCl_2$	605	0.66	0.34
CsCl	685	0.64	0.36
$CsNO_3$	450	0.46	0.54
KCl	830	0.62	0.38
KNO_2	300	0.62	0.38
KNO_3	350	0.60	0.40
LiCl	600	0.75	0.25
$LiNO_3$	350	0.84	0.16
$MgCl_2$	800	0.48	0.52
NaCl	860	0.62	0.38
$NaNO_2$	350	0.71	0.29
$NaNO_3$	350	0.71	0.29
$PbBr_2$	600	0.67	0.33
$PbCl_2$	550	0.24	0.76
RbCl	785	0.58	0.42
$RbNO_3$	450	0.49	0.51
$SrCl_2$	1000	0.26	0.74
TlCl	500	0.49	0.51
$TlNO_3$	220	0.31	0.69
$ZnCl_2$	600	0.60	0.40

Table 89

Diffusion coefficients of various metal ions in some systems of fused salts

Ion	Fused electrolyte system	Temperature, °C	Diffusion coefficient, $m^2\ s^{-1}$
Ag^+	$CsNO_3$	400	2.5×10^{-9}
	KBr	780	4.9×10^{-9}
	KI	720	4.6×10^{-9}
		780	5.0×10^{-9}
	KNO_3	360	4.6×10^{-9}
		390	4.9×10^{-9}
	$NaNO_3$	330	4.6×10^{-9}
		360	5.1×10^{-9}
	42% KCl–58% LiCl	400	2.4×10^{-9}
		480	4.6×10^{-9}
		600	5.3×10^{-9}
		740	6.6×10^{-9}

Table 89 (continued)

Ion	Fused electrolyte system	Tempera-ture, °C	Diffusion coefficient, $m^2 s^{8-1}$
Ag^+	KNO_3–$NaNO_3$	300	4×10^{-9}
		400	1.1×10^{-8}
Ba^{2+}	KNO_3	370	2.1×10^{-9}
	$NaNO_3$	360	3.7×10^{-9}
Bi^{3+}	KCl–LiCl	400	0.6×10^{-9}
Cd^{2+}	KCl–LiCl	400	1.2×10^{-9}
		500	2.7×10^{-9}
	KNO_3–$LiNO_3$–$NaNO_3$	160	1.5×10^{-10}
	K_2CO_3–Na_2CO_3 eutectic	710	2.7×10^{-9}
Cs^+	$NaNO_3$	350	1.2×10^{-9}
Cu^+	KCl–LiCl	500	6.7×10^{-9}
K^+	KNO_3	360	3.0×10^{-9}
Na^+	KNO_3	360	5.2×10^{-9}
Ni^{2+}	KCl–LiCl	500	4×10^{-9}
	KNO_3–$LiNO_3$–$NaNO_3$	160	1.2×10^{-10}
Pb^{2+}	42% KCl–58% LiCl	530	2.0×10^{-9}
		720	4.4×10^{-9}
	KNO_3–$LiNO_3$–$NaNO_3$	160	1.8×10^{-10}
Pt^{2+}	KCl–LiCl	400	0.8×10^{-9}
Sr^{2+}	KNO_3	360	2.8×10^{-9}
	$NaNO_3$	360	4.4×10^{-9}
Tl^+	KBr	770	4×10^{-9}
	KI	720	3.1×10^{-9}
		780	3.3×10^{-9}
	KNO_3	380	3.4×10^{-9}
	$NaNO_3$	330	3.9×10^{-9}
		360	4.3×10^{-9}
	42% KCl–58% LiCl	600	3.5×10^{-9}
U^{4+}	KCl–LiCl	400	0.5×10^{-9}
Zn^{2+}	KNO_3–$LiNO_3$–$NaNO_3$	160	1.5×10^{-10}

Table 90

Self-diffusion coefficients of ions in some molten salts

Molten electrolyte	Temperature, °C	Cation	Diffusion coefficients, $m^2\,s^{-1}$ (cation)	Diffusion coefficients, $m^2\,s^{-1}$ (anion)	Anion
$AgNO_3$	350	Ag^+	2.4×10^{-9}	1.4×10^{-9}	NO_3^-
$CdCl_2$	590	Cd^{2+}	2.6×10^{-9}	2.4×10^{-9}	Cl^-
$KCl \times CdCl_2$	470		1.4×10^{-9}		
CsCl	670	Cs^+	3.52×10^{-9}	3.82×10^{-9}	Cl^-
$CsNO_3$	350		1.22×10^{-9}	1.11×10^{-9}	NO_3^-
KNO_3	350	K^+	1.51×10^{-9}	1.35×10^{-9}	NO_3^-
$LiNO_3$	350	Li^+	2.93×10^{-9}	1.15×10^{-9}	NO_3^-
NaCl	840		9.6×10^{-9}	6.7×10^{-9}	Cl^-
NaI	670	Na^+	7.35×10^{-9}	4.05×10^{-9}	I^-
$NaNO_3$	350		2.49×10^{-9}	1.48×10^{-9}	NO_3^-
Na_2CO_3	900		5.6×10^{-9}	3×10^{-9}	CO_3^{2-}
$PbCl_2$	510	Pb^{2+}	0.99×10^{-9}	1.78×10^{-9}	Cl^-
$KCl \times 2\,PbCl_2$	500		0.8×10^{-9}	1.97×10^{-9}	
RbCl	740	Rb^+	4.7×10^{-9}	4.2×10^{-9}	Cl^-
TlCl	570 (cation) 530 (anion)	Tl^+	5.0×10^{-9}	4.91×10^{-9}	Cl^-

Table 91

Heats of formation (ΔH^0), standard entropies (S^0) and heats of hydration (ΔH_{hyd}) of ions in aqueous solutions at 25°C

Ion	ΔH^0		S^0		ΔH_{hyd}	
	kJ mol^{-1}	kcal mol^{-1}	$JK^{-1}\,mol^{-1}$	cal $K^{-1}\,mol^{-1}$	kJ mol^{-1}	kcal mol^{-1}
acetate$^-$	−489.5	−117	—	—	—	—
Ag^+	105.9	25.3	73.2	17.5	−451.9	−108
$[Ag(NH_3)]^+$	—	—	241.8	57.8	—	—
Al^{3+}	−528.4	−126.3	−318.0	−76	−4548.0	−1087
As^{3+}	—	—	−251.0	−60	—	—
AsO_4^{3-}	−899.6	−215	—	—	—	—
Ba^{2+}	−537.6	−128.5	9.6	2.3	−1305.4	−312
Be^{2+}	−355.6	−85	−113.0	−27	−2389.1	−571
Br^-	−120.1	−28.7	80.7	19.3	−296.2	−70.8
BrO_3^-	−48.5	−11.6	161.1	38.5	—	—
CN^-	146.0	34.9	118.0	28.2	—	—

Ion	ΔH^0		S^0		ΔH_{hyd}	
	kJ mol^{-1}	kcal mol^{-1}	JK^{-1} mol^{-1}	cal K^{-1} mol^{-1}	kJ mol^{-1}	kcal mol^{-1}
CNO^-	−140.2	−33.5	—	—	—	—
CO_3^{2-}	−676.1	−161.6	−54.4	−13	—	—
Ca^{2+}	−542.2	−129.6	−55.2	−13.2	−1569.0	−375
Cd^{2+}	−73.6	−17.6	−68.6	−16.4	−1782.4	−426
Ce^{3+}	−726.8	−173.7	−184.1	−44	—	—
Cl^-	−167.4	−40.0	55.2	13.2	−330.5	−79
ClO^-	−107.9	−25.8	41.8	10.0	—	—
ClO_2^-	−58.6	−14.0	100.8	24.1	—	—
ClO_3^-	−87.9	−21	164.8	39.4	—	—
ClO_4^-	−165.3	−39.5	182.4	43.6	—	—
Co^{2+}	−68.2	−16.3	−113.0	−27	−1924.6	−460
Cr^{2+}	−179.9	−43	—	—	−1882.8	−450
Cr^{3+}	−272.0	−65	−307.5	−73.5	−4142.2	−990
CrO_4^{2-}	−869.8	−207.9	44.3	10.6	—	—
$Cr_2O_7^{2-}$	−1523.0	−364	213.8	51.1	—	—
Cs^+	−247.7	−59.2	133.0	31.8	−263.6	−63
Cu^+	51.9	12.4	−26.4	−6.3	−453.1	−108.3
Cu^{2+}	64.4	15.4	−110.9	−26.5	−2062.7	−493
Er^{3+}	−665.3	−159	—	—	—	—
F^-	−327.2	−78.2	−9.6	−2.3	−472.8	−113
Fe^{2+}	−86.6	−20.7	−113.4	−27.1	−1874.4	−448
Fe^{3+}	−39.7	−9.5	−293.3	−70.1	−4707.0	−1125
formate$^-$	−410.0	−98.0	91.6	21.9	—	—
Ga^{3+}	—	—	−347.3	−83	−4389.0	−1049
Gd^{3+}	682.0	−163	−197.1	−47.1	—	—
Ge^{4+}	—	—	−656.9	−157	—	—
H^+	0.00	0.00	0.00	0.00	−1076.5	−257.3
HCO_3^-	−688.7	−164.6	92.9	22.2	—	—
HPO_4^{2-}	−1285.7	−307.3	36.4	8.7	—	—
HS^-	−15.5	−3.7	62.3	14.9	−267.8	−64
HSO_3^-	−627.6	−150	136.4	32.6	—	—
HSO_4^-	−892.4	−213.3	126.8	30.3	—	—
$H_2AsO_4^-$	—	—	117.1	28	—	—
$H_2PO_4^-$	−1290.3	−308.4	90.4	21.6	—	—
Hg_2^{2+}	168.2	40.2	82.4	19.7	—	—
Hg^{2+}	174.0	41.6	−27.2	−6.5	−1807.5	−432
I^-	−56.1	−13.4	105.8	25.3	−263.6	−63
IO_3^-	−228.0	−54.5	117.1	28	—	—
In^{3+}	—	—	−175.7	−42	−4050.1	−968
Ir^{4+}	—	—	−443.5	−106	—	—
K^+	−252.3	−60.3	100.4	24	−328.9	−78.6
La^{3+}	−707.1	−169	−184.1	−44	−3334.6	−797
Li^+	−278.6	−66.6	14.2	3.4	−502.5	−120.1
Mg^{2+}	−461.5	−110.3	−118.0	−28.2	−1887.0	−451
Mn^{2+}	−205.8	−49.2	−79.9	−19.1	−1824.2	−436
MnO_4^-	−511.7	−122.3	195.4	46.7	—	—
Mo^{4+}	—	—	−430.9	−103	—	—

(continued)

Ion	ΔH^0		S^0		ΔH_{hyd}	
	kJ mol^{-1}	kcal mol^{-1}	J K^{-1} mol^{-1}	cal K^{-1} mol^{-1}	kJ mol^{-1}	kcal mol^{-1}
NH_4^+	−131.8	−31.5	110.5	26.4	−330.5	−79
NO_2^-	−107.1	−25.6	125.1	29.9	—	—
NO_3^-	207.9	49.7	146.4	35.0	—	—
Na^+	−240.6	−57.5	58.6	14	−410.0	−98
Nb^{4+}	—	—	422.6	−101	—	—
Ni^{2+}	−63.6	−15.2	129.7	−31	−2033.4	−486
OH^-	−229.7	−54.9	10.5	−2.5	−338.9	−81
Os^{4+}	—	—	−435.1	−104	—	—
oxalate^{2-}	−845.2	−202	40.2	9.6	—	—
PO_4^{3-}	−1245.2	−297.6	−217.6	−52	—	—
Pb^{2+}	−1.7	−0.4	21.3	5.1	−1485.3	−355
Pb^{4+}	—	—	−351.5	−84	−6276.0	−1500
Pr^{3+}	−702.9	−168	—	—	—	—
Pu^{3+}	—	—	−163.2	−39	—	—
Pu^{4+}	—	—	−364.0	−87	—	—
Ra^{2+}	−527.2	−126	54.4	13	—	—
Rb^+	−255.2	−61.0	120.1	28.7	−313.8	−75
Rh^{3+}	—	—	−251.0	−60	—	—
Ru^{4+}	—	—	−451.9	−108	—	—
S^{2-}	41.8	10.0	−23.0	−5.5	−1338.9	−320.0
SO_3^{2-}	12.5	3	—	—	—	—
SO_4^{2-}	−903.7	−216	18.4	4.4	—	—
Sb^{3+}	—	—	−179.9	−43	—	—
Se^{3+}	—	—	−200.8	−48	—	—
Si^{4+}	—	—	−740.6	−177	—	—
Sn^{2+}	−10.0	−2.4	−20.5	−4.9	−1569.0	−375
Sn^{4+}	—	—	−397.5	−95	−7531.2	−1800
Sr^{2+}	−543.9	−130.0	−30.5	−7.3	−1414.2	−338
Te^{4+}	—	—	−330.5	−79	—	—
Th^{4+}	−765.7	−183.0	−272.0	−65	−7610.7	−1819
Ti^{4+}	—	—	−456.1	−109	—	—
Tl^+	4.2	1	127.6	30.5	−320.5	−76.6
Tl^{3+}	115.9	27.7	−146.4	−35	−4041.7	−966
U^{3+}	−514.6	−123.0	−150.6	−36	—	—
U^{4+}	−613.8	−146.7	−326.3	−78	—	—
UO_2^+	−1035.1	−247.4	50.2	12	—	—
V^{3+}	—	—	−272.0	−65	−3598.2	−860
V^{4+}	—	—	−477.0	−114	—	—
W^{4+}	—	—	−431.0	−103	—	—
Y^{3+}	−702.9	−168	−142.3	−34	−3447.6	−824
Zn^{2+}	−152.3	−36.4	−107.1	−25.6	−2008.3	−480
Zr^{4+}	—	—	−338.9	−81	—	—

Table 92

Solvation energies of some ions in various solvents

Ion	Solvent					
	Ammonia (l)		Ethanol		Methanol	
	Solvation energy					
	kJ mol^{-1}	kcal mol^{-1}	kJ mol^{-1}	kcal mol^{-1}	kJ mol^{-1}	kcal mol^{-1}
Ag^+	−548.1	−131	−472.8	−113	−472.8	−113
Br^-	−334.7	−80	−326.3	−78	−330.5	−79
Cl^-	−355.6	−85	−380.7	−91	−351.5	−84
I^-	−297.1	−71	−288.7	−69	−292.9	−70
K^+	−339.0	−81	−330.5	−79	−330.5	−79
Li^+	−539.7	−129	−531.4	−127	−531.4	−127
Na^+	−422.6	−101	−414.2	−99	−418.4	−100
Zn^{2+}	−2259.4	−540	−2054.3	−491	−2050.2	−490

Table 93

Relaxation times of some electrolytes in 0.001 M solutions

Electrolyte	*t*, °C	Relaxation time × 10^7, s	Electrolyte	*t*, °C	Relaxation time × 10^7, s
$Ca_2[Fe(CN)_6]$	25	0.109	$K_4[Fe(CN)_6]$	25	0.103
$CdSO_4$	18	0.315	$LaCl_3$	18	0.190
HCl	18	0.189	LiCl	18	0.723
KCl	18	0.551	$MgCl_2$	18	0.323

Table 94

Relative permittivities (static) of elements and inorganic compounds

Formula	*t*, °C	ε	Formula	*t*, °C	ε
AgBr	—	12.2	BaO_2	—	10.7
AgCN	—	5.6	$BaSO_4$	15	11.4
AgCl	—	8.8	$BaTiO_3$	20	1650
Ag_2O	—	11.2		121	9000
$AlBr_3$	100	3.4	Br_2	21	3.1
Al_2O_3	—	12.6	C (diamond)	180	1.013
Ar	−191	1.54		—	16.5
$AsBr_3$ (s)	20	3.3		—	5.5
AsBr (l)	35	8.8	CCl_4	20	2.24
$AsCl_3$ (l)	21	12.4		25	2.23
$AsCl_3$ (s)	−50	3.6		110	1.003
AsH_3	−100	2.5	$(CN)_2$	23	2.5
$BaCO_3$	—	8.5	CO	0	1.0007
$BaCl_2$	—	11.4	CO_2 (l)	0	1.6
$BaCl_2 \cdot 2H_2O$	—	9.4	CS_2	20	2.64
$Ba(NO_3)_2$	—	5.9	CS_2 (g)	0	1.003

Formula	t, °C	ε	Formula	t, °C	ε
$CaCO_3$	—	6.1	H_2O (l)	55	68.34
$Ca(NO_3)_2$	—	6.5		60	66.81
CaF_2	—	7.4		65	65.32
$CaTiO_3$	25	165		70	63.85
CdBr	—	8.6		75	62.43
Cl_2	−50	2.1		80	61.03
	0	1.9		85	59.66
CsCl	—	6.3		90	58.32
CsI	25	5.6		95	57.00
CuCl	—	10		100	55.72
CuO	15	18.1	H_2O (vapour)	110	1.013
$CuSO_4 \cdot H_2O$	—	7.0		140	1.008
$CuSO_4 \cdot 5\,H_2O$	—	6.5	H_2O_2 (100%)	0	90
Cu_2O	—	10.5		20	74
D_2O	25	78.25	H_2S (l)	−79	9
F_2	−202	1.54		0	6
$Fe(CO)_5$	—	2.6		10	5.7
FeO	15	14.2	H_2S (g)	0	1.004
$GeCl_4$	25	2.4		23	1.003
H_2 (l)	−253	1.23	H_2SO_4	20	~84
H_2	0	1.00026	He (l)	−271	1.06
HBr	−85	7.0	Hg (vapour)	400	1.0007
	−80	6.3	$HgCl_2$	—	3.2
HBr (g)	0	1.003	Hg_2Cl_2	—	9.4
HCN	0	152	I_2	—	4
	20	115	I_2 (l)	118	11
	25	107	$KAl(SO_4)_2$	—	3.8
HCl (l)	−15	6.4	KBr	—	4.9
HCl (l)	−90	8.9	$KBrO_3$	—	7.9
HCl (s)	−176	2.9	KCN	—	6.2
HCl (g)	0	1.005	KCNS	—	7.9
HF	0	84	KCl	—	5
HI (l)	−50	3.4	$KClO_3$	—	6
	−90	3.9	$KClO_4$	—	5.9
HI (g)	0	1.002	KF	—	6
H_2O (s)	−2	94	KH_2PO_4	−130	5000
H_2O (s)	0	87.74	KI	—	5.6
H_2O (l)	5	85.76	KIO_3	—	16.9
	10	83.83	KNO_3	—	5
	15	81.94	K_2CO_3	15	5.6
	20	80.10	K_2CrO_4	—	7.3
	25	78.30	K_2S	—	6.9
	30	76.55	K_2SO_4	—	5.9
	35	74.82	K_3PO_4	—	7.8
	40	73.15	LiCl	—	10.6
	45	71.51	$MgCO_3$	—	8.1
	50	69.91	MgF_2	—	9.5

Formula	t, °C	ε
MgO	—	8.2
$MgSO_4$	—	8.2
N_2 (l)	−203	1.45
N_2	0	1.0006
	20	1.00058
NH_3 (l)	−33	22
NH_3 (l)	−24	15
NH_3	0	1.007
NH_4Br	—	7.1
NH_4Cl	—	6.9
$(NH_4)SO_4$	—	3.3
NO	0	1.006
N_2H_4	20	53
N_2O (l)	0	1.6
N_2O	0	1.001
$NaBrO_3$	—	7.7
NaCl	—	6
$NaClO_4$	—	5.4
NaF	—	6.9
$NaHCO_3$	—	4.4
$NaNO_3$	—	5.2
Na_2CO_3	—	8.4
$Na_2CO_3 \cdot 10H_2O$	—	5.3
Ne	0	1.00013
$Ni(CO)_4$	—	2.2
O_2 (l)	−182	1.5
O_2	0	1.0005
P yellow	—	3.6
P red	—	4.1
P (l)	46	4
PBr_3	—	3.9
PCl_3	18	3.7
	25	3.4
PH_3 (l)	−50	2.6
PI_3 (s)	20	3.7
PI_3 (l)	65	4.1
$POCl_3$	—	13
P_2O_3	22	3.2
$Pb(CH_3COO)_2$	—	2.6
$PbCl_2$	—	~32
$PbCO_3$	15	18.6
PbI_2	—	20.8
$PbMoO_4$	—	24
$Pb(NO_3)_2$	—	16.8
PbO	15	25.9

Formula	t, °C	ε
PbS	15	17.9
$PbSO_4$	—	15
Pb_3O_4	—	17.8
RbCl	—	4.7
RbF	—	5.9
RbI	—	4.8
Rb_2CO_3	—	6.7
S	—	~4
S (l)	118	3.5
$SOCl_2$	20	9.25
	22	9.05
SO_2	0	1.0093
	15	1.0090
SO_2 (l)	20	14.1
SO_2Cl_2	—	10
SO_3 (l)	18	3.1
	21	3.6
S_2Cl_2	15	4.8
$SbBr_3$ (s)	20	5.1
$SbBr_3$ (l)	100	21
$SbCl_3$ (s)	—	5.3
$SbCl_3$ (l)	75	33
$SbCl_5$	20	3.22
	22	3.8
Se (amorph)	25	6.1
Se (l)	250	5.4
$SiCl_4$	16	2.4
$SnCl_4$	20	2.87
SnO_2	—	24
$SrCO_3$	—	8.9
	22	3.2
ThO_2	—	16.5
$TiCl_4$	—	2.8
TiO_2 (rutile)	—	‖180*
	—	⊥92
TlCl	—	~40
$TlNO_3$	—	16.5
U_3O^8	—	41.8
VCl_4	25	3
$VOCl_3$	25	3.4
ZnS	—	8.3
$ZnSO_4 \cdot H_2O$	—	8.3
$ZnSO_4 \cdot 7\,H_2O$	—	6.2
ZrO_2	—	12.4

* The symbols ⊥ and ‖ signify that the measurements were made perpendicular and parallel, respectively, to the optical axes of the crystals.

Table 95

Relative permittivities (static) of some aqueous electrolyte solutions at 25°C

Electrolyte	N	ε	Electrolyte	N	ε
$BaCl_2$	1.0	64.0	$MgCl_2$	0.468	71.0
	2.0	51.0		0.935	64.5
HCl	0.25	72.5	NaI	0.428	71.0
	0.5	69.0		0.856	64.0
KCl	0.5	73.5	NaOH	0.25	73.0
	1.0	68.5		0.5	68.0
	1.5	63.5	Na_2SO_4	0.5	73.0
	2.0	58.5		1.0	67.0
LiCl	0.5	71.2		2.0	60.5
	1.0	64.2	RbCl	0.5	73.5
	1.5	57.0		1.0	68.5
	2.0	51.0		1.5	63.5
				2.0	58.5

Table 96

Relative permittivities of organic compounds.

The values given in this table are the so-called static values.

Figures in italics are values measured at high frequencies (100–500 MHz)

No.	Compound	Formula	t, °C	ε
1	Acetal	$CH_3CH(OC_2H_5)_2$	20	3.45
2	Acetaldehyde (g)	CH_3CHO	20	1.0213
3	Acetaldehyde (l)		10	*21.8*
			21	*21.1*
4	Acetaldoxime	CH_3CHNOH	23	3.0
5	Acetamide	CH_3CONH_2	20	4
6	Acetamide (l)		83	*59*
7	Acetanilide	$C_6H_5NHCOCH_3$	20	2.9
8	Acetic acid (s)	CH_3COOH	2	4.1
9	Acetic acid		20	6.14
			40	6.3
			70	6.6
10	Acetic anhydride	$(CH_3CO)_2O$	1	22
			19	20.7
11	Acetoacetic ester	$CH_3COCH_2COOC_2H_5$	22	*15.7*
12	Acetone	CH_3COCH_3	−80	34.5
			−40	28.42
			−20	25.91
			0	23.65
			20	21.45
			25	20.70
			40	19.38

No.	Compound	Formula	t, °C	ε
	Acetone (g)		100	1.0159
13	Acetone dichloride	$(CH_3)_2CCl_2$	20	10.2
14	Acetonitrile	CH_3CN	20	37.5
			82	26.6
15	Acetophenone	$CH_3COC_6H_5$	25	17.39
			202	8.64
16	Acetylacetone	$(CH_3CO)_2CH_2$	20	*25.7*
17	Acetyl bromide	CH_3COBr	20	*16.2*
18	Acetyl chloride	CH_3COCl	2	16.9
			22	15.8
	Acetyl chloride (g)		20	1.0217
19	Acetylene	C_2H_2	0	1.00134
20	*cis*-Acetylene dibromide	CHBrCHBr	0	7.7
			25	7.1
21	*trans*-Acetylene dibromide	CHBrCHBr	0	7.7
			25	7.1
22	Acetylene dichloride See 1,2-Dichloroethylene			
23	Acetylene tetrachloride	$(CHCl_2)_2$	20	8.20
24	Allyl alcohol	CH_2CHCH_2OH	15	21.6
25	Allyl chloride	CH_2CHCH_2Cl	1	8.7
			20	8.2
26	Allyl isothiocyanate	CH_2CHCH_2NCS	18	*17.2*
27	Allyl mustard oil See Allyl isothiocyanate			
28	Allyl sulphide	$(CH_2CHCH_2S)_2$	20	4.9
29	Amyl acetate	$CH_3COO(CH_2)_4CH_3$	20	4.75
30	Amyl alcohol	$CH_3(CH_2)_4OH$	25	13.9
31	*tert*-Amyl alcohol	$(C_2H_5)(CH_3)_2COH$	25	5.82
32	Amylamine	$CH_3(CH_2)_4NH_2$	22	*4.5*
33	Amyl benzoate	$C_7H_5COOC_5H_{11}$	20	5.0
34	Amyl bromide	$CH_3(CH_2)_3CH_2Br$	−90	9.9
			25	6.32
35	Amyl chloride	$CH_3(CH_2)_3CH_2Cl$	11	6.6
36	*tert*-Amyl chloride	$(C_2H_5)(CH_3)_2CCl$	−50	12.3
			16	9.3
37	Amyl fluoride	$CH_3(CH_2)_3CH_2F$	20	4.24
38	*tert*-Amyl fluoride	$(CH_3)_2CFC_2H_5$	20	5.89
39	Amyl formate	$HCOO(CH_2)_4CH_3$	25	6.5
40	Amyl iodide	$CH_3(CH_2)_3CH_2I$	20	5.81
41	*tert*-Amyl iodide	$(C_2H_5)(CH_3)_2CI$	20	8.19

(continued)

No.	Compound	Formula	t, °C	ε
42	Amyl mercaptan	$CH_3(CH_2)_4SH$	25	4.55
			50	4.23
43	Amyl mustard oil	$CH_3(CH_2)_4NCS$	20	*17*
44	Amyl nitrate	$CH_3(CH_2)_4ONO_2$	18	*9*
45	Amyl sulphide	$[CH_3(CH_2)_4]_2S$	25	3.83
46	Aniline	$C_6H_5NH_2$	20	6.89
			70	5.93
			184	4.5
47	Anisaldehyde	$CH_3OC_6H_4CHO$	22	22.3
			247	10.4
48	Anisole	$CH_3OC_6H_5$	25	4.3
			70	3.9
49	Aryl phosphates		25	~4.5
50	Azole See Pyrrole			
51	Azoxybenzene	$C_6H_5NONC_6H_5$	40	5.1
52	Benzal chloride	$C_6H_5CHCl_2$	20	*6.9*
53	Benzaldehyde	C_6H_5CHO	0	19.7
			20	17.8
54	Benzaldehyde oxime	C_6H_5CHNOH	20	3.8
55	Benzene	C_6H_6	15	2.292
			20	2.283
			25	2.274
			129	2.073
			182	1.966
	Benzene (vapour)		100	1.0028
56	Benzyl	$C_6H_5COCOC_6H_5$	95	13.0
			120	12.1
57	Benzonitrile	C_6H_5CN	20	26.5
			25	25.20
			40	24.02
			70	22.10
58	Benzophenone (s)	$C_6H_5COC_6H_5$	19	3
	Benzophenone (l)		50	11.4
59	Benzoylacetic ester	$C_6H_5COCH_2COOC_2H_5$	20	12
60	Benzoyl acetoacetic ester	$CH_3COCH(C_6H_5CO)COOC_2H_5$	21	12
61	Benzoyl chloride	C_6H_5COCl	0	29
			20	23
62	Benzyl acetate	$C_6H_5CH_2COOCH_3$	21	*5.1*
63	Benzyl alcohol	$C_6H_5CH_2OH$	20	13.1
			70	9.5
			132	6.6
64	Benzylamine	$C_6H_5CH_2NH_2$	1	5.5
			21	4.6
65	Benzyl benzoate	$C_6H_5CO_2CH_2C_6H_5$	20	*4.9*
66	Benzylcarbinol	$C_6H_5CHOHCH_3$	20	13
			60	9
			90	7.6

No.	Compound	Formula	t, °C	ε
67	Benzyl cyanide	$C_6H_5CH_2CN$	25	19.0
			234	8.5
68	Benzylethylamine	$(C_6H_5CH_2)(C_2H_5)NH$	20	*4.3*
69	Benzylidene chloride	$C_6H_5CHCl_2$	20	*6.9*
70	Benzyl salicylate	$C_6H_5CH_2CO_2C_6H_4OH$	20	*4.1*
71	*dl*-Borneol acetate	$C_{10}H_{17}OCOCH_3$	21	4.6
72	*dl*-Bornyl acetate See *dl*-Borneol acetate			
73	Bromal	CBr_3CHO	20	*7.6*
74	*m*-Bromoaniline	$BrC_6H_4NH_2$	19	13
75	*p*-Bromoanisole	$BrC_6H_4OCH_3$	30	7.06
76	Bromobenzene	C_6H_5Br	25	5.40
77	1-Bromobutane	$C_2H_5CH_2CH_2Br$	−90	11.1
			−50	9.26
			−10	7.88
			20	7.07
78	2-Bromobutane	$C_2H_5CHBrCH_3$	25	8.6
79	1-Bromo-2-chloro-benzene	C_6H_4BrCl	20	6.8
80	1-Bromo-3-chloro-benzene	C_6H_4BrCl	20	4.5
81	1-Bromo-2-chloro-ethane	C_2H_4BrCl	−10	7.98
82	*cis*-1-Bromo-2-chloroethylene	BrCH : CHCl	17	7.3
83	*trans*-1-Bromo-2-chloroethylene	BrCH : CHCl	17	2.5
84	Bromocyclohexane	$C_6H_{11}Br$	−65	11
			25	7.9
85	1-Bromodecane	$CH_3(CH_2)_9Br$	1	4.75
			25	4.44
86	1-Bromododecane	$CH_3(CH_2)_{10}CH_2Br$	25	4.07
87	Bromoethane	C_2H_5Br	−90	16.1
			−60	13.6
			20	9.39
88	1-Bromo-2-ethoxy-pentane	$CH_3(CH_2)_2CH(OC_2H_5)CH_2Br$	25	6.45
89	2-Bromo-3-ethoxy-pentane	$CH_3CH_2CH(OC_2H_5)CHBrCH_3$	25	6.40
90	3-Bromo-2-ethoxy-pentane	$CH_3CH_2CHBrCH(OC_2H_5)CH_3$	25	8.24
91	Bromoform	$CHBr_3$	20	4.39
92	1-Bromoheptane	$CH_3(CH_2)_5CH_2Br$	−10	5.96
			10	5.58
			25	5.33
			90	4.48

(continued)

No.	Compound	Formula	*t*, °C	ε
93	2-Bromoheptane	$CH_3(CH_2)_4CHBrCH_3$	22	6.46
94	3-Bromoheptane	$CH_3(CH_2)_3CHBrCH_2CH_3$	22	6.93
95	4-Bromoheptane	$CH_3(CH_2)_2CHBr(CH_2)_2CH_3$	22	6.81
96	1-Bromohexadecane	$CH_3(CH_2)_{14}CH_2Br$	25	3.71
97	1-Bromohexane	$CH_3(CH_2)_4CH_2Br$	1	6.30
			25	5.82
98	α-Bromoisovaleric acid	$CH_3(CH_2)_2CHBrCOOH$	20	*6.5*
99	Bromomethane (l)	CH_3Br	0	9.82
100	α-Bromonaphthalene	$C_{10}H_7Br$	25	4.83
101	1-Bromononane	$CH_3(CH_2)_7CH_2Br$	−20	5.42
			25	4.74
102	1-Bromooctane	$CH_3(CH_2)_6CH_2Br$	−50	6.35
103	1-Bromopentadecane	$CH_3(CH_2)_{13}CH_2Br$	20	3.9
104	2-Bromopropane See Isopropyl bromide			
105	α-Bromopropionic acid	$CH_3CHBrCOOH$	21	*11*
106	1-Bromotetradecane	$CH_3(CH_2)_{12}CH_2Br$	25	3.84
107	*m*-Bromotoluene	$CH_3C_6H_4Br$	58	5.36
108	*o*-Bromotoluene	$CH_3C_6H_4Br$	58	4.28
109	*p*-Bromotoluene	$CH_3C_6H_4Br$	58	5.49
110	1-Bromoundecane	$CH_3(CH_2)_9CH_2Br$	− 9	4.73
111	1,4-Butanediol	$HO(CH_2)_4OH$	15	33
			30	30
112	1,3-Butanediol dinitrate	$CH_3CH(ONO_2)CH_2CH_2ONO_2$	20	19
113	2,3-Butanediol dinitrate	$CH_3CH(ONO_2)CH(ONO_2)CH_3$	20	29
114	1-Butanethiol	$CH_3(CH_2)_2CH_2SH$	25	4.95
			50	4.6
115	2-Butanone	$CH_3COC_2H_5$	−40	24.58
			−20	22.27
			0	20.30
			20	18.51
			40	16.80
			60	15.29
116	2-Butanone oxime	$CH_3C(NOH)C_2H_5$	20	*3.4*
117	1-Butene	$C_2H_5CHCH_2$	0	1.0032
118	Butoxyacetylene	$CH:CO(CH_2)_3CH_3$	25	*6.62*
119	Butyl acetate	$CH_3COOC_4H_9$	−73	6 8
			20	5 01
120	Butyl alcohol	$CH_3(CH_2)_2CH_2OH$	20	17.8
			25	17.1
			118	8 2
121	*sec*-Butyl alcohol	$CH_3CH_2CHOHCH_3$	25	15.8

No.	Compound	Formula	t, °C	ε
122	*tert*-Butyl alcohol	$(CH_3)_3COH$	30	10.9
			50	8.5
			70	6.9
123	Butylamine	$C_2H_5CH_2CH_2NH_2$	21	*5.3*
124	*tert*-Butylbenzene	$C_6H_5C(CH_3)_3$	20	2.37
125	Butyl bromide	$C_2H_5CH_2CH_2Br$	−90	11.1
			−50	9.26
			−10	7.88
			20	7.07
126	*sec*-Butyl bromide	$C_2H_5CHBrCH_3$	25	8.6
127	*tert*-Butyl bromide	$(CH_3)_3CBr$	25	10.1
128	Butyl chloral	$CH_3CHClCCl_2CHO$	18	*10*
129	Butyl chloride	$C_2H_5CH_2CH_2Cl$	−90	12.2
			−50	9.9
			−30	9.1
			20	7.4
130	*tert*-Butyl chloride	$(CH_3)_3CCl$	0	10.9
131	Butyl cyanide See Valeronitrile			
132	α-Butylene	$C_2H_5CHCH_2$	0	1.0032
133	β-Butylene bromide	$(CH_3CHBr)_2$	25	5.75
134	Butyl iodide	$CH_3(CH_2)_2CH_2I$	−80	8.9
			−40	7.5
			20	6.2
			130	4.5
135	*sec*-Butyl iodide	$C_2H_5CHICH_3$	20	7.9
136	*tert*-Butyl iodide	$(CH_3)_3CI$	−33	10.5
			20	8.4
137	Butyl mercaptan	$CH_3(CH_2)_2CH_2SH$	25	4.95
			50	4.6
138	Butyl nitrate	$CH_3(CH_2)_2CH_2ONO_2$	20	13
139	Butyl oleate	$CH_3(CH_2)_2CHCH(CH_2)_7CO_2(CH_2)_3$-$CH_3$	25	4.0
140	Butyl stearate	$CH_3(CH_2)_{16}CO_2(CH_2)_3CH_3$	30	3.11
141	Butyraldehyde	$CH_3(CH_2)_2CHO$	26	13.4
			77	10.8
142	Butyric acid	$C_2H_5CH_2COOH$	20	2.97
143	Butyric anhydride	$(CH_3CH_2CH_2CO)_2O$	20	*13*
144	Butyronitrile	$CH_3(CH_2)_2CN$	21	*20.3*
145	Camphene	$C_{10}H_{16}$	40	2.3
146	Caproic acid	$CH_3(CH_2)_4COOH$	71	2.63
147	Caprylic acid	$CH_3(CH_2)_6COOH$	20	2.45
			71	2.5
148	Carbamide	$(NH_2)_2CO$	18	3.5
149	Carbon disulphide	CS_2	−112	3.0
			20	2.64
			180	2.19

(continued)

No.	Compound	Formula	t, °C	ε
150	Carbon tetrachloride	CCl_4	20	2.238
			25	2.228
151	Carvenone	$C_{10}H_{16}O$	20	19
152	Carvone	$C_{10}H_{14}O$	22	*11*
153	Cedrene	$C_{15}H_{24}$	25	3.3
154	Cellosolve acetate	$CH_3COO(CH_2)_2OC_2H_5$	30	7.6
155	Cellulose	$(C_6H_{10}O_5)_n$	19	6.7
156	Cetyl iodide	$CH_3(CH_2)_{14}CH_2I$	20	3.5
157	Chloral	CCl_3CHO	−40	7.6
			20	4.9
			62	4.2
158	Chloroacetic acid	$CH_2ClCOOH$	20	20
	Chloroacetic acid (l)		62	12
159	Chloroacetone	$CH_2ClCOCH_3$	19	*30*
160	*m*-Chloroaniline	$ClC_6H_4NH_2$	19	*13*
161	Chlorobenzene	C_6H_5Cl	−50	7.3
			−20	6.3
			20	5.71
			25	5.62
			130	4.2
162	Chlorocyclohexane	$(CH_2)_5CHCl$	−47	11
			25	7.6
163	1-Chlorododecane	$CH_3(CH_2)_{10}CH_2Cl$	20	4.2
			50	3.9
164	Chloroethane (g)	C_2H_5Cl	19	1.0132
165	*β*-Chloroethyl-2,5-dichlorobenzene	$Cl_2C_6H_3CH_2CH_2Cl$	24	5.2
166	Chloroform	$CHCl_3$	−64	6.8
			−40	6.1
			−20	5.6
			20	4.806
			25	4.641
			100	3.7
			140	3.3
			180	2.9
	Chloroform (g)		120	1.004
167	1-Chloroheptane	$CH_3(CH_2)_5CH_2Cl$	20	5.5
168	2-Chloroheptane	$CH_3(CH_2)_4CHClCH_3$	22	6.5
169	3-Chloroheptane	$CH_3(CH_2)_3CHClCH_2CH_3$	22	6.7
170	4-Chloroheptane	$CH_3(CH_2)_2CHCl(CH_2)_2CH_3$	22	6.5
171	Chloromethane	CH_3Cl	−20	12.6
	Chloromethane (g)		100	1.0069
172	1-Chloronaphthalene	$C_{10}H_7Cl$	25	5.04
173	1-Chlorooctane	$CH_3(CH_2)_6CH_2Cl$	25	5
174	*o*-Chlorophenol	ClC_6H_4OH	25	6.3
175	*p*-Chlorophenol	ClC_6H_4OH	55	9.5
176	*α*-Chlorotoluene	$ClC_6H_4CH_3$	13	7

No.	Compound	Formula	t, °C	ε
177	*m*-Chlorotoluene	$ClC_6H_4CH_3$	20	5.5
			60	5.0
178	*o*-Chlorotoluene	$ClC_6H_4CH_3$	20	4.5
			55	4.2
179	*p*-Chlorotoluene	$ClC_6H_4CH_3$	20	6.1
			55	5.6
180	1,8-Cineole	$C_{10}H_{18}O$	23.5	4.57
181	Cinnamaldehyde	$C_6H_5CHCHCHO$	20	17
182	Cocaine	$C_{17}H_{21}O_4N$	18	3.1
183	Copper oleate	$Cu(C_{18}H_{33}O_2)_2$	100	*2.8*
184	Creosol	$(CH_3O)(CH_3)C_6H_3OH$	16	11
185	*m*-Cresol	$CH_3C_6H_4OH$	25	11.8
186	*o*-Cresol	$CH_3C_6H_4OH$	25	11.5
187	*p*-Cresol	$CH_3C_6H_4OH$	58	9.91
188	Cumaldehyde	$CH_3CH(C_6H_4COH)CH_3$	15	11
189	Cumene	$C_6H_5CH(CH_3)_2$	20	2.38
190	Cyanoacetic acid	$COOHCH_2NC$	19	33.4
191	1,3-Cyclohexadiene	C_6H_8	− 89	2.6
192	Cyclohexane	$(CH_2)_6$	20	2.023
			25	2.015
193	1,4-Cyclohexanedione	$C_6H_8O_2$	25	15.0
194	Cyclohexanol	$(CH_2)_5CHOH$	100	7.2
			150	4.9
195	Cyclohexanone	$(CH_2)_5CO$	− 40	20
			20	18.3
196	Cyclohexanone oxime	$(CH_2)_5CNOH$	89	3.0
197	Cyclohexene	C_6H_{10}	−105	2.6
			25	2.22
198	Cyclohexylamine	$(CH_2)_5CHNH_2$	− 21	5.37
199	Cyclohexyl bromide	$C_6H_{11}Br$	− 65	11
			25	7.9
200	Cyclohexyl chloride	$(CH_2)_5CHCl$	− 47	11
			25	7.6
201	Cyclohexylmethanol	$(CH_2)_5CHCH_2OH$	60	9.7
			80	8.1
202	*o*-Cyclohexyl phenol	$(CH_2)_5CHC_6H_4OH$	55	3.97
203	*p*-Cyclohexyl phenol	$(CH_2)_5CHC_6H_4OH$	131	4.42
204	Cyclohexyl trifluoromethane	$(CH_2)_5CHCF_3$	− 85	12
205	Cyclopentane	$(CH_2)_5$	20	1.96
206	Cyclopentanol	$(CH_2)_4CHOH$	− 20	25
			20	18
207	Cyclopentanone	$(CH_2)_4CO$	− 51	16
208	*p*-Cymene	$CH_3C_6H_4CH(CH_3)_2$	20	2.24
209	*cis*-Decahydronaphthalene See *cis*-Decalin			
210	*cis*-Decalin	$C_{10}H_{18}$	20	2.18

(continued)

No.	Compound	Formula	t, °C	ε
211	*trans*-Decalin		20	2.17
212	Decamethyl-tetrasiloxane	$(CH_3)_3Si[OSi(CH_3)_2]_3CH_3$	20	2.4
213	Decamethylcyclo-pentasiloxane	$(C_2H_6OSi)_5$	20	2.5
214	Decane	$CH_3(CH_2)_8CH_3$	−30	2.05
			20	1.991
			130	1.844
			170	1.783
215	1-Decanol	$CH_3(CH_2)_8CH_2OH$	20	8.1
216	Decyl alcohol See 1-Decanol			
217	Diacetone alcohol	$(CH_3)_2COHCH_2COCH_3$	25	18.2
218	1,2-Diaminoethane	$(CH_2NH_2)_2$	20	14.2
219	Diamylacetylene	$CH_3(CH_2)_4C : C(CH_2)_4CH_2$	25	2.17
220	Diamyl ether	$[(CH_3)_2CHCH_2CH_2]_2O$	25	2.77
221	Diamyl sulphide	$[CH_3(CH_2)_4]_2S$	25	3.83
222	Dibenzofuran	$(C_6H_4)_2O$	100	3.0
223	Dibenzylamine	$(C_6H_5CH_2)_2NH$	20	*3.6*
224	Dibenzyl sebacate	$(C_6H_5CH_2)_2(CO_2)_2(CH_2)_8$	25	4.6
225	*m*-Dibromobenzene	$C_6H_4Br_2$	20	4.80
226	*o*-Dibromobenzene	$C_6H_4Br_2$	20	7.35
227	*p*-Dibromobenzene	$C_6H_4Br_2$	95	2.6
228	2,3-Dibromobutane	$(CH_3CHBr)_2$	25	5.75
229	1,2-Dibromoethane	$BrCH_2CH_2Br$	25	4.78
			130	4.1
230	1,2-Dibromoethylene (*cis*)	CHBrCHBr	0	7.7
			25	7.1
231	1,2-Dibromoethylene (*trans*)	CHBrCHBr	0	2.9
			25	2.8
232	1,2-Dibromoheptane	$CH_3(CH_2)_4CHBrCH_2Br$	25	3.8
233	2,3-Dibromoheptane	$CH_3(CH_2)_3CHBrCHBrCH_3$	25	5.1
234	3,4-Dibromoheptane	$CH_3(CH_2)_2CHBrCHBrCH_2CH_3$	25	4.7
235	Dibromomethane	CH_2Br_2	10	7.8
			40	6.7
236	1,2-Dibromopropane	$CH_3CHBrCH_2Br$	20	*4.3*
237	Dibutyl ether	$(C_2H_5CH_2CH_2)_2O$	25	3.06
238	Dibutyl phthalate	$[CH_3(CH_2)_3]_2(CO_2)_2C_6H_4$	30	6.43
239	Dibutyl sebacate	$[(CH_2)_4CO_2C_4H_9]_2$	30	4.54
240	Dibutyl tartrate	$(CHOHCO_2C_4H_9)_2$	41	9.4
241	Dichloroacetic acid	$CHCl_2COOH$	22	8.2
			61	7.8
242	Dichloroacetone	$CH_3COCHCl_2$	20	14
243	*m*-Dichlorobenzene	$C_6H_4Cl_2$	25	5.04
244	*o*-Dichlorobenzene		25	9.93

No.	Compound	Formula	t, °C	ε
245	*p*-Dichlorobenzene		50	2.41
246	1,4-Dichlorobutane	$Cl(CH_2)_4Cl$	25	8.9
247	1,1-Dichloroethane	CH_3CHCl_2	18	10.1
			25	9.9
248	1,2-Dichloroethane	$ClCH_2CH_2Cl$	−10	12.7
			20	10.65
			25	10.36
249	1,1-Dichloroethylene	CH_2CCl_2	16	4.7
250	1,2-Dichloroethylene (*cis*)	$CHClCHCl$	16	4.6
251	1,2-Dichloroethylene (*trans*)		25	2.1
252	Dichloroethyl ether	$(C_2H_4Cl)_2$	20	21.2
253	Dichloromethane	CH_2Cl_2	18	9.1
254	Dicyclopentadiene	$C_{10}H_{12}$	40	2.43
255	Diethylamine	$(C_2H_5)_2NH$	22	*3.6*
256	N-Diethylaniline	$(C_2H_5)_2NC_6H_5$	19	*5.5*
257	Diethyl azelate	$(CH_2)_7(CO_2C_2H_5)_2$	30	5.13
258	Diethyl benzal-malonate	$C_6H_5CH : C(CO_2)_2(C_2H_5)_2$	0	8.0
			20	7.6
			70	5.9
259	Diethyl carbonate	$(C_2H_5)_2CO_3$	20	2.82
260	Diethyl fumarate	$(C_2H_5CO_2CH)_2$	23	6.5
261	Diethyl glutarate	$(CH_2)_3(CO_2C_2H_5)_2$	30	6.7
262	Diethyl ketone	$CO(C_2H_5)_2$	−40	19.8
			−20	19.4
			20	17.0
263	Diethyl maleate	$(C_2H_5CO_2CH)_2$	23	8.58
264	Diethyl malonate	$CH_2(CO_2C_2H_5)_2$	25	8.03
265	Diethyl oxalate	$C_2H_5(CO_2)_2C_2H_5$	21	*8.1*
266	Diethyl sebacate	$(CH_2)_8(CO_2C_2H_5)_2$	30	5.0
267	Diethyl succinate	$(CH_2CO_2C_2H_5)_2$	30	6.64
268	Diethyl sulphate	$(C_2H_5)_2SO_4$	20	29
269	Diethyl sulphide	$(C_2H_5)_2S$	25	5.72
			50	5.24
270	Diethyl sulphite	$(C_2H_5)_2SO_3$	1	17
			20	16
			50	14
271	*o*-Dihydrobenzene	C_6H_8	−89	2.6
272	1,4-Dihydroxybutane	$HO(CH_2)_4OH$	15	33
			30	30
273	*m*-Diiodobenzene	$C_6H_4I_2$	25	4.3
274	*o*-Diiodobenzene		20	5.7
275	*p*-Diiodobenzene		120	2.9
276	Diiodomethane	CH_2I_2	25	5.3
277	1,2-Diiodoethane (*cis*)	ICH_2CH_2I	83	4.5

(continued)

No.	Compound	Formula	t, °C	ε
278	1,2-Diiodoethane (*trans*)		83	3.2
279	Diisoamylamine	$[(CH_3)_2CHCH_2CH_2]_2NH$	18	*2.5*
280	Diisobutylamine	$[(CH_3)_2CHCH_2]_2NH$	22	*2.7*
281	*o*-Dimethoxybenzene See Veratrole			
282	Dimethoxymethane	$CH_2(OCH_3)_2$	20	*2.7*
283	Dimethylacetamide	$CH_3CON(CH_3)_2$	25	37.78
284	Dimethylamine (l)	$(CH_3)_2NH$	0	6.3
			25	5.3
	Dimethylamine (g)		100	1.0033
285	Dimethylaniline	$(CH_3)_2NC_6H_5$	20	4.9
			70	4.4
286	Dimethyl ether See Methyl ether			
287	2,4-Dimethylheptane	$CH_3(CH_2)_2CH(CH_3)CH_2CH(CH_3)CH_3$	20	1.9
288	2,5-Dimethylheptane	$CH_3CH_2CH(CH_3)(CH_2)_2CH(CH_3)CH_3$	20	1.9
289	2,6-Dimethylheptane	$(CH_3)_2CH(CH_2)_3CH(CH_3)_2$	20	2
290	3,4-Dimethyl-1-hydroxybenzene	$C_6H_3(OH)(CH_3)_2$	17	*4.8*
291	Dimethyl malonate	$CH_2(CO_2CH_3)_2$	20	*10*
292	2,2-Dimethylpentane	$CH_3(CH_2)_2C(CH_3)_2CH_3$	20	1.91
293	2,3-Dimethylpentane	$CH_3CH_2CH(CH_3)CH(CH_3)CH_3$	20	1.94
294	2,4-Dimethylpentane	$CH_3CH(CH_3)CH_2CH(CH_3)CH_3$	20	1.91
295	3,3-Dimethylpentane	$CH_3CH_2C(CH_3)_2CH_2CH_3$	20	1.94
296	Dimethyl phthalate	$C_6H_4(CO_2CH_3)_2$	24	8.5
297	2,5-Dimethylpyrazine	C_6H_8N	20	2.43
298	2,3-Dimethyl-quinoxaline	$C_{10}H_{10}N_2$	25	2.3
299	Dimethyl succinate	$CH_3CO_2(CH_2)_2CO_2CH_3$	20	5.1
300	Dimethyl sulphate	$(CH_3)_2SO_4$	−30	60
			0	48
301	Dimethyl sulphide	$(CH_3)_2S$	20	*6.2*
302	Dimethyl sulphoxide See Methyl sulphoxide			
303	Dimethyl-*o*-toluidine	$CH_3C_6H_4N(CH_3)_2$	20	*3.4*
304	Dimethyl-*p*-toluidine		20	*3.9*
305	Dioctyl phthalate	$C_6H_4(CO_2)_2(CH_2)_7CH_3$	25	5.1
306	Dioctyl sebacate	$CH_3(CH_2)_7CO_2(CH_2)_8CO_2(CH_2)_7CH_3$	27	4.0
307	1,4-Dioxan	$O(CH_2)_4O$	25	2.21
308	*m*-Dioxybenzene See Resorcinol			
309	α,γ-Dipalmitin	$C_{35}H_{68}O_5$	72	3.52
			76	3.49
310	Diphenyl	$C_6H_5C_6H_5$	75	2.53
311	Diphenylamine	$(C_6H_5)_2NH$	52	3.3
312	1,2-Diphenylethane	$C_6H_5CH_2CH_2C_6H_5$	110	2.4

No.	Compound	Formula	t, °C	ε
313	Diphenyl ether	$(C_6H_5)_2O$	30	3.65
314	Diphenylmethane	$(C_6H_5)_2CH_2$	18	2.7
	Diphenylmethane (l)		26	2.5
315	Diphenyl oxide	$(C_6H_5)_2O$	30	3.65
316	Dipropenyl	$CH_3CH : CHCH : CHCH_3$	25	2.2
317	Dipropylamine	$(C_2H_5CH_2)_2NH$	21	*2.9*
318	Dipropylcarbinol	$CH_3(CH_2)_2CHOH(CH_2)_2CH_3$	22	6.2
319	Dipropyl ketone See 4-Heptanone			
320	α,γ-Distearin	$C_{39}H_{76}O_5$	78	3.32
			82	3.29
321	Dodecamethyl-cyclohexasiloxane	$(C_2H_6OSi)_6$	20	2.6
322	Dodecamethyl-pentasiloxane	$(CH_3)_3Si[OSi(CH_3)_2]_4CH_3$	20	2.5
323	Dodecane	$CH_3(CH_2)_{10}CH_3$	− 10	2.05
			20	2.01
324	1-Dodecanol	$CH_3(CH_2)_{11}OH$	25	6.5
325	Dodecyl alcohol See 1-Dodecanol			
326	Enanthaldehyde	$(CH_3(CH_2)_5CHO$	20	9.1
327	Enanthic acid	$CH_3(CH_2)_5COOH$	71	2.6
328	Epichlorohydrin	C_3H_5ClO	1	25
			22	22.6
329	1,2-Epoxyethane	$(CH_2)_2O$	− 1	14
330	Erythritol	$(CH_2OHCHOH)_2$	128	28
331	Ethane	C_2H_6	0	1.0015
332	Ethanethiol See Ethyl mercaptan			
333	Ethoxybenzene	$C_2H_5OC_6H_5$	20	4.22
334	1-Ethoxy-3-methylbutane	$C_2H_5OCH_2CH_2(CH_3)CHCH_3$	20	3.96
335	1-Ethoxynaphthalene	$C_2H_5OC_{10}H_7$	19	*3.3*
336	1-Ethoxypentane	$CH_3(CH_2)_4OC_2H_5$	23	3.6
337	α-Ethoxytoluene	$C_2H_5OCH_2C_6H_5$	20	*3.9*
338	Ethyl acetate	$CH_3COOC_2H_5$	20	6.11
			25	6.02
			77	5.3
339	Ethyl alcohol	C_2H_5OH	20	25.00
			25	24.30
	Ethyl alcohol (g)		100	1.006
340	Ethylamine	$C_2H_5NH_2$	10	6.94
341	Ethyl amyl ether	$CH_3(CH_2)_4OC_2H_5$	23	3.6
342	Ethylaniline	$C_6H_5NHC_2H_5$	20	5.8
343	Ethylbenzene	$C_6H_5C_2H_5$	18	2.46
			20	2.41
344	Ethyl benzoate	$C_6H_5CO_2C_2H_5$	20	6
345	Ethyl benzoylacetate	$C_6H_5COCH_2CO_2C_2H_5$	20	12

(continued)

No.	Compound	Formula	t, °C	ε
346	Ethyl benzoyl acetoacetate	$CH_3COCH(C_6H_5CO)COOC_2H_5$	21	12
347	Ethyl benzyl ether	$C_2H_5OCH_2C_6H_5$	20	*3.9*
348	Ethyl bromide	C_2H_5Br	−90	16.1
			−60	13.6
			20	9.39
	Ethyl bromide (g)		20	1.0139
349	Ethyl α-bromo-butyrate	$C_6H_{11}BrO_2$	20	*8*
350	Ethyl α-bromo-isobutyrate	$(CH_3)_2CBrCO_2C_2H_5$	20	*7.9*
351	Ethyl butylcarbinol	$C_2H_5CH(OH)(CH_2)_3CH_3$	22	6.9
352	Ethyl butyl ketone See 3-Heptanone			
353	Ethyl butyrate	$CH_3(CH_2)_2COOC_2H_5$	18	5.1
354	Ethyl carbamate	$NH_2COOC_2H_5$	50	14.2
355	Ethyl chloride (l)	C_2H_5Cl	170	6.3
			180	6.0
			183	5.1
			185.5	4.7
	Ethyl chloride (g)		19	1.0132
356	Ethyl chloroformate	$C_2H_5CO_2Cl$	20	*11*
357	Ethyl cinnamate	$C_6H_5C_2H_2CO_2C_2H_5$	18	6.1
358	Ethyl crotonate	$C_2H_5CO_2C_3H_5$	20	*5.4*
359	Ethyl cyanide See Propionitrile			
360	Ethyl cyanoacetate	$CH_2(CN)COOC_2H_5$	20	26.9
361	Ethyl cyclobutane	$C_2H_5CHCH_2CH_2CH_2$	20	1.96
362	Ethyl dichloroacetate	$C_2H_5CO_2CHCl_2$	2	12
			22	10
363	Ethylene	CH_2CH_2	0	1.00144
364	Ethylene bromide	$BrCH_2CH_2Br$	25	4.78
			130	4.1
365	Ethylene chloride	$ClCH_2CH_2Cl$	−10	12.7
			20	10.65
			25	10.36
366	Ethylene chlorohydrin	$ClCH_2CH_2OH$	20	26
			132	13
367	Ethylenediamine	$(CH_2NH_2)_2$	20	14.2
368	Ethylene glycol	$HOCH_2CH_2OH$	25	37.7
369	Ethylene nitrate	$(O_2NOCH_2)_2$	20	28
370	Ethylene oxide See 1,2-Epoxyethane			
371	Ethyl ether	$(C_2H_5)_2O$	−116	10.4
			20	4.34
			40	3.97
			180	2.1
			190	1.9

No.	Compound	Formula	t, °C	ε
	Ethyl ether (g)		100	1.005
372	Ethyl-*o*-ethoxy-benzoate	$C_2H_5OC_6H_4CO_2C_2H_5$	21	*7*
373	Ethyl formate	$C_2H_5O_2CH$	25	7.16
	Ethyl formate (g)		100	1.008
374	Ethyl fumarate	$(C_2H_5CO_2CH)_2$	23	6.5
375	Ethylidene chloride See 1,1-Dichloro-ethane			
376	Ethyl iodide	C_2H_5I	−90	12.3
			−50	10.2
			20	7.82
	Ethyl iodide (g)		20	1.014
			100	1.009
377	Ethyl isoamyl ether	$C_2H_5OCH_2CH_2(CH_3)CHCH_3$	20	3.96
378	Ethyl isothiocyanate	C_2H_5NCS	21	19.5
379	Ethyl isovalerate	$(CH_3)_2CHCH_2COOC_2H_5$	18	4.71
380	Ethyl laurate	$C_2H_5CO_2(CH_2)_{10}CH_3$	20	3.4
			143	2.7
381	Ethyl levulinate	$C_2H_5CO_2(CH_2)_2COCH_3$	21	*12*
382	Ethyl maleate	$(C_2H_5CO_2CH)_2$	23	8.6
383	Ethyl mercaptan	C_2H_5SH	15	6.9
384	Ethyl mustard oil See Ethyl isothio-cyanate			
385	Ethyl-1-naphthyl ether See 1-Ethoxy-naphthalene			
386	Ethyl nitrate	$C_2H_5ONO_2$	20	19
387	Ethyl oleate	$C_2H_5CO_2C_{17}H_{33}$	25	3.2
			150	2.6
388	Ethyl palmitate	$C_2H_5CO_2C_8H_{17}$	20	3.2
389	3-Ethylpentane	$(C_2H_5)_3CH$	20	1.94
390	Ethyl phenylacetate	$C_6H_5CH_2COOC_2H_5$	21	*5.3*
391	Ethyl propionate	$C_2H_5CO_2CH_2CH_3$	18	5.7
392	Ethyl salicylate	$C_2H_5CO_2C_6H_4OH$	30	8
393	Ethyl stearate	$C_2H_5CO_2(CH_2)_{16}CH_3$	40	2.98
			100	2.69
			167	2.48
394	Ethyl thiocyanate	C_2H_5SCN	21	29.3
395	*p*-Ethyltoluene	$C_2H_5C_6H_4CH_3$	25	2.24
396	Ethyl trichloroacetate	$C_2H_5CO_2CCl_3$	20	7.8
397	Ethyl valerate	$C_2H_5CO_2(CH_2)_3CH_3$	18	4.7
398	Eugenol	$C_6H_3(C_3H_5)(OCH_3)OH$	0	10.5
399	Eunatrol See Sodium oleate			
400	Fluorobenzene	C_6H_5F	25	5.42
			60	4.7

(continued)

No.	Compound	Formula	t, °C	ε
401	*m*-Fluorotoluene	$CH_3C_6H_4F$	30	5.42
			60	4.9
402	*o*-Fluorotoluene		30	4.22
			60	3.9
403	*p*-Fluorotoluene		30	5.86
			60	5.3
404	Formamide	$HCONH_2$	25	109.5
405	Formic acid	$HCOOH$	16	58
			21	57
406	Furan	C_4H_4O	25	2.95
407	Furfural	C_4H_3OCHO	1	47
			20	42
			50	35
408	Glycerol	$CH_2OHCHOHCH_2OH$	25	42.5
409	Glycerol triacetate	$C_3H_5(CO_2CH_3)_3$	20	7.2
410	Glycerol trinitrate See Nitroglycerin			
411	Glycerol trioleate	$C_{57}H_{104}O_6$	26	3.2
412	Glycerol tripalmitate	$C_{51}H_{98}O_6$	65	2.9
413	Glycerol tristearate	$C_{57}H_{110}O_6$	70	2.8
414	Glycol See Ethylene glycol			
415	Glycol acetate	$CH_3COOCH_2CH_2OH$	30	13
416	Glycol dimethyl ether	$CH_3OCH_2CH_2OCH_3$	20	3.5
417	Glycol dinitrate See Ethylene nitrate			
418	Guaiacol	$CH_3OC_6H_4OH$	25	*12*
419	Hemimellitene	$(CH_3)_3C_6H_3$	20	2.636
			30	2.609
420	Heptane	$CH_3(CH_2)_5CH_3$	−90	2.074
			20	1.924
			70	1.85
	Heptane (g)		100	1.0035
421	1-Heptanol	$CH_3(CH_2)_5CH_2OH$	22	12.1
422	2-Heptanol	$CH_3(CH_2)_4CHOHCH_3$	22	9.21
423	3-Heptanol	$C_2H_5CH(OH)\ (CH_2)_3CH_3$	22	6.9
424	4-Heptanol	$CH_3(OH_2)_2CHOH(CH_2)_2CH_3$	22	6.2
425	3-Heptanone	$C_2H_5CO(CH_2)_3CH_3$	22	12.9
426	4-Heptanone	$(C_2H_5CH_2)_2CO$	−20	15.10
			0	13.80
			20	12.60
			40	11.42
			80	9.46
			120	8.00
427	1-Heptene	$CH_3(CH_2)_4CHCH_2$	20	2
428	Heptoic acid See Enanthic acid			

No.	Compound	Formula	t, °C	ε
429	Heptyl alcohol See 1-Heptanol			
430	Heptyl aldehyde See Enanthaldehyde			
431	Heptyl bromide	$CH_3(CH_2)_5CH_2Br$	−10	5.96
			10	5.58
			25	5.33
			90	4.48
432	α-Heptylene See 1-Heptene			
433	Heptyl iodide	$CH_3(CH_2)_5CH_2I$	22	4.9
434	Hexachlorobuta-1,3-diene	$Cl_2C : CClCCl : CCl_2$	20	2.6
435	α-Hexachloro-cyclohexane	$(CHCl)_6$	157	4.8
436	Hexadecamethyl cyclooctasiloxane	$(C_2H_6OSi)_8$	20	2.7
437	1-Hexadecanol	$CH_3(CH_2)_{14}CH_2OH$	50	3.8
438	2,4-Hexadiene See Dipropenyl			
439	Hexahydrobenzoic acid	$(CH_2)_6COOH$	31	2.6
440	Hexalin See Cyclohexanol			
441	Hexamethylacetone	$(CH_3)_3CCOC(CH_3)_3$	14.5	10.0
442	Hexamethyldisiloxane	$(CH_3)_3SiOSi(CH_3)_2CH_3$	20	2.2
443	Hexane	$CH_3(CH_2)_4CH_3$	−90	2.044
			−50	1.990
			15	1.904
			20	1.890
444	1-Hexanol	$CH_3(CH_2)_4CH_2OH$	25	13.3
			75	8.5
445	2-Hexanone	$CH_3CO(CH_2)_3CH_3$	14.5	14.6
446	Hexyl alcohol See 1-Hexanol			
447	Hexyl bromide See 1-Bromohexane			
448	Hexyl iodide See 1-Iodohexane			
449	Iodobenzene	C_6H_5I	20	4.6
450	1-Iodododecane	$CH_3(CH_2)_{10}CH_2I$	20	3.9
451	Iodoethane See Ethyl iodide			
452	1-Iodoheptane See Heptyl iodide			
453	3-Iodoheptane	$CH_3(CH_2)_3CHICH_2CH_3$	22	6.4
454	1-Iodohexadecane See Cetyl iodide			

(continued)

No.	Compound	Formula	t, C°	ε
455	1-Iodohexane	$CH_3(CH_2)_4CH_2I$	20	5.4
456	Iodomethane See Methyl iodide			
457	1-Iodo-octane	$CH_3(CH_2)_7I$	25	4.6
458	2-Iodo-octane	$CH_3(CH_2)_5CHICH_3$	20	5.8
459	2-Iodopropane See Isopropyl iodide			
460	*p*-Iodotoluene	$CH_3C_6H_4I$	35	4.4
461	α-Ionone	$C_{10}H_{16}CHCOCH_3$	18	11
462	β-Ionone		20	12
463	Iron pentacarbonyl	$Fe(CO)_5$	20	2.6
464	Isoamyl acetate	$CH_3COO(CH_2)_2CH(CH_3)_2$	20	4.81
			30	4.63
465	Isoamyl alcohol	$(CH_3)_2CH(CH_2)_2OH$	25	14.7
			130	5.8
466	Isoamyl bromide	$(CH_3)_2CHCH_2CH_2Br$	−107	10.2
			− 56	8.04
			20	6.05
467	Isoamyl butyrate	$CH_3(CH_2)CO_2CH_2CH_2CH(CH_3)_2$	20	*4.0*
468	Isoamyl chloride	$(CH_3)_2CHCH_2CH_2Cl$	−100	10.0
			− 70	7.63
			20	6.05
469	Isoamyl ether	$[(CH_3)_2CH(CH_2)_2]O$	20	2.82
470	Isoamyl iodide	$(CH_3)_2CHCH_2CH_2I$	19	*5.6*
471	Isoamyl isovalerate	$(CH_3)_2CHCH_2COOC_5H_{11}$	19	3.62
472	Isoamyl propionate	$(CH_3)_2CHCH_2CH_2COOC_2H_5$	20	*4.2*
473	Isoamyl salicylate	$(CH_3)_2CHCH_2CH_2CO_2C_6H_4OH$	20	*5.4*
474	Isoamyl valerate	$(CH_3)_2CHCH_2CH_2O_2C(CH_2)_3CH_3$	19	*3.6*
475	Isobutyl acetate	$CH_3COOCH_2CH(CH_3)_2$	20	5.29
476	Isobutyl alcohol	$(CH_3)_2CHCH_2OH$	− 80	34
			− 34	26
			25	17.8
477	Isobutylamine	$(CH_3)_2CHCH_2NH_2$	21	*4.4*
478	Isobutylbenzene	$(CH_3)_2CHCH_2C_6H_5$	20	2.319
			30	2.298
479	Isobutyl benzoate	$(CH_3)_2CHCH_2O_2CC_6H_5$	20	5.4
480	Isobutyl bromide	$(CH_3)_2CHCH_2Br$	25	7.2
481	Isobutyl butyrate	$(CH_3)_2CHCH_2O_2C(CH_2)_2CH_3$	20	*4.1*
482	Isobutyl chloride	$(CH_3)_2CHCH_2Cl$	−120	12.2
			− 89	10.1
			− 38	7.9
			14	6.5
			19	6.1
483	Isobutyl cyanide See Isovaleronitrile			
484	Isobutyl formate	$HCO_2CH_2CH(CH_3)_2$	19	*6.4*
485	Isobutyl iodide	$(CH_3)_2CHCH_2I$	20	6.5

No.	Compound	Formula	t, °C	ε
486	Isobutyl nitrate	$(CH_3)_2CHCH_2ONO_2$	19	*12*
487	Isobutyl ricinoleate	$HOC_{17}H_{32}CO_2C_4H_9$	21	4.7
488	Isobutyl valerate	$CH_3(CH_2)_3CO_2CH_2CH(CH_3)_2$	19	*3.8*
489	Isobutyric acid	$(CH_3)_2CHCOOH$	20	2.7
490	Isobutyric anhydride	$[(CH_3)_2CHCO]_2O$	20	*14*
491	Isobutyronitrile	$(CH_3)_2CHCN$	24	*20.4*
492	Isocapronitrile	$(CH_3)_2CH(CH_2)_2CN$	22	*15*
493	Isononane See 2-Methyl octane			
494	Isopentane See 2-Methylbutane			
495	Isoprene	$CH : CHC(CH_3) : CH_2$	25	2.1
496	Isopropyl alcohol	$(CH_3)_2CHOH$	18	18.62
			40	16.24
			60	14.03
497	Isopropylamine	$(CH_3)_2CHNH_2$	20	*5.5*
498	Isopropylbenzene See Cumene			
499	Isopropyl bromide	$CH_3CHBrCH_3$	−89	16.1
			25	9.46
500	Isopropyl ether	$(CH_3)_2CHOCH(CH_3)_2$	25	3.88
501	Isopropyl iodide	CH_3CHICH_3	20	8.19
502	Isopropyl nitrite	$(CH_3)_2CHONO$	19	*12*
503	Isoquinoline	C_9H_7N	20	11
504	Isosafrole	$C_{10}H_{10}O_2$	21	*3.3*
505	Isovaleric acid	$(CH_3)_2CHCH_2COOH$	20	2.64
506	Isovaleronitrile	$(CH_3)_2CHCH_2CN$	22	*18*
507	Ketine See 2,5-Dimethyl-pyrazine			
508	*dl*-Lactic acid	$CH_3CHOHCOOH$	17	22
509	Lactonitrile	$CH_3CHOHCN$	20	*38*
510	Lead oleate	$Pb(C_{18}H_{33}O_2)_2$	m.p.	*3.7*
511	*d*-Limonene	$C_{10}H_{16}$	20	2.4
512	*dl*-Limonene	$C_{10}H_{16}$	20	2.3
513	Linoleic acid	$C_{18}H_{32}O_2$	0	2.61
			20	2.71
			70	2.70
			120	2.60
514	Maleic anhydride	$(CHCO)_2O$	60	*50*
515	Malonic dinitrile	$CH_2(CN)_2$	36	*46*
516	Mandelonitrile	$C_6H_5CHOHCN$	20	18
517	Mannitol	$HOCH_2(CHOH)_4CH_2OH$	170	25
518	*l*-Menthol	$C_{10}H_{19}OH$	43	3.95
519	Menthone	$C_{10}H_{18}O$	18	*8.8*
520	Mercury diethyl	$Hg(C_2H_5)_2$	23	2.3
521	Mesitylene	$(CH_3)_3C_6H_3$	20	2.3

(continued)

No.	Compound	Formula	t, °C	ε
522	Mesityl oxide	$(CH_3)_2C : CHCOCH_3$	0	15.6
			20	15.1
523	Methane	CH_4	0	1.00094
	Methane (l)		−184	1.7
524	Methanol	CH_3OH	−110	64
			− 80	54
			− 20	40
			20	33.62
			25	32.63
525	Methoxybenzene See Anisole			
526	Methoxyethanol	$CH_3OCH_2CH_2OH$	30	16.0
527	*o*-Methoxyphenol See Guaiacol			
528	*m*-Methoxytoluene	$CH_3OC_6H_4CH_3$	20	4.1
529	*o*-Methoxytoluene		20	3.5
530	*p*-Methoxytoluene		20	4 0
531	Methyl acetate	CH_3COOCH_3	20	7.03
532	Methylal	$CH_2(OCH_3)_2$	20	2.7
533	Methylamine (l)	CH_3NH_2	− 10	11.4
			18	10.0
			25	9.4
	Methylamine (g)		100	1.0038
534	Methyl amyl ketone	$CH_3(CH_2)_4COCH_3$	− 20	14.27
			0	13.13
			20	11.95
			40	10.85
			100	8.27
			140	7.10
535	Methyl benzoate	$C_6H_5COOCH_3$	20	6.59
536	α-Methylbenzylamine	$C_6H_5CH(CH_3)NH_2$	19	*4.4*
537	Methyl bromide (l)	CH_3Br	0	9 82
	Methyl bromide (g)		100	1.0068
538	2-Methyl-1,3-butadiene See Isoprene			
539	2-Methylbutane	$(CH_3)_2CHCH_2CH_3$	−130	2.049
			− 61	1.954
			− 34	1.920
			0	1.871
			20	1.845
540	3-Methyl-1-butene (g)	$(CH_3)_2CHCHCH_2$	100	1.0028
541	Methyl butyrate	$CH_3(CH_2)_2COOCH_3$	20	*5.6*
542	Methyl chloride	CH_3Cl	− 20	12.6
	Methyl chloride (g)		100	1.0069
543	Methyl cyanoacetate	$NCCH_2COOCH_3$	20	29
544	Methylcyclohexane	$CH_3C_6H_{11}$	−127	2.26
			25	2.07

No.	Compound	Formula	t, °C	ε
545	2-Methylcyclohexanol	$CH_3C_6H_{10}OH$	20	13.3
546	3-Methylcyclohexanol		20	12.3
547	4-Methylcyclohexanol		20	13.3
548	2-Methyl-		−15	16
	cyclohexanone	$C_7H_{12}O$	20	14
549	3-Methyl-		−89	18
	cyclohexanone		20	12
550	4-Methyl-		−41	15
	cyclohexanone		20	12
551	Methylcyclopentane	C_6H_{12}	20	1.98
552	Methylene bromide See Dibromomethane			
553	Methylene chloride	CH_2Cl_2	18	9.1
	Methylene chloride (g)		100	1.0065
554	Methylene iodide See Diiodomethane			
555	Methyl ether	CH_3OCH_3	25	5.0
			110	2.9
			125	2.4
			127.6	1.9
556	Methyl ethyl ketone See 2-Butanone			
557	Methyl ethyl ketoxime See 2-Butanone oxime			
558	Methyl formate	$HCOOCH_3$	20	8.5
559	Methylglycol See 1,2-Propanediol			
560	2-Methyl-2-heptanol	$(CH_3)_2COH(CH_2)_4CH_3$	−33	3.5
			−13	3.4
			− 7	3.4
			25	3.5
561	2-Methyl-3-heptanol	$CH_3(CH_2)_3CHOCH(CH_3)CH_3$	−40	2.7
			−20	2.9
			20	3.4
			40	3.6
			60	3.7
562	2-Methyl-4-heptanol	$CH_3(CH_2)_2CHOHCH_2CH(CH_3)CH_3$	−20	2.9
			20	3.3
			60	3.6
563	3-Methyl-3-heptanol	$CH_3CH_2COH(CH_3)(CH_2)_3CH_3$	−30	3.58
			−20	3.57
			0	3.6

(continued)

No.	Compound	Formula	t, °C	ε
	3-Methyl-3-heptanol (cont.)	$CH_3CH_2COH(CH_3)(CH_2)_3CH_3$	20	3.7
			40	3.8
			60	3.9
564	3-Methyl-4-heptanol	$CH_3(CH_2)_2CHOHCH(CH_3)CH_2CH_3$	−20	9.1
			20	7.4
565	4-Methyl-3-heptanol	$CH_3(CH_2)_2CH(CH_3)CHOHCH_2CH_3$	−53	7.1
			−30	6.6
			20	5.3
			55	4.6
566	4-Methyl-4-heptanol	$CH_3(CH_2)_2COH(CH_3)(CH_2)_2CH_3$	−44	2.5
			−20	2.6
			0	2.7
			20	2.9
			60	3.3
567	2-Methylhexane	$(CH_3)_2CH(CH_2)_2CH_2CH_3$	20	1.92
568	3-Methylhexane	$CH_3CH_2CH(CH_3)CH_2CH_2CH_3$	20	1.93
569	Methyl hexyl ketone See 2-Octanone			
570	Methyl iodide	CH_3I	20	7
	Methyl iodide (g)		100	1.0063
571	Methyl isoeugenol	$C_6H_2(CH_3)(OCH_3)(C_3H_5)OH$	18	4.7
572	Methyl-*o*-methoxybenzoate	$CH_3OC_6H_4CO_2CH_3$	21	7.7
573	Methyl-*p*-methylbenzoate	$CH_3C_6H_4CO_2CH_3$	33	4.3
574	1-Methylnaphthalene	$C_{11}H_{10}$	20	2.7
575	Methyl nitrate See Nitromethane			
576	Methyl-*o*-nitrobenzoate	$NO_2C_6H_4CO_2CH_3$	25	28
577	2-Methyl octane	$CH_3(CH_2)_5CH(CH_3)CH_3$	20	1.97
578	4-Methyl octane	C_9H_{20}	20	1.97
579	4-Methyl-2-pentanone	$CH_3COCH_2CH(CH_3)_2$	−40	17.37
			−20	15.91
			0	14.50
			20	13.11
			40	11.78
			80	9.75
			100	8.90
580	Methylphenylcarbinol	$C_6H_5CHOHCH_3$	20	8.9
581	Methylphenylhydrazine	$CH_3C_6H_4NHNH_2$	19	7.3
582	Methyl propyl ketoxime	$CH_3CNOCH_2CH_2CH_3$	20	3.3
583	2-Methylpyridine See α-Picoline			
584	Methyl rhodanide See Methylthiocyanate			

No.	Compound	Formula	t, °C	ε
585	Methyl salicylate	$HOC_6H_4COOCH_3$	30	9.41
586	Methyl sulphate	$(CH_3)_2SO_4$	−32	60
			0	48
			20	43
587	Methyl sulphide	$(CH_3)_2S$	20	*6.2*
588	Methyl sulphoxide	CH_3SOCH_3	25	46.7
589	Methyl thiocyanate	CH_3SCN	16	*35*
590	Methyl valerate	$CH_3(CH_2)_3COOCH_3$	19	*4.3*
591	Morpholine	C_4H_9O	25	7.3
592	Mustard oil See Allyl isothiocyanate			
593	Myristyl alcohol See 1-Tetradecanol			
594	Naphthalene (l)	$C_{10}H_8$	85	2.54
595	1-Naphthonitrile	$C_{10}H_7CN$	70	*16*
596	2-Naphthonitrile		70	*17*
597	α-Naphthyl bromide	$C_{10}H_7Br$	25	4.83
598	α-Naphthyl chloride	$C_{10}H_7Cl$	25	5
599	Neopentane (s)	$(CH_3)_4C$	−35	1.710
			98	1.678
600	*o*-Nitroaniline	$NO_2C_6H_4NH_2$	90	34.5
601	*p*-Nitroaniline		160	56.3
602	Nitrobenzene	$C_6H_5NO_2$	20	35.74
			25	34.82
			90	24.9
			130	20.8
603	*m*-Nitrobenzyl alcohol	$NO_2C_6H_4CH_2OH$	20	*22*
604	*m*-Nitrochlorobenzene	$NO_2C_6H_4Cl$	50	21
			80	18
			110	16
			140	14
			160	13
605	*o*-Nitrochlorobenzene	$NO_2C_6H_4Cl$	50	38
			80	32
			110	27
			140	24
			160	22
606	*p*-Nitrochlorobenzene	$NO_2C_6H_4Cl$	120	8
607	Nitroethane	$CH_3CH_2NO_2$	30	28
608	Nitroglycerin	$C_3H_5(ONO_2)_3$	20	19
609	Nitroglycol See Ethylene nitrate			
610	Nitromethane	CH_3NO_2	30	35.8
	Nitromethane (g)		100	1.0247
611	*o*-Nitrophenol	$NO_2C_6H_4OH$	50	17
612	1-Nitropropane	$CH_3(CH_2)_2NO_2$	30	23.24
613	2-Nitropropane	$(CH_3)_2CHNO_2$	30	25.52

(continued)

No.	Compound	Formula	t, °C	ε
614	N-Nitrosodimethylamine	$(CH_3)_2NNO$	20	*53*
615	*m*-Nitrotoluene	$NO_2C_6H_4CH_3$	20	24
			58	22
616	*o*-Nitrotoluene		20	27.4
			58	22.0
			223	11.8
617	*p*-Nitrotoluene		52	22
618	Nonane	$CH_3(CH_2)_7CH_3$	−54	2.1
			20	1.97
			110	1.85
			150	1.78
619	Octamethyl-cyclotetrasiloxane	$(C_2H_6OSi)_4$	20	2.4
620	Octamethyl-trisiloxane	$(CH_3)_3Si[OSi(CH_3)_2]_2CH_3$	20	2.3
621	Octane	$CH_3(CH_2)_6CH_3$	20	1.95
			70	1.88
			110	1.82
			−10	13.3
			10	11.3
622	1-Octanol	$CH_3(CH_2)_6CH_2OH$	20	10.34
623	2-Octanol	$CH_3(CH_2)_5CHOHCH_3$	−10	12.0
			20	8.2
			40	6.5
			56	5.6
624	2-Octanone	$CH_3COC_6H_{13}$	−20	12.53
			0	11.45
			20	10.39
			60	8.70
			100	7.42
			160	6.10
625	Octyl alcohol See 1-Octanol			
626	Oenanthic acid See Enanthic acid			
627	Oleic acid	$C_8H_{17}CH : CH(CH_2)_7COOH$	20	2.46
			60	2.45
			100	2.41
628	Oxalyl chloride	$(COCl)_2$	21	3.5
629	Palmitic acid	$CH_3(CH_2)_{14}COOH$	70	2.3
630	Paraldehyde	$(C_2H_4O)_3$	25	13.9
			126	6.3
631	Pentachloroethane	$CHCl_2CCl_3$	20	3.73
632	Pentalin See Pentachloroethane			
633	Pentanal See Valeraldehyde			
634	Pentane	$CH_3(CH_2)_3CH_3$	−90	2.0

No.	Compound	Formula	t, °C	ε
	Pentane (cont.)	$CH_3(CH_2)_3CH_3$ (cont.)	−70	1.9
			20	1.84
635	2-Pentanone	$CH_3COCH_2CH_2CH_3$	−40	20.19
			−20	18.39
			0	16.82
			20	15.45
			40	14.08
			80	11.73
636	3-Pentanone See Diethyl ketone			
637	1-Pentene	$C_2H_5CH_2CHCH_2$	20	2.10
638	Phenanthrene	$(C_6H_4CH)_2$	20	2.8
639	Phenetole		110	2.7
	See Ethoxybenzene			
640	Phenol	C_6H_5OH	60	9.78
641	Phenoxyacetylene	C_6H_5OCCH	20	4.8
642	Phenoxyacetaldehyde	$C_6H_5CH_2CHO$	20	*4.8*
643	Phenyl acetate	$C_6H_5COOCH_3$	20	5.2
644	Phenylacetonitrile See Benzyl cyanide			
645	Phenylacetylene	C_6H_5CCH	20	3.0
646	Phenyl bromide	C_6H_5Br	25	5.40
647	Phenyl ether	$(C_6H_5)_2O$	23	7.6
648	α-Phenylethyl alcohol See Methylphenyl-carbinol			
649	β-Phenylethyl alcohol See Benzylcarbinol			
650	Phenylhydrazine	$C_6H_5NHNH_2$	23	7.2
651	Phenyl isocyanate	C_6H_5NCO	20	*8.8*
652	Phenyl isothiocyanate	C_6H_5NCS	20	*10*
653	Phenyl mustard oil See Phenyl isothiocyanate			
654	1-Phenylpropene	$C_6H_5CHCHCH_3$	20	2.7
655	2-Phenylpropene	$CH_2C(C_6H_5)CH_3$	20	2.3
656	3-Phenylpropene	$CH_2CHCH_2C_6H_5$	20	2.6
657	Phenyl salicylate	$HOC_6H_4CO_2C_6H_5$	50	6.3
658	Phosgene	$COCl_2$	0	*4.7*
			22	*4.3*
659	Phthalide	$C_8H_6O_2$	75	*36*
660	α-Picoline	$CH_2C_5H_4N$	20	*9.8*
661	Pinacolin	$CH_3COC(CH_3)_3$	14.5	13.1
662	*dl*-Pinene	$C_{10}H_{16}$	25	2.64
663	*l*-Pinene		20	2.76
664	Piperidine	$(CH_2)_5NH$	22	*5.8*
665	Propanal See Propionaldehyde			

(continued)

No.	Compound	Formula	t, °C	ε
666	Propane	$CH_3CH_2CH_3$	0	1.6
667	1,2-Propanediol	$CH_3CHOHCH_2OH$	20	32.0
668	1,3-Propanediol	$HO(CH_2)_3OH$	20	35.0
669	2-Propanol See Isopropyl alcohol			
670	Propene	$CH_3CH : CH_2$	20	1.87
			45	1.79
			65	1.69
			85	1.53
			91.9	1.33
671	1-Propenylbenzene See 1-Phenylpropene			
672	2-Propenylbenzene See 2-Phenylpropene			
673	Propionaldehyde	CH_3CH_2CHO	17	*18.5*
674	Propionic acid	CH_3CH_2COOH	10	3.3
			40	3.4
675	Propionic aldehyde See Propionaldehyde			
676	Propionic anhydride	$(CH_3CH_2CO)_2O$	16	*18*
677	Propionitrile	CH_3CH_2CN	0	31
			20	27
			50	24
678	Propyl acetate	$CH_3COOC_3H_7$	19	5.69
679	Propyl alcohol	$CH_3CH_2CH_2OH$	−80	38
			−34	29
			25	20.1
680	Propyl aldehyde See Propionaldehyde			
681	Propylbenzene	$C_6H_5CH_2CH_2CH_3$	20	2.372
			30	2.351
682	Propyl bromide	$CH_3CH_2CH_2Br$	25	8.09
683	Propyl butyrate	$CH_3(CH_2)_2COO(CH_2)_2CH_3$	20	*4.3*
684	Propyl chloride	$CH_3CH_2CH_2Cl$	20	*7.7*
685	Propylene See Propene			
686	Propylene dibromide	$CH_3CHBrCH_2Br$	20	*4.3*
687	Propylene dichloride	$CH_3CHClCH_2Cl$	26	8.93
688	Propyleneglycol See 1,2-Propanediol			
689	Propyl ether	$(CH_3CH_2CH_2)_2O$	26	3.39
690	Propyl formate	$HCOOCH_2CH_2CH_3$	19	*7.7*
691	Propyl iodide	$CH_3CH_2CH_2I$	20	7.0
692	Propyl nitrate	$CH_3CH_2CH_2ONO_2$	18	*14*
693	Propyl propionate	$CH_3CH_2COOCH_2CH_2CH_3$	20	*4.7*
694	Propyl valerate	$CH_3(CH_2)_3COOC_3H_7$	19	*4*
695	Pseudocumene	$(CH_3)_3C_6H_3$	20	2.38
696	Pulegone	$C_{10}H_{16}O$	20	*9.5*

No.	Compound	Formula	t, °C	ε
697	Pyrazine	$C_4H_4N_2$	54	2.8
698	Pyridine	C_5H_5N	25	12.3
			116	9.4
699	Pyrrole	$NH(CHCH_2)_2$	18	7.5
700	Quinoline	C_9H_7N	25	9.0
			238	5
701	Resorcinol	$C_6H_4(OH)_2$	18	3.2
702	Safrole	$C_{10}H_{10}O_2$	21	*3.1*
703	Salicylaldehyde	C_6H_4OHCHO	30	17.1
704	Salol See Phenyl salicylate			
705	Sodium oleate	$NaC_{18}H_{33}O_2$	240	*2.8*
706	*d*-Sorbitol	$HOCH_2(CHOH)_4CH_2OH$	80	33
707	Stearic acid	$CH_3(CH_2)_{16}COOH$	70	2.29
			100	2.26
708	Styrene	$C_6H_5CH : CH_2$	25	2.43
			75	2.32
709	Succinonitrile	$(CH_2CN)_2$	68	54
710	Tartaric acid	$(CHOHCOOH)_2$	19	35.9
711	Terpinene	$C_{10}H_{16}$	21	*2.7*
712	1,1,2,2-Tetrabromo-ethane	$Br_2CHCHBr_2$	3	8.6
			22	7.0
713	Tetrachloroethane See Acetylene tetrachloride			
714	Tetrachloroethylene	$Cl_2C : CCl_2$	25	2.3
715	Tetradecamethyl-hexasiloxane	$(CH_3)_3Si[OSi(CH_3)_2]_5$	20	2.5
716	Tetradecamethyl-cycloheptasiloxane	$(C_2H_6OSi)_7$	20	2.7
717	1-Tetradecanol	$CH_3(CH_2)_{12}CH_2OH$	38	4.7
			48	4.4
718	1,2,3,4-Tetrahydro-naphthalene See Tetralin			
719	1,2,3,4-Tetrahydro-2-naphthol	$C_{10}H_{12}O$	20	11.7
			60	8.2
			90	6.7
720	Tetralin	$C_{10}H_{12}$	20	2.76
721	Tetramethylene dichloride See 1,4-Dichloro-butane			
722	Tetramethyleneglycol See 1,4-Butanediol			

(continued)

No.	Compound	Formula	t, °C	ε
723	Tetramethylmethane See Neopentane			
724	Tetranitromethane	$C(NO_2)_4$	25	2.52
725	Tetrathiomethyl-metane	$O(SCH_3)_4$	70	2.82
726	Thioacetic acid	CH_3COSH	20	*13*
727	Thiophene	C_4H_4S	15	2.8
728	α-Thujone	$C_{10}H_{16}O$	0	11.0
729	Toluene	$C_6H_5CH_3$	0	2.44
			20	2.385
			25	2.379
			30	2.364
			127	2.15
			181	2.04
	Toluene (vapour)		126	1.0043
730	*m*-Toluidine	$CH_3C_6H_4NH_2$	18	5.95
			58	5.45
731	*o*-Toluidine		18	6.34
			58	5.71
			200	4.00
732	*p*-Toluidine		45	4.98
733	*o*-Tolunitrile	$CH_3C_6H_4CN$	23	*18.5*
734	Tolyl phosphate See Tricresyl phosphate			
735	Triacetin See Glycerol triacetate			
736	1,2,3-Tribromo-propane	$CH_2BrCHBrCH_2Br$	20	6.45
737	Tributyl phosphate	$(C_4H_9)_3PO_4$	30	7.95
738	Trichloroacetic acid	CCl_3COOH	60	4.6
739	1,1,1-Trichloroethane	CH_3CCl_3	7	7.1
			20	7.52
740	Trichloroethylene	$CHCl:CCl_2$	10	3.42
741	1,2,3-Trichloro-propane	$CH_2ClCHClCH_2Cl$	20	*7.5*
742	α-Trichlorotoluene	$C_6H_5CCl_3$	21	*6.9*
743	Tricresyl phosphate	$(CH_3C_6H_4)_3PO_4$	25	6.9
744	Triethyl aluminium	$(C_2H_5)_3Al$	20	2.9
745	Triethylamine	$(C_2H_5)_3N$	25	2.42
746	Triethyl methane See 3-Ethylpentane			
747	Trifluoroacetic acid	CF_3COOH	−15	26
			20	39
748	α-Trifluorotoluene	$C_6H_5CF_3$	30	9.2
			60	8.1
749	Trimethylamine	$(CH_3)_3N$	25	2.4

No.	Compound	Formula	t, °C	ε
750	1,2,3-Trimethylbenzene See Hemimellitene			
751	1,2,4-Trimethylbenzene See Pseudocumene			
752	Trimethyl borate	$(CH_3)_3BO_3$	20	*8*
753	2,2,3-Trimethyl-butane	$CH_3CH(CH_3)C(CH_3)_3$	20	1.93
754	Trimethyleneglycol See 1,3-Propanediol			
755	Trimethylene glycol dinitrate	$O_2NO(CH_2)_3ONO$	20	19
756	2,2,3-Trimethyl-pentane	$(CH_3)_3CCH(CH_3)C_2H_5$	20	1.96
757	2,2,4-Trimethyl-pentane	$(CH_3)_3CCH_2CH(CH_3)_2$	20	1.94
758	Triolein See Glycerol trioleate			
759	Tripalmitin See Glycerol tripalmitate			
760	Tristearin See Glycerol tristearate			
761	Undecane	$CH_3(CH_2)_9CH_3$	− 10	2.04
			20	2.00
			150	1.84
			196	1.78
762	Urea See Carbamide			
763	Urethan See Ethyl carbamate			
764	Valeraldehyde	$CH_3(CH_2)_3CHO$	17	*10*
765	Valeric acid	$CH_3(CH_2)_3COOH$	20	2.66
766	Valeronitrile	$CH_3(CH_2)_3CN$	21	17.4
767	Veratrole	$C_6H_4(OCH_3)_2$	23	4.5
768	Vinyl bromide	$CH_2 : CHBr$	17	1.008
769	Vinyl ether	$(CH_2 : CH)_2O$	20	3.9
770	*m*-Xylene	$C_6H_4(CH_3)_2$	20	2.37
			30	2.35
771	*o*-Xylene		20	2.57
			30	2.54
772	*p*-Xylene		20	2.26
			30	2.25
			50	2.22
773	Xylidine	$(CH_3)_2NC_6H_5$	20	4.9
			70	4.4
774	Xylitol	$C_5H_{12}O_5$	20	40
775	Zinc diethyl	$(C_2H_5)_2Zn$	20	2.5

Table 97

Relative permittivity index

ε	t, °C	Compound	Compound number
1.84	20	Pentane	634
1.845	20	2-Methylbutane	539
1.87	20	Propene	670
1.890	20	Hexane	443
1.91	20	Dimethylpentanes	292/294
1.92	20	2-Methylhexane	567
1.924	20	Heptane	420
1.93	20	3-Methylhexane	568
1.94	20	Dimethylpentanes	293/295
1.94	20	3-Ethylpentane	389
1.94	20	2,2,4-Trimethylpentane	757
1.95	20	Octane	621
1.96	20	Cyclopentane	205
1.96	20	Ethyl cyclobutane	361
1.96	20	2,2,3-Trimethylpentane	756
1.97	20	Methyl octanes	577/578
1.97	20	Nonane	618
1.98	20	Methylcyclopentane	551
1.991	20	Decane	214
2.00	20	Undecane	761
2.01	20	Dodecane	323
2.015	25	Cyclohexane	192
2.07	25	Methylcyclohexane	544
2.1	25	*trans*-1,2-Dichloroethylene	251
2.10	20	1-Pentene	637
2.17	20	*trans*-Decalin	211
2.17	25	Diamylacetylene	219
2.18	20	*cis*-Decalin	210
2.21	25	1,4-Dioxan	307
2.22	25	Cyclohexene	197
2.228	25	Carbon tetrachloride	150
2.24	20	Cymene	208
2.24	25	*p*-Ethyltoluene	395
2.26	20	*p*-Xylene	772
2.274	25	Benzene	55
2.319	20	Isobutylbenzene	478
2.37	20	*tert*-Butylbenzene	124
2.37	20	*m*-Xylene	770
2.372	20	Propylbenzene	681
2.379	25	Toluene	729
2.38	20	Cumene	189
2.4	20	Decamethyltetrasiloxane	212
2.41	20	Ethylbenzene	343
2.42	25	Triethylamine	745
2.43	20	2,5-Dimethylpyrazine	297
2.43	25	Styrene	708

Table 97

ε	t, °C	Compound	Compound number
2.45	20	Caprylic acid	147
2.46	20	Oleic acid	627
2.5	17	1-Bromo-2-chloroethylene	83
2.5	20	Decamethylcyclopentasiloxane	213
2.52	25	Tetranitromethane	724
2.57	20	*o*-Xylene	771
2.636	20	Hemimellitene	419
2.64	20	Carbon disulphide	149
2.64	20	Isovaleric acid	505
2.64	25	*dl*-Pinene	662
2.66	20	Valeric acid	765
2.71	20	Linoleic acid	513
2.76	20	*l*-Pinene	663
2.77	25	Diamyl ether	220
2.8	25	*trans*-1,2-Dibromoethylene	231
2.8	20	Phenanthrene	638
2.82	20	Diethyl carbonate	259
2.82	20	Isoamyl ether	469
2.9	20	Acetanilide	7
2.95	25	Furan	406
2.97	20	Butyric acid	142
3.0	23	Acetaldoxime	4
3.0	19	Benzophenone	58
3.06	25	Dibutyl ether	237
3.1	18	Cocaine	182
3.11	30	Butyl stearate	140
3.3	25	Cedrene	153
3.39	26	Propyl ether	689
3.4	20	2-Butanone oxime	116
3.4	20	Ethyl laurate	380
3.45	20	Acetal	1
3.5	20	Cetyl iodide	156
3.6	23	1-Ethoxypentane	336
3.6	22	Diethylamine	255
3.6	20	Dibenzylamine	223
3.62	19	Isoamyl isovalerate	471
3.65	30	Diphenyl ether	313/315
3.71	25	1-Bromohexadecane	96
3.73	20	Pentachloroethane	631
3.8	20	Benzaldehyde oxime	54
3.8	25	1,2-Dibromoheptane	232
3.83	25	Amyl sulphide	45/221
3.84	25	1-Bromotetradecane	106
3.88	25	Isopropyl ether	500
3.9	20	1-Bromopentadecane	103
3.96	20	Ethyl isoamyl ether	377
4.0	20	Acetamide	5
4.0	25	Butyl oleate	139

(continued)

ε	t, °C	Compound	Compound number
4.07	25	1-Bromododecane	86
4.1	20	Benzyl salicylate	70
4.2	20	1-Chlorododecane	163
4.22	20	Ethoxybenzene	333
4.22	30	*o*-Fluorotoluene	402
4.24	20	Amyl fluoride	37
4.3	25	Anisole	48
4.3	20	1,2-Dibromopropane	236
4.3	20	Benzylethylamine	68
4.34	20	Ethyl ether	371
4.39	20	Bromoform	91
4.44	25	1-Bromodecane	85
4.5	20	*o*-Chlorotoluene	178
4.5	20	1-Bromo-3-chlorobenzene	80
4.5	22	Amylamine	32
~4.5	25	Aryl phosphates	49
4.54	30	Dibutyl sebacate	239
4.55	25	Amyl mercaptan	42
4.57	23.5	1,8-Cineole	180
4.6	21	Benzylamine	64
4.6	21	Borneol acetate	71
4.6	25	Dibenzyl sebacate	224
4.6	16	*cis*-1,2-Dichloroethylene	250
4.641	25	Chloroform	166
4.7	25	3,4-Dibromoheptane	234
4.7	16	1,1-Dichloroethylene	249
4.71	18	Ethyl isovalerate	379
4.74	25	1-Bromononane	101
4.75	20	Amyl acetate	29
4.78	25	Ethylene bromide	229/364
4.80	20	*m*-Dibromobenzene	225
4.81	20	Isoamyl acetate	464
4.83	25	α-Bromonaphthalene	100/597
4.9	20	Allyl sulphide	28
4.9	20	Chloral	157
4.9	20	Dimethylaniline	285/773
4.9	20	Benzyl benzoate	65
4.95	25	1-Butanethiol	114
4.95	25	Butyl mercaptan	137
5.0	20	Amyl benzoate	33
5.0	25	Methyl ether	555
5.01	20	Butyl acetate	119
5.04	25	1-Chloronaphthalene	172
5.04	25	*m*-Dichlorobenzene	243
5.1	21	Benzyl acetate	62
5.1	18	Ethyl butyrate	353
5.1	25	2,3-Dibromoheptane	233
5.1	25	Dioctyl phthalate	305

Table 97

ε	t, °C	Compound	Compound number
5.13	30	Diethyl azelate	257
5.2	24	β-Chloroethyl-2,5-dichlorobenzene	165
5.29	20	Isobutyl acetate	475
5.3	21	Butylamine	123
5.3	25	Dimethylamine	284
5.33	25	1-Bromoheptane	92/431
5.40	25	Bromobenzene	76/646
5.42	25	Fluorobenzene	400
5.42	30	*m*-Fluorotoluene	401
5.5	20	1-Chloroheptane	167
5.5	20	*m*-Chlorotoluene	177
5.62	25	Chlorobenzene	161
5.69	19	Propyl acetate	678
5.7	18	Ethyl propionate	391
5.72	25	Diethyl sulphide	269
5.75	25	Butylene bromide	133/228
5.8	20	Ethylaniline	342
5.81	20	Amyl iodide	40
5.82	25	*tert*-Amyl alcohol	31
5.82	25	1-Bromohexane	97
5.86	30	*v*-Fluorotoluene	403
5.89	20	*tert*-Amyl fluoride	38
5.95	18	*m*-Toluidine	730
6	20	Ethyl benzoate	344
6.02	25	Ethyl acetate	338
6.05	20	Isoamyl bromide	466
6.05	20	Isoamyl chloride	468
6.1	20	*p*-Chlorotoluene	179
6.1	18	Ethyl cinnamate	357
6.14	20	Acetic acid	9
6.2	20	Butyl iodide	134
6.2	22	Dipropylcarbinol	318
6.3	25	*o*-Chlorophenol	174
6.32	25	Amyl bromide	34
6.34	18	*o*-Toluidine	731
6.40	25	2-Bromo-3-ethoxypentane	89
6.43	30	Dibutyl phthalate	238
6.45	25	1-Bromo-2-ethoxypentane	88
6.46	22	2-Bromoheptane	93
6.5	20	α-Bromoisovaleric acid	98
6.5	23	Ethyl fumarate	374
6.5	25	Amyl formate	39
6.5	22	2-Chloroheptane	168
6.5	22	4-Chloroheptane	170
6.59	20	Methylbenzoate	535
6.62	25	Butoxyacetylene	118
6.64	30	Diethyl succinate	267
6.7	19	Cellulose	155

(continued)

ε	t, °C	Compound	Compound number
6.7	22	3-Chloroheptane	169
6.8	20	1-Bromo-2-chlorobenzene	79
6.81	22	4-Bromoheptane	95
6.89	20	Aniline	46
6.9	22	Ethyl butylcarbinol	351
6.9	20	Benzylidene chloride	52/69
6.93	22	3-Bromoheptane	94
7	20	Methyl iodide	570
7.03	20	Methyl acetate	531
7.06	30	*p*-Bromoanisole	75
7.07	20	1-Bromobutane	77/125
7.1	25	Acetylene dibromide	20/21/230
7.16	25	Ethyl formate	373
7.3	17	1-Bromo-2-chloroethylene	82
7.35	20	*o*-Dibromobenzene	226
7.4	20	Butyl chloride	129
7.52	20	1,1,1-Trichloroethane	739
7.6	30	Cellosolve acetate	154
7.6	25	Chlorocyclohexane	162
7.6	25	Cyclohexyl chloride	200
7.6	20	Bromal	73
7.82	20	Ethyl iodide	376
7.9	25	Bromocyclohexane	84
7.9	20	*sec*-Butyl iodide	135
7.9	25	Cyclohexyl bromide	199
7.95	30	Tributyl phosphate	737
8.03	25	Diethyl malonate	264
8.09	25	Propyl bromide	682
8.1	20	1-Decanol	215
8.19	20	*tert*-Amyl iodide	41
8.19	20	Isopropyl iodide	501
8.20	20	Acetylene tetrachloride	23
8.2	20	Allyl chloride	25
8.2	22	Dichloroacetic acid	241
8.2	20	2-Octanol	623
8.24	25	3-Bromo-2-ethoxypentane	90
8.4	20	*tert*-Butyl iodide	136
8.5	20	Methyl formate	558
8.58	23	Diethyl maleate	263
8.6	25	2-Bromobutane	78/126
8.9	25	1,4-Dichlorobutane	246
8.93	26	Propylene dichloride	687
9	18	Amyl nitrate	44
9.0	25	Quinoline	700
9.1	20	Enanthaldehyde	326
9.21	22	2-Heptanol	422
9.3	16	*tert*-Amyl chloride	36

Table 97

ε	t, °C	Compound	Compound number
9.39	20	Bromoethane	87/348
9.41	30	Methyl salicylate	585
9.46	25	Isopropyl bromide	499
9.9	25	1,1-Dichloroethane	247
9.93	25	*o*-Dichlorobenzene	244
10.1	25	*tert*-Butyl bromide	127
10.2	20	Acetone dichloride	13
10.34	20	1-Octanol	622
10.36	25	1,2-Dichloroethane	248/365
10.39	20	2-Octanone	624
10.9	30	*tert*-Butyl alcohol	122
11.5	25	*o*-Cresol	186
11.8	25	*m*-Cresol	185
11.95	20	Methyl amyl ketone	534
12	20	Ethyl benzoylacetate	59/345
12.3	25	Pyridine	698
12.60	20	4-Heptanone	426
13	30	Glycol acetate	415
13.1	20	Benzyl alcohol	63
13.11	20	4-Methyl-2-pentanone	579
13.4	26	Butyraldehyde	141
13.9	25	Amyl alcohol	30
13.9	25	Paraldehyde	630
14.2	20	Ethylenediamine	218/367
15.0	25	1,4-Cyclohexanedione	193
15.45	20	2-Pentanone	635
15.7	22	Acetoacetic ester	11
15.8	22	Acetyl chloride	18
15.8	25	*sec*-Butyl alcohol	121
16.0	30	Methoxyethanol	526
16.2	20	Acetylbromide	17
17	20	Amyl mustard oil	43
17.1	25	Butyl alcohol	120
17.1	30	Salicylaldehyde	703
17.2	18	Allyl isothiocyanate	26
17.39	25	Acetophenone	15
17.4	31	Valeronitrile	766
17.8	20	Benzaldehyde	53
17.8	25	Isobutyl alcohol	476
18.2	25	Diacetone alcohol	217
18.3	20	Cyclohexanone	195
18.51	20	2-Butanone	115
18.62	20	Isopropyl alcohol	496
19.0	25	Benzyl cyanide	67
19	20	Nitroglycerin	608
19.5	21	Ethyl isothiocyanate	378
20.1	25	Propyl alcohol	679

(continued)

ε	t, °C	Compound	Compound number
20.3	21	Butyronitrile	144
20.70	25	Acetone	12
20.7	19	Acetic anhydride	10
21.1	21	Acetaldehyde	3
21.2	20	Dichloroethyl ether	252
21.6	15	Allyl alcohol	24
22.3	22	Anisaldehyde	47
22.6	22	Epichlorohydrin	328
23	20	Benzoyl chloride	61
23.24	30	1-Nitropropane	612
24.30	25	Ethanol	339
25.20	25	Benzonitrile	57
25.52	30	2-Nitropropane	613
25.7	20	Acetylacetone	16
26	20	Ethylene chlorohydrin	366
26.9	20	Ethyl cyanoacetate	360
27	20	Propionitrile	677
27.4	20	*o*-Nitrotoluene	616
29	20	Methyl cyanoacetate	543
32.0	20	1,2-Propanediol	667
32.63	25	Methanol	524
33.4	19	Cyanoacetic acid	190
34.82	25	Nitrobenzene	602
35.0	20	1,3-Propanediol	668
35.9	19	Tartaric acid	710
37.5	20	Acetonitrile	14
37.7	25	Ethylene glycol	368
37.78	25	Dimethylacetamide	283
39	20	Trifluoroacetic acid	747
40	20	Xylitol	774
42	20	Furfural	407
42.5	25	Glycerol	408
46.7	25	Methyl sulphoxide	588
57	21	Formic acid	405
109.5	25	Formamide	404

Table 98

Relative permittivities of ethanol–water mixtures at 25°C

Ethanol, w.%	ε	Ethanol, w.%	ε
10	72.8	71.9	37.0
20	67.0	88.5	27.4
30	61.1	98	25.1
40	55.0	100	24.3
50	49.0		

Table 99

Relative permittivities of methanol–water mixtures at 25°C

Methanol, w. %	ε
10	74.2
20	70.0
40	60.9
60	51.7
80	42.6
90	37.9
94	35.7
100	32.6

Table 100

Relative permittivities of ethylene glycol–water mixtures at 25°C

Ethylene glycol w. %	ε
5	76.9
10	75.6
15	74.2
20	72.8
30	69.8
40	66.6
60	59.4

Table 101

Relative permittivities of dioxan–water mixtures at 25°C

Dioxan w. %	ε
20	60.8
45	38.5
70	17.7
82	9.5

Table 102

Relative permittivities of *d*-glucose solutions at 25°C

d-glucose, w. %	ε
5	77.3
10	76.1
20	73.4
30	70.5

Table 103

Relative permittivities of isopropyl alcohol–water mixtures at 25°C

Isopropyl alcohol, w. %	ε
5	74.9
10	71.4
20	64.1

Table 104

Relative permittivities of glycerol–water mixtures at 25°C

Glycerol, w. %	ε
5	77.2
10	75.5
20	72.8
30	70.1
50	64.0

Table 105

Relative permittivities of minerals at room temperature

Name	Composition	ε
Anatase	TiO_2	$\parallel$ 48*
Apatite	$3\,Ca_3(PO_4)_2Ca(F, Cl)_2$	$\perp$ 9.5
		$\parallel$ 7.4
Aragonite	$CaCO_3$	$\parallel a$ 9.1
		$\parallel c$ 7
Beryl	$3\,BeO \cdot Al_2O_3 \cdot 6\,SiO_2$	$\perp$ 7.0
Calcite (Calc spar.)	$CaCO_3$	$\perp$ 8.5
		$\parallel$ 7.6

* The symbols $\perp$ and $\parallel$ signify that the measurements were made perpendicular and parallel, respectively, to the optical axes of the crystals.

Name	Composition	ε
Cassiterite	SnO_2	⊥ 23.4
		∥ 24
Diamond	C	16.5
		5.5
Dolomite	$CaCO_3 \cdot MgCO_3$	⊥ 8
		∥ 6.8
Fluorite	CaF_2	6.9
Halite	NaCl	5.6–6.1
Malachit	$CuCO_3 \cdot Cu(OH)_2$	~7
Mica	Al, K, Mg silicate	6–7
Quartz (cryst.)	SiO_2	~5
		~4
Quartz (fused)		3.5–3.6
Rock salt See Halite		
Ruby	Al_2O_3 with a little Cr_2O_3	⊥ 13.3
		∥ 11.3
Rutile	TiO_2	⊥ 90
		∥ 180
Sapphire	Al_2O_3	⊥ 13.7
		∥ 11.4
Smithsonite	$ZnCO_3$	∥, ⊥ 9.2–9.5
Sphalerite	ZnS	7.9–8.3
Sulphur	S	4.1–4.6
Sylvite	KCl	~5
Tinstone See Cassiterite		
Tourmaline	Al borosilicate	∥ 6.4
		⊥ 7.1
Witherite	$BaCO_3$	8.4–8.6
Wulfenite	$PbMoO_4$	22–25
Wurtzite	ZnS	8.0–8.3
Zircon	$ZrSiO_4$	11.8–12.1

Table 106

Relative permittivities and tan δ values of raw and other materials at room temperature

Material	ε	tan δ
Almond oil	~2.8	
Alumina	4.6–8.3	0.0002–0.01
Amber	2.6–2.8	
Asphalt	2.7–3.5	
Barite glass	6.5–7.0	
Beech, dry		
(perpendicular to the fibres)	~4	
(parallel to the fibres)	~3	

Table 106

Material	ε	tan δ
Beeswax	2.8–3.0	0.003
Benzine	1.8–2.0	
Birch, dry	3–4	
Bitumen	2.6–2.9	0.01
Borosilicate glass	4.2–4.7	0.0006
Brazil wax		
See Carnauba wax		
Canada balsam	2.7	
Caoutchouc	2.4–2.7	0.0016–0.0018
See rubber		
Carbolite	4.5	0.09
Carnauba wax	2.8	
Casein	6.1–6.8	
Castor oil	4.6–4.7	
Cerasine	2.1–2.3	
Colophony	2.5–2.8	0.005
Cottonseed oil	3.1–3.2	
Crown glass	6.0–6.5	
Diamond	16.5	
Ebonite	2.8–3.2	0.01
Electrical porcelain	~6	0.01
Flaxseed oil		
See Linseed oil		
Flint glass	7–10	
Glasses	5–10	
Gutta-percha	2.6–4.0	0.09–0.5
Halowax	4.3–4.8	0.008
Hard rubber	2.8–3.1	0.005
Hazelnut oil	2.9–3.1	
Ivory	6.9	
Lead glass	6.5–9.5	0.0009–0.0016
Lemon oil	2.2–2.3	
Lignite wax		
See Montan wax		
Linseed oil	3.1–3.3	
Marble	8.3–8.9	0.01
Mica	6.0–7.2	0.0004
Minium	17–18	
Montan wax	2.6	
Oak, dry		
(parallel to the fibres)	~4	
(perpendicular to the fibres)	~6	
Oils	2.2–3.2	
Olive oil	~3	
Ozokerite	2.6–3.1	0.0004
Paper	~2	
Paper, paraffined	~3.5	0.03

(continued)

Material	ε	tan δ
Paraffin		
m.p. 44–46°C	2.1	
54–56°C	2.15	0.0005
74–76°C	2.2	
Paraffin oil	2.1–2.2	
Petroleum	2.1	
Pine resin	2.5–2.8	0.005
Plastics		
See Table 107		
Porcelain	5.8–8.0	
PVC	3–6	0.02
Pyrex glass	4.5–4.6	0.003–0.005
Pyrophyllite	6	0.007
Quartz (cryst)	4–5	
Quartz glass	3.5–4.0	
Rapeseed oil	2.8–2.9	
Rubber	2.6–2.9	0.0018–0.005
Ruby, artificial	∥ 11.3	
	⊥ 13.3	
Sapphire, artificial	11–14	
Sealing wax	~5	
Seignette salt	∥ *a* 6.7	
	∥ *b* 6.9	
	∥ *c* 8.9	
Sesame oil	~3	
Shellac	2.9–3.7	0.008–0.01
Silk, natural	4.5	0.02
Spanish wax		
See Sealing wax		
Steatite	5.5–7.5	0.0002–0.004
Succinite		
See Amber		
Transformer oil	2.1–2.2	0.005–0.008
Turpentine oil	2.2–2.3	
Vulcanized fibre	4–7	0.05–0.09
Vycor glass	3.8	0.0005
Wood, dry	2.5–6.0	

Table 107

Relative permittivities and tan δ values

Material	ε_1^*	tan δ_1^*	ε_2^*	tan δ_2^*
Acrylate resin	3.0–3.7	0.05–0.07	2.7–3.3	0.015–0.03
Alkyd resin			4.8–5.2	
Allyl resin			3.5–3.7	0.05–0.07
Anilineformaldehyde resin	3.7–3.9	0.002–0.01	3.5–3.7	0.006–0.008
Bakelite	2.5–2.7	0.00006–0.00008	2.5–2.7	0.0001–0.0008
Butadieneacrylonitrile rubber	9.8–10	0.1		
Butadienestyrene rubber	2.6–2.8	0.005		
Caseinformaldehyde resin	6–7	0.10–0.20	6.1–6.8	0.05–0.06
Celluloid	6.8–8.6	0.03–0.14	6.0–6.4	0.04–0.10
Cellulose acetate	3.5–7.5	0.01–0.06	3.1–6.8	0.02–0.09
Cellulose acetate butyrate	3.4–6.4	0.01–0.05	3.2–6.2	0.01–0.05
Cellulose nitrate	6.8–8.6	0.03–0.14	6.0–6.4	0.04–0.10
Cellulose propionate	~4	0.01	3.6–3.7	0.01
Cresolformaldehyde resin	4–5	0.05–0.08		
Cresolformaldehyde resin (papelr filled, laminates)	6–10	0.04–0.11		
Cresolformaldehyde resin (textile filled, laminates)	4.8–12	0.05–0.10		
Diallyl phthalate (glass fibre)	4.3	0.01	4.5	0.009
Dially phthalate (mineral filled)	5.2	0.03	4.8	0.02
Epoxy resin (unfilled)	3.5–5.0	0.002–0.01		
Epoxy resin (silica filled)	3.2–4.5	0.008–0.03		
Ethyl cellulose	2.5–4.0	0.003–0.03	2.3–3.8	0.007–0.05
Melamineformaldehyde resin	6.4–11.6	0.07–0.17	6.5–6.8	0.04–0.05
Melamineformaldehyde resin (cellulose filled)	7.8–9.5	0.01–0.08	7.2–8.2	0.03–0.07
Methacrylate	3.0–3.7	0.05–0.07	2.7–3.3	0.015–0.03
Neoprene			4.0–4.2	0.03–0.05
Nitrocellulose	6.7–8.7	0.04–0.15	6.0–6.3	0.05–0.10
Nylon	4–10	0.014–0.19	3.5–4.5	0.03–0.14
Oppanol	2.3–2.5	0.0004–0.0006		
Phenolformaldehyde resin	5.5–7.5	0.01–0.15	4.0–5.5	0.04–0.05
Phenolformaldehyde resin (mineral filled)	4.5–5.0	0.01–0.30	4–20	0.005–0.20
Phenolformaldehyde resin (wood filled)	4–15	0.04–0.30	4–8	0.04–0.10
Phenolformaldehyde resin (paper filled)			3.6–7.0	0.02–0.08
Phenolfurfuraldehyde resin (paper filled, laminated)	3.7–3.8	0.01–0.20		
Plexiglas	3.0–3.7	0.05–0.07	2.7–3.3	0.015–0.03
Pliolite	2.5-2.7	0.001–0.002	2.6–2.7	0.0003–0.0005
Polyamide	4–10	0.01–0.2	3.5–4.5	0.03–0.14
Polycarbonate	3.1–3 3	0.0009	2.9–3.1	0.01
Polydichlorstyrene			2.6–2.7	0.0002–0.0003
Polyester resin	2.5-4.5	0.003–0.05	2.8–4.0	0.025–0.06

of plastics at room temperature

Material	ε_1^*	tan δ_1^*	ε_2^*	tan δ_2^*
Polyester resin (glass laminate)	4.3–6.0	0.005–0.05	4–5	0.01–0.03
Polyethylene	2.2–2.3	0.0005–0.005	2.2–2.3	0.0005–0.005
Polyisobutylene	2.2–2.4	0.0003–0.0005		
Polymethylmethacrylate	3.5–4.0	0.04–0.06	3.0–3.6	0.02–0.03
Polypropylene	2.5–2.7	<0.0005	2.5–2.7	<0.0005
Polystyrene	2.5–3.2	0.00006–0.0008	2.5–2.9	0.0002–0.0008
Polystyrene–butadiene	2.5–2.7	0.001–0.002	2.6–2.7	0.0003–0.0005
Polytetrafluoroethylene	1.9–2.1	<0.0002	1.9–2.0	<0.0003
Polytrifluorochloroethylene	2.3–2.8	0.015–0.025	2.4–2.6	0.01–0.03
Polyurethane	3.2–4.2	0.01–0.04	3.5–3.9	0.02–0.04
Polyurethane (foam)	1.0–1.5			
Polyvinyl acetate	2.7–5.6	0.007–0.12	2.9–3.9	0.007–0.06
Polyvinyl carbazol			2.8–3.2	0.0004–0.001
Polyvinyl chloride (without plasticizer)	3–8	0.02–0.20	3–5	0.01–0.10
Polyvinyl chloride (with plasticizer)	6–10	0.05–0.15		
Polyvinyl formal	3.3–3.7	0.007–0.01	2.9–3.2	0.01–0.03
Polyvinylidene chloride	4–6	0.03–0.08	3–4	0.04–0.07
Silicone resin (glass laminate)			3.8–4.2	0.002–0.03
Silicone rubber	3.4–9.6	0.3–2.0	3.2–9.0	0.2–2.5
Teflon	1.9–2.1	<0.0002	1.9–2.0	<0.0003
Ureaformaldehyde resin	6.6–9.5	0.035–0.10	5.5–7.7	0.01–0.035
Ureaformaldehyde resin (paper laminates)	6–7	0.02–0.10		
Vinylchloridevinylacetate copolymer	3.2–3.3	0.008–0.012	2.9–3.1	0.01–0.02
Vinylchlorideacrylate copolymer	3.4–3.6	0.01–0.02	3.1–3.3	0.01–0.02
Vinylidene chloride	2.5–5.0	0.03–0.15	2.5–5.0	0.03–0.15
Vulcanized fibre	4–7	0.05–0.09	4–7	0.04–0.08

* ε_1 static (low frequency) relative permittivity
tan δ_1 low frequency dielectric loss
ε_2 high frequency (>1 MHz) relative permittivity
tan δ_2 high frequency dielectric loss

III

EQUILIBRIUM VALUES, ACTIVITY COEFFICIENTS SOLUBILITY PRODUCTS, rH VALUES

Table 108

Dissociation constants of inorganic acids

Acid	t, °C		K
H_3AlO_3	25		6×10^{-12}
H_3AsO_3	20	K_1	4×10^{-10}
		K_2	3×10^{-14}
H_3AsO_4	18	K_1	6.62×10^{-3}
		K_2	1.70×10^{-7}
		K_3	5.95×10^{-12}
H_3BO_3	20	K_1	7.3×10^{-10}
		K_2	1.8×10^{-12}
		K_3	1.6×10^{-14}
$H_2B_4O_7$	25	K_1	$\sim10^{-14}$
		K_2	$\sim10^{-9}$
HBrO	25		2.06×10^{-9}
HCN	20		4.8×10^{-10}
H_2CO_3	25	K_1	4.45×10^{-7}
		K_2	4.69×10^{-11}
HClO	25		5.6×10^{-8}
H_2CrO_4	25	K_1	1.8×10^{-1}
		K_2	3.2×10^{-7}
HF	25		3.53×10^{-4}
$H_4[Fe(CN)_6]$	25	K_1	5.6×10^{-5}
H_2GeO_3	25	K_1	2.6×10^{-9}
		K_2	1.9×10^{-13}
HIO	20		2.3×10^{-11}
HIO_3	25		1.7×10^{-1}
HIO_4	25		2.3×10^{-2}
HN_3	18		2.14×10^{-5}
HNO_2	25		4.6×10^{-4}
H_2O_2	25		2.4×10^{-12}
HOCN	20		2.2×10^{-4}
H_3PO_2	20		8.5×10^{-2}
H_3PO_3	18	K_1	1.0×10^{-2}
		K_2	2.6×10^{-7}
H_3PO_4	20	K_1	7.9×10^{-3}
		K_2	1×10^{-7}
		K_3	4.5×10^{-12}
$H_4P_2O_6$	20	K_1	6.4×10^{-3}
		K_2	1.55×10^{-3}
		K_3	5.4×10^{-8}
		K_4	9.4×10^{-11}
$H_4P_2O_7$	18	K_1	1.4×10^{-1}
		K_2	3.2×10^{-2}
		K_3	1.7×10^{-6}
		K_4	6.0×10^{-9}
H_2S	18	K_1	9.1×10^{-8}
		K_2	1.2×10^{-12}
H_2SO_3	25	K_1	1.7×10^{-2}
		K_2	5×10^{-6}
H_2SO_4	25	K_2	1.2×10^{-2}
$H_2S_2O_3$	25	K_1	1×10^{-2}
$H_2S_2O_4$	25	K_1	3.5×10^{-3}
H_2Se	20	K_1	1.9×10^{-4}
H_2SeO_3	18	K_1	2.88×10^{-3}
		K_2	9.55×10^{-9}
H_2SeO_4	25	K_2	1.2×10^{-2}
H_2SiO_3	20	K_1	2×10^{-10}
		K_2	1×10^{-12}
H_4SiO_4	30	K_1	2.2×10^{-10}
		K_2	2.2×10^{-12}
		K_3	1×10^{-12}
		K_4	1×10^{-12}
H_2SnO_3	25	K_1	4×10^{-10}
H_2Te	25		1.88×10^{-4}
H_2TeO_3	25	K_1	3×10^{-3}
		K_2	2×10^{-8}
H_2TeO_4	18	K_1	2.1×10^{-8}
		K_2	6.5×10^{-12}

Table 109

Dissociation constants of inorganic bases

Base	t, °C		K
AgOH	25		1.1×10^{-4}
$Be(OH)_2$	25	K_2	5×10^{-11}
$Ca(OH)_2$	25		3.74×10^{-3}
$Ga(OH)_3$	18	K_2	$\sim 1.6 \times 10^{-11}$
		K_3	$\sim 4 \times 10^{-12}$
ND_4OD	25		$\sim 1.1 \times 10^{-5}$
$NH_2OH \cdot H_2O$	20		1.07×10^{-8}
NH_4OH	0		1.4×10^{-5}
	10		1.6×10^{-5}
	25		1.8×10^{-5}
	40		2×10^{-5}
	75		1.6×10^{-5}
	100		1.4×10^{-5}
$N_2H_4 \cdot H_2O$	20		1.7×10^{-6}
$Pb(OH)_2$	25	K_1	9.6×10^{-4}
		K_2	3×10^{-8}
$Zn(OH)_2$	25	K_2	1.5×10^{-9}

Table 110

Dissociation constants of organic acids

Acid	Formula	t, °C	K
Acetic acid	CH_3COOH	0	1.66×10^{-5}
		5	1.70×10^{-5}
		10	1.73×10^{-5}
		15	1.74×10^{-5}
		20	1.75×10^{-5}
		25	1.75×10^{-5}
		30	1.75×10^{-5}
		35	1.73×10^{-5}
		40	1.70×10^{-5}
		45	1.67×10^{-5}
		50	1.63×10^{-5}
		55	1.59×10^{-5}
		60	1.54×10^{-5}
Acetoacetic acid	CH_3COCH_2COOH	18	2.62×10^{-4}
Acetoxime	$(CH_3)_2C : NOH$	25	6.0×10^{-13}
γ-Acetylbutyric acid	$CH_3CO(CH_2)_3COOH$	18	2.18×10^{-5}
Acetylsalicylic acid	$CH_3CO_2C_6H_4COOH$	17	2.72×10^{-5}

Acid	Formula	t, °C	K
Acrylic acid	$CH_2:CHCOOH$	25	5.5×10^{-5}
Adipic acid	$COOH(CH_2)_4COOH$	25	K_1 3.70×10^{-5}
			K_2 3.22×10^{-6}
		50	K_1 3.29×10^{-5}
			K_2 3.22×10^{-6}
		74	K_1 2.90×10^{-5}
			K_2 2.55×10^{-6}
Alanine	$CH_3CH(NH_2)COOH$	25	1.9×10^{-10}
Allantoin	$C_4H_6N_4O_3$	25	1.1×10^{-9}
Alloxan	$CONHCONHCOC(OH)_2$	25	2.3×10^{-7}
Allylacetic acid	$CH_2:CH(CH_2)_2COOH$	25	2.1×10^{-5}
Amber acid See Succinic acid			
o-Aminobenzoic acid See Anthranilic acid			
p-Aminobenzoic acid	$H_2NC_6H_4COOH$	25	5.1×10^{-3}
β-Aminopropionic acid	$NH_2(CH_2)_2COOH$	0	K_1 2.21×10^{-4}
			K_2 1.00×10^{-11}
		5	K_1 2.36×10^{-4}
			K_2 1.48×10^{-11}
		15	K_1 2.61×10^{-4}
			K_2 2.98×10^{-11}
		25	K_1 2.81×10^{-4}
			K_2 5.82×10^{-11}
		35	K_1 2.99×10^{-4}
			K_2 1.09×10^{-10}
		40	K_1 3.04×10^{-4}
			K_2 1.44×10^{-10}
4-Aminosalicylic acid	$H_2NC_6H_3(OH)COOH$	25	1.0×10^{-2}
tert-Amylacetic acid	$(CH_3)_3C(CH_2)_2COOH$	18	1.63×10^{-5}
Angelic acid	$CH_3CH:C(CH_3)COOH$	18	5.1×10^{-5}
Anthranilic acid	$H_2NC_6H_4COOH$	25	7.3×10^{-3}
Arginine	$HN:C(NH_2)NH(CH_2)_3CH(NH_2)COOH$	25	3.32×10^{-13}
Ascorbic acid	$C_6H_8O_6$	25	K_1 7.9×10^{-5}
			K_2 1.6×10^{-12}
Asparagine	$CO(NH_2)CH_2CH(NH_2)COOH$	20	1.41×10^{-9}
Asparaginic acid	$COOHCH_2CH(NH_2)COOH$	0	K_1 1.7×10^{-4}
			K_2 4.9×10^{-11}
dl-Aspartic acid	$COOHCH_2CH(NH_2)COOH$	25	K_1 1.38×10^{-4}
			K_2 1.51×10^{-10}
α-Aspartic acid See Asparaginic acid			
Atropic acid	$C_6H_3C(CH_2)COOH$	25	1.43×10^{-4}
Azelaic acid	$COOH(CH_2)_7COOH$	18	K_1 2.88×10^{-5}
			K_2 3.86×10^{-6}
Barbituric acid	$COCH_2CONHCONH$	25	1.05×10^{-4}
Benzenesulphonic acid	$C_6H_5SO_3H$	25	2×10^{-1}

Acid	Formula	t, °C	K
Benzoic acid	C_6H_5COOH	20	6.24×10^{-5}
		25	6.29×10^{-5}
		30	6.27×10^{-5}
		35	6.24×10^{-5}
Benzyl boric acid	$C_6H_5CH_2BO_3H_2$	25	7.55×10^{-9}
α-Benzyl-α-cyano-propionic acid	$C_6H_5CH_2C(CH_3)(CN)COOH$	25	5.13×10^{-3}
Benzylsuccinic acid	$C_6H_5CH_2CH(COOH)CH_2COOH$	20	K_1 7.75×10^{-5}
			K_2 2.3×10^{-6}
β-Benzylthiopropionic acid	$C_6H_5CH_2S(CH_2)_2COOH$	18	3.44×10^{-5}
Bromoacetic acid	$BrCH_2COOH$	15	1.33×10^{-3}
		20	1.30×10^{-3}
		25	1.25×10^{-3}
		30	1.21×10^{-3}
		35	1.16×10^{-3}
Bromocresol green	$C_{21}H_{14}O_5Br_4S$	25	1.1×10^{-5}
m-Bromobenzoic acid	BrC_6H_4COOH	15	1.52×10^{-4}
		20	1.54×10^{-4}
		25	1.55×10^{-4}
		30	1.55×10^{-4}
		35	1.55×10^{-4}
		40	1.54×10^{-4}
		45	1.52×10^{-4}
o-Bromobenzoic acid	BrC_6H_4COOH	25	1.40×10^{-3}
p-Bromobenzoic acid	BrC_6H_4COOH	15	9.73×10^{-5}
		20	9.88×10^{-5}
		25	9.95×10^{-5}
		30	9.95×10^{-5}
		35	9.88×10^{-5}
		40	9.88×10^{-5}
		45	9.84×10^{-5}
m-Bromomandelic acid	$BrC_6H_4CH(OH)COOH$	25	5.89×10^{-4}
2-Bromonitrobenzoic acid	$Br(NO_2)C_6H_3COOH$	25	4.24×10^{-2}
m-Bromophenol	BrC_6H_4OH	25	1.36×10^{-5}
o-Bromophenol		25	4.1×10^{-9}
p-Bromophenol		25	5.7×10^{-9}
Bromphenol blue	$C_{19}H_{10}O_5Br_4S$	25	5.85×10^{-9}
m-Bromophenoxy-acetic acid	$BrC_6H_4OCH_2COOH$	25	8.0×10^{-4}
o-Bromophenoxy-acetic acid		25	7.5×10^{-4}
p-Bromophenoxy acetic acid		25	7.4×10^{-4}
o-Bromophenylacetic acid	$BrC_6H_4CH_2COOH$	25	8.8×10^{-5}

(continued)

Acid	Formula	t, °C	K
p-Bromophenylacetic acid		25	6.5×10^{-5}
α-Bromopropionic acid	$CH_3CHBrCOOH$	18	1.07×10^{-3}
β-Bromopropionic acid	CH_2BrCH_2COOH	18	1.02×10^{-4}
o-*tert*-Butylbenzoic acid	$(CH_3)_3CC_6H_4COOH$	25	2.91×10^{-4}
p-*tert*-Butylbenzoic acid		25	3.98×10^{-5}
p-*tert*-Butylphenyl acetic acid	$(CH_3)_3CC_6H_4CH_2COOH$	25	3.8×10^{-5}
Butyric acid	$CH_3(CH_2)_2COOH$	0	1.56×10^{-5}
		5	1.57×10^{-5}
		10	1.58×10^{-5}
		15	1.57×10^{-5}
		20	1.54×10^{-5}
		25	1.52×10^{-5}
		30	1.48×10^{-5}
		35	1.44×10^{-5}
		40	1.40×10^{-5}
		45	1.35×10^{-5}
		50	1.30×10^{-5}
		55	1.25×10^{-5}
		60	1.20×10^{-5}
Cacodylic acid	$(CH_3)_2AsO_2H$	25	5.3×10^{-7}
Camphoric acid	$C_8H_{14}(COOH)_2$	25	K_1 2.7×10^{-5}
			K_2 8×10^{-6}
Caproic acid	$CH_3(CH_2)_4COOH$	0	1.44×10^{-6}
		10	1.45×10^{-5}
		20	1.42×10^{-5}
		30	1.36×10^{-5}
		40	1.29×10^{-5}
		50	1.20×10^{-5}
		60	1.11×10^{-5}
Capronic acid See Caproic acid			
Caprylic acid	$CH_3(CH_2)_6COOH$	25	1.27×10^{-5}
cis-Caronic acid	$(CH_3)_2CCH(COOH)CHCOOH$	25	K_1 4.6×10^{-3}
			K_2 4.9×10^{-9}
		50	K_1 3.8×10^{-3}
			K_2 4.5×10^{-9}
		74	K_1 2.8×10^{-3}
			K_2 3.8×10^{-9}
trans-Caronic acid	$(CH_3)_2CCH(COOH)HCCOOH$	25	K_1 1.5×10^{-4}
			K_2 4.8×10^{-6}
		50	K_1 1.2×10^{-4}
			K_2 3.6×10^{-6}
		74	K_1 1.0×10^{-4}
			K_2 2.6×10^{-6}

Table 110

Acid	Formula	t, °C	K
Chloroacetic acid	$CH_2ClCOOH$	0	1.53×10^{-3}
		10	1.49×10^{-3}
		15	1.43×10^{-3}
		20	1.39×10^{-3}
		25	1.36×10^{-3}
		30	1.31×10^{-3}
		35	1.26×10^{-3}
		40	1.23×10^{-3}
m-Chlorobenzoic acid	ClC_6H_4COOH	25	1.5×10^{-4}
o-Chlorobenzoic acid		25	1.2×10^{-3}
p-Chlorobenzoic acid		15	1.00×10^{-4}
		20	1.02×10^{-4}
		25	1.03×10^{-4}
		30	1.05×10^{-4}
		35	1.05×10^{-4}
		40	1.05×10^{-4}
		45	1.04×10^{-4}
m-Chloro-*trans*-cinnamic acid	$ClC_6H_4CH : CHCOOH$	25	5.1×10^{-5}
o-Chloro-*trans*-cinnamic acid		25	5.8×10^{-5}
p-Chloro-*trans*-cinnamic acid		25	3.9×10^{-5}
α-Chloro isobutyric acid	$(CH_3)_2CClCOOH$	18	1.06×10^{-3}
m-Chloromandelic acid	$ClC_6H_4CH(OH)COOH$	25	5.80×10^{-4}
2-Chloro-3-nitro-benzoic acid	$Cl(NO_2)C_6H_5COOH$	25	9.51×10^{-3}
2-Chloro-4-nitro-benzoic acid		25	10.9×10^{-3}
2-Chloro-5-nitro-benzoic acid		25	6.8×10^{-3}
2-Chloro-6-nitro-benzoic acid		25	4.6×10^{-3}
m-Chlorophenol	ClC_6H_4OH	25	6.6×10^{-9}
o-Chlorophenol		25	7.7×10^{-9}
p-Chlorophenol		25	6.3×10^{-9}
m-Chlorophenoxy-acetic acid	$ClC_6H_4OCH_2COOH$	25	8.5×10^{-4}
o-Chlorophenoxy-acetic acid		25	8.9×10^{-4}
p-Chlorophenoxy-acetic acid		25	7.9×10^{-4}
m-Chlorophenylacetic acid	$ClC_6H_4CH_2COOH$	25	7.24×10^{-5}
o-Chlorophenylacetic acid		25	8.60×10^{-5}

(continued)

Acid	Formula	t, °C	K
p-Chlorophenylacetic acid		25	6.45×10^{-5}
β-*m*-Chlorophenyl-propionic acid	$ClC_6H_4(CH_2)_2COOH$	25	2.60×10^{-5}
β-*o*-Chlorophenyl-propionic acid		25	2.65×10^{-5}
β-*p*-Chlorophenyl-propionic acid		25	2.47×10^{-5}
α-Chloropropionic acid	$CH_3CHClCOOH$	18	1.3×10^{-3}
β-Chloropropionic acid	CH_2ClCH_2COOH	18	8.0×10^{-5}
cis-Cinnamic acid	$C_6H_5CH : CHCOOH$	25	1.3×10^{-4}
trans-Cinnamic acid		25	3.7×10^{-5}
Citric acid	$COOHCH_2C(OH)(COOH)CH_2COOH$	10	K_1 6.0×10^{-4}
			K_2 1.5×10^{-5}
			K_3 4.0×10^{-6}
		20	K_1 6.7×10^{-4}
			K_2 1.6×10^{-5}
			K_3 4.1×10^{-6}
		25	K_1 8.6×10^{-4}
			K_2 1.7×10^{-5}
			K_3 4.0×10^{-6}
		30	K_1 7.2×10^{-4}
			K_2 1.7×10^{-5}
			K_3 4.0×10^{-6}
		40	K_1 7.9×10^{-4}
			K_2 1.8×10^{-5}
			K_3 3.7×10^{-6}
		50	K_1 8.0×10^{-4}
			K_2 1.8×10^{-5}
			K_3 3.3×10^{-6}
Congo red	$C_{32}H_{24}O_6N_6S_2$	25	6.4×10^{-5}
m-Cresol	$CH_3C_6H_4OH$	25	9.8×10^{-11}
o-Cresol		25	6.3×10^{-11}
p-Cresol		25	6.7×10^{-11}
trans-Crotonic acid	$CH_3CH : CHCOOH$	18	1.95×10^{-5}
		25	2.00×10^{-5}
Cyanoacetic acid	$CNCH_2COOH$	25	3.5×10^{-3}
m-Cyanobenzoic acid	CNC_6H_4COOH	15	2.46×10^{-4}
		20	2.52×10^{-4}
		25	2.53×10^{-4}
		30	2.53×10^{-4}
		35	2.52×10^{-4}
		40	2.48×10^{-4}
		45	2.44×10^{-4}

Acid	Formula	t, °C	K
p-Cyanobenzoic acid	CNC_6H_4COOH	15	2.77×10^{-4}
		20	2.81×10^{-4}
		25	2.81×10^{-4}
		30	2.88×10^{-4}
		35	2.80×10^{-4}
		40	2.75×10^{-4}
		45	2.71×10^{-4}
γ-Cyanobutyric acid	$CN(CH_2)_3COOH$	25	3.7×10^{-5}
trans-1-Cyanocyclohexane-2-carboxylic acid	$C_8H_{11}O_2N$	25	1.36×10^{-4}
α-Cyanoisobutyric acid	$(CH_3)_2C(CN)COOH$	25	3.8×10^{-3}
m-Cyanophenoxyacetic acid	$CNC_6H_4OCH_2COOH$	25	9.2×10^{-4}
o-Cyanophenoxyacetic acid		25	1.1×10^{-3}
p-Cyanophenoxyacetic acid		25	1.2×10^{-3}
Cyclobutanecarboxylic acid	$CH_2CH_2CH_2CHCOOH$	25	1.6×10^{-5}
1,1-Cyclobutanedicarboxylic acid	$CH_2CH_2CH_2C(COOH)_2$	25	K_1 7.5×10^{-4}
			K_2 1.3×10^{-6}
Cyclohexanecarboxylic acid	$CH_2(CH_2)_4CHCOOH$	25	1.3×10^{-5}
1,1-Cyclohexanedicarboxylic acid	$CH_2(CH_2)_4C(COOH)_2$	25	K_1 3.5×10^{-4}
			K_2 7.8×10^{-5}
1,1-Cyclohexylacetoacetic acid	$CH_2(CH_2)_4C(CH_2COOH)_2$	25	K_1 3.25×10^{-4}
			K_2 1.09×10^{-7}
		50	K_1 2.42×10^{-4}
			K_2 9.09×10^{-8}
		74	K_1 1.79×10^{-4}
			K_2 7.80×10^{-8}
Cyclohexylcyanoacetic acid	$C_6H_5CH(CN)COOH$	25	4.30×10^{-3}
Cyclopentanecarboxylic acid	$CH_2(CH_2)_3CHCOOH$	25	1.0×10^{-5}
1,1-Cyclopentanedicarboxylic acid	$CH_2(CH_2)_3C(COOH)_2$	25	K_1 5.9×10^{-4}
			K_2 8.3×10^{-5}
1,1-Cyclopentylacetoacetic acid	$CH_2(CH_3)_3C(CH_2COOH)_2$	25	K_1 1.6×10^{-4}
			K_2 1.7×10^{-7}
Cyclopropanecarboxylic acid	$CH_2CH_2CHCOOH$	25	1.5×10^{-5}

(continued)

Acid	Formula	t, °C	K
1,1-Cyclopropane-dicarboxylic acid	$CH_2CH_2C(COOH)_2$	25	K_1 1.5×10^{-2}
			K_2 3.7×10^{-6}
Deuteroacetic acid (in D_2O)	CD_3COOD	25	5.5×10^{-6}
Dichloroacetic acid	$CHCl_2COOH$	18	5.8×10^{-2}
		25	5.5×10^{-2}
2,4-Dichlorophenol	$Cl_2C_6H_3OH$	25	1.41×10^{-8}
Diethylacetic acid	$(C_2H_5)_2CHCOOH$	25	1.77×10^{-5}
		30	1.74×10^{-5}
		40	1.54×10^{-5}
		50	1.35×10^{-5}
		60	1.81×10^{-5}
Diethylbarbituric acid	$(C_2H_5)_2C(COHN)_2CO$	25	3.7×10^{-8}
Diethylglycolic acid	$(C_2H_5)_2C(OH)COOH$	18	1.6×10^{-4}
Diethylmalonic acid	$(C_2H_5)_2C(COOH)_2$	25	K_1 6.2×10^{-3}
			K_2 5.1×10^{-8}
3,4-Dimethoxyphenyl-acetic acid	$(CH_3O)_2C_6H_3CH_2COOH$	25	4.64×10^{-5}
β,β′-Dimethylacrylic acid	$(CH_3)_2C(CH)COOH$	25	7.6×10^{-6}
Dimethylarsinic acid See Cacodylic acid			
2,3-Dimethylbenzoic acid	$(CH_3)_2C_6H_3COOH$	25	1.83×10^{-4}
2,4-Dimethylbenzoic acid		25	6.57×10^{-5}
2,5-Dimethylbenzoic acid		25	1.06×10^{-4}
2,6-Dimethylbenzoic acid		25	5.68×10^{-4}
3,4-Dimethylbenzoic acid		25	3.91×10^{-5}
3,5-Dimethylbenzoic acid		25	5.00×10^{-5}
Dimethylethylacetic acid	$C_2H_5C(CH_3)_2COOH$	18	9.3×10^{-6}
β,β′-Dimethylglutaric acid	$COOHCH_2C(CH_3)_2CH_2COOH$	25	K_1 2.01×10^{-4}
			K_2 3.26×10^{-7}
		50	K_1 1.28×10^{-4}
			K_2 3.26×10^{-7}
		74	K_1 9.33×10^{-5}
			K_2 2.52×10^{-7}
Dimethylglycine	$(CH_3)_2NCH_2COOH$	25	1.3×10^{-10}
Dimethylglycolic acid	$CH_3CCH_3OHCOOH$	18	9.2×10^{-5}
Dimethylmalonic acid	$(CH_3)_2C(COOH)_2$	25	K_1 6.83×10^{-4}
			K_2 8.72×10^{-7}

Acid	Formula	t, °C	K
2,3-Dimethyl-1-naphthoic acid	$(CH_3)_2C_6H_5COOH$	25	4.7×10^{-4}
2,6-Dimethyl-4-nitrophenol	$(CH_3)_2(NO_2)C_6H_5OH$	25	6.5×10^{-8}
3,5-Dimethyl-4-nitrophenol		25	5.7×10^{-9}
2,6-Dimethylphenoxy-acetic acid	$CH_3(CH_3)_2C_6H_3OCH_2COOH$	25	4.4×10^{-4}
2,3-Dinitrobenzoic acid	$(NO_2)_2C_6H_3COOH$	25	1.41×10^{-2}
2,4-Dinitrobenzoic acid		25	3.76×10^{-2}
2,5-Dinitrobenzoic acid		25	2.39×10^{-2}
2,6-Dinitrobenzoic acid		25	7.25×10^{-2}
3,4-Dinitrobenzoic acid		25	1.52×10^{-3}
3,5-Dinitrobenzoic acid		25	1.5×10^{-3}
2,4-Dinitrophenol	$(NO_2)_2C_6H_3OH$	25	8×10^{-5}
2,5-Dinitrophenol		25	6.1×10^{-6}
2,6-Dinitrophenol		25	1.9×10^{-4}
3,4-Dinitrophenol		25	3.8×10^{-6}
2,4-Dinitrophenyl-acetic acid	$(NO_2)_2C_6H_3CH_2COOH$	25	3.15×10^{-4}
3,5-Dinitro-*p*-toluic acid	$(CH_3)(NO_2)_2C_6H_2COOH$	25	1.07×10^{-3}
2,3-Dioxybenzoic acid	$(OH)_2C_6H_3COOH$	25	1.14×10^{-3}
2,4-Dioxybenzoic acid		25	1.08×10^{-3}
2,6-Dioxybenzoic acid		25	5.0×10^{-2}
3,4-Dioxybenzoic acid		25	3.3×10^{-5}
3,5-Dioxybenzoic acid		25	9.1×10^{-5}
Diphenylacetic acid	$(C_6H_5)_2CHCOOH$	25	1.15×10^{-4}
α,α′-Diphenyladipic acid	$(C_6H_5)_2C(COOH)(CH_2)_3COOH$	20	K_1 6.8×10^{-5}
			K_2 4.0×10^{-6}
β,β′-Diphenyladipic acid	$COOHCH_2CH(C_6H_5)CH(C_6H_5)$-$CH_2COOH$	25	K_1 6.04×10^{-5}
			K_2 6.39×10^{-6}
		50	K_1 5.31×10^{-5}
			K_2 4.67×10^{-6}
		74	K_1 3.97×10^{-5}
			K_2 3.05×10^{-6}
α,α′-Diphenylglutaric acid	$(C_6H_5)_2C(COOH)(CH_2)_2COOH$	20	K_1 1.24×10^{-4}
			K_2 4.2×10^{-7}
α,α′-Diphenylpimelic acid	$(C_6H_5)_2C(COOH)(CH_2)_4COOH$	20	K_1 5.25×10^{-5}
			K_2 4.1×10^{-6}
α,α′-Diphenylsuberic acid	$(C_6H_5)_2C(COOH)(CH_2)_5COOH$	20	K_1 4.99×10^{-5}
			K_2 4.1×10^{-6}

(continued)

Acid	Formula	t, °C	K
α,α′-Diphenylsuccinic acid	$(C_6H_5)_2C(COOH)CH_2COOH$	20	K_1 8.9×10^{-4} K_2 5×10^{-8}
β,β′-Dipropylglutaric acid	$(CH_3CH_2CH_2)_2C(CH_2COOH)_2$	25	K_1 2.1×10^{-4} K_2 4.9×10^{-8}
Dipropylmalonic acid	$(CH_3CH_2CH_2)_2C(COOH)_2$	25	K_1 8.6×10^{-3} K_2 3.1×10^{-8}
Dithioacetoacetic acid	$COOHCH_2SSCH_2COOH$	18	K_1 8.41×10^{-4} K_2 6.30×10^{-5}
Enanthic acid	$CH_3(CH_2)_5COOH$	25	1.28×10^{-5}
Ethoxyacetic acid	$CH_3CH_2OCH_2COOH$	18	2.23×10^{-4}
β-Ethylacrylic acid	$C_2H_5CHCHCOOH$	25	2.02×10^{-5}
o-Ethylbenzoic acid	$C_2H_5C_6H_4COOH$	25	1.61×10^{-4}
p-Ethylbenzoic acid		25	4.44×10^{-5}
α-Ethylbutyric acid See Diethylacetic acid			
Ethylenedithioacetic acid	$COOHCH_2S(CH_2)_2SCH_2COOH$	18	K_1 4.2×10^{-4} K_2 4.5×10^{-5}
β-Ethylglutaric acid	$COOHCH_2CH(C_2H_5)CH_2COOH$	25	K_1 5.2×10^{-5} K_2 4.7×10^{-6}
Ethylmalonic acid	$(C_2H_5)CH(COOH)_2$	25	K_1 1.0×10^{-3} K_2 1.5×10^{-6}
p-Ethylphenylacetic acid	$C_2H_5C_6H_4CH_2COOH$	25	4.24×10^{-5}
Ethylpropylacetic acid	$CH_3(CH_2)_2CH(C_2H_5)COOH$	18	1.96×10^{-5}
Ethylpropylmalonic acid	$CH_3(CH_2)_2C(C_2H_5)(COOH)_2$	25	K_1 7.2×10^{-3} K_2 3.7×10^{-8}
Fluoroacetic acid	FCH_2COOH	15	2.79×10^{-3}
		20	2.68×10^{-3}
		25	2.59×10^{-3}
		30	2.49×10^{-3}
		35	2.38×10^{-3}
m-Fluorobenzoic acid	FC_6H_4COOH	25	1.36×10^{-4}
o-Fluorobenzoic acid		25	5.41×10^{-4}
p-Fluorobenzoic acid		25	7.22×10^{-5}
m-Fluoromandelic acid	$FC_6H_4CH(OH)COOH$	25	5.70×10^{-5}
p-Fluorophenol	FC_6H_4OH	25	1.5×10^{-10}
m-Fluorophenoxyacetic acid	$FC_6H_4OCH_2COOH$	25	8.28×10^{-4}
o-Fluorophenoxyacetic acid		25	8.22×10^{-4}
p-Fluorophenoxyacetic acid		25	7.42×10^{-4}
p-Fluorophenylacetic acid	$FC_6H_4CH_2COOH$	25	5.68×10^{-5}

Acid	Formula	t, °C	K
Formic acid	$HCOOH$	0	1.64×10^{-4}
		5	1.69×10^{-4}
		10	1.73×10^{-4}
		15	1.75×10^{-4}
		20	1.76×10^{-4}
		25	1.77×10^{-4}
		30	1.77×10^{-4}
		35	1.75×10^{-4}
		40	1.72×10^{-4}
		45	1.68×10^{-4}
		50	1.65×10^{-4}
		55	1.61×10^{-4}
		60	1.55×10^{-4}
Fumaric acid	$COOH(CH)_2COOH$	18	K_1 9.31×10^{-4}
			K_2 3.42×10^{-5}
		37	K_1 9.08×10^{-4}
			K_2 3.08×10^{-5}
Furoic acid See Pyromucic acid			
Gallic acid	$C_6H_2(OH)_3COOH$	25	4×10^{-5}
Glucuronic acid	$CH_2OHCH(OH)_4COOH$	20	6.6×10^{-4}
Glutaconic acid	$COOHCH_2CHCHCOOH$	25	K_1 1.70×10^{-4}
			K_2 8.38×10^{-6}
Glutaric acid	$(CH_2)_3(COOH)_2$	25	K_1 4.58×10^{-5}
			K_2 3.89×10^{-6}
		50	K_1 4.41×10^{-5}
			K_2 4.34×10^{-6}
		74	K_1 3.69×10^{-5}
			K_2 2.47×10^{-6}
Glycine	NH_2CH_2COOH	10	3.9×10^{-3}
		20	4.3×10^{-3}
		25	4.5×10^{-3}
		30	4.6×10^{-3}
		40	4.8×10^{-3}
Glycolic acid	$CH_2OHCOOH$	0	1.33×10^{-4}
		10	1.41×10^{-4}
		25	1.48×10^{-4}
		50	1.42×10^{-4}
Glyoxalic acid	$CHOCOOH \cdot H_2O$	25	5.0×10^{-4}
Glyoxylic acid See Glyoxalic acid			
Hexahydrobenzoic acid See Cyclohexane-carboxylic acid			
Hippuric acid	$C_6H_5CONHCH_2COOH$	25	2.3×10^{-4}
Histidine	$C_6H_9O_2N_3$	25	6.7×10^{-10}
Hydroquinone	$C_6H_6O_2$	18	1.1×10^{-10}

(continued)

Acid	Formula	t, °C	K
Iodoacetic acid	ICH_2COOH	15	7.19×10^{-4}
		20	6.95×10^{-4}
		25	6.68×10^{-4}
		30	6.41×10^{-4}
		35	6.13×10^{-4}
m-Iodobenzoic acid	IC_6H_4COOH	25	1.4×10^{-4}
o-Iodobenzoic acid		25	1.37×10^{-3}
m-Iodomandelic acid	$IC_6H_4CH(OH)COOH$	25	5.45×10^{-4}
m-Iodophenol	IC_6H_4OH	25	1.32×10^{-9}
o-Iodophenol		25	3.44×10^{-9}
p-Iodophenol		25	6.30×10^{-10}
m-Iodophenoxyacetic acid	$IC_6H_4OCH_2COOH$	25	7.44×10^{-4}
o-Iodophenoxyacetic acid		25	6.72×10^{-4}
p-Iodophenoxyacetic acid		25	6.94×10^{-4}
m-Iodophenylacetic acid	$IC_6H_4CH_2COOH$	25	6.93×10^{-5}
o-Iodophenylacetic acid		25	9.16×10^{-5}
p-Iodophenylacetic acid		25	6.64×10^{-5}
α-Iodopropionic acid	$CH_3CHICOOH$	18	7.8×10^{-4}
β-Iodopropionic acid	CH_2ICH_2COOH	18	8.2×10^{-5}
Isobutyric acid	$(CH_3)_2CHCOOH$	0	1.50×10^{-5}
		10	1.49×10^{-5}
		20	1.45×10^{-5}
		30	1.30×10^{-5}
		40	1.21×10^{-5}
		50	1.11×10^{-5}
		60	1.02×10^{-5}
Isocaproic acid	$(CH_3)_2CH(CH_2)_2COOH$	0	1.49×10^{-5}
		10	1.49×10^{-5}
		20	1.46×10^{-5}
		30	1.40×10^{-5}
		40	1.32×10^{-5}
		50	1.24×10^{-5}
		60	1.14×10^{-5}
Isocrotonic acid	$CH_3(CH)_2COOH$	18	3.9×10^{-5}
Isonicotinic acid	$C_6H_5O_2N$	25	1.46×10^{-5}
Isopropylacrylic acid	$CH_3CH(CH_3)CHCHCOOH$	25	1.99×10^{-5}
o-Isopropylbenzoic acid	$(CH_3)_2CHC_6H_4COOH$	25	2.32×10^{-4}
p-Isopropylbenzoic acid		25	4.43×10^{-5}
β-Isopropylglutaric acid	$(CH_3)_2CHCH(CH_2COOH)_2$	25	K_1 5.05×10^{-5}
			K_2 3.08×10^{-6}
Isopropylmalonic acid	$(CH_3)_2CHCH(COOH)_2$	25	K_1 1.14×10^{-3}
			K_2 1.32×10^{-6}
p-Isopropylphenylacetic acid	$(CH_3)_2CHC_6H_4CH_2COOH$	25	4.06×10^{-5}

Acid	Formula	t, °C	K
Isovaleric acid	$(CH_3)_2CHCH_2COOH$	0	1.88×10^{-5}
		10	1.81×10^{-5}
		20	1.71×10^{-5}
		25	1.67×10^{-5}
		30	1.61×10^{-5}
		40	1.48×10^{-5}
		50	1.35×10^{-5}
		60	1.22×10^{-5}
Itaconic acid	$COOHC(CH_2)CH_2COOH$	25	K_1 1.5×10^{-4}
			K_2 2.8×10^{-6}
Lactic acid	$CH_3CHOHCOOH$	0	1.32×10^{-4}
		5	1.34×10^{-4}
		10	1.36×10^{-4}
		15	1.38×10^{-4}
		20	1.39×10^{-4}
		25	1.38×10^{-4}
		30	1.37×10^{-4}
		35	1.36×10^{-4}
		40	1.34×10^{-4}
		45	1.30×10^{-4}
		50	1.27×10^{-4}
Leucine	$(CH_3)_2CHCH_2CH(NH_2)COOH$	20	2.5×10^{-10}
Levulinic acid	$CH_3CO(CH_2)_2COOH$	18	2.3×10^{-5}
Lysine	$NH_2(CH_2)_4CH(NH_2)COOH$	25	2.95×10^{-11}
Maleic acid	$COOHCH:CHCOOH$	25	K_1 1.0×10^{-2}
			K_2 5.5×10^{-7}
		37	K_1 1.02×10^{-2}
			K_2 4.79×10^{-7}
l-Malic acid	$COOHCH_2CHOHCOOH$	25	K_1 4×10^{-4}
			K_2 9×10^{-6}
Malonic acid	$CH_2(COOH)_2$	18	K_1 1.58×10^{-3}
			K_2 2.16×10^{-6}
Mandelic acid	$C_6H_5CH(OH)COOH$	25	3.9×10^{-4}
Mesaconic acid	$COOHCH:C(CH_3)COOH$	25	K_1 8.2×10^{-4}
			K_2 1.8×10^{-5}
Metanilic acid	$NH_2C_6H_4COOH$	0	0.84×10^{-4}
		5	0.99×10^{-4}
		10	1.17×10^{-4}
		15	1.37×10^{-4}
		20	1.58×10^{-4}
		25	1.83×10^{-4}
		30	2.09×10^{-4}
		35	2.39×10^{-4}
		40	2.71×10^{-4}
		45	3.06×10^{-4}
		50	3.44×10^{-4}
α-Methacrylic acid	$CH_2C(CH_3)COOH$	18	2.2×10^{-5}

(continued)

Acid	Formula	t, °C	K
m-Methoxybenzoic acid	$CH_3OC_6H_4COOH$	25	8.17×10^{-5}
o-Methoxybenzoic acid		25	8.0×10^{-5}
p-Methoxybenzoic acid		25	3.38×10^{-5}
m-Methoxycinnamic acid	$CH_3OC_6H_4CH : CHCOOH$	25	4.21×10^{-5}
o-Methoxycinnamic acid		25	3.45×10^{-5}
p-Methoxycinnamic acid		25	2.89×10^{-5}
m-Methoxyphenoxyacetic acid	$CH_3OC_6H_4OCH_2COOH$	25	7.22×10^{-4}
o-Methoxyphenoxyacetic acid		25	5.9×10^{-4}
p-Methoxyphenoxyacetic acid		25	6.1×10^{-4}
p-Methoxyphenylacetic acid	$CH_3OC_6H_4CH_2COOH$	25	4.4×10^{-5}
β-*m*-Methoxyphenylpropionic acid	$CH_3OC_6H_4(CH_2)_2COOH$	25	2.2×10^{-5}
β-*o*-Methoxyphenylpropionic acid		25	1.6×10^{-5}
β-*p*-Methoxyphenylpropionic acid	$CH_3C_6H_4CH : CHCOOH$	25	2.0×10^{-5}
		25	3.6×10^{-5}
o-Methyl-*trans*-cinnamic acid		25	3.2×10^{-5}
p-Methyl-*trans*-cinnamic acid		25	2.7×10^{-5}
1-Methylcyclohexanecarboxylic acid	$CH_2(CH_2)_4C(CH_3)COOH$	25	7.4×10^{-6}
cis-2-Methylcyclohexanecarboxylic acid	$CH_2(CH_2)_3CH(CH_3)CHCOOH$	25	9.2×10^{-6}
trans-2-Methylcyclohexanecarboxylic acid	$CH_2(CH_2)_3HC(CH_3)CHCOOH$	25	1.8×10^{-6}
cis-4-Methylcyclohexanecarboxylic acid	$CH_3C_6H_4COOH$	25	9.2×10^{-6}
trans-4-Methylcyclohexanecarboxylic acid		25	1.3×10^{-5}
2-Methylcyclohexyl-1,1-acetoacetic acid	$CH_3CH_2(CH_2)_4C(CH_2COOH)_2$	25	K_1 2.9×10^{-4}
			K_2 1.3×10^{-7}
3-Methylcyclohexyl-1,1-acetoacetic acid		25	K_1 3.2×10^{-4}
			K_2 8.3×10^{-7}
4-Methylcyclohexyl-1,1-acetoacetic acid		25	K_1 3.2×10^{-4}
			K_2 8.0×10^{-7}

Acid	Formula	t, °C	K
3-Methylcyclopentyl-1,1-acetoacetic acid	$CH_2CH(CH_3)(CH_2)_2(COOH)_2$	25	K_1 1.6×10^{-4}
			K_2 1.8×10^{-7}
Methylenedithioacetic acid	$COOHCH_2SCH_2COOH$	18	K_1 4.90×10^{-4}
			K_2 4.52×10^{-5}
Methylethylacetic acid	$C_2H_5CH(CH_3)COOH$	18	1.56×10^{-5}
β,β'-Methylethylglutaric acid	$(C_2H_5)C(CH_3)(CH_2COOH)_2$	25	K_1 2.4×10^{-4}
			K_2 2.0×10^{-7}
Methylethylglycolic acid	$C_2H_5C(CH_3)(OH)COOH$	18	1.0×10^{-4}
Methylethylmalonic acid	$C_2H_5C(CH_3)(COOH)_2$	25	K_1 1.4×10^{-3}
			K_2 3.9×10^{-7}
β-Methyl-β-ethylpropionic acid	$C_2H_5CH(CH_3)CH_2COOH$	18	1.5×10^{-5}
β-Methylglutaric acid	$COOHCH_2CH(CH_3)CH_2COOH$	25	K_1 5.61×10^{-5}
			K_2 3.91×10^{-6}
		50	K_1 5.17×10^{-5}
			K_2 3.18×10^{-6}
		74	K_1 4.29×10^{-5}
			K_2 2.23×10^{-6}
Methylglycine	CH_3NHCH_2COOH	18	1.2×10^{-10}
Methylmalonic acid	$CH_3CH(COOH)_2$	25	K_1 8.9×10^{-5}
			K_2 1.8×10^{-6}
2-Methyl-1-naphthoic acid	$CH_3C_{10}H_6COOH$	25	7.8×10^{-4}
Methyl orange	$C_{14}H_{15}O_3N_3S$	18	3.3×10^{-4}
α-Methyl-β-oxybutyric acid	$CH_3CHOHCHCH_3COOH$	18	2.25×10^{-5}
m-Methylphenoxyacetic acid	$CH_3C_6H_4OCH_2COOH$	25	6.27×10^{-4}
o-Methylphenoxyacetic acid		25	5.93×10^{-4}
p-Methylphenoxyacetic acid		25	6.09×10^{-4}
Methylpropylacetic acid	$CH_3(CH_2)_2CHCH_3COOH$	18	1.62×10^{-5}
Methyl red	$C_{14}H_{15}O_3N_3S$	25	2.3×10^{-3}
Methyl succinic acid See Pyrotartaric acid			
1-Naphthoic acid	$C_{10}H_7COOH$	25	2×10^{-4}
2-Naphthoic acid		25	6.9×10^{-5}
α-Naphthol	$C_{10}H_7OH$	25	2.0×10^{-4}
β-Naphthol		25	6.0×10^{-5}
1-Naphthylacetic acid	$C_{10}H_7CH_2COOH$	25	5.81×10^{-5}
2-Naphthylacetic acid		25	5.55×10^{-5}

(continued)

Acid	Formula	t, °C	K
Nicotinic acid	$C_6H_5O_2N$	25	1.50×10^{-5}
m-Nitrobenzoic acid	$NO_2C_6H_4COOH$	25	3.21×10^{-4}
o-Nitrobenzoic acid		25	6.1×10^{-3}
p-Nitrobenzoic acid		15	3.56×10^{-4}
		20	3.60×10^{-4}
		25	3.61×10^{-4}
		30	3.63×10^{-4}
		35	3.60×10^{-4}
		40	3.59×10^{-4}
		45	3.55×10^{-4}
3-Nitro-4-chloro-phenoxyacetic acid	$NO_2ClC_6H_3OCH_2COOH$	25	1.10×10^{-3}
m-Nitrocinnamic acid	$NO_2C_6H_4CH:CHCOOH$	25	7.6×10^{-5}
o-Nitrocannamic acid		25	7.1×10^{-5}
p-Nitrocinnamic acid		25	9.0×10^{-5}
m-Nitromesitol	$C_9H_{11}O_3N$	25	1.0×10^{-9}
m-Nitrophenol	$NO_2C_6H_4OH$	25	4.5×10^{-9}
o-Nitrophenol		25	8.1×10^{-8}
p-Nitrophenol		25	7.0×10^{-8}
m-Nitrophenoxyacetic acid	$NO_2C_6H_4OCH_2COOH$	25	1.1×10^{-3}
o-Nitrophenoxyacetic acid		25	1.3×10^{-3}
p-Nitrophenoxyacetic acid		25	1.3×10^{-3}
m-Nitrophenylacetic acid	$NO_2C_6H_4CH_2COOH$	25	1.1×10^{-4}
o-Nitrophenylacetic acid		25	9.9×10^{-5}
p-Nitrophenylacetic acid		25	1.4×10^{-4}
β-*o*-Nitrophenyl-propionic acid	$NO_2C_6H_4(CH_2)_2COOH$	25	3.41×10^{-5}
β-*p*-Nitrophenyl-propionic acid		25	3.37×10^{-5}
Octanoic acid See Caprylic acid			
Oenanthic acid See Enanthic acid			
Oxalic acid	HOOCCOOH	25	K_1 6.5×10^{-2}
			K_2 6.1×10^{-5}
Oxaloacetic acid	$COOHCH_2COCOOH$	25	K_1 2.8×10^{-3}
			K_2 4.3×10^{-5}
		37	K_1 3.6×10^{-3}
			K_2 4.4×10^{-5}
m-Oxybenzoic acid	HOC_6H_4COOH	18	7×10^{-5}
p-Oxybenzoic acid		15	2.53×10^{-5}
		20	2.60×10^{-5}
		25	2.62×10^{-5}
		30	2.65×10^{-5}
		35	2.64×10^{-5}
		40	2.63×10^{-5}
		45	2.61×10^{-5}

Acid	Formula	t, °C	K
cis-2-Oxycyclohexane-carboxylic acid	$HOCH(CH_2)_4CHCOOH$	25	1.60×10^{-5}
trans-2-Oxycyclo-hexanecarboxylic acid	$HOCH(CH_2)_4CHCOOH$	25	2.08×10^{-5}
cis-3-Oxycyclohexane-carboxylic acid	$CH_2CH(OH)(CH_2)_3CHCOOH$	25	2.50×10^{-5}
trans-3-Oxycyclo-hexanecarboxylic acid	$CH_2CH(OH)(CH_2)_3CHCOOH$	25	1.53×10^{-5}
cis-4-Oxycyclohexane-carboxylic acid	$CH_2CH_2CH(OH)(CH_2)_2CHCOOH$	25	1.46×10^{-5}
trans-4-Oxycyclo-hexanecarboxylic acid	$CH_2CH_2CH(OH)(CH_2)_2CHCOOH$	25	2.10×10^{-5}
γ-Oxyisocaproic acid	$CH_3C(CH_3)OH(CH_2)_2COOH$	18	1.34×10^{-5}
γ-Oxyvaleric acid	$CH_3CHOH(CH_2)_2COOH$	18	2.06×10^{-5}
Pelargonic acid	$CH_3(CH_2)_7COOH$	25	1.11×10^{-5}
Pentamethylene-dithioacetic acid	$COOHCH_2S(CH_2)_5SCH_2COOH$	18	K_1 3.27×10^{-4}
			K_2 3.86×10^{-5}
Phenetylthioacetic acid	$C_6H_5(CH_2)_2SCH_2COOH$	18	1.61×10^{-4}
Phenol	C_6H_5OH	25	1.2×10^{-10}
Phenolphthalein	$C_{20}H_{14}O_4$	25	2×10^{-10}
Phenoxyacetic acid	$C_6H_5OCH_2COOH$	25	6.8×10^{-4}
m-Phenoxybenzoic acid	$C_6H_5OC_6H_4COOH$	25	1.1×10^{-4}
o-Phenoxybenzoic acid		25	2.9×10^{-4}
p-Phenoxybenzoic acid		25	3.0×10^{-5}
Phenylacetic acid	$C_6H_5CH_2COOH$	25	4.88×10^{-5}
o-Phenylbenzoic acid	$C_6H_5C_6H_4COOH$	25	3.47×10^{-4}
α-Phenyl-α-benzyl-succinic acid	$COOH(C_6H_5)C(CH_2C_6H_5)CH_2COOH$	20	K_1 2.0×10^{-4}
			K_2 3.2×10^{-7}
Phenylboric acid	$C_6H_5B(OH)_2$	25	1.4×10^{-9}
γ-Phenylbutyric acid	$C_6H_5(CH_2)_3COOH$	25	1.7×10^{-5}
Phenylmalonic acid	$C_6H_5CH(COOH)_2$	25	K_1 2.7×10^{-3}
			K_2 9.4×10^{-6}
α-Phenyl-α-oxy-propionic acid	$C_6H_5C(CH_3)(OH)COOH$	18	2.9×10^{-4}
β-Phenyl-β-oxy-propionic acid	$C_6H_5CH(OH)CH_2COOH$	18	4.0×10^{-5}
β-Phenylpropionic acid	$C_6H_5(CH_2)_2COOH$	25	2.2×10^{-5}
Phenylsuccinic acid	$C_6H_5CH(COOH)CH_2COOH$	20	K_1 1.6×10^{-4}
			K_2 2.8×10^{-6}
Phenylsulphonic acid	$C_6H_5SO_3H$	25	2.8×10^{-3}
Phthalic acid	$C_6H_4(COOH)_2$	0	K_1 1.19×10^{-3}
			K_2 3.69×10^{-6}
		5	K_1 1.18×10^{-3}
			K_2 3.82×10^{-6}

Acid	Formula	t, °C	K
Phthalic acid	$C_6H_4(COOH)_2$	10	K_1 1.17×10^{-3}
			K_2 3.89×10^{-6}
		15	K_1 1.16×10^{-3}
			K_2 3.93×10^{-6}
		20	K_1 1.14×10^{-3}
			K_2 3.94×10^{-6}
		25	K_1 1.12×10^{-3}
			K_2 3.91×10^{-6}
		30	K_1 1.10×10^{-3}
			K_2 3.84×10^{-6}
		35	K_1 1.08×10^{-3}
			K_2 3.74×10^{-6}
		40	K_1 1.05×10^{-3}
			K_2 3.61×10^{-6}
		45	K_1 1.03×10^{-3}
			K_2 3.45×10^{-6}
		50	K_1 0.99×10^{-3}
			K_2 3.27×10^{-6}
		55	K_1 0.97×10^{-3}
			K_2 3.07×10^{-6}
		60	K_1 0.94×10^{-3}
			K_2 2.87×10^{-6}
Picolinic acid	$C_6H_5O_2N$	25	4.0×10^{-6}
Picric acid	$(NO_2)_3C_6H_2OH$	18	3.8×10^{-1}
Pimelic acid	$(CH_2)_5(COOH)_2$	18	K_1 3.19×10^{-5}
			K_2 3.74×10^{-6}
Pivalic acid	$C(CH_3)_3COOH$	0	9.65×10^{-6}
		10	9.68×10^{-6}
		20	9.44×10^{-6}
		30	9.11×10^{-6}
		40	8.58×10^{-6}
		50	7.97×10^{-6}
		60	7.32×10^{-6}
Propionic acid	CH_3CH_2COOH	0	1.27×10^{-5}
		5	1.30×10^{-5}
		10	1.33×10^{-5}
		15	1.33×10^{-5}
		20	1.34×10^{-5}
		25	1.33×10^{-5}
		30	1.33×10^{-5}
		40	1.28×10^{-5}
		50	1.23×10^{-5}
		60	1.16×10^{-5}
β-Propylglutaric acid	$CH_3(CH_2)_2CH(CH_2COOH)_2$	25	K_1 4.9×10^{-5}
			K_2 4.1×10^{-6}
Propylmalonic acid	$CH_3(CH_2)_2CH(COOH)_2$	25	K_1 1.0×10^{-3}
			K_2 1.4×10^{-6}

Table 110

Acid	Formula	t, °C	K
Pyromucic acid	C_4H_3OCOOH	25	7.1×10^{-4}
Pyroracemic acid See Pyruvic acid			
Pyrotartaric acid	$COOHCH_2CH(CH_3)COOH$	25	K_1 8.7×10^{-5}
Pyruvic acid	$CH_3COCOOH$	25	3.24×10^{-3}
		37	3.80×10^{-3}
β-Resorcylic acid	$(HO)_2C_6H_4COOH$	30	6.05×10^{-4}
γ-Resorcylic acid		30	6.00×10^{-2}
Rhodan acetic acid	$CH_2(CNS)COOH$	25	2.6×10^{-3}
Salicylic acid	$C_6H_4OHCOOH$	25	1.05×10^{-3}
Suberic acid	$(CH_2)_6(COOH)_2$	18	K_1 3.05×10^{-5}
			K_2 3.85×10^{-6}
Succinic acid	$COOH(CH_2)_2COOH$	0	K_1 5.20×10^{-5}
			K_2 2.12×10^{-6}
		5	K_1 5.46×10^{-5}
			K_2 2.18×10^{-6}
		10	K_1 5.70×10^{-5}
			K_2 2.24×10^{-6}
		15	K_1 5.88×10^{-5}
			K_2 2.88×10^{-6}
		20	K_1 6.07×10^{-5}
			K_2 2.30×10^{-6}
		25	K_1 6.21×10^{-5}
			K_2 2.31×10^{-6}
		30	K_1 6.34×10^{-5}
			K_2 2.28×10^{-6}
		40	K_1 6.50×10^{-5}
			K_2 2.22×10^{-6}
		50	K_1 6.52×10^{-5}
			K_2 2.09×10^{-6}
Sulphanilic acid	$H_2NC_6H_4SO_3H$	0	3.02×10^{-4}
		5	3.49×10^{-4}
		10	4.00×10^{-4}
		15	4.59×10^{-4}
		20	5.22×10^{-4}
		25	5.92×10^{-4}
		30	6.67×10^{-4}
		40	8.34×10^{-4}
		50	10.25×10^{-4}
d-Tartaric acid	$COOH(OH)CH(OH)COOH$	0	K_1 7.62×10^{-4}
			K_2 3.75×10^{-5}
		5	K_1 $8{\cdot}04\times10^{-4}$
			K_2 3.92×10^{-5}
		10	K_1 8.41×10^{-4}
			K_2 4.06×10^{-5}
		15	K_1 8.77×10^{-4}
			K_2 4.16×10^{-5}

(continued)

Acid	Formula	t, °C	K
d-Tartaric acid	COOH(OH)CH(OH)COOH	20	K_1 9.04×10^{-4}
			K_2 4.25×10^{-5}
		25	K_1 9.21×10^{-4}
			K_2 4.31×10^{-5}
		30	K_1 9.44×10^{-4}
			K_2 4.32×10^{-5}
		40	K_1 9.59×10^{-4}
			K_2 4.25×10^{-5}
		50	K_1 9.53×10^{-4}
			K_2 4.06×10^{-5}
meso-Tartaric acid	COOHCH(OH)CH(OH)COOH	25	K_1 6.0×10^{-4}
			K_2 1.53×10^{-5}
		50	K_1 7.3×10^{-4}
			K_2 1.46×10^{-5}
		74	K_1 5.2×10^{-4}
			K_2 1.26×10^{-5}
Taurine	$NH_2CH_2CH_2SO_3H$	25	1.8×10^{-9}
cis-Tetrahydronaphthalene-2,3-dicarboxylic acid	$C_{10}H_{10}(COOH)_2$	20	K_1 1.05×10^{-4}
			K_2 3.39×10^{-7}
Tetramethylene-dithioacetic acid	$COOHH_2S(CH_2)_4SCH_2COOH$	18	K_1 3.44×10^{-4}
			K_2 3.78×10^{-5}
Tetramethylsuccinic acid	$COOHC(CH_3)_2C(CH_3)_2COOH$	25	K_1 3.2×10^{-4}
			K_2 5.2×10^{-8}
Tetrolic acid	$CH_3C : CCOOH$	18	1.85×10^{-3}
		25	2.22×10^{-3}
Thioacetic acid	CH_3COSH	25	4.7×10^{-4}
Thioacetoacetic acid	$COOHCH_2SCH_2COOH$	18	K_1 5.01×10^{-4}
			K_2 3.16×10^{-5}
γ-Thiodibutyric acid	$COOH(CH_2)_3S(CH_2)_3COOH$	18	K_1 4.46×10^{-5}
			K_2 5.53×10^{-6}
β-Thiodipropionic acid	$COOH(CH_2)_2S(CH_2)_2COOH$	18	K_1 8.22×10^{-5}
			K_2 8.41×10^{-6}
Thioglycolic acid	$SHCH_2COOH$	25	2.14×10^{-4}
Tiglic acid	$CH_3CH : C(CH_3)COOH$	18	1.1×10^{-5}
α-Toluic acid See Phenylacetic acid			
m-Toluic acid	$CH_3C_6H_4COOH$	25	5.35×10^{-5}
o-Toluic acid		25	1.23×10^{-4}
p-Toluic acid		25	4.24×10^{-5}
o-Tolylacetic acid	$CH_3C_6H_4CH_2COOH$	18	4.5×10^{-5}
p-Tolylacetic acid		25	4.3×10^{-5}
β-*m*-Tolylpropionic acid	$CH_3C_6H_4(CH_2)_2COOH$	25	2.1×10^{-5}
β-*o*-Tolylpropionic acid		25	2.2×10^{-5}

Acid	Formula	t, °C	K
β-p-Tolylpropionic acid	$CH_3C_6H_4(CH_2)_2COOH$	25	2.1×10^{-5}
Trichloroacetic acid	CCl_3COOH	25	2.3×10^{-1}
Trichlorolactic acid	$CCl_3CH(OH)COOH$	25	4.6×10^{-3}
Trimethylacetic acid See Pivalic acid			
2,4,6-Trimethylbenzoic acid	$(CH_3)_3C_6H_4COOH$	25	3.66×10^{-4}
Trimethylenedithioacetic acid	$COOHCH_2S(CH_2)_3SCH_2COOH$	18	K_1 3.67×10^{-4}
			K_2 4.14×10^{-5}
Trimethylpyruvc acid	$C(CH_3)_3COCOOH$	20	5×10^{-3}
2,4,6-Trinitrobenzoic acid	$(NO_2)_3C_6H_4COOH$	25	2.22×10^{-1}
Tryptophane	$C_{11}H_{12}O_2N_2$	25	4.2×10^{-10}
Uric acid	$C_5H_4N_4O_3$	25	2×10^{-4}
Valeric acid	$CH_3(CH_2)_3COOH$	0	1.51×10^{-5}
		10	1.50×10^{-5}
		20	1.46×10^{-5}
		30	1.41×10^{-5}
		40	1.33×10^{-5}
		50	1.24×10^{-5}
		60	1.15×10^{-5}
Valine	$(CH_3)_2CHCH(NH_2)COOH$	25	2.4×10^{-10}
Vinylacetic acid	CH_2CHCH_2COOH	25	4.5×10^{-5}
Violuric acid	$CO : (NHCO)_2 : C : NOH$	18	2×10^{-5}

Table 111

Dissociation constants of organic bases

Compound	Formula	t, °C	K
Acetamide	CH_3CONH_2	25	2.5×10^{-13}
Acetanilide	$C_6H_5NHCOCH_3$	40	4.1×10^{-14}
Acetoxime	$(CH_3)_2CNOH$	25	6.5×10^{-13}
Aconitine	$C_{34}H_{47}O_{11}N$	25	1.3×10^{-6}
α-Alanine	$C_3H_7O_2N$	25	5.1×10^{-12}
Aniline	$C_6H_5NH_2$	25	3.83×10^{-10}
Apomorphine	$C_{17}H_{17}O_2N$	25	1.0×10^{-7}
Atropine	$C_{17}H_{23}O_3N$	25	4.5×10^{-5}
Benzidine	$NH_2C_6H_4C_6H_4NH_2$	30	K_1 9.3×10^{-10}
			K_2 5.6×10^{-11}
Benzylamine	$C_6H_5CH_2NH_2$	25	2.4×10^{-5}
Betaine	$(CH_3)_3NCH_2COO$	20	1.45×10^{-2}

Compound	Formula	*t*, °C	*K*
Brucine	$C_{23}H_{26}O_4N_2$	15	K_1 9.2×10^{-7}
			K_2 2×10^{-12}
Butylamine	$CH_3(CH_2)_3NH_2$	25	4.1×10^{-4}
sec-Butylamine	$CH_3CH_2CH(NH_2)CH_3$	25	3.6×10^{-4}
tert-Butylamine	$(CH_3)_3CNH_2$	25	2.8×10^{-4}
Butyronitrile	$CH_3(CH_2)_2CN$	25	1.8×10^{-15}
Caffeine	$C_8H_{10}O_2N_4$	40	4.1×10^{-14}
Carbamide			
See Urea			
Cinchonidine	$C_{19}H_{22}ON_2$	15	K_1 1.6×10^{-6}
			K_2 8.4×10^{-11}
Cinchonine	$C_{19}H_{22}ON_2$	15	K_1 1.4×10^{-6}
			K_2 1.1×10^{-10}
Cocaine	$C_{17}H_{21}O_4N$	15	2.6×10^{-6}
Codeine	$C_{18}H_{21}O_3N$	18	7.9×10^{-7}
Coffeine			
See Caffeine			
Colchicine	$C_{22}H_{25}O_6N$	25	4.5×10^{-13}
Coniine	$C_8H_{17}N$	15	8×10^{-4}
Creatinine	$C_4H_7ON_3$	40	3.7×10^{-11}
Diethylamine	$(C_2H_5)_2NH$	25	1.3×10^{-3}
Diethylaniline	$C_6H_5N(C_2H_5)_2$	25	3.7×10^{-8}
Diethylbenzylamine	$C_6H_5CH_2N(C_2H_5)_2$	25	3.4×10^{-5}
Diisoamylamine	$[(CH_3)_2CHCH_2CH_2]_2NH$	25	9.6×10^{-4}
Diisobutylamine	$[(CH_3)_2CHCH_2]_2NH$	25	4.8×10^{-4}
Dimethylamine	$(CH_3)_2NH$	25	5.1×19^{-4}
Dimethylaminoantipyrine			
See Pyramidone			
Dimethylaniline			
See Xylidine			
Dimethylbenzylamine	$C_6H_5CH_2N(CH_3)_2$	25	1×10^{-5}
Dimethylpyrone	$C_5H_2O_2(CH_3)_2$	25	2×10^{-14}
Diphenylamine	$(C_6H_5)_2NH$	15	7.6×10^{-14}
Dipropylamine	$(C_3H_7)_2NH$	25	1.02×10^{-3}
Emetine	$C_{29}H_{40}O_4N_2$	25	K_1 1.7×10^{-6}
			K_2 2.3×10^{-6}
Eserine			
See Physostigmine			
Ethanolamine	$H_2NC_2H_4OH$	25	2.77×10^{-5}
Ethylamine	$C_2H_5NH_2$	25	3.44×10^{-4}
Ethylaniline	$C_6H_5NHC_2H_5$	25	1.29×10^{-9}
Ethylenediamine	$NH_2CH_2CH_2NH_2$	25	8.5×10^{-5}
Glycine	NH_2CH_2COOH	10	4.68×10^{-5}
		20	5.57×10^{-5}
		25	6.07×10^{-5}
		30	6.52×10^{-5}
		40	7.43×10^{-5}

Compound	Formula	t, °C	K
Guanine	$C_5N_4H_3ONH_2$	40	8.4×10^{-12}
Hydrastine	$C_{21}H_{21}O_6N$	25	1.7×10^{-8}
Hydroquinine	$C_{20}H_{26}O_2N_2$	25	4.7×10^{-6}
Isoamylamine	$(CH_3)_2CHCH_2CH_2NH_2$	25	4×10^{-4}
Isobutylamine	$(CH_3)_2CHCH_2NH_2$	25	3.1×10^{-4}
Isopropylamine	$(CH_3)_2CHNH_2$	25	4.9×10^{-4}
Isoquinoline	C_9H_7N	40	4.1×10^{-14}
Leucoline See Isoquinoline			
Lupinidine See Sparteine			
Methylamine	CH_3NH_2	25	4.38×10^{-4}
Methylaniline	$C_6H_5NHCH_3$	25	5×10^{-10}
Methyldiethylamine	$CH_3N(C_2H_5)_2$	25	2.7×10^{-4}
Methyl red	$C_{15}H_{15}O_2N_3$	18	3×10^{-12}
Morphine	$C_{17}H_{19}O_3N$	15	6.8×10^{-7}
		25	7.4×10^{-7}
α-Naphthylamine	$C_{10}H_7NH_2$	25	8.36×10^{-11}
β-Naphthylamine	$C_{10}H_7NH_2$	25	1.29×10^{-10}
Narceine	$C_{23}H_{27}O_8N$	25	2×10^{-11}
Narcotine	$C_{22}H_{23}O_7N$	15	1.5×10^{-8}
Nicotine	$C_{10}H_{14}N_2$	25	K_1 7.0×10^{-7}
			K_2 1.4×10^{-11}
m-Nitroaniline	$O_2NC_6H_4NH_2$	0	2.7×10^{-5}
o-Nitroaniline	$O_2NC_6H_4NH_2$	0	6×10^{-4}
Novocaine	$C_{13}H_{20}O_2N_2$	25	7×10^{-6}
Oxyquinoline	NC_9H_6OH	20	6.2×10^{-10}
Papaverine	$C_{20}H_{21}O_4N$	25	8×10^{-9}
Paramorphine See Thebaine			
m-Phenetidine	$H_2NC_6H_4OC_2H_5$	25	1.5×10^{-10}
o-Phenetidine	$H_2NC_6H_4OC_2H_5$	25	3×10^{-10}
p-Phenetidine	$H_2NC_6H_4OC_2H_5$	25	1.8×10^{-9}
o-Phenylenediamine	$C_6H_4(NH_2)_2$	25	3.3×10^{-10}
p-Phenylenediamine	$C_6H_4(NH_2)_2$	25	K_1 1.1×10^{-8}
			K_2 3.5×10^{-12}
Phenylhydrazine	$C_6H_5NHNH_2$	40	1.6×10^{-9}
γ-Phenylpropylamine	$C_6H_5(CH_2)_3CH_2$	25	2.48×10^{-4}
Physostigmine	$C_{15}H_{21}O_2N_3$	25	K_1 7.6×10^{-7}
			K_2 5.7×10^{-13}
α-Picoline	$NC_5H_4CH_3$	25	3×10^{-8}
β-Picoline	$NC_5H_4CH_3$	25	1×10^{-8}
γ-Picoline	$NC_5H_4CH_3$	25	1×10^{-8}
Pilocarpine	$C_{11}H_{16}O_2N_2$	25	K_1 7×10^{-8}
			K_2 2×10^{-13}
Piperazine	$(CH_2)_4(NH_2)_2$	25	K_1 6.4×10^{-5}
			K_2 3.7×10^{-9}

(continued)

Compound	Formula	t, °C		K
Piperidine	$C_5H_{10}NH$	25		1.6×10^{-3}
Piperine	$C_{17}H_{19}O_3N$	25		1.0×10^{-14}
Propylamine	$CH_3(CH_2)_2NH_2$	25		4×10^{-4}
Propylaniline	$C_6H_5NH(CH_2)_2CH_3$	25		1.05×10^{-9}
Propyl cyanide See Butyronitrile				
Putrescine	$NH_2(CH_2)_4NH_2$	25		4.9×10^{-4}
Pyramidone	$(CH_3)_2NC_{10}H_9ON_2$	25		6.9×10^{-10}
Pyrazole	N : CHCH : CHNH	25		3.0×10^{-12}
Pyridine	C_6H_5N	20		1.71×10^{-9}
Pyrrolidine	$NHCOCH_2CH_2CH_2$	25		1.3×10^{-3}
Quinidine	$C_{20}H_{24}O_2N_2$	15	K_1	3.7×10^{-6}
			K_2	1.0×10^{-10}
Quinine	$C_{20}H_{24}O_2N_2$	15	K_1	1.1×10^{-6}
			K_2	1.3×10^{-10}
Quinoline	C_9H_7N	20		6.4×10^{-10}
Semicarbazide	$NH_2CONHNH_2$	40		2.7×10^{-11}
Solanine	$C_{44}H_{71}O_{15}N$	25		2.2×10^{-7}
Sparteine	$C_{15}H_{26}N_2$	25	K_1	5.7×10^{-3}
			K_2	1×10^{-6}
Strychnine	$C_{21}H_{22}O_2N_2$	25	K_1	1×10^{-6}
			K_2	2×10^{-12}
Tetramethylenediamine See Putrescine				
Thebaine	$C_{19}H_{21}O_3N$	20		1.2×10^{-14}
Theobromine	$C_7H_8O_2N_4$	18		1.3×10^{-14}
		40		4.8×10^{-14}
Theocin See Theophylline				
Theophylline	$C_7H_8O_2N_4$	25		1.9×10^{-14}
Thiazole	C_3H_3NS	25		4.1×10^{-12}
Thiocarbamide See Thiourea				
Thiourea	$CS(NH_2)_2$	25		3.3×10^{-15}
m-Toluidine	$H_2NC_6H_4CH_3$	25		5×10^{-10}
o-Toluidine	$H_2NC_6H_4CH_3$	25		3×10^{-10}
p-Toluidine	$H_2NC_6H_4CH_3$	25		1.2×10^{-9}
Triethylamine	$(C_2H_5)_3N$	25		5.65×10^{-4}
Triisobutylamine	$[(CH_3)_2CHCH_2]_3N$	25		2.6×10^{-4}
Trimethylamine	$(CH_3)_3N$	25		5.3×10^{-5}
Trimethylenediamine	$NH_2(CH_2)_3NH_2$	25		3×10^{-4}
Tripropylamine	$[CH_3(CH_2)_2]_3N$	25		5×10^{-4}
Urea	$CO(NH_2)_2$	25		1.5×10^{-14}
Veratrine	$C_{32}H_{49}O_9N$	25		7×10^{-6}
Xanthine	$C_5H_4O_2N_4$	40		4.8×10^{-14}
Xylidine	$C_6H_5N(CH_3)_2$	25		1.2×10^{-9}

Table 112

Degrees of electrolytic dissociation of inorganic and some organic compounds at 25°C

Electrolyte	N	α
CH_3COOH	0.1	0.013
	1.0	0.004
$AgNO_3$	0.01	0.99
	0.02	0.98
	0.05	0.97
	0.1	0.95
	0.5	0.88
$AgOH$	0.002	0.40
$BaCl_2$	0.005	0.90
	0.01	0.88
	0.05	0.80
	0.1	0.76
$Ba(OH)_2$	0.015	0.92
	0.1	0.80
	1.0	0.69
$(CH_3)_4NOH$	0.053	0.96
$Ca(OH)_2$	0.015	0.90
$CaSO_4$	0.01	0.63
$CdCl_2$	0.004	0.79
	0.01	0.66
	0.02	0.54
$CsCl$	0.1	0.98
$CuSO_4$	0.1	0.83
HBr	0.5	0.90
HCN	0.1	0.0001
HCl	0.005	0.98
	0.01	0.97
	0.05	0.94
	0.1	0.91
	0.5	0.88
	1.0	0.78
	cc.	0.14
$HClO_3$	0.5	0.88
$HClO_4$	0.5	0.86
HF	0.1	0.15
	1.0	0.07
HI	0.5	0.90
$HMnO_4$	0.5	0.93
HNO_3	0.1	0.92
	1.0	0.82
	cc.	0.096
H_2CO_3	0.04	0.0021*
	0.1	0.0017*
H_2S	0.1	0.0007*
H_2SO_4	0.1	0.58*
	cc.	0.01*
H_3BO_3	0.1	0.0001*
H_3PO_4	0.1	0.27*
	0.5	0.17*
K acetate	0.1	0.85
$KBrO_3$	0.02	0.99
	0.05	0.98
	0.1	0.97
KCl	0.005	0.96
	0.01	0.94
	0.1	0.86
$KClO_3$	0.01	0.99
	0.02	0.98
	0.05	0.97
	0.1	0.96
KIO_3	0.01	0.99
	0.02	0.99
	0.05	0.98
	0.1	0.97
KNO_3	0.01	0.99
	0.02	0.99
	0.05	0.97
	0.1	0.95

* Primary dissociation

Electrolyte	N	α	Electrolyte	N	α
KOH	0.005 0.01 0.1 1.0	0.97 0.96 0.88 0.77	$NaClO_3$	0.05 0.1	0.99 0.98
			$NaHCO_3$	1 0	0.52
K_2CO_3	0.1	0.70	$NaIO_3$	0.02 0 05 0.1	0.996 0.988 0.984
K_2SO_4	0.1	0.71			
LiCl	0.005 0.01 0.05 0.1	0.95 0.93 0.90 0.85	$NaNO_3$	0 05 0.1	0.99 0.97
			NaOH	0.1 1.0	0.84 0.74
LiOH	0.1	0.63	Na_2HPO_4	0 03	0.78
$MgSO_4$	0.005 0.01 0.05 0.1	0.73 0.66 0.49 0.43	Na_2SO_4	0.1	0.69
			Oxalic acid	0.1	0.50*
NH_4Cl	0.1	0.85	RbCl	0.1	0.99
NH_4OH	0.1 1.0	0.013 0.004	$Sr(OH)_2$	0.015	0.93
			Tartaric acid	0.1	0.082*
Na acetate	0.1	0.78	TlCl	0 01	0.97
NaCl	0.005 0.01 0.05 0.1 0.5 1.0	0.95 0.94 0.88 0.85 0.73 0.67	$TlNO_3$	0.01 0.05 0.1	0.98 0.95 0.92
			$ZnCl_2$	0.1	0.73
			$ZnSO_4$	0.1	0.93

* Primary dissociation

Table 113

Ionic product of water at various temperatures

t, °C	K_w	pK_w	$\sqrt{K_w}$	t, °C	K_w	pK_w	$\sqrt{K_w}$
0	0.13×10^{-14}	14.89	0.36×10^{-7}	18	0.74×10^{-14}	14.13	0.86×10^{-7}
5	0.21×10^{-14}	14.68	0.46×10^{-7}	19	0.79×10^{-14}	14.10	0.89×10^{-7}
10	0.36×10^{-14}	14.45	0.59×10^{-7}	20	0.86×10^{-14}	14.07	0.93×10^{-7}
15	0.58×10^{-14}	14.24	0.76×10^{-7}	21	0.93×10^{-14}	14.03	0.96×10^{-7}
16	0.63×10^{-14}	14.20	0.79×10^{-7}	22	1.00×10^{-14}	14.00	1.00×10^{-7}
17	0.68×10^{-14}	14.17	0.82×10^{-7}	23	1.10×10^{-14}	13.96	1.05×10^{-7}

t, °C	K_w	pK_w	$\sqrt{K_w}$	t, °C	K_w	pK_w	$\sqrt{K_w}$
24	1.19×10^{-14}	13.93	1.09×10^{-7}	38	3.35×10^{-14}	13.48	1.83×10^{-7}
25	1.27×10^{-14}	13.90	1.13×10^{-7}	39	3.59×10^{-14}	13.45	1.89×10^{-7}
26	1.38×10^{-14}	13.86	1.17×10^{-7}	40	3.80×10^{-14}	13.42	1.95×10^{-7}
27	1.50×10^{-14}	13.83	1.23×10^{-7}	50	5.6×10^{-14}	13.25	2.4×10^{-7}
28	1.62×10^{-14}	13.79	1.27×10^{-7}	60	12.6×10^{-14}	12.90	3.5×10^{-7}
29	1.76×10^{-14}	13.76	1.33×10^{-7}	70	21×10^{-14}	12.68	4.6×10^{-7}
30	1.89×10^{-14}	13.73	1.37×10^{-7}	80	34×10^{-14}	12.47	5.8×10^{-7}
31	2.04×10^{-14}	13.69	1.43×10^{-7}	90	52×10^{-14}	12.28	7.2×10^{-7}
32	2.19×10^{-14}	13.66	1.48×10^{-7}	100	74×10^{-14}	12.13	8.6×10^{-7}
33	2.35×10^{-14}	13.63	1.53×10^{-7}	120	125×10^{-14}	11.90	11×10^{-7}
34	2.51×10^{-14}	13.60	1.59×10^{-7}	140	180×10^{-14}	11.75	13×10^{-7}
35	2.71×10^{-14}	13.57	1.65×10^{-7}	160	250×10^{-14}	11.60	16×10^{-7}
36	2.92×10^{-14}	13.54	1.71×10^{-7}	180	320×10^{-14}	11.50	18×10^{-7}
37	3.13×10^{-14}	13.51	1.77×10^{-7}	200	400×10^{-14}	11.40	20×10^{-7}

Table 114

Dissociation and recombination rate constants for organic acids
(Determined from polarographic limiting currents)

Compound	k_d l mol^{-1} s^{-1}	k_r s^{-1}
cis-β-Acetylacrylic acid	1.06×10^{5}	3.87×10^{9}
trans-β-Acetylacrylic acid	7.90×10^{7}	2.93×10^{11}
p-Azobenzoic acid	1.1×10^{9}	5.5×10^{13}
Citraconic acid	6.1×10^{6}	1.2×10^{9}
Diethylbarbituric acid	5×10^{3}	3.3×10^{11}
3,4-Dimethoxypyruvic acid	4.60×10^{8}	5.76×10^{11}
Diphenylpyruvic acid	1.10×10^{8}	6.6×10^{10}
Fumaric acid	1.6×10^{6}	1.7×10^{9}
Hydroxylamine	1.73×10^{7}	1.94×10^{13}
Isonicotinic acid	2.59×10^{6}	2.06×10^{11}
Maleic acid	1.8×10^{8}	2×10^{10}
4-Methylphenylglyoxylic acid	8.4×10^{9}	2.8×10^{11}
Nicotinic acid	2.53×10^{3}	1.42×10^{8}
Nitrosophenylhydroxylamine	4.37×10^{5}	8.3×10^{9}
Oxalic acid	2.1×10^{6}	5.5×10^{7}
Phenylglyoxylic acid	2.3×10^{10}	3.9×10^{11}
Phenylpyruvic acid	5.37×10^{7}	2.57×10^{10}
Picolinic acid	3.08×10^{5}	8.67×10^{10}
Pyruvic acid	2.24×10^{6}	2.08×10^{8}
Trimethylpyruvic acid	2.9×10^{4}	5.7×10^{6}
Vinylchloroacetic acid	2.4×10^{2}	8.4×10^{4}

Table 115

Ionic product of the autoprotolysis of some solvents ([cation] [anion] = K)

Autoprotolytic reaction of the solvent	t, °C	K
$NH_3 + NH_3 \rightleftarrows NH_4^+ + NH_2^-$	−33	10^{-21}
$C_2H_5OH + C_2H_5OH \rightleftarrows C_2H_5OH_2^+ + C_2H_5O^-$	25	10^{-19}
$CH_3OH + CH_3OH \rightleftarrows CH_3OH_2^+ + CH_3O^-$	25	10^{-17}
$H_2O + H_2O \rightleftarrows H_3O^+ + OH^-$	25	10^{-14}
$CH_3CO_2H + CH_3CO_2H \rightleftarrows CH_3CO_2H_2^+ + CH_3CO_2^-$	25	10^{-13}
$HCO_2H + HCO_2H \rightleftarrows HCO_2H_2^+ + HCO_2^-$	25	10^{-6}
$H_2SO_4 + H_2SO_4 \rightleftarrows H_3O^+ + HS_2O_7^-$	10	7×10^{-5}
$H_2SO_4 + H_2SO_4 \rightleftarrows H_3SO_4^+ + HSO_4^-$	10	2×10^{-4}
$HNO_3 + HNO_3 \rightleftarrows NO_2^+ + NO_3^- + H_2O$	25	2×10^{-2}

Table 116

Acidity constants of some Brönsted acids in aqueous solutions at 18°C

Acid	Base	K_{ac}
$Al(H_2O)_6^{3+}$	$Al(H_2O)_5OH^{2+}$	1.3×10^{-5}
$ClCH_2CO_2H$	$CH_2ClCO_2^-$	1.4×10^{-3}
Cl_2CHCO_2H	$CHCl_2CO_2^-$	5.5×10^{-2}
CH_3CO_2H	$CH_3CO_2^-$	1.8×10^{-5}
$CH_3NH_2^+$	CH_3NH_2	1.6×10^{-11}
$(CH_3)_2NH_2$	$(CH_3)_2NH^-$	1.2×10^{-11}
HO_2CCO_2H	$HO_2CCO_2^-$	5.7×10^{-2}
$COOHCOO^-$	$COOCOO^{2-}$	6.8×10^{-5}
$Fe(H_2O)_6^{3+}$	$Fe(H_2O)_5OH^{2+}$	6.3×10^{-3}
HCN	CN^-	7×10^{-10}
HCO_2H	HCO_2^-	2.1×10^{-4}
HSO_4^-	SO_4^{2-}	2×10^{-2}
H_2CO_3	HCO_3^-	4.3×10^{-7}
HCO_3^-	CO_3^{2-}	4.7×10^{-11}
H_2O	OH^-	1.07×10^{-16}
H_2S	HS^-	8×10^{-3}
HS^-	S^{2-}	2×10^{-15}
H_2SO_3	HSO_3^-	1.7×10^{-2}
HSO_3^-	SO_3^{2-}	5×10^{-6}
H_3BO_3	$H_2BO_3^-$	6×10^{-10}
H_3PO_4	$H_2PO_4^-$	7.6×10^{-3}
$H_2PO_4^-$	HPO_4^{2-}	5.9×10^{-3}
HPO_4^{2-}	PO_4^{3-}	3.5×10^{-13}
NH_4^+	NH_3	3.3×10^{-10}

Table 117

Ionic strengths in 1 M solutions of various electrolyte types

Type of electrolyte	Ionic strength
1–1 (*e.g.* $NaCl$)	$(1 + 1)/2 = 1$
1–2 (*e.g.* $BaCl_2$, K_2SO_4)	$(4 + 2)/2 = 3$
1–3 (*e.g.* $AlCl_3$, Na_3PO_4)	$(9 + 3)/2 = 6$
1–4 (*e.g.* $K_4[Fe(CN)_6]$)	$(16 + 4)/2 = 10$
2–2 (*e.g.* $ZnSO_4$)	$(4 + 4)/2 = 4$
2–3 (*e.g.* $Mg_3(PO_4)_2$)	$(12 + 18)/2 = 15$
2–4 (*e.g.* $Mg_2[Fe(CN)_6]$)	$(8 + 16)/2 = 12$
3–3 (*e.g.* $LaPO_4$)	$(9 + 9)/2 = 9$

Table 118

Mean activity coefficients of $AgNO_3$, $AlCl_3$, $Al(ClO_3)_3$ and $Al_2(SO_4)_3$ solutions at 25°C

Concentration, *m*	$AgNO_3$	$AlCl_3$	$Al(ClO_3)_3$	$Al_2(SO_4)_3$
0.001	—	—	0.783	—
0.005	—	—	0.620	—
0.01	—	—	0.533	—
0.05	—	0.447	0.350	—
0.1	0.731	0.389	0.299	0.035
0.2	0.654	0.353	—	0.023
0.3	0.603	0.351	—	0.018
0.4	0.567	—	—	0.015
0.5	0.534	0.384	0.258	0.014
0.6	0.509	—	—	0.014
0.7	0.483	0.449	—	0.014
0.8	0.464	—	—	0.015
0.9	0.446	—	—	0.016
1.0	0.428	0.621	—	0.018
1.2	0.399	0.814	—	—
1.4	0.374	1.087	—	—
1.5	0.362	—	—	—
1.6	0.352	1.508	—	—
1.8	0.333	2.170	—	—
2.0	0.315	—	—	—
2.5	0.280	—	—	—
3.0	0.252	—	—	—
3.5	0.229	—	—	—
4.0	0.210	—	—	—
4.5	0.194	—	—	—
5.0	0.181	—	—	—
5.5	0.169	—	—	—
6.0	0.159	—	—	—

Table 118 (continued)

Concentration, m	$AgNO_3$	$AlCl_3$	$Al(ClO_3)_3$	$Al_2(SO_4)_3$
7.0	0.142	—	—	—
8.0	0.129	—	—	—
9.0	0.118	—	—	—
10.0	0.110	—	—	—
11.0	0.102	—	—	—
12.0	0.096	—	—	—
13.0	0.001	—	—	—

Table 119

Mean activity coefficients of Ba acetate, $BaBr_2$, $BaCl_2$, $Ba(ClO_4)_2$ and BaI_2 solutions at 25°C

Concentration, m	$BaAc_2$	$BaBr_2$	$BaCl_2$	$Ba(ClO_4)_2$	BaI_2
0.01	—	—	0.723	—	—
0.05	—	—	0.559	—	—
0.1	0.462	0.513	0.492	0.524	0.536
0.2	0.406	0.465	0.438	0.481	0.503
0.3	0.380	0.446	0.411	0.464	0.496
0.4	0.366	0.438	0.398	0.459	0.504
0.5	0.356	0.437	0.390	0.462	0.517
0.6	0.349	0.439	0.386	0.469	0.534
0.7	0.344	0.444	0.384	0.477	0.556
0.8	0.340	0.452	0.385	0.487	0.581
0.9	0.337	0.463	0.388	0.500	0.610
1.0	0.334	0.473	0.392	0.513	0.642
1.2	0.329	0.500	0.402	0.545	0.716
1.4	0.323	0.534	0.416	0.581	0.805
1.6	0.319	0.572	0.431	0.622	0.914
1.8	0.314	0.616	0.450	0.674	1.043
2.0	0.309	0.666	—	0.718	1.208
2.5	0.294	—	—	0.868	—
3.0	0.278	—	—	1.047	—
3.5	0.263	—	—	1.287	—
4.0	—	—	—	1.545	—
4.5	—	—	—	1.826	—
5.0	—	—	—	2.13	—

Table 120

Mean activity coefficients of $Ba(NO_3)_2$, $Ba(OH)_2$ and $BeSO_4$ solutions at 25°C

Concentration, *m*	$Ba(NO_3)_2$	$Ba(OH)_2$	$BeSO_4$
0.005	—	0.773	—
0.01	—	0.712	—
0.02	—	0.628	—
0.05	—	0.526	—
0.1	0.431	0.443	0.150
0.2	0.345	—	0.109
0.3	0.295	—	0.0885
0.4	0.262	—	0.0769
0.5	—	—	0.0692
0.6	—	—	0.0639
0.7	—	—	0.0600
0.8	—	—	0.0570
0.9	—	—	0.0546
1.0	—	—	0.0530
1.2	—	—	0.0506
1.4	—	—	0.0493
1.6	—	—	0.0488
1.8	—	—	0.0490
2.0	—	—	0.0497
2.5	—	—	0.0538
3.0	—	—	0.0613
3.5	—	—	0.0724
4.0	—	—	0.0875

Table 121

Mean activity coefficients of $CaBr_2$, $CaCl_2$, $Ca(ClO_4)_2$, CaI_2 and $Ca(NO_3)_2$ solutions at 25°C

Concentration, *m*	$CaBr_2$	$CaCl_2$	$Ca(ClO_4)_2$	CaI_2	$Ca(NO_3)_2$
0.001	—	0.889	—	—	—
0.002	—	0.852	—	—	—
0.005	—	0.789	—	—	—
0.01	—	0.731	—	—	—
0.02	—	0.668	—	—	—
0.05	—	0.583	—	—	—
0.1	0.532	0.523	0.557	0.552	0.513
0.2	0.491	0.482	0.532	0.524	0.421
0.3	0.481	0.462	0.532	0.524	0.391
0.4	0.482	0.456	0.544	0.535	0.373
0.5	0.490	0.457	0.564	0.553	0.360

Concentration, *m*	$CaBr_2$	$CaCl_2$	$Ca(ClO_4)_2$	CaI_2	$Ca(NO_3)_2$
0.6	0.504	0.462	0.589	0.576	0.351
0.7	0.521	0.469	0.618	0.602	0.344
0.8	0.542	0.479	0.654	0.641	0.339
0.9	0.567	0.493	0.695	0.682	0.336
1.0	0.596	0.509	0.743	0.731	0.334
1.2	0.664	0.550	0.853	0.840	0.332
1.4	0.746	0.599	0.992	0.978	0.333
1.6	0.846	0.657	1.161	1.148	0.335
1.8	0.968	0.726	1.372	1.356	0.339
2.0	1.119	0.800	1.634	1.617	0.343
2.5	1.654	1.063	2.62	—	0.360
3.0	2.53	1.483	4.21	—	0.380
3.5	3.88	2.08	6.76	—	0.403
4.0	6.27	2.93	10.77	—	0.435
4.5	10.64	4.17	17.02	—	0.468
5.0	18.43	5.89	26.7	—	0.507
5.5	31.7	8.18	41.7	—	0.546
6.0	55.7	11.11	63.7	—	0.591

Table 122

Mean activity coefficients of $CdBr_2$, $CdCl_2$, CdI_2, $Cd(NO_3)_2$ and $CdSO_4$ solutions at 25°C

Concentration, *m*	$CdBr_2$	$CdCl_2$	CdI_2	$Cd(NO_3)_2$	$CdSO_4$
0.0005	0.855	0.880	—	—	0.774
0.001	0.787	0.819	—	—	0.697
0.002	0.699	0.743	0.615	—	—
0.005	0.570	0.623	0.492	—	0.476
0.007	0.520	—	0.436	—	—
0.01	0.468	0.524	0.382	—	0.383
0.02	0.370	0.456	0.281	—	—
0.05	0.259	0.304	0.167	—	0.199
0.1	0.189	0.228	0.107	0.517	0.150
0.2	0.132	0.164	0.0675	0.469	0.103
0.3	0.105	0.133	0.0521	0.448	0.0822
0.4	0.089	0.114	0.0428	0.437	0.0699
0.5	0.0789	0.1001	0.0369	0.433	0.0615
0.6	0.0699	0.0904	0.0335	0.431	0.0553
0.7	0.0650	0.0825	0.0304	0.432	0.0505
0.8	0.0591	0.0765	0.0283	0.435	0.0468
0.9	0.0551	0.0713	0.0265	0.438	0.0438
1.0	0.0530	0.0664	0.0250	0.443	0.0415

Table 122 (continued)

Concentration, *m*	$CdBr_2$	$CdCl_2$	CdI_2	$Cd(NO_3)_2$	$CdSO_4$
1.2	0.0468	0.0597	0.0226	0.455	0.0379
1.4	0.0431	0.0543	0.0213	0.469	0.0355
1.5	0.0425	0.0523	0.0205	—	—
1.6	0.0402	0.0503	0.0198	0.487	0.0338
1.8	0.0380	0.0467	0.0189	0.507	0.0327
2.0	0.0361	0.0439	0.0183	0.528	0.0321
2.5	0.0328	0.0387	0.0166	0.581	0.0317
3.0	0.0305	0.0351	—	—	0.0329
3.5	0.0290	0.0324	—	—	0.0356
4.0	0.0278	0.0304	—	—	—
4.5	—	0.0289	—	—	—
5.0	—	0.0278	—	—	—
5.5	—	0.0268	—	—	—
6.0	—	0.0261	—	—	—

Table 123

Mean activity coefficients of $CeCl_3$, $CoBr_2$, $CoCl_2$, CoI_2 and $Co(NO_3)_2$ solutions at 25°C

Concentration, *m*	$CeCl_3$	$CoBr_2$	$CoCl_2$	CoI_2	$Co(NO_3)_2$
0.05	0.447	—	—	—	—
0.1	0.380	0.540	0.526	0.56	0.521
0.2	0.333	0.507	0.482	0.54	0.474
0.3	0.319	0.503	0.466	0.55	0.455
0.4	—	0.511	0.463	0.57	0.448
0.5	0.324	0.526	0.465	0.60	0.448
0.6	—	0.548	0.473	0.64	0.451
0.7	0.350	0.574	0.483	0.69	0.458
0.8	—	0.605	0.496	0.74	0.468
0.9	—	0.641	0.514	0.81	0.480
1.0	0.420	0.682	0.538	0.88	0.493
1.2	0.488	0.780	0.578	1.05	0.526
1.4	0.577	0.904	0.635	1.27	0.566
1.6	0.696	1.057	0.706	1.54	0.613
1.8	0.862	1.241	0.785	1.89	0.668
2.0	1.067	1.462	0.884	2.3	0.730
2.5	—	2.23	1.12	4.3	0.926
3.0	—	3.38	1.46	7.4	1.189
3.5	—	5.04	1.83	13.2	1.535
4.0	—	7.54	2.2	—	1.984
4.5	—	10.9	—	—	2.6
5.0	—	15.2	—	—	3.3

Table 124

Mean activity coefficients of $CrCl_3$, $Cr(NO_3)_3$, $Cr_2(SO_4)_3$, CsAc and CsBr solutions at 25°C

Concentration, *m*	$CrCl_3$	$Cr(NO_3)_3$	$Cr_2(SO_4)_3$	CsAc	CsBr
0.1	(0.331)	(0.319)	(0.0458)	0.798	0.754
0.2	0.298	0.285	0.0300	0.773	0.692
0.3	0.294	0.279	0.0238	0.763	0.652
0.4	0.300	0.201	0.0207	0.764	—
0.5	0.314	0.291	0.0190	0.765	0.603
0.6	0.335	0.304	0.0182	0.770	—
0.7	0.362	0.322	0.0185	0.777	0.570
0.8	0.397	0.344	0.0194	0.789	—
0.9	0.436	0.371	0.0208	0.798	—
1.0	0.481	0.401	0.0250	0.802	0.537
1.2	0.584	0.474	—	0.829	—
1.4	—	0.565	—	0.857	—
1.5	—	—	—	0.868	0.504
1.6	—	—	—	0.888	—
1.8	—	—	—	0.923	—
2.0	—	—	—	0.952	0.486
2.5	—	—	—	1.046	0.474
3.0	—	—	—	1.153	0.468
3.5	—	—	—	1.277	0.462
4.0	—	—	—	—	0.460
4.5	—	—	—	—	0.459
5.0	—	—	—	—	0.460

Table 125

Mean activity coefficients of CsCl, CsI, $CsNO_3$, CsOH and Cs_2SO_4 solutions at 25°C

Concentration, *m*	CsCl	CsI	$CsNO_3$	CsOH	Cs_2SO_4
0.05	—	—	—	0.831	—
0.1	0.755	0.753	0.729	0.809	0.464
0.2	0.693	0.691	0.651	0.774	0.390
0.3	0.653	0.651	0.598	0.757	0.345
0.4	—	—	—	0.752	0.317
0.5	0.604	0.599	0.526	0.752	0.297
0.6	—	—	—	0.755	0.279
0.7	0.573	0.566	0.475	0.761	0.267
0.8	—	—	—	0.767	0.256
0.9	—	—	—	0.775	0.247
1.0	0.543	0.532	0.419	0.785	0.240
1.2	—	—	—	—	0.226
1.4	—	—	—	—	0.218
1.5	0.514	0.495	0.354	—	—
1.6	—	—	—	—	0.211

Table 125 (continued)

Concentration, m	CsCl	CsI	$CsNO_3$	CsOH	Cs_2SO_4
1.8	—	—	—	—	0.205
2.0	0.495	0.470	—	—	—
2.5	0.485	0.450	—	—	—
3.0	0.480	0.434	—	—	—
3.5	0.476	—	—	—	—
4.0	0.474	—	—	—	—
4.5	0.474	—	—	—	—
5.0	0.476	—	—	—	—
7.0	0.486	—	—	—	—
8.0	0.496	—	—	—	—
9.0	0.503	—	—	—	—
10.0	0.508	—	—	—	—
11.0	0.512	—	—	—	—

Table 126

Mean activity coefficients of $CuCl_2$, $Cu(NO_3)_2$ and $CuSO_4$ solutions at 25°C

Concentration, m	$CuCl_2$	$Cu(NO_3)_2$	$CuSO_4$
0.001	—	—	0.74
0.005	—	—	0.53
0.01	—	—	0.41
0.05	—	—	0.20
0.1	0.501	0.513	0.16
0.2	0.447	0.464	0.104
0.3	0.423	0.443	0.0829
0.4	0.409	0.434	0.0704
0.5	0.405	0.432	0.0620
0.6	0.403	0.434	0.0559
0.7	0.403	0.438	0.0512
0.8	0.405	0.445	0.0475
0.9	0.408	0.453	0.0446
1.0	0.411	0.463	0.0423
1.2	0.419	0.485	0.0388
1.4	0.430	0.513	0.0365
1.6	0.442	0.541	—
1.8	0.454	0.577	—
2.0	0.466	0.614	—
2.5	0.498	0.731	—
3.0	0.520	0.908	—
3.5	0.546	1.123	—
4.0	0.574	1.389	—
4.5	0.597	1.70	—
5.0	0.621	2.05	—
5.5	0.648	2.48	—
6.0	0.675	2.99	—

Table 127

Mean activity coefficients of $EuCl_3$, $FeCl_2$, $FeCl_3$ and $Ga(ClO_4)_3$ solutions at 25°C

Concentration, *m*	$EuCl_3$	$FeCl_2$	$FeCl_3$	$Ga(ClO_4)_3$
0.001	—	—	0.80	—
0.005	—	—	0.65	—
0.01	—	—	0.59	—
0.05	0.447	—	0.47	—
0.1	0.385	0.525	0.41	0.443
0.2	0.342	0.480	—	0.422
0.3	0.329	0.463	—	0.439
0.4	—	0.459	—	0.477
0.5	0.334	0.460	0.35	0.532
0.6	—	0.467	—	0.604
0.7	0.367	0.475	—	0.697
0.8	—	0.486	—	0.814
0.9	—	0.501	—	0.961
1.0	0.448	0.519	0.42	1.150
1.2	0.527	0.558	—	1.704
1.4	0.637	0.607	—	2.63
1.6	0.781	0.668	—	4.21
1.8	0.973	0.739	—	6.85
2.0	1.237	0.817	—	11.20

Table 128

Mean activity coefficients of HBr, HCl, $HClO_4$ and HI solutions at 25°C

Concentration, *m*	HBr	HCl	$HClO_4$	HI
0.0001	—	0.9891	—	—
0.0002	—	0.9842	—	—
0.0005	—	0.9752	—	—
0.001	0.966	0.9656	—	0.966
0.002	0.952	0.9521	—	0.953
0.005	0.930	0.9285	—	0.931
0.01	0.906	0.9048	—	0.908
0.02	0.879	0.8755	—	0.882
0.05	0.838	0.8404	—	0.845
0.1	0.805	0.796	0.803	0.818
0.2	0.782	0.767	0.778	0.807
0.3	0.777	0.756	0.768	0.811
0.4	0.781	0.755	0.766	—
0.5	0.790	0.757	0.769	0.839
0.6	0.801	0.763	0.776	—
0.7	0.815	0.772	0.785	0.883
0.8	0.832	0.783	0.795	—
0.9	0.850	0.795	0.808	—
1.0	0.871	0.809	0.823	0.965

Table 128 (continued)

Concentration, *m*	HBr	HCl	$HClO_4$	HI
1.2	0.917	0.840	0.858	—
1.4	0.969	0.876	0.900	—
1.5	—	0.896	0.923	1.139
1.6	1.029	0.916	0.947	—
1.8	1.094	0.960	0.998	—
2.0	1.168	1.009	1.055	1.367
2.5	1.389	1.147	1.227	1.656
3.0	1.674	1.316	1.448	2.025
3.5	—	1.518	1.726	—
4.0	—	1.762	2.08	—
4.5	—	2.04	2.53	—
5.0	—	2.38	3.11	—
5.5	—	2.77	3.83	—
6.0	—	3.22	4.76	—
7.0	—	4.37	7.44	—
8.0	—	5.90	11.83	—
9.0	—	7.94	19.11	—
10.0	—	10.44	30.9	—
11.0	—	—	50.1	—
12.0	—	—	80.8	—

Table 129

Mean activity coefficients of HNO_3, H_2SO_4, $In_2(SO_4)_3$, K acetate and KBr solutions at 25°C

Concentration, *m*	HNO_3	H_2SO_4	$IN_2(SO_4)_3$	KAc	KBr
0.0005	—	0.885	—	—	—
0.0007	—	0.857	—	—	—
0.001	0.965	0.830	—	—	—
0.002	—	0.757	—	—	—
0.003	—	0.709	—	—	—
0.005	0.927	0.639	—	—	—
0.007	—	0.591	—	—	—
0.01	0.902	0.544	0.142	—	—
0.02	—	0.453	0.095	—	—
0.03	—	0.401	—	—	—
0.05	0.823	0.340	0.054	—	—
0.07	—	0.301	—	—	—
0.1	0.785	0.265	—	0.796	0.771
0.2	—	0.209	—	0.767	0.721
0.3	0.753	—	—	0.752	0.692
0.5	0.715	0.154	—	0.751	0.657
0.7	—	—	—	0.755	0.637

Table 129 (continued)

Concentration, *m*	HNO_3	H_2SO_4	$In_2(SO_4)_3$	KAc	KBr
1.0	0.720	0.130	—	0.779	0.617
1.5	0.751	0.124	—	0.839	0.601
2.0	0.793	0.124	—	0.910	0.596
2.5	0.876	—	—	0.993	0.596
3.0	0.915	0.141	—	1.086	0.600
3.5	—	—	—	1.187	0.606
4.0	—	0.171	—	—	0.615
4.5	—	—	—	—	0.621
5.0	—	0.212	—	—	0.632
5.5	—	—	—	—	0.645
6.0	—	0.264	—	—	—
7.0	—	0.326	—	—	—
8.0	—	0.397	—	—	—
9.0	—	0.470	—	—	—
10.0	—	0.553	—	—	—

Table 130

Mean activity coefficients of $KBrO_3$, KCNS, KCl, $KClO_3$ and KF solutions at 25°C

Concentration, *m*	$KBrO_3$	KCNS	KCl	$KClO_3$	KF
0.001	—	—	0.965	—	—
0.002	—	—	0.952	—	—
0.005	—	—	0.927	—	—
0.01	—	—	0.902	—	—
0.02	—	—	0.869	—	—
0.05	—	—	0.816	—	—
0.1	0.745	0.769	0.769	0.749	0.774
0.2	0.674	0.716	0.719	0.681	0.727
0.3	0.625	0.685	0.688	0.635	0.701
0.4	0.585	—	—	0.599	—
0.5	0.552	0.646	0.651	0.568	0.672
0.6	—	—	—	0.541	—
0.7	—	0.623	0.628	0.518	0.657
1.0	—	0.600	0.606	—	0.649
1.5	—	0.574	0.585	—	0.649
2.0	—	0.558	0.576	—	0.663
2.5	—	0.548	0.572	—	0.684
3.0	—	0.542	0.571	—	0.713
3.5	—	0.537	0.574	—	0.748
4.0	—	—	0.579	—	0.790
4.5	—	—	0.590	—	—

Table 131

Mean activity coefficients of KH adipate, KH malonate, KH succinate, KH_2AsO_4 and KH_2PO_4 solutions at 25°C

Concentration, *m*	KH adipate	KH malonate	KH succinate	KH_2AsO_4	KH_2PO_4
0.1	0.772	0.759	0.762	0.750	0.731
0.2	0.724	0.702	0.705	0.679	0.653
0.3	0.693	0.665	0.668	0.630	0.602
0.4	0.664	0.634	0.640	0.593	0.561
0.5	0.654	0.610	0.619	0.562	0.529
0.6	0.642	0.588	0.602	0.537	0.501
0.7	0.631	0.570	0.588	0.515	0.477
0.8	0.622	0.554	0.575	0.495	0.456
0.9	0.615	0.541	0.564	0.479	0.438
1.0	0.609	0.528	0.553	0.463	0.421
1.2	—	0.507	0.536	0.438	0.393
1.4	—	0.488	0.521	—	0.369
1.6	—	0.472	0.510	—	0.348
1.8	—	0.460	0.501	—	0.332
2.0	—	0.450	0.493	—	—
2.5	—	0.427	0.478	—	—
3.0	—	0.408	0.468	—	—
3.5	—	0.392	0.463	—	—
4.0	—	0.377	0.457	—	—
4.5	—	0.365	0.453	—	—
5.0	—	0.353	—	—	—

Table 132

Mean activity coefficients of KI, KNO_3, KOH, K toluenesulphonate, K_2CrO_4 and K_2HPO_4 solutions at 25°C

Concentration, *m*	KI	KNO_3	KOH	KTol	K_2CrO_4	K_2HPO_4
0.001	—	0.965	—	—	—	—
0.005	—	0.926	—	—	—	—
0.01	—	0.898	—	—	—	—
0.05	—	0.799	0.824	—	—	—
0.1	0.776	0.738	0.798	0.760	0.455	0.469
0.2	0.731	0.659	0.760	0.701	0.379	0.387
0.3	0.704	0.607	0.742	0.662	0.338	0.342
0.4	—	—	0.734	—	0.311	0.310
0.5	0.675	0.546	0.728	0.607	0.292	0.288
0.6	—	—	0.731	—	0.276	0.270
0.7	0.659	0.494	0.736	0.562	0.263	0.256
0.8	—	—	0.742	—	0.253	0.243

Table 132 (continued)

Concentration, *m*	KI	KNO_3	KOH	KTol	K_2CrO_4	K_2HPO_4
0.9	—	—	0.749	—	0.244	0.234
1.0	0.646	0.443	0.756	0.509	0.236	0.225
1.2	—	—	0.776	—	0.224	—
1.4	—	—	—	—	0.214	—
1.5	0.639	0.378	0.814	0.438	—	—
1.6	—	—	—	—	0.207	—
1.8	—	—	—	—	0.201	—
2.0	0.641	0.327	0.888	0.387	0.197	—
2.5	0.649	0.293	0.974	0.349	—	—
3.0	0.657	0.266	1.081	0.318	—	—
3.5	0.667	0.244	1.215	0.294	—	—
4.0	0.678	—	1.352	—	—	—
4.5	0.692	—	1.53	—	—	—
5.0	—	—	1.72	—	—	—

Table 133

Mean activity coefficient of K_2SO_4, K_3AsO_4, $K_3[Fe(CN)_6]$, K_3PO_4, $K_4[Fe(CN)_6]$ and $K_4[Mo(CN)_8]$ solutions at 25°C

Concentration, *m*	K_2SO_4	K_3AsO_4	$K_3[Fe(CN)_6]$	K_3PO_4	$K_4[Fe(CN)_6]$	$K_4[Mo(CN)_8]$
0.001	—	—	0.785	—	0.650	—
0.005	—	—	0.618	—	0.447	—
0.01	—	—	0.547	—	0.360	—
0.05	—	—	0.365	—	0.189	—
0.1	0.436	0.331	0.291	0.312	0.134	0.145
0.2	0.356	0.270	0.212	0.244	0.100	0.104
0.3	0.313	0.242	0.184	0.211	0.081	0.083
0.4	0.283	0.224	0.167	0.190	0.070	0.071
0.5	0.261	0.212	0.155	0.175	0.061	0.063
0.6	0.243	0.202	0.146	0.164	0.056	0.057
0.7	0.229	0.195	0.140	0.156	0.052	0.052
0.8	—	—	0.135	—	0.048	0.049
0.9	—	—	0.131	—	0.046	0.046
1.0	—	—	0.128	—	—	0.044
1.2	—	—	0.124	—	—	0.040
1.4	—	—	0.122	—	—	0.038

Table 134

Mean activity coefficients of $LaCl_3$, $La(NO_3)_3$, Li acetate, LiBr, LiCl and $LiClO_4$ solutions at 25°C

Concentration, *m*	$LaCl_3$	$La(NO_3)_3$	LiAc	LiBr	LiCl	$LiClO_4$
0.001	0.790	0.792	—	—	—	—
0.002	0.729	—	—	—	—	—
0.05	0.636	0.630	—	—	—	—
0.01	0.560	0.551	—	—	—	—
0.02	0.483	—	—	—	—	—
0.05	0.388	0.380	—	—	—	—
0.1	0.383	0.317	0.782	0.794	0.792	0.812
0.2	0.337	—	0.740	0.764	0.761	0.794
0.3	0.323	—	0.718	0.757	0.748	0.792
0.5	0.328	—	0.698	0.755	0.742	0.808
0.7	0.354	—	0.691	0.770	0.754	0.834
1.0	0.424	—	0.690	0.811	0.781	0.887
1.2	0.493	—	—	—	—	0.931
1.4	0.587	—	—	—	—	0.979
1.5	—	—	0.709	0.899	0.841	—
1.6	—	—	—	—	—	1.034
2.0	—	—	0.734	1.016	0.931	1.158
2.5	—	—	0.769	1.166	1.043	1.350
3.0	—	—	0.807	1.352	1.174	1.582
3.5	—	—	0.847	1.589	1.324	1.866
4.0	—	—	0.893	1.903	1.531	2.180
5.0	—	—	—	2.74	2.03	—
6.0	—	—	—	3.92	2.75	—
7.0	—	—	—	5.76	3.75	—
8.0	—	—	—	8.61	5.13	—
9.0	—	—	—	12.92	6.98	—
10.0	—	—	—	19.92	9.43	—

Table 135

Mean activity coefficients of LiI, $LiNO_3$, LiOH, Li toluenesulphonate and Li_2SO_4 solutions at 25°C

Concentration, *m*	LiI	$LiNO_3$	LiOH	LiTol	Li_2SO_4
0.1	0.811	0.788	0.718	0.773	0.478
0.2	0.800	0.751	0.663	0.729	0.406
0.3	0.799	0.737	0.628	0.698	0.369
0.4	—	—	0.603	—	0.344
0.5	0.819	0.728	0.583	0.664	0.326
0.6	—	—	0.566	—	0.313
0.7	0.848	0.731	0.553	0.642	0.303
0.8	—	—	0.541	—	0.295
0.9	—	—	0.532	—	0.288
1.0	0.907	0.746	0.523	0.621	0.283
1.2	—	—	0.512	—	0.277

Table 135 (continued)

Concentration, *m*	LiI	$LiNO_3$	LiOH	LiTol	Li_2SO_4
1.4	—	—	0.503	—	0.273
1.5	1.029	0.783	—	0.595	—
1.6	—	—	0.496	—	0.271
1.8	—	—	0.489	—	0.270
2.0	1.196	0.840	0.485	0.574	0.269
2.5	1.423	0.903	0.475	0.565	0.280
3.0	1.739	0.973	0.467	0.563	0.294
3.5	—	1.052	0.460	0.566	—
4.0	—	1.133	0.454	0.573	—
4.5	—	1.324	—	0.584	—
5.0	—	1.317	—	—	—
5.5	—	1.413	—	—	—
6.0	—	1.517	—	—	—
7.0	—	1.723	—	—	—
8.0	—	1.952	—	—	—
9.0	—	2.19	—	—	—
10.0	—	2.44	—	—	—

Table 136

Mean activity coefficients of Mg acetate, $MgBr_2$, $MgCl_2$, $Mg(ClO_4)_2$, MgI_2, $Mg(NO_3)_2$ and $MgSO_4$ solution at 25°C

Concentration, *m*	$MgAc_2$	$MgBr_2$	$MgCl_2$	$Mg(ClO_4)_2$	MgI_2	$Mg(NO_3)_2$	$MgSO_4$
0.01	—	—	—	—	—	—	0.40
0.05	—	—	—	—	—	—	0.22
0.1	0.459	0.582	0.565	0.577	0.599	0.522	0.18
0.2	0.397	0.546	0.520	0.565	0.577	0.480	0.11
0.3	0.366	0.547	0.507	0.576	0.585	0.467	0.087
0.4	0.347	0.560	0.508	0.599	0.607	0.465	0.076
0.5	0.335	0.579	0.514	0.633	0.637	0.469	0.068
0.6	0.326	0.604	0.527	0.673	0.676	0.478	0.062
0.7	0.320	0.635	0.542	0.723	0.723	0.488	0.057
0.8	0.316	0.671	0.563	0.780	0.782	0.501	0.054
0.9	0.314	0.714	0.587	0.849	0.851	0.518	0.051
1.0	0.313	0.764	0.613	0.925	0.929	0.536	0.049
1.2	0.314	0.885	0.680	1.112	1.112	0.580	0.045
1.4	0.316	1.032	0.764	1.355	1.353	0.631	0.043
1.6	0.321	1.214	0.867	1.667	1.651	0.691	0.042
1.8	0.327	1.440	0.986	2.08	—	0.758	0.042
2.0	0.336	—	1.143	2.59	—	0.835	0.042
2.5	0.358	—	—	4.78	—	1.088	0.044
3.0	0.386	—	—	8.99	—	1.449	0.049
3.5	0.414	—	—	17.26	—	1.936	—
4.0	0.445	—	—	33.3	—	2.59	—
4.5	—	—	—	—	—	3.50	—
5.0	—	—	—	—	—	4.74	—

Table 137

Mean activity coefficients of $MnCl_2$, $MnSO_4$, Na acetate, NaBr and $NaBrO_3$ solutions at 25°C

Concentration, *m*	$MnCl_2$	$MnSO_4$	NaAc	NaBr	$NaBrO_3$
0.1	0.522	0.150	0.791 ?	0.782	0.758
0.2	0.474	0.105	0.755	0.740	0.696
0.3	0.454	0.085	0.741	0.718	0.657
0.4	0.446	0.073	—	—	0.628
0.5	0.446	0.064	0.740	0.695	0.605
0.6	0.448	0.058	—	—	0.585
0.7	0.455	0.053	0.741	0.687	0.569
0.8	0.463	0.049	—	—	0.554
0.9	0.474	0.046	—	—	0.541
1.0	0.486	0.044	0.757	0.686	0.528
1.2	0.516	0.040	—	—	0.507
1.4	0.554	0.038	—	—	0.489
1.5	—	—	0.799	0.703	—
1.6	0.596	0.037	—	—	0.473
1.8	0.637	0.036	—	—	0.461
2.0	0.682	0.035	0.854	0.734	0.450
2.5	0.807	0.035	0.920	0.773	0.426
3.0	0.948	0.037	0.993	0.826	—
3.5	1.097	0.041	1.070	0.878	—
4.0	1.254	0.047	—	—	—
4.5	1.423	—	—	—	—
5.0	1.58	—	—	—	—

Table 138

Mean activity coefficients of Na butyrate, Na caprate, Na caproate, Na caprylate and NaCNS solutions at 25°C

Concentration, *m*	NaBut	NaCap	NaCapr	NaCapry	NaCNS
0.1	0.800	—	0.803	—	0.787
0.2	0.774	—	0.779	—	0.750
0.3	0.769	—	0.775	—	0.731
0.4	0.774	—	0.783	—	—
0.5	0.782	0.285	0.794	0.693	0.715
0.6	0.795	0.244	0.810	0.621	—
0.7	0.812	0.212	0.826	0.553	0.710
0.8	0.830	0.184	0.841	0.491	—
0.9	0.848	0.169	0.851	0.434	—
1.0	0.868	0.147	0.858	0.401	0.712
1.2	0.908	0.120	0.865	0.349	—
1.4	0.952	0.107	0.855	0.309	0.725

Table 138 (continued)

Concentration, *m*	NaBut	NaCap	NaCapr	NaCapry	NaCNS
1.6	0.992	0.097	0.830	0.279	—
1.8	1.036	0.089	0.799	0.253	—
2.0	1.083	—	0.763	0.236	0.751
2.5	1.182	—	0.673	0.206	0.784
3.0	1.278	—	0.612	0.185	0.820
3.5	1.368	—	0.576	—	0.860
4.0	—	—	0.556	—	0.911
4.5	—	—	0.542	—	—

Table 139

Mean activity coefficients of NaCl, $NaClO_3$, $NaClO_4$ and NaF solutions at 25°C

Concentration, *m*	NaCl	$NaClO_3$	$NaClO_4$	NaF
0.001	0.965	—	—	—
0.002	0.952	—	—	—
0.005	0.927	—	—	—
0.01	0.902	—	—	—
0.02	0.871	—		—
0.05	0.819	—		—
0.1	0.778	0.772	0.775	0.764
0.2	0.734	0.720	0.729	0.708
0.3	0.710	0.688	0.701	0.675
0.4	—	0.664	0.683	—
0.5	0.682	0.645	0.668	0.631
0.6	—	0.630	0.656	—
0.7	0.668	0.617	0.648	0.602
0.8	—	0.606	0.641	—
0.9	—	0.597	0.635	—
1.0	0.658	0.589	0.629	0.572
1.2	—	0.575	0.622	—
1.4	—	0.563	0.616	—
1.5	0.659	—	—	—
1.6	—	0.553	0.613	—
1.8	—	0.545	0.611	—
2.0	0.671	0.538	0.609	—
2.5	0.692	0.525	0.609	—
3.0	0.720	0.515	0.611	—
3.5	0.753	0.508	0.617	—
4.0	0.792	—	0.626	—
4.5	0.836	—	0.637	—
5.0	0.885	—	0.649	—

Table 140

Mean activity coefficients of Na formate, NaH adipate, NaH malonate, NaH succinate and Na heptylate solutions at 25°C

Concentration, *m*	NaForm	NaHAd	NaHMal	NaHSucc	NaHept
0.1	0.778	0.776	0.764	0.765	0.803
0.2	0.734	0.730	0.709	0.712	0.780
0.3	0.710	0.703	0.674	0.677	0.777
0.4	0.696	0.683	0.647	0.653	0.780
0.5	0.685	0.670	0.626	0.635	0.783
0.6	0.676	0.658	0.609	0.618	0.781
0.7	0.671	0.650	0.595	0.607	0.775
0.8	0.667	—	0.582	0.596	0.754
0.9	0.664	—	0.572	0.586	0.700
1.0	0.661	—	0.563	0.579	0.650
1.2	0.658	—	0.546	0.565	0.562
1.4	0.657	—	0.533	0.556	0.512
1.6	0.656	—	0.523	0.548	0.468
1.8	0.657	—	0.514	0.543	0.430
2.0	0.658	—	0.507	0.538	0.398
2.5	0.667	—	0.490	0.529	0.340
3.0	0.678	—	0.477	0.526	0.306
3.5	0.691	—	0.467	0.524	0.284
4.0	—	—	0.458	0.525	0.267
4.5	—	—	0.451	0.528	0.255
5.0	—	—	0.445	0.534	0.245

Table 141

Mean activity coefficients of NaH_2AsO_4, NaH_2PO_4, NaI, $NaNO_3$ and NaOH solutions at 25°C

Concentration, *m*	NAH_2AsO_4	NaH_2PO_4	NaI	$NaNO_3$	NaOH
0.05	—	—	—	—	0.818
0.1	0.767	0.744	0.788	0.758	0.766
0.2	0.708	0.675	0.752	0.702	0.726
0.3	0.667	0.629	0.737	0.664	0.707
0.4	0.637	0.593	—	—	0.696
0.5	0.611	0.563	0.726	0.615	0.693
0.6	0.589	0.539	—	—	0.684
0.7	0.569	0.517	0.729	0.583	0.680
0.8	0.552	0.499	—	—	0.678
0.9	0.537	0.483	—	—	0.677
1.0	0.522	0.468	0.739	0.548	0.679
1.2	0.498	0.442	—	—	0.680
1.4	—	0.420	—	—	—
1.5	—	—	0.772	0.509	0.683
1.6	—	0.401	—	—	0.691

Table 141 (continued)

Concentration, m	NaH_2AsO_4	NaH_2PO_4	NaI	$NaNO_3$	NaOH
1.8	—	0.385	—	—	0.699
2.0	—	0.371	0.824	0.481	0.708
2.5	—	0.343	0.889	0.457	0.742
3.0	—	0.320	0.967	0.438	0.783
3.5	—	0.305	1.060	0.423	0.833
4.0	—	0.293	—	0.410	0.902
4.5	—	0.283	—	0.398	0.983
5.0	—	0.276	—	0.388	1.075
5.5	—	0.270	—	0.380	1.179
6.0	—	0.265	—	0.373	1.297
7.0	—	—	—	—	1.60
8.0	—	—	—	—	2.00
9.0	—	—	—	—	2.54
10.0	—	—	—	—	3.22

Table 142

Mean activity coefficients of Na pelargonate, Na propionate, Na toluenesulphonate, Na valerate and Na_2CO_3 solutions at 25°C

Concentration, m	NaPel	NaProp	NaTol	NaVal	Na_2CO_3
0.001	—	—	—	—	0.891
0.005	—	—	—	—	0.791
0.01	—	—	—	—	0.729
0.05	—	—	—	—	0.565
0.1	—	0.800	0.764	0.800	0.466
0.2	—	0.772	0.708	0.776	0.394
0.3	—	0.763	0.672	0.771	0.356
0.4	—	0.762	—	0.780	0.332
0.5	0.390	0.764	0.624	0.790	0.313
0.6	0.335	0.769	—	0.805	0.301
0.7	0.295	0.777	0.592	0.817	0.290
0.8	0.264	0.787	—	0.835	0.281
0.9	0.239	0.797	—	0.852	0.272
1.0	0.219	0.808	0.551	0.868	0.264
1.2	0.189	0.833	—	0.907	0.250
1.4	0.168	0.864	—	0.945	0.238
1.5	—	—	0.502	—	—
1.6	0.152	0.897	—	0.984	0.227
1.8	0.140	0.932	—	1.012	—
2.0	0.130	0.966	0.460	1.030	—
2.5	0.126	1.061	0.428	1.027	—
3.0	—	1.160	0.403	0.982	—
3.5	—	—	0.385	0.901	—
4.0	—	—	0.368	—	—

Table 143

Mean activity coefficients of Na_2CrO_4, Na_2 fumarate, Na_2HAsO_4, Na_2HPO_4 and Na_2 maleate solutions at 25°C

Concentration, *m*	Na_2CrO_4	Na_2Fum	Na_2HAsO_4	Na_2HPO_4	Na_2Mal
0.001	—	—	—	0.885	—
0.005	—	—	—	0.771	—
0.01	—	—	—	0.706	—
0.05	—	—	—	0.530	—
0.1	0.479	0.468	0.488	0.466	0.427
0.2	0.407	0.405	0.411	0.394	0.352
0.3	0.364	0.372	0.366	0.356	0.312
0.4	0.337	0.350	0.334	0.332	0.287
0.5	0.317	0.337	0.310	0.313	0.270
0.6	0.301	0.330	0.290	0.301	0.260
0.7	0.289	0.325	0.274	0.290	0.248
0.8	0.278	0.322	0.260	0.281	0.241
0.9	0.269	0.321	0.249	0.272	0.234
1.0	0.261	0.321	0.238	0.264	0.229
1.2	0.249	0.322	—	0.250	0.222
1.4	0.240	0.325	—	0.238	0.217
1.6	0.234	0.332	—	0.227	0.214
1.8	0.231	0.338	—	—	0.213
2.0	0.229	0.345	—	—	0.212
2.5	0.232	—	—	—	0.213
3.0	0.244	—	—	—	0.218
3.5	0.263	—	—	—	—
4.0	0.294	—	—	—	—

Table 144

Mean activity coefficients of Na_2SO_4, $Na_2S_2O_3$, Na_3AsO_4, Na_3PO_4 and $NdCl_3$ solutions at 25°C

Concentration, *m*	Na_2SO	$Na_2S_2O_3$	Na_3AsO_4	Na_3PO_4	$NdCl_3$
0.001	0.887	—	—	—	—
0.005	0.778	—	—	—	—
0.01	0.714	—	—	—	—
0.05	0.536	—	—	—	0.447
0.1	0.453	0.466	0.299	0.293	0.381
0.2	0.371	0.390	0.225	0.216	0.333
0.3	0.325	0.347	0.188	0.177	0.318
0.4	0.294	0.319	0.165	0.151	—
0.5	0.270	0.298	0.148	0.134	0.322
0.6	0.252	0.282	0.136	0.120	—
0.7	0.237	0.267	0.126	0.109	0.348
0.8	0.225	0.256	—	—	—
0.9	0.213	0.247	—	—	—
1.0	0.204	0.239	—	—	0.418

Table 144 (continued)

Concentration, *m*	Na_2SO_4	$Na_2S_2O_3$	Na_3AsO_4	Na_3PO_4	$NdCl_3$
1.2	0.189	0.226	—	—	0.488
1.4	0.177	0.218	—	—	0.581
1.6	0.168	0.211	—	—	0.703
1.8	0.161	0.206	—	—	0.862
2.0	0.154	0.202	—	—	1.079
2.5	0.144	0.199	—	—	—
3.0	0.139	0.203	—	—	—
3.5	0.137	0.211	—	—	—
4.0	0.138	—	—	—	—

Table 145

Mean activity coefficients of NH_4Cl, NH_4NO_3, $(NH_4)_2SO_4$, $NiCl_2$ and $NiSO_4$ solutions at 25°C

Concentration, *m*	NH_4Cl	NH_4NO_3	$(NH_4)_2SO_4$	$NiCl_2$	$NiSO_4$
0.001	0.961	—	—	—	0.764
0.005	0.911	—	—	—	0.561
0.01	0.880	—	—	—	0.455
0.05	0.790	—	—	—	0.246
0.1	0.770	0.740	0.423	0.526	0.180
0.2	0.718	0.677	0.343	0.483	0.105
0.3	0.687	0.636	0.300	0.468	0.084
0.4	0.665	0.606	0.270	0.465	0.071
0.5	0.649	0.582	0.248	0.468	0.063
0.6	0.636	0.562	0.231	0.476	0.056
0.7	0.625	0.545	0.218	0.489	0.052
0.8	0.617	0.530	0.206	0.504	0.048
0.9	0.609	0.516	0.198	0.522	0.045
1.0	0.603	0.504	0.189	0.542	0.043
1.2	0.592	0.483	0.175	0.595	0.040
1.4	0.584	0.464	0.165	0.660	0.037
1.6	0.578	0.447	0.156	0.737	0.035
1.8	0.574	0.433	0.149	0.826	0.035
2.0	0.570	0.419	0.144	0.938	0.034
2.5	0.564	0.391	0.132	1.24	0.036
3.0	0.561	0.368	0.125	1.69	—
3.5	0.560	0.348	0.119	2.26	—
4.0	0.560	0.331	0.116	2.96	—
4.5	0.561	0.316	—	3.76	—
5.0	0.562	0.302	—	4.69	—
5.5	0.563	0.290	—	—	—
6.0	0.564	0.279	—	—	—
7.0	—	0.261	—	—	—
8.0	—	0.245	—	—	—
9.0	—	0.232	—	—	—
10.0	—	0.221	—	—	—

Table 146

Mean activity coefficients of $PbCl_2$, $Pb(ClO_4)_2$, $Pb(NO_3)_2$ and $PrCl_3$ solutions at 25°C

Concentration, *m*	$PbCl_2$	$Pb(ClO_4)_2$	$Pb(NO_3)_2$	$PrCl_3$
0.0005	0.902	—	—	—
0.001	0.859	—	0.885	—
0.002	0.803	—	—	—
0.005	0.704	—	0.763	—
0.01	0.612	—	0.687	—
0.02	0.497	—	—	—
0.05	—	—	0.464	0.447
0.1	—	0.525	0.405	0.380
0.2	—	0.483	0.316	0.333
0.3	—	0.467	0.267	0.319
0.4	—	0.462	0.234	—
0.5	—	0.465	0.210	0.322
0.6	—	0.471	0.192	—
0.7	—	0.479	0.176	0.346
0.8	—	0.491	0.164	—
0.9	—	0.506	0.154	—
1.0	—	0.523	0.145	0.413
1.2	—	0.563	0.130	0.482
1.4	—	0.613	0.118	0.573
1.6	—	0.669	0.109	0.686
1.8	—	0.734	0.102	0.834
2.0	—	0.809	0.095	1.033
2.5	—	1.045	—	—
3.0	—	1.386	—	—
3.5	—	1.831	—	—
4.0	—	2.39₀	—	—
4.5	—	3.22	—	—
5.0	—	4.05	—	—
5.5	—	5.23	—	—
6.0	—	6.67	—	—
7.0	—	10.69	—	—
8.0	—	16.31	—	—
9.0	—	23.7	—	—
10.0	—	34.1	—	—

Table 147

Mean activity coefficients of Rb acetate, RbBr, RbCl, RbI, $RbNO_3$ and Rb_2SO_4 solutions at 25°C

Concentration, *m*	RbAc	RbBr	RbCl	RbI	$RbNO_3$	Rb_2SO_4
0.1	0.797	0.763	0.764	0.762	0.730	0.460
0.2	0.771	0.706	0.709	0.705	0.656	0.382
0.3	0.759	0.674	0.675	0.673	0.603	0.338
0.4	—	—	—	—	—	0.308
0.5	0.760	0.634	0.634	0.631	0.534	0.285
0.6	—	—	—	—	—	0.269
0.7	0.769	0.606	0.607	0.602	0.484	0.254
0.8	—	—	—	—	—	0.243
0.9	—	—	—	—	—	0.233
1.0	0.795	0.579	0.583	0.575	0.429	0.224
1.2	—	—	—	—	—	0.211
1.4	—	—	—	—	—	0.200
1.5	0.859	0.552	0.559	0.548	0.365	—
1.6	—	—	—	—	—	0.193
1.8	—	—	—	—	—	0.186
2.0	0.940	0.537	0.547	0.533	0.319	—
2.5	1.034	0.527	0.540	0.525	0.284	—
3.0	1.139	0.521	0.538	0.519	0.256	—
3.5	1.255	0.518	0.539	0.518	0.235	—
4.0	—	0.517	0.541	0.517	0.216	—
4.5	—	0.517	0.544	0.519	0.200	—
5.0	—	0.518	0.547	0.520	—	—

Table 148

Mean activity coefficients of $ScCl_3$, $SmCl_3$, $SrBr_2$, $SrCl_2$, $Sr(ClO_4)_2$, SrI_2 and $Sr(NO_3)_2$ solutions at 25°C

Concentration, *m*	$ScCl_3$	$SmCl_3$	$SrBr_2$	$SrCl_2$	$Sr(ClO_4)_2$	SrI_2	$Sr(NO_3)_2$
0.05	0.447	0.447	—	0.571	—	—	—
0.1	0.385	0.384	0.527	0.514	0.528	0.549	0.478
0.2	0.340	0.341	0.483	0.463	0.494	0.516	0.410
0.3	0.329	0.333	0.468	0.440	0.488	0.513	0.373
0.4	—	—	0.465	0.430	0.494	0.520	0.348
0.5	0.333	0.355	0.467	0.425	0.507	0.532	0.329
0.6	—	—	0.473	0.426	0.525	0.551	0.314
0.7	0.363	0.403	0.484	0.430	0.546	0.573	0.302
0.8	—	—	0.497	0.436	0.573	0.603	0.292
0.9	—	—	0.515	0.444	0.604	0.637	0.283
1.0	0.442	0.523	0.535	0.455	0.638	0.675	0.275
1.2	0.520	0.647	0.583	0.480	0.718	0.767	0.262

Table 148 (continued)

Concentration, m	$ScCl_3$	$SmCl_3$	$SrBr_2$	$SrCl_2$	$Sr(ClO_4)_2$	SrI_2	$Sr(NO_3)_2$
1.4	0.623	0.813	0.643	0.510	0.812	0.878	0.253
1.6	0.761	1.033	0.715	0.546	0.928	1.013	0.244
1.8	0.941	1.326	0.800	0.587	1.060	1.181	0.238
2.0	1.182	1.706	0.906	0.636	1.220	1.396	0.232
2.5	—	—	—	—	1.755	—	0.223
3.0	—	—	—	—	2.57	—	0.217
3.5	—	—	—	—	3.68	—	0.214
4.0	—	—	—	—	5.20	—	0.212
4.5	—	—	—	—	7.30	—	—
5.0	—	—	—	—	10.09	—	—

Table 149

Mean activity coefficients of $ThCl_4$, $Th(NO_3)_4$, Tl acetate, TlCl, $TlClO_4$ and $TlNO_3$ solutions at 25°C

Concentration, m	$ThCl_4$	$Th(NO_3)_4$	TlAc	TlCl	$TlClO_4$	$TlNO_3$
0.001	—	—	—	0.962	—	—
0.002	—	—	—	0.946	—	—
0.005	—	—	—	0.912	—	—
0.01	—	—	—	0.876	—	—
0.1	0.292	0.279	0.748	—	0.730	0.701
0.2	0.257	0.225	0.684	—	0.652	0.605
0.3	0.253	0.203	0.643	—	0.599	0.544
0.4	0.261	0.192	—	—	0.599	0.500
0.5	0.275	0.189	0.588	—	0.527	—
0.6	0.297	0.188	—	—	—	—
0.7	0.327	0.191	0.552	—	—	—
0.8	0.364	0.195	—	—	—	—
0.9	0.409	0.201	—	—	—	—
1.0	0.463	0.207	0.513	—	—	—
1.2	0.583	0.224	—	—	—	—
1.4	0.729	0.246	—	—	—	—
1.5	—	—	0.472	—	—	—
1.6	0.966	0.269	—	—	—	—
1.8	—	0.296	—	—	—	—
2.0	—	0.326	0.444	—	—	—
2.5	—	0.405	0.422	—	—	—
3.0	—	0.486	0.405	—	—	—
3.5	—	0.568	0.390	—	—	—
4.0	—	0.647	0.377	—	—	—
4.5	—	0.722	0.365	—	—	—
5.0	—	0.791	0.354	—	—	—

Table 150

Mean activity coefficients of UO_2Cl_2, $UO_2(ClO_4)_2$, $UO_2(NO_3)_2$, UO_2SO_4 and YCl_3 solutions at 25°C

Concentration, *m*	UO_2Cl_2	$UO_2(ClO_4)_2$	$UO_2(NO_3)_2$	UO_2SO_4	YCl_3
0.05	—	—	—	—	0.447
0.1	0.539	0.604	0.543	0.150 ?	0.382
0.2	0.505	0.612	0.512	0.102	0.337
0.3	0.497	0.646	0.510	0.081	0.326
0.4	0.500	0.698	0.518	0.069	—
0.5	0.512	0.762	0.534	0.061	0.338
0.6	0.527	0.841	0.555	0.057	—
0.7	0.544	0.935	0.568	0.052	0.373
0.8	0.565	1.049	0.608	0.048	—
0.9	0.589	1.183	0.641	0.046	—
1.0	0.614	1.341	0.679	0.044	0.465
1.2	0.671	1.741	0.761	0.041	0.559
1.4	0.737	2.30	0.855	0.039	0.686
1.6	0.808	3.06	0.943	0.038	0.858
1.8	0.885	4.14	1.083	0.037	1.091
2.0	0.968	5.70	1.218	0.037	1.417
2.5	1.216	12.90	1.602	0.037	—
3.0	1.535	29.8	2.00	0.038	—
3.5	—	67.9	2.37	0.040	—
4.0	—	154.6	2.64	0.043	—
4.5	—	345	2.85	0.047	—
5.0	—	724	3.01	0.050	—

Table 151

Mean activity coefficients of $ZnBr_2$, $ZnCl_2$, $Zn(ClO_4)_2$, ZnI_2, $Zn(NO_3)_2$ and $ZnSO_4$ solutions at 25°C

Concentration, *m*	$ZnBr_2$	$ZnCl_2$	$Zn(ClO_4)_2$	ZnI_2	$Zn(NO_3)_2$	$ZnSO_4$
0.0005	—	—	—	—	—	0.780
0.001	—	—	—	—	—	0.700
0.002	—	—	—	0.851	—	0.608
0.005	—	0.789	—	0.799	—	0.477
0.01	—	0.731	—	0.746	—	0.387
0.02	0.685	0.667	—	0.690	—	0.298
0.05	0.605	0.578	—	0.621	—	0.202
0.1	0.555	0.515	0.568	0.578	0.530	0.150
0.2	0.517	0.459	0.552	0.564	0.487	0.104
0.3	0.504	0.444	0.560	0.570	0.472	0.084
0.4	0.506	0.435	0.583	0.598	0.467	0.071
0.5	0.507	0.429	0.615	0.624	0.471	0.063
0.6	0.513	0.411	0.655	0.654	0.478	0.057
0.7	0.520	0.394	0.704	0.701	0.487	0.052
0.8	0.534	0.385	0.763	0.729	0.499	0.049
0.9	0.543	0.357	0.831	0.771	0.516	0.046
1.0	0.546	0.337	0.909	0.799	0.533	0.044
1.2	0.560	0.321	1.102	0.876	0.572	0.040
1.4	0.564	0.301	1.356	0.923	0.623	0.038
1.6	0.567	0.300	1.681	0.963	0.677	0.036
1.8	0.569	0.294	2.11	0.998	0.741	0.036
2.0	0.570	0.282	2.68	1.023	0.814	0.036
2.5	0.579	0.284	5.04	1.060	1.045	0.037
3.0	0.593	0.287	9.77	1.112	1.358	0.041
3.5	0.624	0.295	19.17	1.178	1.766	0.048
4.0	0.662	0.301	37.9	1.243	2.30	—
4.5	0.710	0.324	—	1.340	2.98	—
5.0	0.771	0.353	—	1.456	3.86	—

Table 152

Mean activity coefficients of $BaCl_2$ solutions at various temperatures

Concentration, *m*	0°C	15°C	25°C	35°C	45°C
0.01	0.725	0.727	0.723	0.720	0.710
0.05	0.555	0.565	0.559	0.554	0.536
0.1	0.483	0.498	0.492	0.492	0.487
0.2	0.422	0.442	0.438	0.436	0.431
0.3	0.394	0.416	0.411	0.411	0.405
0.5	0.371	0.395	0.390	0.390	0.382
0.7	0.365	0.390	0.384	0.384	0.376
1.0	0.377	0.395	0.392	0.389	0.381
1.5	0.410	0.410	0.425	0.417	0.409

Table 153

Mean activity coefficients of $CdBr_2$ and $CdCl_2$ solutions at various temperatures

Concentration, *m*	$CdBr_2$				$CdCl_2$	
	Temperature, °C					
	5	15	30	40	0	40
0.0005	0.850	0.854	0.855	0.853	0.885	0.872
0.001	0.777	0.784	0.787	0.784	0.834	0.811
0.002	0.688	0.696	0.699	0.696	0.746	0.739
0.005	0.553	0.564	0.571	0.569	0.659	0.607
0.007	0.504	0.514	0.521	0.518	—	—
0.01	0.453	0.463	0.468	0.465	0.545	0.505
0.02	0.358	0.366	0.370	0.367	0.444	0.408
0.03	0.309	0.317	0.320	0.317	—	—
0.05	0.250	0.257	0.259	0.256	0.318	0.292
0.07	0.215	0.221	0.223	0.221	—	—
0.1	0.182	0.187	0.189	0.186	0.237	0.218
0.2	0.127	0.130	0.132	0.129	—	—
0.5	0.0753	0.0779	0.0787	0.0772	—	—
0.7	0.0619	0.0643	0.0650	0.0638	—	—
1.0	0.0505	0.0526	0.0532	0.0522	—	—
1.2	0.0449	0.0467	0.0473	0.0465	—	—
1.5	0.0400	0.0418	0.0424	0.0417	—	—
1.8	0.0359	0.0376	0.0383	0.0376	—	—

Table 154

Mean activity coefficients of CdI_2 solutions at various temperatures

Concentration, *m*	Temperature, °C					
	5	15	20	25	30	40
0.002	0.566	0.596	0.607	0.615	0.622	0.629
0.005	0.445	0.472	0.483	0.492	0.499	0.506
0.007	0.391	0.417	0.428	0.436	0.443	0.440
0.01	0.338	0.364	0.374	0.382	0.389	0.397
0.02	0.243	0.265	0.274	0.281	0.287	0.294
0.05	0.141	0.156	0.162	0.167	0.171	0.177
0.07	0.113	0.126	0.131	0.135	0.139	0.143
0.1	0.0891	0.0989	0.103	0.107	0.110	0.113
0.2	0.0562	0.0625	0.0652	0.0675	0.0694	0.0718
0.5	0.0307	0.0342	0.0356	0.0369	0.0379	0.0392
0.7	0.0254	0.0282	0.0294	0.0304	0.0312	0.0323
1.0	0.0210	0.0233	0.0242	0.0250	0.0257	0.0265
1.5	0.0173	0.0191	0.0198	0.0205	0.0210	0.0216
2.0	0.0155	0.0171	0.0177	0.0183	0.0187	0.0192

Table 155

Mean activity coefficients of HBr in aqueous solutions at various temperatures

t, °C	Concentration, *m*								
	0.001	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1.0
	Mean activity coefficient, γ								
0	0.967	0.932	0.910	0.883	0.843	0.812	0.793	0.806	0.900
5	0.967	0.932	0.910	0.883	0.843	0.812	0.791	0.803	0.894
10	0.967	0.932	0.909	0.883	0.843	0.811	0.790	0.800	0.889
15	0.966	0.930	0.908	0.883	0.842	0.808	0.787	0.797	0.888
20	0.966	0.930	0.907	0.882	0.838	0.807	0.785	0.793	0.877
25	0.966	0.930	0.906	0.879	0.838	0.805	0.782	0.790	0.871
30	0.966	0.929	0.906	0.879	0.837	0.804	0.780	0.784	0.864
35	0.965	0.928	0.905	0.878	0.834	0.802	0.777	0.781	0.856
40	0.964	0.928	0.904	0.877	0.833	0.800	0.774	0.776	0.850
45	0.964	0.927	0.904	0.875	0.831	0.797	0.772	0.772	0.844
50	0.964	0.926	0.902	0.873	0.830	0.795	0.769	0.767	0.838
55	0.963	0.924	0.900	0.871	0.827	0.791	0.765	0.764	0.831
60	0.963	0.924	0.898	0.869	0.826	0.788	0.758	0.760	0.823

Table 156

Mean activity coefficients of HCl in aqueous solutions at various temperatures

Concentration, *m*	Temperature, °C												
	0	5	10	15	20	25	30	35	40	45	50	55	60
	Mean activity coefficient, γ												
0.0001	0.9890	0.9886	0.9890	0.9890	0.9892	0.9891	0.9890	0.9886	0.9885	0.9883	0.9879	0.9879	0.9879
0.0002	0.9848	0.9847	0.9846	0.9844	0.9842	0.9835	0.9838	0.9833	0.9835	0.9831	0.9831	0.9833	0.9831
0.0005	0.9756	0.9756	0.9756	0.9757	0.9759	0.9752	0.9747	0.9745	0.9741	0.9741	0.9735	0.7935	0.9734
0.001	0.9668	0.9662	0.9666	0.9661	0.9661	0.9656	0.9650	0.9647	0.9643	0.9644	0.9639	0.9636	0.9632
0.002	0.9541	0.9539	0.9514	0.9530	0.9527	0.9521	0.9515	0.9413	0.9505	0.9504	0.9500	0.9497	0.9491
0.005	0.9303	0.9300	0.9300	0.9297	0.9294	0.9285	0.9275	0.9268	0.9265	0.9261	0.9250	0.9240	0.9235
0.01	0.9065	0.9056	0.9055	0.9055	0.9052	0.9048	0.9034	0.9025	0.9016	0.9008	0.9000	0.8990	0.8987
0.02	0.8774	0.8778	0.8773	0.8770	0.8768	0.8755	0.8741	0.8731	0.8715	0.8704	0.8890	0.8680	0.8666
0.05	0.8346	0.8344	0.8338	0.8329	0.8317	0.8404	0.8285	0.8265	0.8246	0.8232	0.8211	0.8195	0.8168
0.1	0.8027	0.8023	0.8016	0.8000	0.7985	0.7964	0.7940	0.7918	0.7891	0.7872	0.7850	0.7829	0.7813
0.2	0.7756	0.7756	0.7740	0.7717	0.7694	0.7667	0.7630	0.7604	0.7569	0.7538	0.7508	0.7474	0.7437
0.5	0.7761	0.7730	0.7694	0.7658	0.7616	0.7571	0.7526	0.7477	0.7432	0.7381	0.7344	0.7292	0.7237
1.0	0.8419	0.8363	0.8295	0.8229	0.8162	0.8090	0.8018	0.7942	0.7865	0.7790	0.7697	0.7628	0.7541
1.5	0.9452	0.9365	0.9270	0.9154	0.9065	0.8962	0.8849	0.8740	0.8601	0.8517	0.8404	0.2876	0.8178
2.0	1.078	1.068	1.053	1.039	1.024	1.009	0.9929	0.9755	0.9602	0.9481	0.9327	0.9186	0.9072
3.0	1.452	1.427	1.401	1.373	1.345	1.316	—	—	—	—	—	—	—
4.0	2.000	1.960	1.911	1.862	1.812	1.762	—	—	—	—	—	—	—

Table 157

Mean activity coefficients in H_2SO_4 solutions at various temperatures
(Values calculated from *EMF* measurements)

Concentration, *m*	Temperature, °C							
	0	10	20	25	30	40	50	60
	Mean activity coefficient, γ							
0.0005	0.912	0.901	0.890	0.885	0.880	0.869	0.859	0.848
0.0007	0.896	0.880	0.867	0.857	0.854	0.841	0.828	0.814
0.001	0.876	0.957	0.839	0.830	0.823	0.806	0.790	0.775
0.002	0.825	0.796	0.769	0.757	0.746	0.722	0.701	0.680
0.003	0.788	0.754	0.723	0.709	0.695	0.669	0.645	0.622
0.005	0.734	0.693	0.656	0.639	0.623	0.593	0.566	0.533
0.007	0.691	0.647	0.608	0.591	0.574	0.543	0.515	0.489
0.01	0.649	0.603	0.562	0.544	0.527	0.495	0.467	0.441
0.02	0.554	0.509	0.470	0.453	0.437	0.407	0.380	0.356
0.03	0.495	0.453	0.417	0.401	0.386	0.358	0.333	0.311
0.05	0.426	0.387	0.354	0.340	0.326	0.301	0.279	0.260
0.07	0.383	0.346	0.315	0.301	0.290	0.266	0.246	0.228
0.1	0.341	0.307	0.278	0.265	0.254	0.227	0.214	0.197
0.2	0.271	0.243	0.219	0.209	0.199	0.161	0.166	0.153
0.5	0.202	0.181	0.162	0.154	0.147	0.133	0.122	0.107
1.0	0.173	0.153	0.137	0.130	0.123	0.111	0.101	0.0922
1.5	0.167	0.147	0.131	0.124	0.117	0.106	0.0956	0.0869
2.0	0.170	0.149	0.132	0.124	0.118	0.105	0.0949	0.0859
3.0	0.210	0.173	0.151	0.141	0.132	0.117	0.104	0.0926
4.0	0.254	0.215	0.184	0.171	0.159	0.138	0.121	0.106
5.0	0.330	0.275	0.231	0.212	0.196	0.168	0.145	0.126
6.0	0.427	0.350	0.289	0.264	0.242	0.205	0.174	0.150
7.0	0.546	0.440	0.359	0.326	0.297	0.247	0.208	0.177
8.0	0.686	0.545	0.439	0.397	0.358	0.296	0.246	0.206
9.0	0.843	0.662	0.527	0.470	0.425	0.346	0.285	0.237
10.0	1.012	0.785	0.618	0.553	0.493	0.398	0.325	0.268
11.0	1.212	0.940	0.725	0.643	0.573	0.458	0.370	0.302
12.0	1.431	1.088	0.840	0.742	0.656	0.521	0.418	0.339
13.0	1.676	1.261	0.965	0.830	0.750	0.590	0.471	0.379
14.0	1.958	1.458	1.104	0.967	0.850	0.664	0.525	0.420
15.0	2.271	1.671	1.254	1.093	0.957	0.741	0.583	0.462
16.0	—	1.907	1.420	1.234	1.076	0.828	0.647	0.511
17.0	3.015	2.176	1.604	1.387	1.204	0.919	0.712	0.559
17.5	3.217	2.316	1.703	1.471	1.275	0.972	0.752	0.589

Table 158

Mean activity coefficients of KCl in aqueous solutions at various temperatures

Concentration, *m*	Temperature, °C								
	0	5	10	15	20	25	30	35	40
	Mean activity coefficient, γ								
0.1	0.786	0.769	0.769	0.769	0.770	0.769	0.768	0.767	0.765
0.2	0.717	0.718	0.718	0.719	0.718	0.719	0.718	0.717	0.715
0.3	0.683	0.685	0.687	0.687	0.688	0.688	0.687	0.685	0.682
0.5	0.642	0.646	0.648	0.650	0.651	0.651	0.651	0.648	0.646
0.7	0.613	0.619	0.623	0.624	0.627	0.628	0.629	0.627	0.626
1.0	0.588	0.595	0.598	0.601	0.604	0.606	0.604	0.604	0.603
1.5	0.563	0.570	0.576	0.579	0.582	0.585	0.585	0.585	0.585
2.0	0.547	0.554	0.562	0.568	0.573	0.576	0.578	0.579	0.578
2.5	0.540	0.549	0.556	0.562	0.568	0.572	0.574	0.575	0.575
3.0	0.539	0.549	0.556	0.562	0.567	0.571	0.573	0.574	0.573
3.5	0.540	0.550	0.558	0.565	0.571	0.574	0.577	0.578	0.578
4.0	—	—	0.563	0.569	0.574	0.579	0.582	0.584	0.585

Table 159

Mean activity coefficients of KOH in aqueous solutions at various temperatures

Concentration, *m*	Temperature °C							
	0	5	10	15	20	25	30	35
	Mean activity coefficient, γ							
0.05	0.829	0.828	0.828	0.827	0.825	0.824	0.823	0.822
0.10	0.795	0.796	0.798	0.798	0.798	0.798	0.796	0.793
0.15	0.778	0.778	0.778	0.777	0.776	0.774	0.773	0.771
0.25	0.757	0.758	0.759	0.758	0.757	0.757	0.753	0.751
0.35	0.738	0.740	0.740	0.739	0.739	0.739	0.736	0.733
0.50	0.737	0.736	0.735	0.734	0.732	0.728	0.725	0.725
0.75	0.742	0.742	0.743	0.743	0.741	0.740	0.740	0.736
1.0	0.755	0.756	0.758	0.757	0.756	0.756	0.755	0.752
1.5	0.809	0.812	0.815	0.815	0.814	0.814	0.812	0.809
2.0	0.880	0.886	0.890	0.890	0.889	0.888	0.884	0.879
2.5	0.974	0.978	0.981	0.982	0.980	0.974	0.972	0.965
3.0	1.088	1.091	1.094	1.093	1.087	1.081	1.072	1.065
3.5	1.219	1.229	1.231	1.229	1.219	1.215	1.199	1.195
4.0	1.391	1.395	1.389	1.381	1.361	1.352	1.334	1.314

Table 160

Mean activity coefficients of NaBr in aqueous solutions at various temperatures

Concentration, *m*	Temperature, °C								
	0	5	10	15	20	25	30	35	40
	Mean activity coefficient, γ								
0.1	0.784	0.784	0.784	0.783	0.783	0.782	0.781	0.779	0.777
0.2	0.738	0.739	0.741	0.740	0.741	0.740	0.739	0.737	0.734
0.3	0.713	0.716	0.718	0.720	0.718	0.718	0.717	0.715	0.712
0.5	0.685	0.689	0.693	0.693	0.695	0.695	0.694	0.692	0.689
0.7	0.670	0.675	0.681	0.684	0.683	0.687	0.686	0.685	0.685
1.0	0.659	0.667	0.675	0.680	0.684	0.686	0.687	0.686	0.686
1.5	0.664	0.673	0.686	0.693	0.699	0.703	0.706	0.708	0.707
2.0	0.679	0.693	0.708	0.719	0.727	0.734	0.739	0.741	0.743
2.5	0.708	0.727	0.745	0.738	0.769	0.773	0.784	0.789	0.791
3.0	0.745	0.766	0.787	0.802	0.815	0.826	0.834	0.839	0.842
3.5	0.787	0.811	0.834	0.852	0.866	0.878	0.887	0.893	0.896
4.0	0.832	0.858	0.885	0.905	0.921	0.934	0.945	0.951	0.954

Table 161

Mean activity coefficients of NaCl in aqueous solutions at various temperatures

t, °C	Concentration, *m*									
	0.1	0.2	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
	Mean activity coefficient, γ									
0	0.781	0.731	0.671	0.6375	0.626	0.630	0.641	0.660	0.687	0.717
5	0.781	0.733	0.675	0.6435	0.6355	0.6425	0.659	0.677	0.706	0.7395
10	0.781	0.734	0.677	0.649	0.6425	0.652	0.667	0.691	0.721	0.757
15	0.780	0.734	0.678	0.652	0.648	0.659	0.677	0.702	0.735	0.772
20	0.779	0.733	0.679	0.654	0.652	0.665	0.684	0.7115	0.744	0.783
25	0.778	0.732	0.680	0.656	0.659	0.670	0.691	0.719	0.752	0.791
30	0.777	0.731	0.679	0.657	0.658	0.674	0.695	0.724	0.756	0.797
35	0.776	0.729	~0.67	~0.66	~0.66	~0.67	~0.69	0.7255	~0.76	0.800
40	0.774	0.728	~0.67	0.657	~0.66	~0.67	~0.69	~0.73	0.761	~0.80
50	0.770	~0.72	~0.67	~0.66	~0.66	~0.68	~0.70	~0.73	~0.76	~0.80
60	0.766	0.721	~0.67	~0.65	~0.66	~0.68	~0.69	~0.73	~0.76	~0.80
70	0.762	0.717	0.667	0.648	~0.65	0.672	~0.69	~0.72	~0.76	~0.79
80	0.757	0.711	0.660	0.641	0.646	0.663	0.685	~0.71	0.742	0.777
90	0.752	0.705	0 653	0.632	0.638	0.651	0.674	0.700	0.730	0.763
100	0.746	0.698	0.644	0.662	0.629	0.641	0.649	0.687	0.716	0.746

Table 162

Mean activity coefficients of NaOH in dilute aqueous solutions at various temperatures

Concentration, *m*	Temperature, °C							
	0	5	10	15	20	25	30	35
	Mean activity coefficient, γ							
0.05	0.820	0.821	0.820	0.820	0.819	0.818	0.818	0.816
0.1	0.767	0.768	0.768	0.767	0.766	0.766	0.765	0.764
0.25	0.713	0.715	0.716	0.717	0.714	0.713	0.712	0.712
0.5	0.648	0.688	0.690	0.692	0.693	0.693	0.693	0.694
1.0	0.660	0.668	0.672	0.676	0.678	0.679	0.680	0.678
1.5	0.661	0.669	0.673	0.681	0.682	0.683	0.685	0.683

Table 163

Mean activity coefficients of NaOH in concentrated aqueous solutions at various temperatures

Concentration, *m*	Temperature, °C							
	0	10	20	30	40	50	60	70
	Mean activity coefficient, γ							
1.5	0.661	0.673	0.682	0.685	0.684	0.674	0.657	0.635
2.0	0.682	0.702	0.709	0.712	0.707	0.696	0.677	0.652
3.0	0.763	0.766	0.789	0.791	0.783	0.767	0.742	0.711
4.0	0.900	0.920	0.916	0.911	0.895	0.872	0.839	0.800
5.0	1.100	1.109	1.098	1.081	1.053	1.017	0.971	0.822
6.0	1.39	1.40	1.35	1.32	1.27	1.21	1.14	1.07
8.0	2.35	2.31	2.17	2.06	1.93	1.78	1.63	1.48
10.0	4.12	4.00	3.61	3.31	3.00	2.67	2.34	2.03
12.0	7.16	6.67	5.80	5.11	4.43	3.79	3.19	2.65
14.0	11.4	10.00	8.68	7.43	6.26	5.20	4.26	3.43
17.0	22.5	19.0	15.82	13.00	10.52	9.39	6.60	5.11

Table 164

Mean activity coefficients of $ZnCl_2$ in aqueous solutions at various temperatures

Concentration, *m*	Temperature, °C			
	10	20	30	40
	Mean activity coefficient, γ			
0.005	0.794	0.971	0.787	0.783
0.01	0.737	0.733	0.728	0.723
0.02	0.673	0.669	0.663	0.657
0.03	0.635	0.631	0.625	0.617
0.05	0.587	0.582	0.575	0.566
0.07	0.556	0.551	0.543	0.532
0.1	0.525	0.520	0.510	0.497
0.2	0.476	0.465	0.452	0.434
0.5	0.453	0.439	0.419	0.393
0.7	0.433	0.409	0.379	0.347
0.8	0.415	0.384	0.349	0.313
1.0	0.394	0.357	0.318	0.280

Table 165

Mean activity coefficients of ZnI_2 in aqueous solutions at various temperatures

Concentration, *m*	Temperature, °C			
	5	15	30	40
	Mean activity coefficient, γ			
0.005	0.808	0.802	0.797	0.793
0.007	0.782	0.775	0.770	0.765
0.008	0.772	0.765	0.759	0.754
0.01	0.757	0.750	0.744	0.738
0.02	0.701	0.694	0.687	0.680
0.03	0.671	0.664	0.655	0.648
0.05	0.634	0.627	0.617	0.609
0.07	0.611	0.604	0.594	0.585
0.1	0.592	0.585	0.574	0.564
0.2	0.581	0.572	0.559	0.546
0.5	0.650	0.638	0.614	0.593
0.7	0.740	0.723	0.687	0.656
0.8	0.787	0.766	0.724	0.687

Table 166

Mean activity coefficients of HBr in KCl solutions at various ɾemperatures $C_{HBr} = 0.01\ m = \text{const.}$

KBr, *m*	Temperature, °C										
	0	5	10	15	20	25	30	35	40	45	50
	Mean activity coefficient, γ										
0.01	0.881	0.880	0.879	0.877	0.876	0.874	0.874	0.873	0.871	0.870	0.868
0.02	0.861	0.860	0.858	0.856	0.855	0.853	0.852	0.852	0.849	0.847	0.846
0.03	0.845	0.844	0.843	0.841	0.839	0.838	0.837	0.835	0.833	0.831	0.829
0.05	0.824	0.824	0.822	0.821	0.820	0.818	0.817	0.814	0.812	0.811	0.810
0.1	0.792	0.792	0.790	0.787	0.785	0.783	0.782	0.778	0.776	0.773	0.771
0.2	0.760	0.759	0.757	0.754	0.752	0.750	0.748	0.744	0.741	0.738	0.736
0.5	0.728	0.728	0.725	0.722	0.722	0.717	0.714	0.710	0.705	0.701	0.697
1.0	0.748	0.745	0.741	0.737	0.732	0.728	0.724	0.718	0.712	0.706	0.700
1.5	0.777	0.774	0.770	0.765	0.760	0.756	0.751	0.743	0.736	0.729	0.722
2.0	0.840	0.836	0.825	0.818	0.810	0.803	0.794	0.785	0.776	0.775	0.767
3.0	0.974	0.976	0.958	0.948	0.937	0.926	0.916	0.903	0.890	0.874	0.864

Table 167

Mean activity coefficients of HBr in LiBr solutions at various temperatures $C_{HBr} = 0.1\ m = \text{const.}$

LiBr, *m*	Temperature, °C										
	0	5	10	15	20	25	30	35	40	45	50
	Mean activity coefficient, γ										
0.01	0.885	0.885	0.884	0.883	0.882	0.880	0.878	0.877	0.874	0.872	0.870
0.02	0.866	0.867	0.866	0.865	0.864	0.863	0.861	0.858	0.856	0.853	0.850
0.03	0.854	0.854	0.853	0.852	0.851	0.849	0.847	0.844	0.841	0.838	0.835
0.05	0.834	0.834	0.834	0.833	0.831	0.829	0.827	0.824	0.821	0.817	0.814
0.07	0.821	0.821	0.821	0.820	0.818	0.816	0.813	0.811	0.807	0.804	0.799
0.1	0.810	0.809	0.807	0.807	0.805	0.802	0.799	0.796	0.793	0.789	0.785
0.2	0.796	0.794	0.792	0.789	0.787	0.783	0.780	0.776	0.772	0.767	0.763
0.3	0.796	0.793	0.791	0.788	0.784	0.780	0.776	0.772	0.768	0.763	0.758
0.4	0.802	0.799	0.796	0.792	0.788	0.784	0.780	0.775	0.770	0.765	0.760
0.6	0.824	0.822	0.818	0.814	0.809	0.805	0.800	0.794	0.789	0.783	0.777
1.0	0.911	0.905	0.898	0.892	0.888	0.878	0.870	0.863	0.856	0.848	0.840
1.5	1.061	1.050	1.039	1.028	1.017	1.006	0.996	0.985	0.974	0.964	0.954
2.0	1.255	1.241	1.227	1.213	1.197	1.160	1.168	1.152	1.137	1.121	1.105
3.0	1.775	1.748	1.720	1.694	1.667	1.641	1.615	1.589	1.564	1.538	1.514

Table 168

Mean activity coefficients of HBr in NaBr solutions at various temperatures $C_{HBr} = 0.01$ m = const.

NaBr, *m*	Temperature, °C										
	0	5	10	15	20	25	30	35	40	45	50
	Mean activity coefficient, γ										
0.01	0.884	0.883	0.882	0.880	0.879	0.878	0.878	0.878	0.875	0.876	0.874
0.02	0.866	0.866	0.865	0.863	0.861	0.859	0.858	0.858	0.854	0.852	0.850
0.03	0.850	0.850	0.848	0.846	0.844	0.842	0.841	0.841	0.837	0.835	0.833
0.05	0.829	0.828	0.827	0.824	0.822	0.821	0.820	0.818	0.815	0.813	0.811
0.1	0.801	0.799	0.797	0.795	0.793	0.791	0.789	0.788	0.783	0.781	0.779
0.2	0.780	0.778	0.775	0.772	0.769	0.767	0.765	0.765	0.759	0.756	0.753
0.5	0.774	0.772	0.768	0.764	0.761	0.756	0.752	0.747	0.739	0.735	0.730
1.0	0.833	0.827	0.821	0.814	0.808	0.801	0.795	0.788	0.778	0.770	0.762
1.5	0.934	0.926	0.916	0.906	0.895	0.884	0.875	0.865	0.852	0.840	0.828
2.0	1.050	1.038	1.026	1.009	0.995	0.981	0.967	0.954	0.936	0.921	0.905
3.0	1.362	1.337	1.311	1.284	1.258	1.233	1.208	1.184	1.156	1.131	1.106

Table 169

Mean activity coefficients of HCl in $AlCl_3$ solutions at 25°C $C_{HCl} = 0.05$ m = const.

$AlCl_3$, *m*	γ	$AlCl_3$, *m*	γ
0.005	0.809	0.1	0.708
0.0075	0.799	0.2	0.716
0.01	0.789	0.4	0.797
0.02	0.763	0.6	0.920
0.03	0.750	1.0	1.402
0.05	0.728	2.0	3.96
0.07	0.714		

Table 170

Mean activity coefficients of HCl in $BaCl_2$ solutions at various temperatures $C_{HCl} = 0.01$ m = const.

$BaCl_2$, *I*	Temperature, °C										
	0	5	10	15	20	25	30	35	40	45	50
	Mean activity coefficient, γ										
0.01	0.906	0.906	0.905	0.905	0.905	0.905	0.903	0.903	0.902	0.901	0.900
0.02	0.876	0.876	0.875	0.875	0.875	0.875	0.873	0.872	0.871	0.870	0.869
0.03	0.855	0.855	0.855	0.855	0.855	0.854	0.853	0.852	0.851	0.850	0.848
0.05	0.829	0.828	0.827	0.827	0.827	0.826	0.825	0.824	0.823	0.821	0.820
0.07	0.808	0.808	0.808	0.808	0.808	0.807	0.804	0.802	0.801	0.801	0.799
0.1	0.788	0.788	0.787	0.787	0.787	0.786	0.784	0.783	0.781	0.779	0.777
0.2	0.747	0.748	0.748	0.747	0.747	0.747	0.744	0.741	0.739	0.736	0.733
0.5	0.710	0.709	0.709	0.708	0.707	0.705	0.702	0.698	0.694	0.690	0.686
0.7	0.704	0.704	0.703	0.702	0.700	0.698	0.694	0.691	0.686	0.682	0.677
1.0	0.707	0.706	0.705	0.704	0.702	0.699	0.693	0.690	0.685	0.680	0.675
2.0	0.760	0.758	0.756	0.752	0.748	0.743	0.737	0.731	0.724	0.716	0.708
3.0	0.847	0.844	0.841	0.836	0.830	0.823	0.815	0.805	0.796	0.785	0.774

Table 171

Mean activity coefficients of HCl in CsCl, $GeCl_3$ and $SrCl_2$ solutions at 25°C

$C_{HCl} = 0.01\ m = \text{const.}$

CsCl, *m*	γ	$GeCl_3$, *m*	γ	$SrCl_2$, *m*	γ
0.01	0.875	0.005	0.839	0.025	0.797
0.03	0.836	0.01	0.805	0.05	0.761
0.07	0.795	0.03	0.745	0.075	0.743
0.1	0.773	0.05	0.717	0.1	0.731
0.2	0.730	0.075	0.699	0.2	0.706
0.4	0.685	0.1	0.689	0.3	0.711
0.7	0.656	0.165	0.662	0.5	0.739
1.0	0.644	0.25	0.655	0.75	0.801
1.34	0.638	0.375	0.664	1.0	0.888
1.5	0.639	0.5	0.698	1.5	1.121
2.0	0.641	0.75	0.767	2.0	1.460
3.0	0.672	1.0	0.855	2.5	1.944

Table 172

Mean activity coefficients of HCl in LiCl solutions at various temperatures

$C_{HCl} = 0.01\ m = \text{const.}$

LiCl, *m*	Temperature, °C				
	20	15	25	30	35
	Mean activity coefficient, γ				
0.01	0.878	0.878	0.881	0.879	0.877
0.02	0.859	0.859	0.861	0.859	0.857
0.05	0.826	0.826	0.827	0.824	0.822
0.1	0.798	0.797	0.796	0.793	0.789
0.2	0.769	0.767	0.766	0.762	0.760
0.5	0.762	0.759	0.757	0.753	0.749
1.0	0.812	0.806	0.801	0.793	0.787
1.5	0.896	0.887	0.879	0.869	0.858
2.0	1.012	0.999	0.986	0.972	0.958
3.0	1.334	1.308	1.284	1.257	1.232
4.0	1.791	1.748	1.708	1.665	1.624

Table 173

Mean activity coefficients of HCl in KCl solutions at various temperatures
$C_{HCl} = 0.01\ m = \text{const.}$

KCl, *m*	Temperature, °C										
	0	5	10	15	20	25	30	35	40	45	50
	Mean activity coefficient, γ										
0.01	0.876	0.875	0.875	0.874	0.874	0.874	0.873	0.871	0.871	0.869	0.866
0.02	0.856	0.855	0.853	0.853	0.853	0.852	0.851	0.850	0.850	0.847	0.844
0.03	0.841	0.840	0.840	0.839	0.838	0.837	0.836	0.834	0.834	0.831	0.828
0.05	0.819	0.819	0.817	0.817	0.816	0.816	0.814	0.812	0.812	0.809	0.806
0.1	0.786	0.786	0.786	0.784	0.783	0.782	0.780	0.778	0.777	0.773	0.769
0.2	0.753	0.753	0.752	0.750	0.749	0.747	0.746	0.743	0.742	0.739	0.734
0.5	0.712	0.712	0.711	0.709	0.708	0.706	0.704	0.701	0.699	0.695	0.690
1.0	0.731	0.727	0.728	0.725	0.723	0.720	0.716	0.712	0.709	0.702	0.697
1.5	0.758	0.757	0.754	0.750	0.747	0.743	0.738	0.732	0.728	0.722	0.713
2.0	0.801	0.799	0.796	0.791	0.786	0.781	0.773	0.767	0.761	0.753	0.743
3.0	0.893	0.890	0.882	0.875	0.868	0.860	0.851	0.841	0.831	0.820	0.808
3.5	0.939	0.933	0.926	0.917	0.908	0.899	0.888	0.876	0.867	0.853	0.839

Table 174

Mean activity coefficients of HCl in NaCl solutions at various temperatures
$C_{HCl} = 0.01\ m = \text{const.}$

NaCl, *m*	Temperature, °C										
	0	5	10	15	20	25	30	35	40	45	50
	Mean activity coefficient, γ										
0.01	0.877	0.876	0.876	0.875	0.874	0.874	0.873	0.872	0.871	0.870	0.869
0.02	0.856	0.856	0.856	0.855	0.855	0.854	0.853	0.851	0.850	0.849	0.847
0.05	0.821	0.821	0.821	0.819	0.819	0.818	0.816	0.814	0.812	0.810	0.807
0.1	0.789	0.789	0.788	0.796	0.785	0.784	0.781	0.779	0.777	0.774	0.771
0.2	0.758	0.758	0.757	0.754	0.753	0.752	0.749	0.747	0.745	0.742	0.739
0.5	0.738	0.737	0.736	0.733	0.732	0.730	0.727	0.724	0.721	0.718	0.715
1.0	0.765	0.764	0.762	0.759	0.756	0.754	0.750	0.746	0.742	0.738	0.733
2.0	0.898	0.896	0.893	0.888	0.883	0.878	0.871	0.864	0.856	0.847	0.838
5.0	1.103	1.099	1.094	1.086	1.077	1.068	1.056	1.043	1.029	1.014	0.999

Table 175

Mean activity coefficients of TlCl in aqueous solutions of various electrolytes as a function of the ionic strength at 25°C

TlCl, I	Electrolyte			
	HCl	KCl	KNO_3	$TlNO_3$
	Mean activity coefficient, γ			
0.001	0.970	0.970	0.970	0.970
0.002	0.962	0.962	0.962	0.962
0.005	0.950	0.950	0.950	0.950
0.01	0.909	0.909	0.909	0.909
0.02	0.871	0.871	0.872	0.869
0.05	0.798	0.797	0.809	0.784
0.10	0.718	0.715	0.742	0.686
0.20	0.630	0.613	0.676	0.546

Table 176

Mean activity coefficients of HCl in dioxan–water mixtures

HCl, m	Temperature, °C						
	0	10	20	25	30	40	50
	Mean activity coefficient, γ; $x=20$						
0.005	0.902	0.900	0.898	0.896	0.895	0.892	0.889
0.007	0.889	0.886	0.883	0.880	0.880	0.876	0.871
0.01	0.872	0.869	0.865	0.862	0.861	0.857	0.851
0.02	0.835	0.830	0.825	0.821	0.820	0.814	0.808
0.03	0.811	0.805	0.800	0.796	0.795	0.788	0.781
0.05	0.780	0.774	0.768	0.763	0.762	0.755	0.748
0.07	0.759	0.753	0.746	0.740	0.740	0.732	0.725
0.1	0.736	0.729	0.722	0.720	0.716	0.708	0.701
0.2	0.696	0.688	0.681	0.676	0.673	0.665	0.656
0.3	0.682	0.675	0.667	0.661	0.658	0.649	0.639
0.5	0.684	0.675	0.666	0.660	0.656	0.646	0.633
0.7	0.649	0.690	0.679	0.672	0.667	0.655	0.641
1.0	0.736	0.725	0.712	0.704	0.698	0.683	0.666
1.5	0.830	0.815	0.797	0.786	0.777	0.755	0.732
2.0	0.959	0.938	0.913	0.898	0.885	0.855	0.823
3.0	1.337	1.293	1.245	1.219	1.195	1.141	1.085

HCl, m	Temperature, °C						
	0	10	20	25	30	40	50
	Mean activity coefficient, γ; $x=45$						
0.003	0.849	0.846	0.844	0.842	0.839	0.834	0.828
0.005	0.824	0.817	0.811	0.808	0.803	0.795	0.786
0.007	0.802	0.793	0.786	0.782	0.777	0.767	0.757
0.01	0.776	0.766	0.758	0.753	0.747	0.737	0.725
0.02	0.720	0.707	0.697	0.692	0.686	0.673	0.660
0.03	0.683	0.671	0.661	0.654	0.649	0.635	0.622
0.05	0.637	0.624	0.613	0.607	0.600	0.586	0.573
0.07	0.605	0.593	0.583	0.577	0.570	0.557	0.545
0.1	0.579	0.566	0.553	0.547	0.540	0.525	0.512
0.2	0.529	0.514	0.503	0.496	0.488	0.474	0.459
0.3	0.511	0.496	0.484	0.476	0.466	0.453	0.438
0.5	0.503	0.487	0.473	0.465	0.456	0.440	0.423
0.7	0.513	0.495	0.480	0.471	0.461	0.443	0.424
1.0	0.547	0.526	0.508	0.497	0.485	0.463	0.442
1.5	0.640	0.612	0.585	0.570	0.555	0.524	0.496
2.0	0.773	0.733	0.695	0.676	0.655	0.614	0.575
3.0	1.191	1.112	1.037	1.001	0.962	0.887	0.818

HCl, m	Mean activity coefficient, γ; $x=70$						
0.001	0.719	0.713	0.705	0.700	0.696	0.686	0.675
0.0015	0.672	0.665	0.656	0.651	0.647	0.636	0.624
0.002	0.641	0.633	0.623	0.618	0.613	0.601	0.589
0.003	0.589	0.582	0.573	0.568	0.563	0.552	0.540
0.005	0.530	0.521	0.510	0.505	0.499	0.487	0.473
0.007	0.488	0.479	0.468	0.462	0.457	0.444	0.431
0.01	0.446	0.436	0.425	0.418	0.413	0.401	0.388
0.02	0.369	0.359	0.348	0.342	0.336	0.324	0.312
0.03	0.328	0.318	0.308	0.303	0.297	0.286	0.275
0.05	0.283	0.274	0.264	0.258	0.253	0.243	0.232
0.07	0.259	0.249	0.239	0.234	0.229	0.219	0.208
0.1	0.236	0.226	0.217	0.212	0.207	0.197	0.188
0.2	0.204	0.194	0.185	0.180	0.175	0.165	0.156
0.3	0.193	0.182	0.173	0.168	0.163	0.154	0.144
0.5	0.191	0.179	0.169	0.163	0.158	0.147	0.137
0.7	0.200	0.187	0.175	0.168	0.162	0.150	0.139
1.0	0.227	0.211	0.195	0.187	0.179	0.165	0.151
1.5	0.303	0.277	0.252	0.240	0.228	0.207	0.187

x = dioxan w. %

(continued)

HCl, m	Temperature, °C				
	5	15	25	35	45
	Mean activity coefficient, γ; $x = 82$				
0.001	0.4242	0.4129	0.3979	0.3795	0.3592
0.0015	0.3725	0.3627	0.3488	0.3318	0.3129
0.002	0.3369	0.3277	0.3147	0.2990	0.2810
0.003	0.2862	0.2781	0.2682	0.2553	0.2378
0.005	0.2319	0.2267	0.2181	0.2062	0.1916
0.007	0.2019	0.1977	0.1900	0.1791	0.1654
0.01	0.1744	0.1707	0.1629	0.1529	0.1412
0.015	0.1472	0.1440	0.1371	0.1282	0.1176
0.02	0.1311	0.1274	0.1213	0.1131	0.1035
0.03	0.1112	0.1076	0.1020	0.0946	0.0869
0.05	0.0912	0.0876	0.0826	0.0766	0.0698
0.07	0.0780	0.0756	0.0713	0.0659	0.0596
0.10	0.0701	0.0675	0.0634	0.0582	0.0525
0.15	0.0627	0.0597	0.0560	0.0513	0.0460
0.2	0.0589	0.0560	0.0521	0.0476	0.0425
0.3	0.0563	0.0532	0.0490	0.0443	0.0392
0.5	0.0595	0.0554	0.0504	0.0445	0.0386

x = dioxan w.%

Table 177

Mean activity coefficients of HCl in ethanol–water mixtures at 25°C

$x = 0.0417$		$x = 0.0891$	
HCl concentration, m	γ	HCl concentration, m	γ
0.00631	0.914	0.00470	0.915
0.00758	0.907	0.00787	0.894
0.01088	0.891	0.01015	0.883
0.01987	0.864	0.01983	0.850
0.04210	0.824	0.04150	0.809
0.05100	0.814	0.05166	0.794
0.07085	0.795	0.07123	0.775
0.0800	0.788	0.0816	0.770
0.0885	0.783	0.0924	0.761
0.1091	0.773	0.1042	0.751
0.1990	0.744	0.3038	0.699
0.2999	0.731	0.4751	0.698
0.5050	0.730	0.7309	0.709
0.7014	0.743	1.0216	0.741
0.9946	0.776	1.549	0.819
1.499	0.856	2.079	0.930
1.994	0.954	—	—

x = mole fraction of ethanol

Table 178

Mean activity coefficients of HCl in ethanol–water mixtures and in ethanol at 25°C

$x = 0.5$		$x = 1.0$	
HCl concentration, m	γ	HCl concentration, m	γ
0.005	0.815	0.005	0.728
0.01	0.757	0.01	0.632
0.02	0.676	0.02	0.544
0.05	0.586	0.0249	0.514
0.1	0.521	0.0423	0.445
0.2	0.471	0.05	0.426
0.5	0.432	0.1	0.352
1.0	0.449	0.1242	0.327
1.5	0.510	0.1782	0.300
2.0	0.582	0.2	0.286
2.5	0.697	0.4437	0.218
		1.0	0.177
		1.050	0.168
		1.481	0.159
		3.62	0.150

x = mole fraction of ethanol

Table 179

Mean activity coefficients of HCl in glycerol–water mixtures* at 25°C

HCl concentration, m	$x = 0.01$	$x = 0.05$
	Mean activity coefficient, γ	
0.002	0.951	—
0.005	0.924	0.898
0.01	0.902	0.885
0.02	0.873	0.858
0.05	0.826	0.810
0.10	0.798	0.775
0.20	0.764	0.744
0.28	0.756	0.738
0.38	0.753	0.738
0.5	0.755	0.737
0.7	0.772	0.760
1.0	0.810	0.801
1.5	0.901	0.901
2.0	1.019	1.030
2.5	1.161	1.190
3.0	1.345	1.385
4.0	1.792	1.914

x = mole fraction of glycerol

Table 180

Mean activity coefficients of HCl in isopropanol–water mixtures* at 25°C

HCl concentration, m	Mean activity coefficient, γ
0.001862	0.948
0.004019	0.927
0.006356	0.911
0.008616	0.899
0.00892	0.898
0.02089	0.858
0.03558	0.830
0.04855	0.813
0.06685	0.795
0.07947	0.785
0.1119	0.766
0.1921	0.740
0.2990	0.727
0.4451	0.723
0.6993	0.737
0.8863	0.757
1.0	0.770

* mole fraction of isopropanol: 0.0323

Table 181

Mean activity coefficients of HCl in methanol–water mixtures at various temperatures

HCl, m	$x = 0.0588$			$x = 0.1233$		
	Temperature, °C					
	0	25	40	0	25	40
	Mean activity coefficient, γ			Mean activity coefficient, γ		
0.011	0.964	0.962	0.961	0.961	0.959	0.957
0.002	0.951	0.948	0.946	0.946	0.943	0.941
0.005	0.926	0.922	0.919	0.919	0.915	0.912
0.01	0.901	0.897	0.893	0.893	0.888	0.884
0.02	0.872	0.866	0.861	0.862	0.856	0.850
0.05	0.825	0.819	0.812	0.814	0.806	0.798
0.1	0.790	0.780	0.772	0.771	0.762	0.751
0.2	0.762	0.747	0.736	0.741	0.727	0.715
0.5	0.754	0.737	0.718	0.726	0.708	0.693
1.0	0.809	0.783	0.756	0.772	0.747	0.722
1.5	0.898	0.861	0.827	0.855	0.814	0.781
2.0	1.020	0.966	0.917	0.965	0.911	0.860

x = mole fraction of methanol

Table 182

Mean activity coefficient of HCl in methanol at 25°C

HCl, m	γ	HCl, m	γ
0.00236	0.826	0.02363	0.601
0.00268	0.817	0.02549	0.592
0 00298	0.809	0.04261	0.532
0.00316	0.804	0.04356	0.530
0.00494	0.766	0.05312	0.507
0.00542	0.758	0.0733	0.470
0 00711	0.732	0.0751	0.468
0.00986	0.699	0.0947	0.443
0.0144	0.658	0.1155	0.423
0.01722	0.638	0.4802	0.325
0.01986	0.621	0.5574	0.322

Table 183

Approximate activity coefficients of ions as a function of the ionic strength at 25°C

Ion	Ionic strength, I					
	0	0.005	0.01	0.05	0.1	0.2
	Mean activity coefficient, γ					
Univalent	0.97	0.93	0.90	0.81	0.76	0.70
Divalent	0.87	0.74	0.66	0.44	0.33	0.24
Trivalent	0.73	0.51	0.39	0.15	0.08	0.04
Tetravalent	0.56	0.30	0 19	0.04	0.01	0.003

Table 184

Log γ values of alkali metal and ammonium salts in aqueous solutions at room temperature

Electrolyte	Concentration, *m*									
	0.005	0.01	0.02	0.05	0.1	0.2	0.3	0.5	0.7	1.0
	log *3*									
LiCl	0.0343	0.0463	0.0605	0.0830	0.1017	0.1192	0.1262	0.1281	0.1220	0.1015
LiBr	0.0298	0.0400	0.0525	0.0720	0.0877	0.1008	0.1041	0.0996	0.0875	0.0622
$LiNO_3$	0.0304	0.0412	0.0543	0.0760	0.0947	0.1125	0.1204	0.1246	0.1220	0.1151
$LiClO_3$	0.0302	0.0406	0.0537	0.0745	0.0915	0.1070	0.1131	0.1141	0.1080	0.0923
$LiClO_4$	0.0290	0.0386	0.0506	0.0692	0.0835	0.0940	0.0948	0.0856	0.0697	0.0396
HCOOLi	0.0311	0.0424	0.0573	0.0829	0.1057	0.1312	0.1465	0.1637	0.1729	0.1802
CH_3COOLi	0.0309	0.0421	0.0564	0.0799	0.1000	0.1201	0.1298	0.1373	0.1370	0.1296
NaCl	0.0306	0.0416	0.0557	0.0804	0.1039	0.1309	0.1476	0.1690	0.1824	0.1948
NaBr	0.0282	0.0377	0.0503	0.0721	0.0928	0.1161	0.1300	0.1465	0.1554	0.1622
$NaNO_3$	0.0311	0.0428	0.0584	0.0870	0.1165	0.1543	0.1812	0.2214	0.2525	0.2903
$NaClO_3$	0.0316	0.0433	0.0588	0.0865	0.1139	0.1482	0.1718	0.2066	0.2330	0.2644
$NaClO_4$	0.0321	0.0439	0.0588	0.0857	0.1116	0.1429	0.1640	0.1936	0.2151	0.2393
HCOONa	0.0308	0.0416	0.0557	0.0794	0.1012	0.1262	0.1415	0.1606	0.1720	0.1829
CH_3COONa	0.0306	0.0412	0.0544	0.0754	0.0928	0.1089	0.1160	0.1199	0.1172	0.1074
KCl	0.0317	0.0434	0.0587	0.0857	0.1121	0.1430	0.1632	0.1903	0.2093	0.2302
KBr	0.0313	0.0428	0.0578	0.0839	0.1091	0.1392	0.1590	0.1855	0.2038	0.2236
KNO_3	0.0329	0.0461	0.0645	0.1001	0.1391	0.1923	0.2336	0.2979	0.3502	0.4158
$KClO_3$	0.0301	0.0418	0.0583	0.0913	0.1277	0.1771	—	—	—	—
$KClO_4$	0.0347	0.0492	0.0697	—	—	—	—	—	—	—
HCOOK	0.0302	0.0406	0.0543	0.0774	0.0989	0.1221	0.1356	0.1509	0.1589	0.1648
CH_3COOK	0.0306	0.0411	0.0544	0.0750	0.0915	0.1061	0.1113	0.1107	0.1034	0.0867
NH_4Cl	0.0405	0.0555	0.0732	0.1025	0.1298	0.1616	0.1818	0.2081	0.2249	0.2423
NH_4Br	0.0451	0.0605	0.0786	0.1082	0.1351	0.1657	0.1849	0.2097	0.2260	0.2427
NH_4I	0.0375	0.0509	0.0674	0.0947	0.1193	0.1479	0.1659	0.1897	0.2052	0.2218
NH_4NO_3	0.0401	0.0547	0.0736	0.1064	0.1390	0.1806	0.2101	0.2542	0.2884	0.3306
$(NH_4)_2SO_4$	0.1308	0.1749	0.2294	0.3194	0.4023	0.4994	0.5633	0.6514	0.7141	0.7836

Table 185

Mean activity coefficients of some chlorides in molten KCl–NaCl system at 700°C

Chloride	Activity coefficient, γ
AgCl	1
$CrCl_2$	0.011
$CrCl_3$	0.041
CuCl	0.27
$CuCl_2$	0.003
$FeCl_2$	0.006
$MnCl_2$	0.010
$NiCl_2$	0.3
$ZnCl_2$	0.015

Table 186

Solubility products of slightly soluble electrolytes

Compound	t, °C	K
Ag_3AsO_3	25	4.5×10^{-19}
Ag_3AsO_4	25	1.0×10^{-19}
$AgBO_2$	25	3.6×10^{-3}
AgBr	12	1.0×10^{-13}
	20	3.2×10^{-13}
	25	6.3×10^{-13}
	40	2.5×10^{-12}
	60	2.4×10^{-11}
	70	5.0×10^{-11}
$AgBrO_3$	20	3.97×10^{-5}
	25	5.77×10^{-5}
AgO_2CCH_3 (acetate)	25	4.4×10^{-3}
$AgO_2C(CH_2)_3CH_3$ (valerate)	20	8×10^{-5}
$AgO_2CC_6H_4OH$ (salicylate)	20	1.4×10^{-5}
$AgO_2CC_6H_5$ (benzoate)	20	9.3×10^{-5}
AgCN	25	7×10^{-15}
AgCNO	19	2.3×10^{-7}
AgCNS	18	0.49×10^{-12}
AgCNSe	19	4.0×10^{-16}
AgCl	5	0.2×10^{-10}
	10	0.4×10^{-10}
	15	1.1×10^{-10}
	20	1.8×10^{-10}
	30	2.3×10^{-10}
	50	1.3×10^{-9}
	60	2.9×10^{-9}
	80	7.5×10^{-9}
AgI	12	2.9×10^{-17}
	22	1.6×10^{-16}
	25	2.3×10^{-16}
	30	6.3×10^{-16}
	55	8.5×10^{-15}
$AgIO_3$	10	0.9×10^{-8}
	25	3.2×10^{-8}
$AgMnO_4$	25	3.1×10^{-11}
$AgNO_2$	25	7×10^{-4}
AgOH	20	1.5×10^{-8}
Ag_2CO_3	25	6.15×10^{-12}
$Ag_2C_2O_4$	25	1.1×10^{-11}
Ag_2CrO_4	15	1.2×10^{-12}
	25	4×10^{-12}
$Ag_2Cr_2O_7$	25	2×10^{-7}
Ag_2MoO_4	18	3.1×10^{-11}
Ag_2S	25	6×10^{-51}
Ag_2SO_4	25	7×10^{-5}
$Ag_2[Fe(CN)_5NO]$	25	7.8×10^{-13}

Compound	t, °C	K
Ag_2WO_4	18	5.2×10^{-10}
$Ag_3[Fe(CN)_6]$	25	9.8×10^{-26}
Ag_3PO_4	20	1.8×10^{-18}
Ag_3VO_4	20	5×10^{-7}
$Ag_4[Fe(CN)_6]$	25	1.5×10^{-41}
$Al(OH)_3$ (as acid)	18	1.1×10^{-15}
	25	3.7×10^{-15}
$Al(OH)_3$ (as base)	25	1.9×10^{-33}
AsO(HO)	25	6×10^{-10}
As_2S_3	18	4×10^{-29}
Au_2O_3	25	8.5×10^{-46}
$Ba(BrO_3)_2$	25	3.3×10^{-5}
$BaCO_3$	16	7×10^{-9}
	25	8×10^{-9}
$BaC_2O_4\cdot2H_2O$	25	1.1×10^{-7}
$BaC_2O_4\cdot3.5H_2O$	18	1.62×10^{-7}
$BaCrO_4$	18	1.6×10^{-10}
	25	2.3×10^{-10}
BaF_2	9.4	1.6×10^{-6}
	18	1.7×10^{-6}
	26	1.73×10^{-6}
$Ba(IO_3)_2\cdot H_2O$	10	8.4×10^{-11}
	25	6.5×10^{-10}
$BaMnO_4$	25	2.5×10^{-10}
$BaSO_4$	18	0.87×10^{-10}
	25	1.08×10^{-10}
	50	1.98×10^{-10}
$Be(OH)_2$	25	2.7×10^{-10}
H_2BeO_2	25	2×10^{-30}
$Be_2O(OH)_2$	25	4×10^{-19}
$Bi(OH)_3$	18	4.3×10^{-31}
BiO(OH)	25	1×10^{-12}
BiOCl		
$BiOCl \rightleftharpoons BiO^+ + Cl^-$	25	7×10^{-9}
BiOCl		
$BiOCl + H_2O \rightleftharpoons$		
$\rightleftharpoons Bi^{3+} + Cl^- + 2OH^-$	25	1.6×10^{-31}
Bi_2S_3	18	1.6×10^{-72}
$CaCO_3$	15	9.9×10^{-9}
	25	5×10^{-9}
$CaC_2O_4\cdot H_2O$	18	1.78×10^{-9}
	25	3×10^{-9}
$Ca(C_4H_4O_6)\cdot2H_2O$ (tartrate)	25	7.7×10^{-7}
$CaCrO_4$	18	2.3×10^{-2}
CaF_2	18	3.4×10^{-11}
	26	3.95×10^{-11}
$Ca(IO_3)_2\cdot6H_2O$	10	2.2×10^{-7}
	18	7.4×10^{-7}

(continued)

Compound	t, °C	K
	25	1.93×10^{-6}
	30	3.9×10^{-6}
$Ca(OH)_2$	18	5.47×10^{-6}
	25	7.9×10^{-6}
	100	4×10^{-6}
$CaHPO_4$	25	$\sim5\times10^{-6}$
$Ca_3(PO_4)_2$	25	1×10^{-25}
$CaSO_4$	10	6.1×10^{-5}
	25	6.3×10^{-5}
$CaSO_4 \cdot 2\,H_2O$	25	1.3×10^{-4}
$CdCO_3$	25	2.5×10^{-14}
$CdC_2O_4 \cdot 3\,H_2O$	18	1.53×10^{-8}
$Cd(OH)_2$	18	2.4×10^{-13}
CdS	18	7×10^{-28}
$Ce_2(C_2O_4)_3 \cdot 10\,H_2O$	25	2.5×10^{-29}
$Ce(C_4H_4O_6)_2 \cdot 9\,H_2O$ (tartrate)	25	9.7×10^{-20}
$Ce(IO_3)_4$	20	3.5×10^{-10}
$CoCO_3$	25	1×10^{-12}
$Co(OH)_2$	18	1.6×10^{-18}
$Co(OH)_3$	25	2.5×10^{-43}
CoS (α)	25	3.1×10^{-23}
CoS (β)	25	1.9×10^{-27}
CoS (γ)	18	3.0×10^{-26}
$NaK_2Co(NO_2)_6 \cdot H_2O$	25	2.2×10^{-11}
$Cr(OH)_2$	18	2.0×10^{-20}
$Cr(OH)_3$	17	5.4×10^{-31}
	25	6.7×10^{-31}
Cu_2Br_2	25	5.3×10^{-9}
$Cu_2(CNS)_2$	25	4×10^{-14}
$CuCO_3$	25	2×10^{-10}
CuC_2O_4	25	2.87×10^{-8}
Cu_2Cl_2	25	1.8×10^{-7}
Cu_2I_2	25	1.1×10^{-12}
$Cu(IO_3)_2$	25	1.4×10^{-7}
$Cu(OH)_2$	25	5.6×10^{-20}
Cu_2S	18	2×10^{-47}
CuS	25	3.5×10^{-38}
$FeCO_3$	20	2.5×10^{-11}
	25	2.11×10^{-11}
FeC_2O_4	25	2.1×10^{-7}
$Fe(OH)_2$	18	4.8×10^{-16}
$Fe(OH)_3$	18	3.8×10^{-38}
FeS	25	3.7×10^{-19}
Fe_2S_3	22	1×10^{-88}
$Ga(OH)_3$	25	5×10^{-37}
GeO_2		
$GeO_2 + H_2O \rightleftharpoons H^+ + HGeO_3^-$	25	1.1×10^{-10}

Compound	t, °C	K
$HfO(OH)_2 ½ HfO(OH)_2$		
$2 OH^- + HfO^{2+}$	25	1×10^{-25}
Hg_2Br_2	25	4.6×10^{-23}
$Hg_2(CH_3COO)_2$	25	2×10^{-15}
$Hg_2(C_4H_4O_6)$ (tartrate)	18	2×10^{-10}
$Hg_2(CN)_2$	25	5×10^{-40}
$Hg_2(CNS)_2$	25	3×10^{-20}
Hg_2CO_3	25	9×10^{-17}
$Hg_2C_2O_4$	18	2×10^{-13}
Hg_2Cl_2	25	1.1×10^{-18}
Hg_2CrO_4	25	2×10^{-9}
Hg_2I_2	25	3.7×10^{-29}
$Hg_2(IO_3)_2$	25	3×10^{-20}
Hg_2		
$Hg_2O + H_2O \rightleftharpoons Hg^{2+} + 2 OH^-$	25	1.6×10^{-23}
HgO		
$HgO + H_2O_2Hg^{2+} + 2 OH^-$	25	1.7×10^{-26}
$Hg_2(OH)_2$	18	7.8×10^{-24}
$Hg(OH)_2$	18	1×10^{-26}
Hg_2S	18	1.0×10^{-47}
HgS	18	4.0×10^{-53}
Hg_2SO_4	25	6.1×10^{-7}
Hg_2WO_4	18	1.1×10^{-17}
Ir_2O_3		
$½ Ir_2O_3 + {}^3/_2 H_2O \rightleftharpoons$		
$\rightleftharpoons Ir^{3+} + 3 OH^-$	25	$\sim10^{-5}$
$KClO_4$	25	1.07×10^{-2}
$KH(C_4H_4O_6)$ (tartrate)	18	3.8×10^{-4}
K_2PtCl_6	18	1.1×10^{-5}
K_2PdCl_6	25	5.97×10^{-6}
$La_2(C_2O_4)_3$	18	2.02×10^{-28}
$La_2(C_4H_4O_6)_3$ (tartrate)	18	2×10^{-19}
$La(IO_3)_3$	18	5.97×10^{-10}
$La(OH)_3$	25	$\sim10^{-20}$
$LiCO_3$	25	1.66×10^{-3}
$Lu(OH)_3$	25	10^{-26}
$MgCO_3 \cdot 3 H_2O$	12	2.6×10^{-5}
	25	1.0×10^{-5}
MgC_2O_4	18	8.57×10^{-5}
MgF_2	18	1.7×10^{-9}
	27	6.4×10^{-9}
$MgNH_4PO_4$	25	2.5×10^{-13}
$Mg(NH_4)_2(SO_4)_2$	25	2.5×10^{-13}
$Mg(OH)_2$	25	5.5×10^{-12}
MgS	25	2.0×10^{-15}
$MnCO_3$	25	5.05×10^{-10}
$Mn(OH)_2$	18	4×10^{-14}

(continued)

Compound	t, °C	K
MnS	18	5.6×10^{-16}
$Nd_2(C_2O_4)_3$	25	5.87×10^{-29}
$NiCO_3$	25	1.35×10^{-7}
$Ni(OH)_2$	25	1.6×10^{-14}
NiS (α)	18	3×10^{-21}
NiS (β)	18	1×10^{-26}
NiS (γ)	18	2×10^{-28}
$PbBr_2$	25	5×10^{-5}
$Pb(BrO_3)_2$	25	1.6×10^{-4}
$PbCO_3$	25	1.5×10^{-13}
PbC_2O_4	18	2.74×10^{-11}
$PbCl_2$	25	1.7×10^{-5}
PbClF	25	2.8×10^{-9}
$PbCrO_4$	25	1.77×10^{-14}
PbF_2	9	2.7×10^{-8}
	18	3.2×10^{-8}
	27	3.7×10^{-8}
$PbHPO_4$	25	4×10^{-12}
PbI_2	15	7.47×10^{-9}
	25	8.7×10^{-9}
$Pb(IO_3)_2$	9.2	0.53×10^{-13}
	18	1.2×10^{-13}
	26	2.6×10^{-13}
PbO (crist.)		
$PbO + H_2O \rightleftharpoons Pb^{2+} + 2\,OH^-$	25	5.5×10^{-16}
PbO_2		
$PbO_2 + 2\,H_2O \rightleftharpoons Pb^{4+} + 4\,OH^-$	25	$\sim 10^{-64}$
Pb_3O_4	25	5.3×10^{-51}
$Pb(OH)_2$	25	2.8×10^{-16}
PbS	18	3.4×10^{-28}
	25	1.1×10^{-29}
$PbSO_4$	25	1.8×10^{-8}
$Pd(OH)_2$	25	$\sim 10^{-24}$
$Pt(OH)_2$	25	$\sim 10^{-25}$
PtS	25	$\sim 10^{-68}$
$RaSO_4$	20	4.25×10^{-11}
$RbClO_4$	25	2.5×10^{-3}
Sb_2O_3		
$\frac{1}{2} Sb_2O_3 + \frac{1}{2} H_2O \rightleftharpoons$ $\rightleftharpoons SbO^+ + OH^-$	25	$\sim 10^{-17}$
SbO(OH)	25	$\sim 10^{-11}$
$Sb(OH)_3$	18	4.0×10^{-42}
Sb_2S_3	18	1×10^{-30}
$Sc(OH)_3$	25	$\sim 10^{-28}$
H_2SiO_3		
$H_2SiO_3 \rightleftharpoons HSiO_3^- + H^+$	25	1×10^{-10}
$Sn(OH)_2$	25	5×10^{-26}

Compound	t, °C	K
$Sn(OH)_4$	25	1×10^{-56}
SnS	18	1×10^{-28}
$SrCO_3$	25	9.42×10^{-10}
SrC_2O_4	18	5.6×10^{-8}
$SrCrO_4$	15	3.6×10^{-5}
SrF_2	25	3×10^{-9}
$Sr(HCO_3)_2$	25	1.83×10^{-6}
$SrSO_4$	3	2.77×10^{-7}
	25	2.8×10^{-7}
$TeO(OH)_2$	25	1×10^{-11}
$Te(OH)_4$	18	7×10^{-53}
$Th(OH)_4$	25	1×10^{-50}
Ti_2O_3		
$\frac{1}{2}\,Ti_2O_3 + {}^3/_2\,H_2O \rightleftharpoons$		
$\rightleftharpoons Ti^{3+} + 3\,OH^-$	25	1×10^{-40}
$TiO(OH)_2$	25	1×10^{-30}
$TlBr$	25	3.9×10^{-6}
$TlBrO_3$	25	3.9×10^{-4}
$TlCNS$	25	5.8×10^{-4}
$TlCl$	25	1.9×10^{-4}
TlI	25	5.8×10^{-8}
$TlIO_3$	25	4.5×10^{-6}
$Tl(OH)_3$	25	1.5×10^{-44}
Tl_2S	18	4.5×10^{-23}
	25	1×10^{-24}
$UO_2(OH)_2$	25	2×10^{-15}
$Y(OH)_3$	25	1×10^{-24}
$YbC_2O_4 \cdot 10\,H_2O$	25	4.45×10^{-25}
$ZnCO_3$	25	6×10^{-11}
ZnC_2O_4	25	1.4×10^{-9}
$Zn(OH)_2$	20	2×10^{-17}
ZnS (α)	20	6.9×10^{-26}
ZnS (β)	25	1.1×10^{-24}
$ZnSO_4 \cdot 3\,Zn(OH)_2$		
$ZnSO_4 \cdot 3\,Zn(OH)_2 \rightleftharpoons$		
$\rightleftharpoons 4\,Zn^{2+} + SO_4^{2-} + 6\,OH^-$	20	3×10^{-54}
$ZrO(OH)_2$	25	1×10^{-26}

Table 187

rH values of some redox systems at 30°C

Redox system	rH (pH = 0)	Redox indicator	rH (pH = 7)
$Ti^{4+} + e \rightleftharpoons Ti^{3+}$	−1.3	Methylviologen	−0.6
Hydrogen electrode	0.0	Neutral red	2.6
$Sn^{4+} + 2e \rightleftharpoons Sn^{2+}$	5.0	Rosinduline GG	4.6
$Cu^{2+} + e \rightleftharpoons Cu^{+}$	5.1	Alizarin brilliant blue	8.2
$I_2 + 2e \rightleftharpoons 2\,I^-$	20.7	Gallophenine	9.3
$Fe^{3+} + e \rightleftharpoons Fe^{2+}$	25.7	Indigo disulphonate	9.8
Oxygen electrode	41.0	Indigo trisulphonate	11.3
$CrO_4^{2-} + 8\,H^+ + 3e \rightleftharpoons$		Indigo tetrasulphonate	12.5
$\rightleftharpoons Cr^{3+} + 4\,H_2O$	43.3	Methylene blue	14.4
$Ce^{4+} + e \rightleftharpoons Ce^{3+}$	48.7	Gallocyanin	14.7
$MnO_4^- + 8\,H^+ + 5e \rightleftharpoons$		Thionine	16.1
$\rightleftharpoons Mn^{2+} + 4\,H_2O$	50.3	Toluylene blue	17.8
		1-Naphthol-2-sulphonic acid indophenol	18.2
		2,6-Dichlorophenol indo-*o*-cresol	20.0
		2,6-Dichlorophenol indophenol	21.2
		Variamine blue (pH = 1–6)	24.7

Table 188

Conversion of rH to *E*

(pH = 7)

rH	*E*, V	rH	*E*, V	rH	*E*, V
0	−0.42	15	0.03	29	0.43
1	−0.39	16	0.06	30	0.46
2	−0.36	17	0.09	31	0.49
3	−0.33	18	0.12	32	0.52
4	−0.30	19	0.15	33	0.55
5	−0.27	20	0.18	34	0.58
6	−0.24	21	0.21	35	0.61
7	−0.21	22	0.23	36	0.64
8	−0.18	23	0.26	37	0.67
9	−0.15	24	0.29	38	0.70
10	−0.12	25	0.32	39	0.72
11	−0.09	26	0.35	40	0.75
12	−0.06	27	0.37	41	0.78
13	−0.03	28	0.40	42	0.81
14	±0.00				

IV

INDICATORS, MEASUREMENT OF pH, BUFFER SOLUTIONS, APPROXIMATE VALUES OF pH FOR DIFFERENT MATERIALS, STANDARD MIXTURES FOR DIELECTROMETRIC INVESTIGATIONS

Table 189

Transition pH range of indicators

Indicator	Colour change in the direction of increasing pH		Transition pH range
	Acid	Alkaline	
Eosin	yellow	violet	0.0–3.0
Methyl violet	yellow	violet	0.1–3.2
Safranine	blue	red	0.3–1.0
Metanil yellow	red	yellow	1.2–2.3
Thymol blue	red	yellow	1.2–2.8
Benzylaniline-azo-benzene	pink	yellow	2.3–3.3
Congo red	blue	red	3.0–5.0
Bromophenol blue	yellow	blue	3.0–4.6
Methyl orange	red-	yellow	3.1–4.4
Bromocresol green	yellow	blue	3.8–5.4
Methyl red	red	yellow	4.2–6.3
p-Nitrophenol	colourless	yellow	5.0–7.0
Litmus	red	blue	6.0–8.0
Neutral red	red	yellow	6.5–8.0
α-Naphtholphthalein	rose	green	7.3–8.7
Tropaeolin 000	yellow	red	7.6–8.9
Phenolphthalein	colourless	red	8.3–10.0
Thymolphthalein	colourless	blue	9.3–10.5
Alizarin yellow R	yellow	red	10.1–12.1
Tropaeolin 0	yellow	orange-brown	11.1–12.7

Table 190

Colour change of mixed indicators

Indicator mixture	Transition point pH	Colour	
		Acid	Alkaline
Methylene yellow + methylene blue	3.25	blue-violet	green
Methyl orange + indigo carmine	4.1	violet	green
Na salt methyl red + alphazurine	4.8	purple	green
Bromocresol green + methyl red	5.1	red	green
Methyl red + methylene blue	5.4	red-violet	green
Na salt bromocresol green + Na salt chlorophenol red	6.1	yellow-green	blue-violet
Na salt bromocresol purple + Na salt bromothymol blue	6.7	yellow	violet-blue
Neutral red + methylene blue	7.0	violet-blue	green
Na salt bromothymol blue + Na salt phenol red	7.5	yellow	violet
Na salt phenol red + Na salt cresol red	8.3	yellow	violet
α-Naphtholphthalein + phenolphthalein	8.9	rose	violet
Phenolphthalein + thymolphthalein	9.9	colourless	violet

Table 191

Redox potentials of redox indicators
(pH = 0; t = 20°C)

Indicator	Redox potential, V
Alizarine brilliant blue	−0.173 (pH = 7; 30°C)
4-Amino-2,4′-dimethoxydiphenylamine	0.636
4-Amino-4′-methoxydiphenylamine-2-sulphonic acid	0.776
4-Amino-2-methyl-4′-methoxydiphenylamine	0.686
Benzidine	0.921
Bindschedler green	0.68
Brilliant cresyl blue	0.583
o-Chlorophenol indophenol	0.66
Cyanine B	1.0
Cyanol green 2 G	1.0
2,4-Diaminodiphenylamine	0.7
o-Dianisidine	0.79
2,6-Dibromophenolindophenol	0.668
2,6-Dibromophenolindo-*o*-phenolsulphonic acid Na salt	0.683
2,6-Dichlorophenol indophenol	0.67
2,6-Dichlorophenolindo-*m*-chlorophenol	0.69
2,6-Dichlorophenolindo-*o*-chlorophenol	0.67
2,6-Dichlorophenolindo-*o*-cresol	0.64
Dimethyl-*p*-phenylenediamine	0.75
Dimethylphenosafranine	0.29
5,6-Dimethylferroin	0.97
Dimethylglyoxime-Fe(II)-complex	0.25 (pH = 9.2)
3,3′-Dimethylnaphthidine	0.71
Diphenylamine	0.76
Diphenylamine-2,2′-dicarbonic acid	1.26
Diphenylamine-2,3′-dicarbonic acid	1.12
Diphenylamine-*p*-sulphonic acid	0.85
Diphenylbenzidine	0.76
Diphenylbenzidine-*p*-sulphonic acid	0.80
α,α′-Dipyridyl	0.97
Erioglaucine A	1.0
Eriogreen B	1.0
p-Ethoxychrysoidine	0.97
Ethyl Capri blue	0.54
Ferroin	1.14
Gallocyanin	0.02
Gallophenine	−0.14 (pH = 7; 25°C)
Indigo-5-monosulphonic acid	0.26
Indigo-5,5′-disulphonic acid	0.29
Indigotin-5,5′,7-trisulphonic acid	0.33
Indigotin-5,5′,7,7′-tetrasulphonic acid	0.37
Indophenol	0.65
N-Methyldiphenylamine-*p*-sulphonic acid	0.80
Methylene blue	0.53
Methyl Capri blue	0.45

Indicator	Redox potential, V
Methylviologene	−0.44 (pH = 7; 30°C)
Muscarine	0.20 (pH = 4)
Naphthidine	0.79
1-Naphthol-2-sulphonic acid indophenol	0.54
1-Naphthol-2-sulphonic acid indo 3′, 5′-dichlorophenol	0.56
Neutral blue	0.17
Neutral red	−0.20 (pH = 5)
Nile blue	0.41
p-Nitrodiphenylamine	1.06
Nitro ferroin	1.26
Patent blue A	1.18
Phenosafranine	0.28
N-Phenylanthranilic acid	1.08
Rosinduline GG	−0.16 (pH = 5)
Safranine T	0.24
Setocyanine supra G	1.0
Setogluacine 0	1.0
Tetraethylphenosafranine	0.36
N,N′-Tetramethylbenzidine	0.86
N,N′-Tetramethylbenzidine-3-sulphonic acid	0.88
Tetramethylphenosafranine	0.29
Thionine	0.56
o-Tolidine	0.87
Toluidine blue	0.60
Variamine blue B	0.71
Xylene cyanol FF	1.0
Xylene blue AS	1.0
Xylene blue VS	1.1

Table 192

Standard redox potentials of some redox resins

Resin	Redox group	E^0, (pH = 0) V
PS*	Quinone/hydroquinone	+0.70
F**	Quinone/hydroquinone	+0.70
F	Anthraquinone/anthrahydroquinone	+0.67
F	Naphthoquinone/naphthohydroquinone	+0.60
PS	Methylene blue/leuco methylene blue	+0.53
PS	Ferricene/ferrocene	+0.42
PS	−S−S−/−SH	+0.15
PS	$-CH_2-S-S-CH_2-/CH_2-SH$	+0.15

* PS = polystyrenedivinylbenzene copolymer
** F = phenolformaldehyde condensate

Table 193

Salt correction of some indicators in solutions of different ionic strength for colorimetric pH measurements
(Ionic strength of buffer solution used for comparison is 0.1)

Indicator	Ionic strength, *I*							
	0.0025	0.005	0.01	0.02	0.05	0.1	0.5 (KCl)	0.5 (NaCl)
	pH correction							
Bromophenol blue	+0.15	+0.14	+0.14	+0.13	+0.10	0.00	−0.10	−0.18
Bromocresol green	+0.21	+0.18	+0.16	+0.14	+0.05	0.00	−0.12	−0.16
Chlorophenol red	—	+0.18	+0.15	+0.12	+0.05	0.00	−0.16	−0.19
Methyl orange	−0.04	−0.04	−0.02	0.00	0.00	0.00	0.00	0.00
Methyl red	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neutral red	−0.07	−0.06	−0.05	−0.04	−0.02	0.00	+0.07	+0.12
p-Nitrophenol	+0.06	+0.05	+0.03	+0.02	+0.01	0.00	−0.18	−0.19
Phenolphthalein	—	+0.18	+0.12	+0.10	+0.05	0.00	−0.26	−0.21
Phenol red	+0.14	+0.12	+0.11	+0.07	+0.04	0.00	−0.20	−0.29
Thymol blue (acid)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thymol blue (basic)	—	+0.16	+0.12	+0.09	+0.05	0.00	−0.12	−0.19
Tropaeolin 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Remark:

A positive correction (+) means that the figure has to be added to the experimental value; a negative sign (−) means it has to be subtracted, if comparisons are made with a buffer with an ionic strength of 0.1.

Table 194

Protein correction of some indicators for colorimetric pH measurements

Indicator	pH correction		
	In peptone meat soup	In 10% gelatine solutions	In 2% egg albumin solution
Bromophenol blue	+0.05	—	—
Bromocresol purple	+0.01	+0.04	—
Bromothymol blue	+0.10	+0.04	—
Cresolphthalein	−0.03	+0.20	—
Cresol red	+0.03	+0.20	—
Methyl red	−0.10	—	+0.24
Phenol red	+0.04	+0.20	—
Thymol blue	+0.04	+0.20	—

Table 195

pH of NBS primary standard solutions at 0–95°C

t, °C	pH: Potassium tetroxalate, 0.05 M	Potassium hydrogen tartrate satd. at 25°C	Potassium hydrogen phthalate, 0.05 M	Borax, 0.01 M	Calcium hydroxide satd. at 25° C
0	1.67	—	4.01	9.46	13.43
5	1.67	—	4.01	9.39	13.21
10	1.67	—	4.00	9.33	13.00
15	1.67	—	4.00	9.27	12.81
20	1.68	—	4.00	9.22	12.63
25	1.68	3.56	4.01	9.18	12.45
30	1.69	3.55	4.01	9.14	12.30
35	1.69	3.55	4.02	9.10	12.14
40	1.70	3.54	4.03	9.07	11.90
45	1.70	3.55	4.04	9.04	11.84
50	1.71	3.55	4.06	9.01	11.70
55	1.72	3.56	4.07	8.99	11.58
60	1.72	3.56	4.09	8.96	11.45
70	1.74	3.58	4.12	8.93	—
80	1.77	3.61	4.16	8.89	—
90	1.80	3.65	4.20	8.85	—
95	1.81	3.68	4.23	8.83	—

Table 196

Pressure corrections for the hydrogen electrode

t, °C	Barometric pressure,* mm Hg: 740	750	760	770	780
	ΔE, mV				
0	−0.387	−0.228	−0.071	+0.083	+0.236
5	−0.425	−0.263	−0.103	+0.055	+0.211
10	−0.478	−0.312	−0.149	+0.013	+0.172
15	−0.548	−0.378	−0.211	−0.046	+0.117
20	−0.639	−0.465	−0.294	−0.125	+0.042
25	−0.762	−0.584	−0.409	−0.235	−0.064
30	−0.922	−0.739	−0.558	−0.380	−0.204
35	−1.134	−0.945	−0.759	−0.575	−0.394
40	−1.408	−1.212	−1.019	−0.829	−0.642
45	−1.767	−1.563	−1.362	−1.165	−0.970
50	−2.230	−2.017	−1.807	−1.600	−1.396
55	−2.835	−2.610	−2.388	−2.169	−1.954
60	−3.620	−3.379	−3.141	−2.908	−2.679

Example:

What is the pH of a solution in which a normal hydrogen electrode and a saturated calomel electrode are immersed and the measured *EMF* of the cell at 750 mm Hg barometric pressure and 20°C is 0.7123 V?

$$\mathrm{pH} = \frac{EMF - \Delta E - E^0(\mathrm{SCE})}{0 \times 05816} = \frac{0.7123 + 0.000465 - 0.2438}{0.05816} = 8.06$$

Neglecting the pressure correction:

$$\mathrm{pH} = \frac{0.7123 - 0.2438}{0.05816} = 8.05$$

* Reduced to 0°C but not to sea-level.

Table 197

pH ranges of buffer solutions

Buffer solution*	pH
Glycine + HCl	1.1–3.4
Citric acid + Na_2HPO_4	2.2–8.0
KH phthalate + HCl	2.2–3.8
KH phthalate + NaOH	4.0–6.2
Borax + succinic acid	3.0–5.8
Borax + KH_2PO_4	5.8–9.2
Acetic acid + Na acetate	3.8–5.6
Na_2HPO_4 + KH_2PO_4	5.3–8.0
H_3BO_3 + Borax	6.8–8.4
Veronal + HCl	6.8–9.6
H_3BO_3 + NaOH	8.2–10.0
Glycine + NaOH	9.0–13.0

* The compositions of the buffer mixtures and the mixing proportions of the stock solutions used will be found at the end of Table 198.

Table 198

Buffer solution mixtures (Sörensen)
pH = 1.04–12.97 at 18°C

pH	Glycine, ml	HCl, ml	Citrate, ml	NaOH, ml	KH_2PO_4, ml	Na_2HPO_4, ml	Borate, ml
1.04	—	10.0	—	—	—	—	—
1.15	1.0	9.0	—	—	—	—	—
1.25	2.0	8.0	—	—	—	—	—
1.42	3.0	7.0	—	—	—	—	—
1.65	4.0	6.0	—	—	—	—	—
1.93	5.0	5.0	—	—	—	—	—
2.28	6.0	4.0	—	—	—	—	—
2.61	7.0	3.0	—	—	—	—	—
2.92	8.0	2.0	—	—	—	—	—
3.34	9.0	1.0	—	—	—	—	—
3.53	—	5.25	4.75	—	—	—	—
3.68	9.5	0.5	—	—	—	—	—
3.69	—	5.0	5.0	—	—	—	—
3.95	—	4.5	5.5	—	—	—	—
4.16	—	4.0	6.0	—	—	—	—
4.45	—	3.0	7.0	—	—	—	—
4.65	—	2.0	8.0	—	—	—	—
4.83	—	1.0	9.0	—	—	—	—
4.89	—	0.5	9.5	—	—	—	—
4.96	—	—	10.0	—	—	—	—
5.02	—	—	9.5	0.5	—	—	—
5.11	—	—	9.0	1.0	—	—	—
5.31	—	—	8.0	2.0	—	—	—
5.57	—	—	7.0	3.0	—	—	—
5.91	—	—	—	—	9.0	1.0	—

pH	Glycine, ml	HCl, ml	Citrate, ml	NaOH, ml	KH_2PO_4, ml	Na_2HPO_4, ml	Borate, ml
5.97	—	—	6.0	4.0	—	—	—
6.24	—	—	—	—	8.0	2.0	—
6.47	—	—	—	—	7.0	3.0	—
6.64	—	—	—	—	6.0	4.0	—
6.81	—	—	—	—	5.0	5.0	—
6.98	—	—	—	—	4.0	6.0	—
7.17	—	—	—	—	3.0	7.0	—
7.38	—	—	—	—	2.0	8.0	—
7.62	—	4.75	—	—	—	—	5.25
7.73	—	—	—	—	1.0	9.0	—
7.94	—	4.5	—	—	—	—	5.05
8.04	—	—	—	—	0.5	9.5	—
8.14	—	4.25	—	—	—	—	5.75
8.24	9.75	—	—	0.25	—	—	—
8.29	—	4.0	—	—	—	—	6.0
8.51	—	3.5	—	—	—	—	6.5
8.58	9.5	—	—	0.5	—	—	—
8.68	—	3.0	—	—	—	—	7.0
8.80	—	2.5	—	—	—	—	7.5
8.91	—	2.0	—	—	—	—	8.0
8.93	9.0	—	—	1.0	—	—	—
9.01	—	1.5	—	—	—	—	8.5
9.09	—	1.0	—	—	—	—	9.0
9.17	—	0.5	—	—	—	—	9.5
9.24	—	—	—	—	—	—	10.0
9.36	—	—	—	1.0	—	—	9.0
9.68	—	—	—	3.0	—	—	7.0
9.71	7.0	—	—	3.0	—	—	—
9.97	—	—	—	4.0	—	—	6.0
10.14	6.0	—	—	4.0	—	—	—
10.48	5.5	—	—	4.5	—	—	—
11.07	5.1	—	—	4.9	—	—	—
11.31	5.0	—	—	5.0	—	—	—
11.57	4.9	—	—	5.1	—	—	—
12.10	4.5	—	—	5.5	—	—	—
12.40	4.0	—	—	6.0	—	—	—
12.67	3.0	—	—	7.0	—	—	—
12.86	2.0	—	—	8.0	—	—	—
12.97	1.0	—	—	9.0	—	—	—

Stock solutions:

0.1 N hydrochloric acid,
0.1 M glycine (7.505 g glycine + 5.85 g NaCl/l),
0.1 M sodium citrate (21.008 g citric acid monohydrate + 200 ml N NaOH/l),
0.1 N sodium hydroxide,
1/15 M potassium dihydrogen phosphate (9.078 g KH_2PO_4/l),
1/15 M disodium hydrogen phosphate (11.876 g $Na_2HPO_4 \times 2 H_2O$/l),
0.2 M sodium borate (12.404 g H_3BO_3 + 100 ml N NaOH/l).

A buffer solution of the desired pH can be obtained by mixing the two stock solutions. In some cases the buffer solution of known pH is prepared from a single solution.

Example:

A buffer solution of pH = 4.16 can be prepared by mixing 4.0 ml 0.1 N hydrochloric acid and 6.0 ml 0.1 M sodium citrate stock solutions. The 0.1 M sodium citrate stock solution is a buffer solution of pH 4.96 and the 0.2 M sodium borate stock solution is a buffer solution of pH 9.24.

Table 199

Buffer solution mixtures (Clark and Lubs)
pH = 1.0–10.0 at 20°C

pH	KCl, ml	HCl, ml	KH phthalate, ml	NaOH, ml	KH_2PO_4, ml	H_3BO_3, ml
1.0	25.00	48.50	—	—	—	—
1.2	24.90	75.10	—	—	—	—
1.4	52.60	47.40	—	—	—	—
1.6	70.06	29.90	—	—	—	—
1.8	81.14	18.86	—	—	—	—
2.0	88.10	11.90	—	—	—	—
2.2	92.48	7.52	—	—	—	—
2.4	—	39.60	50 00	—	—	—
2.6	—	33.00	50 00	—	—	—
2.8	—	26.50	50 00	—	—	—
3.0	—	20.40	50.00	—	—	—
3.2	—	14.80	50.00	—	—	—
3.4	—	9.95	50 00	—	—	—
3.6	—	6.00	50 00	—	—	—
3.8	—	2.65	50.00	—	—	—
4.0	—	—	50.00	0.40	—	—
4.2	—	—	50.00	3.65	—	—
4.4	—	—	50.00	7.35	—	—
4.6	—	—	50.00	12.00	—	—
4.8	—	—	50.00	17.50	—	—
5.0	—	—	50 00	23.65	—	—
5.2	—	—	50 00	29.75	—	—
5.4	—	—	50.00	35.25	—	—
5.6	—	—	50.00	39.70	—	—
6.2	—	—	—	8.55	50.00	—
6.4	—	—	—	12.60	50.00	—
6.6	—	—	—	17.74	50.00	—
6.8	—	—	—	23.60	50.00	—
7.0	—	—	—	29.54	50.00	—
7.2	—	—	—	34.90	50.00	—
7.4	—	—	—	39.34	50.00	—
7.6	—	—	—	42.74	50.00	—
8.2	—	—	—	5.90	—	50.00
8.4	—	—	—	8.55	—	50.00
8.6	—	—	—	12.00	—	50.00
8.8	—	—	—	16.40	—	50.00
9.0	—	—	—	21.40	—	50.00
9.2	—	—	—	26.70	—	50.00
9.4	—	—	—	32.00	—	50.00
9.6	—	—	—	36.85	—	50.00
9.8	—	—	—	40.80	—	50.00
10.0	—	—	—	43.90	—	50.00

Stock solutions:

0.2 M potassium chloride (14.912 g KCl/l),
0.2 M potassium biphthalate (40.836 g $KHC_8H_4O_4$/l),
0.2 M potassium dihydrogen phosphate (27.232 g KH_2PO_4/l),
0.2 M boric acid (12.405 g H_3BO_3 + 14.912 g KCl/l),
0.2 M sodium hydroxide,
0.2 M hydrochloric acid

Carbonate-free sodium hydroxide solution should be used. A solution of the desired pH is obtained by mixing two stock solutions. The mixture is diluted with distilled water to exactly 200 ml.

Table 200

Buffer solutions (Britton–Robinson)
pH = 1.8–11.92 at 18°C

pH	NaOH, ml	pH	NaOH, ml	pH	NaOH, ml	pH	NaOH, ml
1.81	0.0	4.10	25.0	6.80	50.0	9.62	75.0
1.89	2.5	4.35	27.5	7.00	52.5	9.91	77.5
1.98	5.0	4.56	30.0	7.24	55.0	10.38	80.0
2.09	7.5	4.78	32.5	7.54	57.5	10.88	82.5
2.21	10.0	5.02	35.0	7.96	60.0	11.20	85.0
2.36	12.5	5.33	37.5	8.36	62.5	11.40	87.5
2.56	15.0	5.72	40.0	8.69	65.0	11.58	90.0
2.87	17.5	6.09	42.5	8.95	67.5	11.70	92.5
3.29	20.0	6.37	45.0	9.15	70.0	11.82	95.0
3.78	22.5	6.59	47.5	9.37	72.5	11.92	97.5

Stock solution:

0.04 M acetic acid, 0.04 M phosphoric acid and 0.04 M boric acid. For the preparation of a buffer solution of desired pH, 100 ml of the above stock solution is mixed with the volume of 0.2 N sodium hydroxide given by the table.

Table 201

Phosphate–citric acid buffer mixtures
pH = 2.2–8.0

pH	Na_2HPO_4, ml	Citric acid, ml	pH	Na_2HPO_4, ml	Citric acid, ml
2.2	0.40	19.60	5.2	10.72	9.28
2.4	1.24	18.76	5.4	11.15	8.85
2.6	2.18	17.82	5.6	11.60	8.40
2.8	3.17	16.83	5.8	12.09	7.91
3.0	4.11	15.89	6.0	12.63	7.37
3.2	4.94	15.06	6.2	13.22	6.78
3.4	5.70	14.30	6.4	13.85	6.15
3.6	6.44	13.56	6.6	14.55	5.45
3.8	7.10	12.90	6.8	15.45	4.55
4.0	7.71	12.29	7.0	16.47	3.53
4.2	8.28	11.72	7.2	17.39	2.61
4.4	8.82	11.18	7.4	18.17	1.83
4.6	9.35	10.65	7.6	18.73	1.27
4.8	9.86	10.14	7.8	19.15	0.85
5.0	10.13	9.70	8.0	19.45	0.55

Stock solutions:

0.2 M disodium hydrogen phosphate (35.599 g $Na_2HPO_4 \cdot 2\,H_2O$/l),
0.1 M citric acid (19.213 g $H_3C_6H_5O_7$/l).

Table 202

Acetate buffer mixtures; pH = 3.6–5.6

pH	Na acetate, ml	Acetic acid, ml	pH	Na acetate, ml	Acetic acid, ml
3.6	1.5	18.5	4.8	12.0	8.0
3.8	2.4	17.6	5.0	14.1	5.9
4.0	3.6	16.4	5.2	15.8	4.2
4.2	5.3	14.7	5.4	17.1	2.9
4.4	7.4	12.6	5.6	18.1	1.9
4.6	9.8	10.2			

Stock solutions:

0.2 M acetic acid,

0.2 M sodium acetate (27.199 g $CH_3COONa \cdot 3\ H_2O$/l).

Table 203

Succinic acid–borax buffer mixtures; pH = 3.0–5.8

pH	Succinic acid, ml	Borax, ml	pH	Succinic acid, ml	Borax, ml
3.0	9.86	0.14	4.6	7.00	3.00
3.2	9.65	0.35	4.8	6.65	3.35
3.4	9.40	0.60	5.0	6.32	3.68
3.6	9.05	0.95	5.2	6.05	3.95
3.8	8.63	1.37	5.4	5.79	4.21
4.0	8.22	1.78	5.6	5.57	4.43
4.2	7.78	2.22	5.8	5.40	4.60
4.4	7.38	2.62			

Stock solutions:

0.05 M succinic acid (5.9 g $C_4H_6O_4$/l),

0.05 M borax solution (19.404 g $Na_2B_4O_7 \cdot 10\ H_2O$/l).

Table 204

Phosphate–borax buffer mixtures; pH = 5.8–9.2

pH	KH_2PO_4, ml	Borax, ml	pH	KH_2PO_4 ml	Borax, ml
5.8	9.21	0.79	7.6	5.17	4.83
6.0	8.77	1.23	7.8	4.92	5.08
6.2	8.30	1.70	8.0	4.65	5.35
6.4	7.78	2.22	8.2	4.30	5.70
6.6	7.22	2.78	8.4	3.87	6.13
6.8	6.67	3.33	8.6	3.40	6.60
7.0	6.23	3.77	8.8	2.76	7.24
7.2	5.81	4.19	9.0	1.75	8.25
7.4	5.50	4.50	9.2	0.50	9.50

Stock solutions:

0.1 M potassium dihydrogen phosphate (13.617 g KH_2PO_4/l),

0.05 M borax solution (19.404 g $Na_2B_4O_7 \cdot 10\ H_2O$/l).

Table 205

Veronal buffer mixtures; pH = 7.0–9.5

pH	Veronal Na, ml	HCl, ml	pH	Veronal Na, ml	HCl, ml
7.00	5.36	4.64	8.20	7.69	2.31
7.20	5.54	4.46	8.40	8.23	1.77
7.40	5.81	4.19	8.60	8.71	1.29
7.60	6.15	3.85	8.80	9.08	0.92
7.80	6.62	3.38	9.00	9.36	0.64
8.00	7.16	2.84	9.20	9.52	0.48

Stock solutions:

20.6 g veronal Na (sodium diethylbarbiturate) dissolved in 1 l CO_2-free distilled water. (20.00 ml of the solution neutralises 20.00 ml 0.1 N HCl using methyl red indicator)

0.1 N HCl.

Table 206

Ammonium hydroxide–ammonium chloride buffer mixtures
pH = 8.0–10.0

pH	NH_4OH, ml	NH_4Cl, ml	pH	NH_4OH, ml	NH_4Cl, ml
8.0	1.1	18.9	9.25	10.0	10.0
8.2	1.7	18.3	9.4	11.7	8.3
8.4	2.5	17.5	9.6	13.8	6.2
8.6	3.7	16.3	9.8	15.6	4.4
8.8	5.2	14.8	10.0	17.0	3.0
9.0	7.2	12.8			

Stock solutions:

0.2 M ammonium hydroxide solution,

0.2 M ammonium chloride solution (10.699 g NH_4Cl/l).

Table 207

Approximate pH values of aqueous solutions of acids at room temperature

Acid	pH	Acid	pH
Acetic acid, 0.001 N	3.9	Hydrochloric acid, 0.1 N	1.0
Acetic acid, 0.01 N	3.4	Hydrochloric acid, N	0.1
Acetic acid, 0.1 N	2.9	Hydrogen sulphide, 0.1 N	4.1
Acetic acid, N	2.4	Hydrogen cyanide, 0.1 N	5.1
Arsenous acid (satd.)	5.0	Lactic acid, 0.1 N	2.4
Benzoic acid, 0.01 N	3.1	Nitrous acid, 0.1 N	2.2
Boric acid, 0.1 N	5.2	Oxalic acid, 0.1 N	1.6
Carbonic acid (satd.)	3.7*	Phosphoric acid, 0.1 N	1.5
Citric acid, 0.1 N	2.2	Sulphurous acid, 0.1 N	1.5
Formic acid, 0.1 N	2.3	Sulphuric acid, 0.01 N	2.1
Hydrochloric acid, 0.0001 N	4.0	Sulphuric acid, 0.1 N	1.2
Hydrochloric acid, 0.001 N	3.0	Sulphuric acid, N	0.3
Hydrochloric acid, 0.01 N	2.0	Tartaric acid, 0.1 N	2.2

* See Table 208.

Table 208

pH value of an aqueous solution of carbonic acid at 25°C

CO_2 pressure over the solution, atm.	pH	CO_2 pressure over the solution, atm.	pH
1.0	3.7	7.2	3.3
1.7	3.5	7.8	3.3
2.5	3.4	9.5	3.3
2.9	3.4	10.5	3.3
3.7	3.4	12.7	3.3
3.8	3.4	18.7	3.3
5.4	3.3	33.3	4.4
6.2	3.3		

Table 209

Approximate pH values of aqueous solutions of inorganic bases at room temperature

Base	pH	Base	pH
Ammonium hydroxide, 0.01 N	10.6	Potassium hydroxide, 0.1 N	13.0
Ammonium hydroxide, 0.1 N	11.1	Potassium hydroxide, N	14.0
Ammonium hydroxide, N	11.6	Potassium hydroxide, 50%	14.5
Borax 0.1 N	9.2	Sodium carbonate, 0.1 N	11.5
Calcium carbonate (satd.)	9.4	Sodium hydrogen carbonate, 0.1 N	8.4
Calcium hydroxide (satd.)	12.4	Sodium hydroxide, 0.001 N	11.0
Disodium phosphate, 0.1 N	9.0	Sodium hydroxide, 0.01 N	12.0
Iron(II)hydroxide (satd.)	9.5	Sodium hydroxide, 0.1 N	13.0
Lime water (satd.)	12.4	Sodium hydroxide, N	14.0
Magnesium hydroxide (satd.)	10.5	Sodium metasilicate, 0.1 N	12.6
Potassium cyanide, 0.1 N	11.0	Trisodium phosphate, 0.1 N	12.0
Potassium hydroxide, 0.01 N	12.0		

Table 210

Approximate pH values of salt solutions of various concentrations, obtained from weak acids and strong bases at room temperature

K_d*	pH			
	0.001 N	0.01 N	0.1 N	1.0 N
10^{-4}	7.5	8.0	8.5	9.0
10^{-6}	8.5	9.0	9.5	10.0
10^{-8}	9.5	10.0	10.5	11.0
10^{-10}	10.4	11.0	11.5	12.0

*K_d is the dissociation constant of the acid.

Table 211

Precipitation pH of metal hydroxides*

Metal ion	pH	Metal ion	pH
Ag^{+}	9.0–10.0	Mg^{2+}	10.5–11.0
Al^{3+}	4.0– 5.5	Mn^{2+}	8.4–10.0
Cd^{2+}	7.0– 8.0	Ni^{2+}	6.7– 8.0
Co^{2+}	6.8– 8.5	Sn^{4+}	2.0– 3.0
Cu^{2+}	6.0– 7.0	Ti^{4+}	2.0– 3.0
Fe^{2+}	5.5– 8.5	Zn^{2+}	6.0– 7.0
Fe^{3+}	3.0– 6.0		

* These values are also the solubility minima.

Table 212

pH of some biological fluids

Fluid	pH	Fluid	pH
Spinal fluid (human)	7.3–7.5	Excrement (human)	4.6–8.4
Bile (human)	6.8–7.0	Gastric acid (human)	0.9–2.5
Blood (dog)	6.9–7.2	Intestinal fluid (human)	8.0–8.3
Blood plasma (human)	7.3–7.5	Milk (human)	6.6–7.6
Blood serum (human)	7.3–7.4	Saliva (human)	6.5–7.5
Duodenal fluid (human)	5.0–8.3	Urine (human)	4.8–8.4

Table 213

pH of some foodstuffs

Name	pH	Name	pH
Alcohol-free drinks	2.0–4.0	Grape	3.5–4.5
Apple	2.9–3.3	Jams	3.5–4.0
Apple wine	2.9–3.3	Lemon	2.2–2.4
Apricot	3.6–4.0	Maize	6.0–6.5
Asparagus	5.4–5.8	Milk (cow)	6.3–6.6
Banana	4.5–4.7	Olive	3.6–3.8
Batata	5.3–5.6	Orange	3.0–3.6
Beans	5.0–6.0	Oyster	6.1–6.6
Beer	4.0–5.0	Peach	3.4–3.6
Beet	5.2–5.6	Pear	5.8–6.4
Blackberry	3.2–3.6	Pumpkin	5.0–6.4
Bread (white)	5.0–6.0	Potatoes	5.6–6.0
Butter	6.1–6.4	Raspberry	3.2–3.6
Cabbage	5.2–5.4	Red beet	4.9–5.5
Carrot	4.9–5.3	Rhubarb	3.1–3.2
Cheese	4.8–6.4	Salmon	6.1–6.3
Cherry	3.2–4.0	Sauerkraut cabbage	3.4–3.6
Cracker	6.5–8.5	Spinach	5.1–5.7
Curdled milk	4.4	Strawberry	3.0–3.5
Date	6.2–6.4	Sultana	2.8–3.0
Drinking water	6.5–8.0	Squash	4.8–5.2
Eggs	7.6–8.0	Tomato	4.0–4.4
Flour	5.5–6.5	Turnip	5.2–5.6
Fruit jelly	2.8–3.4	Vinegar	2.4–3.4
Gooseberry	2.8–3.0	Wines	2.8–3.8

Table 214

Relative permittivities of pure liquids

Liquid	ε_{20}	ε_{25}	Temperature coefficient, α
n-Pentane	1.844	—	0.0016
n-Hexane	1.890	—	0.0015
n-Heptane	1.924	—	0.0014
n-Decane	1.991	—	0.0013
Cyclohexane	2.023	2.015	0.0016
1,4-Dioxan	—	2.209	0.0017
Carbon tetrachloride	2.238	2.228	0.0020
Benzene	2.284	2.274	0.0020
Toluene	—	2.379	0.0024
Carbon disulphide	2.641	—	0.0027
Chloroform	4.806	—	0.0016
Chlorobenzene	5.708	5.621	—
1,2-Dichloroethane	10.65	10.36	—
Methanol	33.62	32.63	—
Nitrobenzene	35.74	34.82	—

Remark: $\varepsilon_{t_2} = \varepsilon_{t_1} - \alpha(t_2 - t_1)$

Table 215

Relative permittivities of acetone–benzene standard mixtures at 25°C and at 400 MHz

Acetone*, w. %	ε	Temperature coefficient, %
0	2.25	0.1
20	5.01	0.3
40	8.23	0.4
60	11.74	0.5
80	15.71	0.5
100	19.76	0.6

* Reagent grade, water free.

Table 216

Relative permittivities of water–acetone standard mixtures at 25°C and at 400 MHz

Water, w. %	ε	Temperature coefficient, %
0	19.76	0.6
20	30.55	0.5
40	42.2	0.5
60	55.3	0.5
80	68.5	0.5
100	79.0	0.4

V

ELECTRODE POTENTIALS, ELECTROMOTIVE FORCES, DIFFUSION POTENTIALS, ZERO CHARGE POTENTIALS, GALVANIC CELLS, ACCUMULATORS

Table 217

Standard electrode potentials of metals in aqueous solution *vs.* SHE
(The electrochemical series)

Electrode	E^0, V	Electrode	E^0, V
Li/Li^+	−3.024	Fe/Fe^{2+}	−0.441
Cs/Cs^+	−3.02	Cd/Cd^{2+}	−0.402
Rb/Rb^+	−2.99	In/In^{3+}	−0.340
K/K^+	−2.924	Tl/Tl^+	−0.338
Ra/Ra^{2+}	−2.92	Co/Co^{2+}	−0.277
Ba/Ba^{2+}	−2.90	In/In^+	−0.25
Sr/Sr^{2+}	−2.89	Ni/Ni^{2+}	−0.250
Ca/Ca^{2+}	−2.87	Mo/Mo^{3+}	−0.2
Na/Na^+	−2.714	Sn/Sn^{2+}	−0.140
Ce/Ce^{3+}	−2.48	Pb/Pb^{2+}	−0.126
Nd/Nd^{3+}	−2.44	Fe/Fe^{3+}	−0.036
Sm/Sm^{3+}	−2.41	$D_2/2\,D^+$	−0.0034
Gd/Gd^{3+}	−2.40	$H_2/2\,H^+$	0.000
La/La^{3+}	−2.37	Bi/Bi^{3+}	0.2
Y/Y^{3+}	−2.37	Sb/Sb^{3+}	0.24
Mg/Mg^{2+}	−2.34	As/As^{3+}	0.3
Am/Am^{3+}	−2.32	Cu/Cu^{2+}	0.345
Lu/Lu^{3+}	−2.225	Co/Co^{3+}	0.4
Sc/Sc^{3+}	−2.08	Ru/Ru^{2+}	0.45
Pu/Pu^{3+}	−2.07	Cu/Cu^+	0.522
Th/Th^{4+}	−1.90	Po/Po^{3+}	0.56
Np/Np^{3+}	−1.86	Te/Te^{4+}	0.568
U/U^{3+}	−1.80	Po/Po^{2+}	0.65
Ti/Ti^{2+}	−1.75	Os/Os^{2+}	0.7
Be/Be^{2+}	−1.70	Tl/Tl^{3+}	0.71
Hf/Hf^{4+}	−1.70	$2\,Hg/Hg_2^{2+}$	0.789
Al/Al^{3+}	−1.67	Ag/Ag^+	0.799
Zr/Zr^{4+}	−1.53	Pb/Pb^{4+}	0.80
U/U^{4+}	−1.4	Rh/Rh^{3+}	∼0.8
Mn/Mn^{2+}	−1.05	Hg/Hg^{2+}	0.854
V/V^{2+}	−1.18	Pd/Pd^{2+}	0.987
Nb/Nb^{3+}	−1.1	Ir/Ir^{3+}	1.0
Cr/Cr^{2+}	−0.9	Pt/Pt^{2+}	∼1.2
Zn/Zn^{2+}	−0.762	Au/Au^{3+}	1.50
Cr/Cr^{3+}	−0.71	Ce/Ce^{4+}	1.68
Ga/Ga^{3+}	−0.52	Au/Au^+	1.70
Ga/Ga^{2+}	−0.45		

Table 218

Standard redox potentials
of metals in aqueous solutions *vs.* SHE

Redox system	E^0, V	Redox system	E^0, V
Am^{3+}/Am^{4+}	2.18	In^{+}/In^{2+}	−0.35
Ag^{+}/Ag^{2+}	1.98	In^{2+}/In^{3+}	−0.45
Au^{+}/Au^{3+}	1.41	Mn^{2+}/Mn^{3+}	1.51
Bk^{3+}/Bk^{4+}	1.6	Np^{3+}/Np^{4+}	0.147
Ce^{3+}/Ce^{4+}	1.61	Pb^{2+}/Pb^{4+}	~1.7
Co^{2+}/Co^{3+}	1.82	Pu^{3+}/Pu^{4+}	0.97
Cr^{2+}/Cr^{3+}	−0.41	Sn^{2+}/Sn^{4+}	0.15
Cu^{+}/Cu^{2+}	0.167	Ti^{2+}/Ti^{3+}	0.37
Eu^{2+}/Eu^{3+}	−0.43	Ti^{3+}/Ti^{4+}	−0.04
Fe^{2+}/Fe^{3+}	0.771	$Tl^{+}Tl^{3+}$	1.25
Ga^{2+}/Ga^{3+}	−0.65	U^{3+}/U^{4+}	−0.61
$Hg^{2+}/2\,Hg^{2+}$	0.920	V^{2+}/V^{3+}	−0.255

Table 219

Standard electrode potentials of some metals
and gas electrodes *vs.* SHE in non-aqueous solutions

Electrode	CH_3OH	C_2H_5OH	NH_3	N_2H_4	HCO_2H	CH_3CN
	Electrode potential, V					
Li/Li^{+}	−3.095	−3.042	−2.24	−2.20	−3.48	−3.23
Na/Na^{+}	−2.728	−2.657	−2.01	−1.82	−3.42	−2.87
K/K^{+}	—	—	−1.98	−2.02	−3.36	−3.16
Rb/Rb^{+}	—	—	−1.93	−2.01	−3.45	−3.17
Cs/Cs^{+}	—	—	−1.95	—	−3.44	−3.16
Ca/Ca^{2+}	—	—	−1.64	−1.91	−3.20	−2.75
Zn/Zn^{2+}	−0.74	−0.64	−0.53	−0.41	−1.05	−0.74
Cd/Cd^{2+}	−0.43	−0.38	−0.20	−0.10	−0.75	−0.47
Tl/Tl^{+}	−0.379	−0.343	—	—	—	—
Pb/Pb^{2+}	−0.20	−0.15	+0.32	+0.35	−0.72	−0.12
$Pt,H_2/2\,H^{+}$	0	0	0	0	0	0
Cu/Cu^{+}	—	—	+0.41	+0.22	—	−0.38
Cu/Cu^{2+}	+0.34	+0.21	+0.43	—	0.14	−0.28
$2\,Hg/Hg_2^{2+}$	+0.74	+0.76	—	—	0.18	—
Hg/Hg^{2+}	—	—	+0.75	—	—	+0.25
Ag/Ag^{+}	+0.764	+0.749	+0.83	+0.77	+0.17	+0.23
$2\,I^{-}/I_2$	+0.357	+0.305	+1.42	—	—	—
$2\,Br^{-}/Br_2$	+0.887	+0.777	+1.83	—	—	—
$2\,Cl^{-}/Cl_2$	+1.116	+1.048	+2.03	—	—	—

Table 220

Standard electrode potentials of some metals in formamide *vs.* SHE

Electrode	E^0, V	Electrode	E^0 V
Cd	-0.408 ± 0.009	K -2.872 ± 0.005	-0.193 ± 0.012
$Cd/CdCl_2$	-0.617 ± 0.004	Pb	-2.855 ± 0.005
$Cd/CdCl_2/KCl$*	-0.608 ± 0.006	Rb	-0.344 ± 0.014
Cu/Cu^{2+}	$+0.279 \pm 0.012$	Tl	-0.757 ± 0.008
		Zn	

* Saturated solution in formamide

Table 221

Electrode potentials of metals in their pure molten halides at 700°C ($E^0_K = 0$)

Metal	Bromide	Iodide	Chloride	Metal	Bromide	Iodide	Chloride
	Relative electrode potential, V				Relative electrode potential, V		
Ag	+2.39	+2.14	+2.68	Mg	—	+1.02	+0.91
Al	+1.67	—	+1.63	Mn	+1.65	+1.60	+1.63
Ba	—	+0.21	−0.10	Na	+0.14	+0.21	+0.17
Bi	+2.9	+2.6	+3.1	Ni	—	—	+2.49
Ca	+0.23	—	+0.14	Pb	—	+2.16	+2.36
Cd	+2.09	+2.36	+2.22	Rb	—	—	−0.10
Co	+2.48	+2.55	+2.54	Sn	+2.22	—	+2.37
Cs	—	—	−0.16	Sr	+0.07	+0.01	−0.02
Cu	+2.42	+2.22	+2.87	Th	—	—	+1.42
K	**0.00**	**0.00**	**0.00**	Tl	+1.74	+1.61	+2.05
Li	+0.08	—	+0.11	Zn	—	—	+2.07

Table 222

Electrode potentials of metals in bromide melts at 700°C ($E^0_K = 0$)

Metal	$AlBr_3$	$AlBr_3 + KBr$	$AlBr_3 + NaBr$	$AlBr_3 + KBr + NaBr$
	Relative electrode potential, V			
Ag	+3.07	+2.97	+3.12	+3.04
Al	+2.65	+2.65	+2.65	+2.65
Bi	+3.53	+3.47	+3.27	+2.98
Cd	+3.05	+2.86	+2.77	—
Co	—	+3.37	—	—
Cu	—	+3.00	+3.37	+3.08
Fe	—	+3.22	—	—
Hg	+3.29	+3.24	+3.40	+3.33
K	**0.00**	**0.00**	**0.00**	**0.00**
Na	0.2	0.2	0.2	0.2
Ni	—	+3.39	—	—
Pb	—	+2.73	+2.82	+2.84
Sb	+3.35	+3.40	—	—
Sn	—	+2.88	+2.93	—
Tl	—	+2.55	—	—
Zn	+2.69	+2.71	+2.71	+2.72

Table 223

Standard potentials of electrochemical reactions

No.	Electrode reaction	E^0, V
1	$Li^+ + e = Li$	−3.024
2	$Cs^+ + e + Cs$	−3.02
3	$Ca(OH)_2 + 2\,e = Ca + 2\,OH^-$	−3.02
4	$Rb^+ + e = Rb$	−2.99
5	$Sr(OH)_2 \cdot 8\,H_2O + 2\,e = Sr + 2\,OH^- + 8\,H_2O + 2\,e$	−2.99
6	$Ba(OH)_2 \cdot 8\,H_2O + 2\,e = Ba + 2\,OH^- + 8\,H_2O + 2\,e$	−2.97
7	$H\,(g) + OH^- = H_2O + e$	−2.93
8	$K^+ + e = K$	−2.924
9	$Ra^{2+} + 2\,e = Ra$	−2.92
10	$Ba^{2+} + 2\,e = Ba$	−2.90
11	$Sr^{2+} + 2\,e = Sr$	−2.89
12	$Ca^{2+} + 2\,e = Ca$	−2.87
13	$La(OH)_3 + 3\,e = La + 3\,OH^-$	−2.80
14	$Lu(OH)_3 + 3\,e = Lu + 3\,OH^-$	−2.72
15	$Na^+ + e = Na$	−2.714
16	$Mg(OH)_2 + 2\,e = Mg + 2\,OH^-$	−2.68
17	$ThO_2 + 2\,H_2O + 4\,e = Th + 4\,OH^-$	−2.64
18	$Sc(OH)_3 + 3\,e = Sc + 3\,OH^-$	−2.6
19	$HfO(OH)_2 + H_2O + 4\,e = Hf + 4\,OH^-$	−2.50
20	$Ce^{3+} + 3\,e = Ce$	−2.48
21	$Nd^{3+} + 3\,e = Nd$	−2.44
22	$Pu(OH)_3 + 3\,e = Pu + 3\,OH^-$	−2.42
23	$Sm^{3+} + 3\,e = Sm$	−2.41
24	$Gd^{3+} + 3\,e = Gd$	−2.40
25	$UO_2 + 2\,H_2O + 4\,e = U + 4\,OH^-$	−2.39
26	$La^{3+} + 3\,e = La$	−2.37
27	$Y^{3+} + 3\,e = Y$	−2.37
28	$H_2AlO^- + H_2O + 3\,e = Al + 4\,OH^-$	−2.35
29	$Mg^{2+} + 2\,e = Mg$	−2.34
30	$H_2ZrO_3 + H_2O + 4\,e = Zr + 4\,OH^-$	−2.32
31	$Am^{3+} + 3\,e = Am$	−2.32
32	$Al(OH)_3 + 3\,e = Al + 3\,OH^-$	−2.31
33	$Be_2O_3^{2-} + 3\,H_2O + 4\,e = 2\,Be + 6\,OH^-$	−2.28
34	$Lu^{3+} + 3\,e = Lu$	−2.25
35	$^1/_2\,H_2 + e = H^-$	−2.23
36	$U(OH)_4 + e = U(OH)_3 + OH^-$	−2.2
37	$U(OH)_3 + 3\,e = U + 3\,OH^-$	−2.17
38	$\mathbf{H^+ + e = H\,(g)}$	**−2.10**
39	$Sc^{3+} + 3\,e = Sc$	−2.08
40	$Pu^{3+} + 3\,e = Pu$	−2.07
41	$AlF_6^{3-} + 3\,e = Al + 6\,F^-$	−2.07
42	$Th^{4+} + 4\,e = Th$	−1.90
43	$Np^{3+} + 3\,e = Np$	−1.86
44	$H_2PO_2^- + e = P + 2\,OH^-$	−1.82
45	$U^{3+} + 3\,e = U$	−1.80

in aqueous solution *vs.* SHE

No.	Electrode reaction	E^0, V
46	$ThO_2 + 4\,H^+ + 4\,e = Th + 2\,H_2O$	−1.80
47	$H_2BO_3^- + 3\,e = B + 4\,OH^-$	−1.79
48	$Ti^{2+} + 2\,e = Ti$	−1.75
49	$SiO_3^{2-} + 3\,H_2O + 4\,e = Si + 6\,OH^-$	−1.73
50	$HPO_3^{2-} + 2\,H_2O + 3\,e = P + 5\,OH^-$	−1.71
51	$Hf^{4+} + 4\,e = Hf$	−1.70
52	$Be^{2+} + 2\,e = Be$	−1.70
53	$HfO^{2+} + 2\,H^+ + 4\,e = Hf + H_2O$	−1.68
54	$Al^{3+} + 3\,e = Al$	−1.67
55	$HPO_3^{2-} + 2\,H_2O + 2\,e = H_2PO_2^- + 3\,OH^-$	−1.65
56	$Na_2UO_4 + 4\,H_2O + 2\,e = U(OH)_4 + 2\,Na^+ + 4\,OH^-$	−1.61
57	$Zr^{4+} + 4\,e = Zr$	−1.53
58	$[Fe(CN)_6]^{4-} + 2\,e = Fe + 6\,CN^-$	−1.5
59	$Mn(OH)_2 + 2\,e = Mn + 2\,OH^-$	−1.47
60	$ZnS + 2\,e = Zn + S^{2-}$	−1.44
61	$ZrO_2 + 4\,H^+ + 4\,e = Zr + 2\,H_2O$	−1.43
62	$2\,SO_3^{2-} + 2\,H_2O + 2\,e = S_2O_4^{2-} + 4\,OH^-$	−1.4
63	$UO_2 + 4\,H^+ + 4\,e = U + 2\,H_2O$	−1.40
64	$As + 3\,H_2O + 3\,e = AsH_3 + 3\,OH^-$	−1.37
65	$MnCO_3 + 2\,e = Mn + CO_3^{2-}$	−1.35
66	$Cr(OH)_3 + 3\,e = Cr + 3\,OH^-$	−1.3
67	$[Cr(CN)_6]^{4-} = [Cr(CN)_6]^{3-} + e$ (in KCN soln.)	−1.28
68	$[Zn(CN)_4]^{2-} + 2\,e = Zn + 4\,CN^-$	−1.26
69	$Zn(OH)_2 + 2\,e = Zn + 2\,OH^-$	−1.245
70	$CdS + 2\,e = Cd + S^{2-}$	−1.23
71	$H_2GaO^- + H_2O + 3\,e = Ga + 4\,OH^-$	−1.22
72	$ZnO_2^{2-} + 2\,H_2O + 2\,e = Zn + 4\,OH^-$	−1.216
73	$CrO_2^- + 2\,H_2O + 3\,e = Cr + 4\,OH^-$	−1.2
74	$SiF_6^{2-} + 4\,e = Si + 6\,F^-$	−1.2
75	$TiF_6^{2-} + 4\,e = Ti + 6\,F^-$	−1.19
76	$In_2O_3 + 3\,H_2O + 6\,e = 2\,In + 6\,OH^-$	−1.18
77	$V^{2+} + 2\,e = V$	−1.18
78	$16\,H_2O + HV_6O_{17}^{3-} + 30\,e = 6\,V + 33\,OH^-$	−1.15
79	$N_2 + 4\,H_2O + 4\,e = N_2H_4 + 4\,OH^-$	−1.15
80	HCO^- (aq) $+ 2\,H_2O + 2\,e = HCHO$ (aq) $+ 3\,OH^-$	−1.14
81	$Nb^{3+} + 3\,e = Nb$	−1.1
82	$NiS\,(\gamma) + 2\,e = Ni + S^{2-}$	−1.07
83	$ZnCO_3 + 2\,e = Zn + CO_3^{2-}$	−1.06
84	$BF_4^- + 3\,e = B + 4\,F^-$	−1.06
85	$Mn^{2+} + 2\,e = Mn$	−1.05
86	$PO_4^{3-} + 2\,H_2O + 2\,e = HPO_3^{2-} + 3\,OH^-$	−1.05
87	$N_2O + 5\,H_2O + 4\,e = 2\,NH_2OH + 4\,OH^-$	−1.05
88	$MoO_4^{2-} + 4\,H_2O + 6\,e = Mo + 8\,OH^-$	−1.05
89	$WO_4^{2-} + 4\,H_2O + 6\,e = W + 8\,OH^-$	−1.05
90	$Tl_2S + 2\,e = Tl + S^{2-}$	−1.04
91	$[Zn(NH_3)_4]^{2+} + 2\,e = Zn + 4\,NH_3$ (aq)	−1.03
92	$FeS\,(\alpha) + 2\,e = Fe + S^{2-}$	−1.01

Table 223

No.	Electrode reaction	E^0, V
93	$In(OH)_3 + 3e = In + 3OH^-$	−1.0
94	$PbS + 2e = Pb + S^{2-}$	−0.98
95	$CNO^- + H_2O + 2e = CN^- + 2OH^-$	−0.96
96	$Sn(OH)_6^{2-} + 2e = HSnO_2^- + 3OH^- + H_2O$	−0.96
97	$Pu(OH)_4 + e = Pu(OH)_3 + OH^-$	−0.95
98	TiO_2 (amorphous) $+ 4H^+ + 4e = Ti + 2H_2O$	−0.95
99	$Cu_2S + 2e = 2Cu + S^{2-}$	−0.95
100	$CO_3^{2-} + 2H_2O + 2e = HCO_2^- + 3OH^-$	−0.95
101	$SnS + 2e = Sn + S^{2-}$	−0.94
102	$CoS\ (\alpha) + 2e = Co + S^{2-}$	−0.93
103	$Te + 2e = Te^{2-}$	−0.92
104	$Cd(CN)_4^{2-} + 2e = Cd + 4CN^-$	−0.90
105	$SO_4^{2-} + H_2O + 2e = SO_3^{2-} + 2OH^-$	−0.90
106	$Cr^{2+} + 2e = Cr$	−0.9
107	$HGeO^- + 2H_2O + 4e = Ge + 5OH^-$	−0.9
108	$P + 3H_2O + 3e = PH_3 + 3OH^-$	−0.88
109	$Fe(OH)_2 + 2e = Fe + 2OH^-$	−0.877
110	$NiS\ (\alpha) + 2e = Ni + S^{2-}$	−0.86
111	$SbS_2^- + 3e = Sb + 2S^{2-}$	−0.85
112	$2NO_3^- + 2H_2O + 2e = N_2O_4 + 4OH^-$	−0.85
113	$Si + 2H_2O = SiO_2 + 4H^+ + 4e$	−0.84
114	$[Co(CN)_6]^{3-} + 2 = [Co(CN)_6]^{4-}$	−0.83
115	$PtS + 2e = Pt + S^{2-}$	−0.83
116	$\mathbf{2H_2O + 2e = H_2 + 2OH^-}$	**−0.828**
117	$UO_2^{2+} + 4H^+ + 6e = U + 2H_2O$	−0.82
118	$[Ni(CN)_4]^{2-} + e = [Ni(CN)_3]^{2-} + CN^-$	−0.82
119	$Cd(OH)_2 + 2e = Cd + 2OH^-$	−0.81
120	$Ta_2O_5 + 10H^+ + 10e = 2Ta + 5H_2O$	−0.81
121	$CdCO_3 + 2e = Cd + CO_3^{2-}$	−0.8
122	$ZnSO_4 \cdot 7H_2O + 2e = Zn$ (amalg.) $+ SO_4^{2-}$ (in cc. $ZnSO_4 \cdot 7H_2O$)	−0.799
123	$HSnO^- + H_2O + 2e = Sn + 3OH^-$	−0.79
124	$Se + 2e = Se^{2-}$	−0.78
125	$Zn^{2+} + 2e = Zn$	−0.762
126	$TlI + e = Tl + I^-$	−0.76
127	$CuS + 2e = Cu + S^{2-}$	−0.76
128	$FeCO_3 + 2e = Fe + CO_3^{2-}$	−0.755
129	$AsS_2^- + 3e = As + 2S^{2-}$	−0.75
130	$CrCl_2^- + 3e = Cr + 2Cl^-$	−0.74
131	$Co(OH)_2 + 2e = Co + 2OH^-$	−0.73
132	$H_3BO_3 + 3H^+ + 3e = B + 3H_2O$	−0.73
133	$N_2O_2^{2-} + 6H_2O + 4e = 2NH_2OH + 6OH^-$	−0.73
134	$Cr^{3+} + 3e = Cr$	−0.71
135	$Ag_2S + 2e = 2Ag + S^{2-}$	−0.71
136	$AsO_4^{3-} + 2H_2O + 2e = AsO^- + 4OH^-$	−0.71
137	$HgS + 2e = Hg + S^{2-}$	−0.70
138	$[Mn(CN)_6]^{3-} + e = [Mn(CN)_4]^{2-} + 2CN^-$	−0.7

(continued)

No.	Electrode reaction	E^0, V
139	$Te + 2\,H^+ + 2\,e = H_2Te$	−0.7
140	$Ni(OH)_2 + 2\,e = Ni + 2\,OH^-$	−0.69
141	$AsO_2^- + 2\,H_2O + 3\,e = As + 4\,OH^-$	−0.68
142	$Ag_2S + H_2O + 2\,e = 2\,Ag + OH^- + SH^-$	−0.67
143	$Fe_2S_3 + 2\,e = 2\,FeS + S^{2-}$	−0.67
144	$SbO^- + 2\,H_2O + 3\,e = Sb + 4\,OH^-$	−0.66
145	$TlBr + e = Tl + Br^-$	−0.658
146	$Ga^{3+} + e = Ga^{2+}$	−0.65
147	$CoCO_3 + 2\,e = Co + CO_3^{2-}$	−0.632
148	$Nb_2O_5 + 10\,H^+ + 10\,e = 2\,Nb + 5\,H_2O$	−0.63
149	$U^{4+} + e = U^{3+}$	−0.61
150	$SO_3^{2-} + 3\,H_2O + 6\,e = S^{2-} + 6\,OH^-$	−0.61
151	$Au(CN)_2^- + e = Au + 2\,CN^-$	−0.60
152	$AsS_4^{3-} + 2\,e = AsS_2^- + 2\,S^{2-}$	−0.6
153	$[Cd(NH_3)_4]^{2+} + 2\,e = Cd + 4\,NH_3$ (aq)	−0.597
154	$ReO_4^- + 2\,H_2O + 3\,e = ReO_2 + 4\,OH^-$	−0.594
155	$H_3PO_3 + 2\,H^+ + 2\,e = H_3PO_2 + H_2O$	−0.59
156	HCHO (aq) $+ 2\,H_2O + 2\,e = CH_3OH$ (aq) $+ 2\,OH^-$	−0.59
157	$ReO_4^- + 4\,H_2O + 7\,e = Re + 8\,OH^-$	−0.584
158	$NO_3^- + NO + e = 2\,NO_2^-$	−0.58
159	$2\,SO_3^{2-} + 3\,H_2O + 4\,e = S_2O_3^{2-} + 6\,OH^-$	−0.58
160	$2\,CuS + 2\,e = Cu_2S + S^{2-}$	−0.58
161	$PbO + H_2O + 2\,e = Pb + 2\,OH^-$	−0.578
162	$ReO_2 + H_2O + 4\,e = Re + 4\,OH^-$	−0.576
163	$TeO_3^{2-} + 3\,H_2O + 4\,e = Te + 6\,OH^-$	−0.57
164	$Fe(OH)_3 + e = Fe(OH)_2 + OH^-$	−0.56
165	$PbS + H_2O + 2\,e = Pb + OH^- + SH^-$	−0.56
166	$O_2^- = O_2 + e$	−0.56
167	$TlCl + e = Tl + Cl^-$	−0.557
168	$2\,NH_4 + 2\,e = 2\,NH_3$ (aq) $+ H_2$	−0.55
169	$S_4^{2-} + 2\,e = S + S_3$	−0.55
170	$As + 3\,H^+ + 3\,e = AsH_3$	−0.54
171	$HPbO^- + H_2O + 2\,e = Pb + 3\,OH^-$	−0.54
172	$Cu_2S + 2\,e = 2\,Cu + S^{2-}$	−0.54
173	$Ga^{3+} + 3\,e = Ga$	−0.52
174	$S_2^{2-} + 2\,e = 2\,S^{2-}$	−0.51
175	$[Ag(CN)_3]^{2-} + e = Ag + 3\,CN^-$	−0.51
176	$Sb + 3\,H^+ + 3\,e = SbH_3$ (g)	−0.51
177	$H_3PO_2 + H^+ + e = P + 2\,H_2O$	−0.51
178	$S + 2\,e = S^{2-}$	−0.508
179	$PbCO_3 + 2\,e = Pb + CO_3^{2-}$	−0.506
180	$H_3PO_3 + 2\,H^+ + 2\,e = H_3PO_2 + H_2O$	−0.50
181	$2\,CO_2 + 2\,H^+ + 2\,e = H_2C_2O_4$ (aq)	−0.49
182	$H_3PO_3 + 3\,H^+ + 3\,e = P + 3\,H_2O$	−0.49
183	$[Ni(NH_3)_6]^{2+} + 2\,e = Ni + 6\,NH_3$ (aq)	−0.48
184	$NO_2^- + H_2O + e = NO + 2\,OH^-$	−0.46
185	$BiOOH + H_2O + 3\,e = Bi + 3\,OH^-$	−0.46

Table 223

No.	Electrode reaction	E^0, V
186	$ClO^- + H_2O + e = ClO_2$ (g) $+ 2\,OH^-$	−0.45
187	$NiCO_3 + 2\,e = Ni + CO_3^{2-}$	−0.45
188	$In^{3+} + e = In^{2+}$	−0.45
189	$Fe^{2+} + 2\,e = Fe$	−0.441
190	$CdSO_4 \cdot {}^8/_3\,H_2O + 2\,e = Cd$ (amalg.) $+ SO_4^{2-}$ (in cc. $CdSO_4 \cdot {}^8/_3\,H_2O$)	−0.435
191	$Eu^{3+} + e = Eu^{2+}$	−0.43
192	$[Cu(CN)_2]^- + e = Cu + 2\,CN^-$	−0.43
193	$[Co(NH_3)_6]^{2+} + 2\,e = Co + 6\,NH_3$ (aq)	−0.422
194	**$2\,H^+([H^+] = 10^{-7}$ m) $+ 2\,e = H_2$**	**−0.414**
195	$Cr^{3+} + e = Cr^{2+}$	−0.41
196	$Cd^{2+} + 2\,e = Cd$	−0.402
197	$Mn(OH)_3 + e = Mn(OH)_2 + OH^-$	−0.40
198	$Ga_2O + 2\,H^+ + 2\,e = 2\,Ga + H_2O$	−0.4
199	$Hg(CN)_4^{2-} + 2\,e = Hg + 4\,CN^-$	−0.37
200	$Ti^{3+} + e = Ti^{2+}$	−0.37
201	$SeO_3^{2-} + 3\,H_2O + 4\,e = Se + 6\,OH^-$	−0.366
202	$PbI_2 + 2\,e = Pb + 2\,I^-$	−0.365
203	$Cu_2O + H_2O + 2\,e = 2\,Cu + 2\,OH^-$	−0.361
204	$Se + 2\,H^+ + 2\,e = H_2Se$	−0.36
205	$Hg_2(CN)_2 + 2\,e = 2\,Hg + 2\,CN^-$	−0.36
206	$PbSO_4 + 2\,e = Pb + SO_2^{4-}$	−0.355
207	$In^{2+} + e = In^+$	−0.35
208	$Tl(OH) + e = Tl + OH^-$	−0.344
209	$In^{3+} + 3\,e = In$	−0.340
210	$InCl + e = In + Cl^-$	−0.34
211	$Tl^+ + e = Tl$	−0.338
212	$PtS + 2\,H^+ + 2\,e = Pt + H_2S$	−0.30
213	$[Ag(CN)_2]^- + e = Ag + 2\,CN^-$	−0.30
214	$NO_3^- + 5\,H_2O + 6\,e = NH_2OH + 7\,OH^-$	−7.30
215	$PbBr_2 + 2\,e = Pb + 2\,Br^-$	−0.280
216	$Co^{2+} + 2\,e = Co$	−0.277
217	$H_3PO_4 + 2\,H^+ + 2\,e = H_3PO_3$	−0.276
218	$HCNO + H^+ + e = {}^1/_2\,(CN)_2 + H_2O$	−0.27
219	$Cu(CNS) + e = Cu + CNS^-$	−0.27
220	$PbCl_2 + 2\,e = Pb + 2\,Cl^-$	−0.268
221	$CuS + 2\,H^+ + 2\,e = Cu + H_2S$	−0.259
222	$V^{3+} + e = V^{2+}$	−0.255
223	$Sb_2O_3 + 6\,H^+ + 6\,e = 2\,Sb + 3\,H_2O$	−0.255
224	$V(OH)_4^- + 4\,H^+ + 5\,e = V + 4\,H_2O$	−0.253
225	$Ni^{2+} + 2\,e = Ni$	−0.250
226	$SnF_6^{2-} + 4\,e = Sn + 6\,F^-$	−0.25
227	CH_3OH (aq) $+ H_2O + 2\,e = CH_4 + 2\,OH^-$	−0.25
228	**$HO_2^- + H_2O + e = OH + 2\,OH^-$**	**−0.24**
229	$2\,H_2SO_3 + H^+ + 2\,e = HS_2O_4^- + 2\,H_2O$	−0.23
230	$N_2 + 5\,H^+ + 4\,e = N_2H_5^+$	−0.23
231	$Cu(OH)_2 + 2\,e = Cu + 2\,OH^-$	−0.224

(continued)

No.	Electrode reaction	E^0, V
232	$SO_4^{2-} + 4\,H^+ + 2\,e = S_2O_6^{2-}$	−0.22
233	$Mo^{3+} + 3\,e = Mo$	−0.2
234	$CuI + e = Cu + I^-$	−0.187
235	$2\,NO_3^- + 2\,H_2O + 4\,e = N_2O_2^{2-} + 4\,OH^-$	−0.180
236	$PbO_2 + 2\,H_2O + 4\,e = Pb + 4\,OH^-$	−0.16
237	$AgI + e = Ag + I^-$	−0.151
238	$GeO_2 + 4\,H^+ + 4\,e = Ge + 2\,H_2O$	−0.15
239	$Sn^{2+} + 2\,e = Sn$	−0.140
240	$CO_2 + 2\,H^+ + 2\,e = HCOOH$ (aq)	−0.14
241	CH_3COOH (aq) $+ 2\,H^+ + 2\,e = CH_3CHO$ (aq) $+ H_2O$	−0.13
242	$Pb^{2+} + 2\,e = Pb$	−0.126
243	$CrO_4^{2-} + 4\,H_2O + 3\,e = Cr(OH)_3 + 5\,OH^-$	−0.12
244	$[Cu(NH_3)_2]^+ + e = Cu + 2\,NH_3$	−0.11
245	$2\,Cu(OH)_2 + 2\,e = Cu_2O + H_2O + 2\,OH^-$	−0.09
246	$WO_3 + 6\,H^+ + 6\,e = W + 3\,H_2O$	−0.09
247	$\mathbf{O_2 + H_2O + 2\,e = HO_2^- + OH^-}$	**−0.076**
248	$N_2O + H_2O + 6\,H^+ + 4\,e = 2\,NH_3OH^+$	−0.05
249	$[Cu(NH_3)_4]^{2+} + 2\,e = Cu + 4\,NH_3$ (aq)	−0.05
250	$Tl(OH)_3 + 2\,e = TlOH + 2\,OH^-$	−0.05
251	$MnO_2 + H_2O + 2\,e = Mn(OH)_2 + 2\,OH^-$	−0.05
252	$Hg_2I_2 + 2\,e = 2\,Hg + 2\,I^-$	−0.0405
253	$HgI_4^- + 2\,e = Hg + 4\,I^-$	−0.04
254	$Ti^{4+} + e = Ti^{3+}$	−0.04
255	$P + 3\,H^+ + 3\,e = PH_3$	−0.04
256	$AgCN + e = Ag + CN^-$	−0.04
257	$RuO_2 + 2\,H_2O + 4\,e = Ru + 4\,OH^-$	−0.04
258	$Fe^{3+} + 3\,e = Fe$	−0.036
259	$Ag_2S + 2\,H^+ + 2\,e = 2\,Ag + H_2S$	−0.036
260	$TeO_3^{2-} + 2\,H_2O + 4\,e = Te + 6\,OH^-$	−0.02
261	$HCOOH$ (aq) $+ 2\,H^+ + 2\,e = HCHO$ (aq) $+ H_2O$	−0.01
262	$\mathbf{2\,De^+ + 2\,e = De_2}$	**−0.0034**
263	H_2MoO_4 (aq) $+ 6\,H^+ + 6\,e = Mo + 4\,H_2O$	0.0
264	$CuI_2^- + e = Cu + 2\,I^-$	0.0
265	$[Cu(NH_3)_4]^{2+} + e = [Cu(NH_3)_2]^+ + 2\,NH_3$ (aq)	0.0
266	$\mathbf{2\,H^+ + 2\,e = H_2}$	**0.0000**
267	$[Ag(S_2O_3)_2]^{3-} + 3 = Ag + 2\,S_2O_3^{2-}$	0.01
268	$NO_2^- + H_2O + 2\,e = NO_3^- + 2\,OH^-$	0.01
269	$Os + 9\,OH^- = HOsO_5^- + 4\,H_2O + 8\,e$	0.02
270	$[Fe(C_2O_4)_3]^{3-} + e = [Fe(C_2O_4)_2]^{2-} + C_2O_4^{2-}$	0.02
271	$SeO_4^{2-} + H_2O + 2\,e = SeO_3^{2-} + 2\,OH^-$	0.03
272	$CuBr + e = Cu + Br^-$	0.033
273	$2\,Rh + 6\,OH^- = Rh_2O_3 + 3\,H_2O + 6\,e$	0.04
274	$UO_2^+ = UO_2^{2+} + e$	0.05
275	$CuBr_2^- + e = Cu + 2\,Br^-$	0.05
276	$CuCO_3 + 2\,e = Cu + CO_3^{2-}$	0.053
277	PH_3 (gas) $= P + 3\,H^+ + 3\,e$	0.06
278	$PbS + 2\,H^+ + 2\,e = Pb + H_2S$	0.07

No.	Electrode reaction	E^0, V
279	$Pd(OH)_2 + 2e = Pd + 2OH^-$	0.07
280	$AgBr + e = Ag + Br^-$	0.073
281	$AgCNS + e = Ag + CNS^-$	0.09
282	$HgO + H_2O + 2e = Hg + 2OH^-$	0.098
283	$Si + 4H^+ + 4e = SiH_4$	0.102
284	$Pd(OH)_2 + 2e = Pd + 2OH^-$	0.1
285	$N_2H_4 + 4H_2O + 2e = 2NH_4OH + 2OH^-$	0.1
286	$Ir_2O_3 + 3H_2O + 6e = 2Ir + 6OH^-$	0.1
287	$[Co(NH_3)_6]^{3+} + e = [Co(NH_3)_6]^{2+}$	0.1
288	$2NO + 2e = N_2O_2^{2-}$	0.1
289	$TiO^{2+} + 2H^+ + e = H_2O + Ti^{3+}$	0.1
290	$Mn(OH)_3 + e = Mn(OH)_2$	0.1
291	$Hg_2O + H_2O + 2e = 2Hg + 2OH^-$	0.123
292	$CuCl + e = Cu + Cl^-$	0.124
293	$C + 4H^+ + 4e = CH_4$	0.13
294	$Hg_2Br_2 + 2e = 2Hg + 2Br^-$	0.139
295	$S + 2H^+ + 2e = H_2S$	0.141
296	$Np^{4+} + e = Np^{3+}$	0.147
297	$Sn^{4+} + 2e = Sn^{2+}$	0.15
298	$ReO_4^- + 8H^+ + 7e = Re + 4H_2O$	0.15
299	$2NO_2^- + 3H_2O + 4e = N_2O + 6OH^-$	0.15
300	$Sb_2O_3 + 6H^+ + 6e = 2Sb + 3H_2O$	0.152
301	$BiCl_4^- + 3e = Bi + 4Cl^-$	0.16
302	$Pt(OH)_2 + 2e = Pt + 2OH^-$	0.16
303	$BiOCl + 2H^+ + 3e = Bi + H_2O + Cl^-$	0.16
304	$Cu^{2+} + e = Cu^+$	0.167
305	$S_4O_6^{2-} + 2e = 2S_2O_3^{2-}$	0.17
306	$ClO_4^- + H_2O + 2e = ClO_3^- + 2OH^-$	0.17
307	$CuCl_2^- + e = Cu + 2Cl^-$	0.19
308	$Ag_4[Fe(CN)_6] + 4e = 4Ag + [Fe(CN)_6]^{4-}$	0.194
309	$SO_4^{2-} + 4H^+ + 2e = H_2SO_3 + H_2O$	0.20
310	$S_2O_6^{2-} + 4H^+ + 2e = 2H_2SO_3$	0.20
311	$2SO_4^{2-} + 4H^+ + 2e = S_2O_6^{2-} + 2H_2O$	0.20
312	$Co(OH)_3 + e = Co(OH)_2 + OH^-$	0.20
313	$HgBr_4^{2-} + 2e = Hg + 4Br^-$	0.21
314	$SbO^+ + 2H^+ + 3e = Sb + H_2O$	0.212
315	$AgCl + e = Ag + Cl^-$	0.222
316	$Hg_2(CNS)_2 + 2e = 2Hg + 2CNS^-$	0.22
317	$(CH_3)_2SO_2 + 2H^+ + 2e = (CH_3)_2SO + H_2O$	0.23
318	H_3AsO_3 (aq) $+ 3H^+ + 3e = As + 3H_2O$	0.24
319	HCHO (aq) $+ 2H^+ + 2e = CH_3OH$ (aq)	0.24
320	**$Hg_2Cl_2 + 2e = 2Hg + 2Cl^-$ (satd. KCl)**	**0.244**
321	$HAsO_2$ (aq) $+ 3H^+ + 3e = As + 2H_2O$	0.247
322	$PbO_2 + H_2O + 2e = PbO + 2OH^-$	0.248
323	$Pb_3O_4 + H_2O + 2e = PbO + 2OH^-$	0.25
324	$ReO_2 + 4H^+ + 4e = Re + 2H_2O$	0.252
325	$IO_3^- = 3H_2O + 6e = I^- + 6OH^-$	0.26

(continued)

No.	Electrode reaction	E^0, V
326	$PuO_2(OH)_2 + e = PuO_2OH + OH^-$	0.26
327	$Hg_2Cl_2 + 2\,e = 2\,Hg + Cl^-$ ($a_{Cl} = 1$)	0.267
328	**$Hg_2Cl_2 + 2\,e = 2\,Hg + 2\,Cl^-$ (N KCl)**	**0.283**
329	$[Ag(SO_3)_2]^{3-} + e = Ag + 2\,SO_3^{2-}$	0.30
330	$VO^{2+} + 2\,H^+ + e = V^{3+} + H_2O$	0.314
331	$BiO^+ + 2\,H^+ + 3\,e = Bi + H_2O$	0.32
332	$Hg_2CO_3 + 2\,e = 2\,Hg + CO_3^{2-}$	0.32
333	$UO_2^{2+} + 2\,e = UO_2$	0.33
334	$(CN)_2 + 2\,H^+ + 2\,e = 2\,HCN$	0.33
335	$UO_2^{2+} + 4\,H^+ + 2\,e = U^{4+} + 2\,H_2O$	0.334
336	**$Hg_2Cl_2 + 2\,e = 2\,Hg + 2\,Cl^-$ (0.1 N KCl)**	**0.336**
337	$Ag_2O + H_2O + 2\,e = 2\,Ag + 2\,OH^-$	0.344
338	$Cu^{2+} + 2\,e = Cu$	0.345
339	$ClO_3^- + H_2O + 2\,e = ClO_2^- + 2\,OH^-$	0.35
340	$Fe(CN)_6^{3-} + e = Fe(CN)_6^{4-}$	0.36
341	$Hg_2(CH_3COO)_2 + 2\,e = 2\,Hg + 2\,CH_3COO^-$	0.36
342	$AgIO_3 + e = Ag + IO^-$	0.37
343	$Ti^{3+} + e = Ti^{2+}$	0.37
344	$[Ag(NH_3)_2]^+ + e = Ag + 2\,NH_3$ (aq)	0.373
345	$HgCl_4^{2-} + 2\,e = Hg + 4\,Cl^-$	0.38
346	$Hg(IO_3)_2 + 2\,e = Hg + 2\,IO_3^-$	0.40
347	$2\,H_2SO_3 + 2\,H^+ + 4\,e = 3\,H_2O + S_2O_3^{2-}$	0.40
348	$U^{6+} + 2\,e = U^{4+}$	0.4
349	$TeO_4^{2-} + H_2O + 2\,e = TeO_3^{2-} + 2\,OH^-$	0.4
350	**$O_2^- + H_2O + e = OH^- + HO_2^-$**	**0.4**
351	$FeF_6^{3-} + e = Fe^{2+} + 6\,F^-$	0.4
352	**$O_2 + 2\,H_2O + 4\,e = 4\,OH^-$**	**0.401**
353	$Hg_2C_2O_4 + 2\,e = 2\,Hg + C_2O_4^{2-}$	0.417
354	$NH_2OH + 2\,H_2O + 2\,e = NH_4OH + 2\,OH^-$	0.42
355	$H_2N_2O_2 + 6\,H^+ + 4\,e = 2\,NH_3OH^+$	0.44
356	$RhCl_6^{3-} + 3\,e = Rh + 6\,Cl^-$	0.44
357	$AgCrO_4 + 2\,e = 2\,Ag + CrO_4^{2-}$	0.446
358	$2\,BrO^- + 2\,H_2O + 2\,e = Br_2 + 4\,OH^-$	0.45
359	$H_2SO_3 + 4\,H^+ + 4\,e = S + 3\,H_2O$	0.45
360	$Ag_2C_2O_4 + 2\,e = 2\,Ag + C_2O_4^{2-}$	0.47
361	$Ag_2CO_3 + 2\,e = 2\,Ag + CO_3^{2-}$	0.47
362	$4\,H_2SO_3 + 4\,H^+ + 6\,e = 6\,H_2O + S_4O_6^{2-}$	0.48
363	$Sb_2O_5 + 2\,H^+ + 2\,e = Sb_2O_4 + H_2O$	0.48
364	$PdI_6^- + 2\,e = PdI_4^{2-} + 2\,I^-$ (in N KI soln.)	0.48
365	$Ag_2MoO_4 + 2\,e = 2\,Ag + MoO_4^{2-}$	0.49
366	$NiO_2 + 2\,H_2O + 2\,e = Ni(OH)_2 + 2\,OH^-$	0.49
367	$IO^- + H_2O + 2\,e = I^- + 2\,OH^-$	0.49
368	$AuI + e = Au + I^-$	0.50
369	$AuO_2^- + 2\,H_2O + 3\,e = Au + 4\,OH^-$	0.5
370	$ReO_4^- + 4\,H^+ + 3\,e = ReO_2 + 2\,H_2O$	0.51
371	$ClO_4^- + 4\,H_2O + 8\,e = Cl^- + 8\,OH^-$	0.51
372	$C_2H_4 + 2\,H^+ + 2\,e = ClH_6$	0.52
373	$2\,ClO^- + 2\,H_2O + 2\,e = Cl_2 + 4\,OH^-$	0.52

No.	Electrode reaction	E^0, V
374	$Cu^+ + e = Cu$	0.522
375	$TeO_2 + 4\,H^+ + 4\,e = Te + 2\,H_2O$	0.529
376	$Ag_2WO_4 + 2\,e = 2\,Ag + WO_4^{2-}$	0.53
377	$I_2 + 2\,e = 2\,I^-$	0.534
378	$I_3^- + 2\,e = 3\,I^-$	0.535
379	$BrO_3^- + 2\,H_2O + 4\,e = BrO^- + 4\,OH^-$	0.54
380	$MnO_4^- + e = MnO_4^{2-}$	0.54
381	$Hg_2CrO_4 + 2\,e = 2\,Hg + CrO_4^{2-}$	0.54
382	$AgBrO_3 + e = Ag + BrO_3^-$	0.55
383	$H_3AsO_4 + 2\,H^+ + 2\,e = H_3AsO_3 + H_2O$	0.559
384	$TeOOH^+ + 3\,H^+ + 4\,e = 2\,H_2O + Te$	0.559
385	$IO_3^- + 2\,H_2O + 4\,e = IO^- + 4\,OH^-$	0.56
386	$Cu^{2+} + Cl^- + e = CuCl$	0.56
387	$AgNO_2 + e = Ag + NO_2^-$	0.564
388	$Te^{4+} + 4\,e = Te$	0.568
389	$MnO_4^- + 2\,H_2O + 3\,e = MnO_2 + 4\,OH^-$	0.57
390	$2\,AgO + H_2O + 2\,e = Ag_2O + 2\,OH^-$	0.57
391	$CH_3OH\ (aq) + 2\,H^+ + 2\,e = CH_4\ (g) + H_2O$	0.58
392	$MnO_4^{2-} + 2\,H_2O + 2\,e = MnO_2 + 4\,OH^-$	0.58
393	$PtBr_4^{2-} + 2\,e = Pt + 4\,Br^-$	0.58
394	$Sb_2O_5 + 6\,H^+ + 4\,e = 2\,SbO^+ + 3\,H_2O$	0.581
395	$ClO_2^- + H_2O + 2\,e = ClO^- + 2\,OH^-$	0.59
396	$OsCl_6^{3-} + 3\,e = Os + 6\,Cl^-$	0.6
397	$PdBr_4^{2-} + 2\,e = Pd + 4\,Br^-$	0.6
398	$RuCl_5^{2-} + 3\,e = Ru + 5\,Cl^-$	0.60
399	$RuO_4^- + e = RuO_4^{2-}$	0.60
400	$2\,NO + 2\,H^+ + 2\,e = H_2N_2O_2$	0.60
401	$BrO_3^- + 3\,H_2O + 6\,e = Br^- + 6\,OH^-$	0.61
402	$Hg_2SO_4 + 2\,e = 2\,Hg + SO_4^{2-}$	0.615
403	$ClO_3^- + 3\,H_2O + 6\,e = Cl^- + 6\,OH^-$	0.62
404	$HNO_2 + 5\,H^+ + 4\,e = NH_3OH^+ + H_2O$	0.62
405	$UO_2^{2+} + 4\,H^+ + 2\,e = U^{4+} + 2\,H_2O$	0.62
406	$PtBr_6^{2-} + 2\,e = PtBr_4^{2-} + 2\,Br^-$	0.63
407	$2\,HgCl_2 + 2\,e = HgCl_2 + 2\,Cl^-$	0.63
408	$PdCl_4^{2-} + 2\,e = Pd + 4\,Cl^-$	0.64
409	$AgC_2H_3O_2 + e = Ag + CH_3COO^-$	0.643
410	$Au(CNS)_4^- + 2\,e = Au(CNS)_2^- + 2\,CNS^-$	0.645
411	$Ag_2SO_4 + 2\,e = 2\,Ag + SO_4^{2-}$	0.653
412	$Cu^{2+} + Br^- + e = CuBr$	0.657
413	$HN_3 + 11\,H^+ + 8\,e = 3\,NH_4^+$	0.66
414	$Au(CNS)_4^- + 3\,e = Au + 4\,CNS^-$	0.66
415	$ClO_2^- + H_2O + 2\,e = ClO^- + 2\,OH^-$	0.66
416	$AgBrO_3 + e = Ag + BrO_3^-$	0.68
417	$Sb_2O_4 + 4\,H^+ + 2\,e = 2\,SbO^+ + 2\,H_2O$	0.68
418	$3\,H_2SO_3 + 2\,e = S_3O_6^{2-} + 3\,H_2O$	0.68
419	$\mathbf{O_2 + 2\,H^+ + 2\,e = H_2O_2}$	**0.682**
420	$Cu^{2+} + 2\,I^- + e = CuI_2^-$	0.690
421	$Au(CNS)_2^- + e = Au + 2\,CNS^-$	0.69

(continued)

No.	Electrode reaction	E^0, V
422*	$\mathbf{C_6H_4O_2 + 2\,H^+ + 2\,e = C_6H_6O_2}$	**0.699**
423	$H_3IO_6^{2-} + 2\,e = IO^- + 3\,OH^-$	0.70
424	$Te + 2\,H^+ + 2\,e = H_2Te$	0.70
425	$IrO_2 + 4\,H^+ + e = Ir^{3+} + 2\,H_2O$	0.7
426	$PtCl_6^{2-} + 2\,e = PtCl_4^{2-} + 2\,Cl^-$	0.72
427	$IrCl_6^{3-} + 3\,e = Ir + 6\,Cl^-$	0.72
428	$PtCl_4^{2-} + 2\,e = Pt + 4\,Cl^-$	0.73
429	$[Mo(CN)_6]^{3-} + e = [Mo(CN)_6]^{4-}$	0.73
430	$H_2SeO_3 + 4\,H^+ + 4\,e = Se + 3\,H_2O$	0.740
431	$2\,NH_2OH + 2\,e = N_2H_4 + 2\,OH^-$	0.74
432	$Ag_2O_3 + H_2O + 2\,e = 2\,AgO + 2\,OH^-$	0.74
433	$H_3SbO_4 + 2\,H^+ + 2\,e = H_3SbO_3 + H_2O$	0.75
434	$NpO_4^+ + 4\,H^+ + e = Np^{4+} + 2\,H_2O$	0.75
435	$BrO^- + H_2O + 2\,e = Br^- + 2\,OH^-$	0.76
436	$(CNS)_2 + 2\,e = 2\,CNS^-$	0.77
437	$F^{3+} + e = Fe^{2+}$	0.771
438	$Hg_2^{2+} + 2\,e = 2\,Hg$	0.789
439	$RuO_2 + 4\,H^+ + 4\,e = Ru + 2\,H_2O$	0.79
440	$Ag^+ + e = Ag$	0.7991
441	$2\,NO_3^- + 4\,H^+ + 2\,e = N_2O_4 + 2\,H_2O$	0.80
442	$Pd(OH)_4 + 2\,e = Pd(OH)_2 + 2\,OH^-$	0.8
443	$Rh^{3+} + 3\,e = Rh$	~0.8
444	$AuBr_4^- + 2\,e = AuBr_2^- + 2\,Br^-$	0.82
445	$OsO_4 + 8\,H^+ + 8\,e = Os + 4\,H_2O$	0.85
446	$2\,HNO_2 + H^+ + 4\,e = H_2N_2O_2 + 2\,H_2O$	0.86
447	$Cu^{2+} + I^- + e = CuI$	0.86
448	$HNO_2 + 7\,H^+ + 6\,e = NH_4^+ + 2\,H_2O$	0.86
449	$AuBr_4^- + 3\,e = Au + 4\,Br^-$	0.87
450	$2\,IBr_2^- + 2\,e = I_2 + 4\,Br^-$	0.87
451	$\mathbf{HO_2^- + H_2O + 2\,e = 3\,OH^-}$	**0.88**
452	$N_2O_4 + 2\,e = 2\,NO_2^-$	0.88
453	$ClO^- + H_2O + 2\,e = Cl^- + 2\,OH^-$	0.89
454	$CoO_2 + H_2O + 2\,e = CoO + 2\,OH^-$	0.9
455	$FeO_4^{2-} + 2\,H_2O + 3\,e = FeO_2^- + 4\,OH^-$	0.9
456	$2\,Hg^{2+} + 2\,e = Hg_2^{2+}$	0.920
457	$PuO_2^{2+} + e = PuO_2^+$	0.93
458	$NO_3^- + 3\,H^+ + 2\,e = HNO_2 + H_2O$	0.94
459	$NO_3^- + 4\,H^+ + 3\,e = NO + 2\,H_2O$	0.96
460	$AuCl_4^- + 2\,e = AuCl_2^- + 2\,Cl^-$	0.96
461	$AuBr_2^- + e = Au + 2\,Br^-$	0.96
462	$Pu^{4+} + e = Pu^{3+}$	0.97
463	$Pt(OH)_2 + 2\,H^+ + 2\,e = Pt + 2\,H_2O$	0.98
464	$Pd^{2+} + 2\,e = Pd$	0.987
465	$HIO + H^+ + 2\,e = I^- + H_2O$	0.99
466	$IrBr_6^{3-} + e = IrBr_6^{4-}$	0.99
467	$ICl\,(s) + 2\,e = ICl\,(soln.) + 2\,Cl^-$	0.99

* Quinone–hydroquinone

No.	Electrode reaction	E^0, V
468	$HNO_2 + H^+ + e = NO + H_2O$	1.00
469	$OsO_4 + 6\,Cl^- + 8\,H^+ + 4\,e = OsCl_6^{2-} + 4\,H_2O$	1.0
470	$AuCl_4^- + 3\,e = Au + 4\,Cl^-$	1.00
471	$V(OH)_4^+ + 2\,H^+ + e = VO^{2+} + 3\,H_2O$	1.00
472	$IrCl_6^{2-} + e = IrCl_6^{3-}$	1.017
473	$H_6TeO_6 + 2\,H^+ + 2\,e = TeO_2 + 4\,H_2O$	1.02
474	$2\,IBr$ (soln.) $+ 2\,e = I_2 + 2\,Br^-$	1.02
475	$N_2O_4 + 4\,H^+ + 4\,e = 2\,NO + 2\,H_2O$	1.03
476	$VO_4^{3+} + 6\,H^+ + e = VO^{2+} + 3\,H_2O$	1.031
477	$PuO_2^{2+} + 4\,H^+ + 2\,e = Pu^{4+} + 2\,H_2O$	1.04
478	$2\,ICl_3$ (s) $+ 6\,e = I_2$ (s) $+ 6\,Cl^-$	1.05
479	$ICl_2^- + e = 2\,Cl^- + {}^1/_2\,I_2$	1.06
480	$Se_2Cl_2 + 2\,e = 2\,Se + 2\,Cl^-$	1.06
481	Br_2 (l) $+ 2\,e = 2\,Br^-$	1.0652
482	$N_2O_4 + 2\,H^+ + 2\,e = 2\,HNO_2$	1.07
483	$IO_3^- + 6\,H^+ + 6\,e = I^- + 3\,H_2O$	1.085
484	$HVO_3 + 3\,H^+ + e = VO^{2+} + 2\,H_2O^+$	1.1
485	$Cu^{2+} + 2\,CN^- + e = Cu(CN)_2^-$	1.12
486	$AuCl_2^- + e = Au + 2\,Cl^-$	1.13
487	$PuO_2^+ + 4\,H^+ + e = Pu^{4+} + 2\,H_2O$	1.15
488	$SeO_4^{2-} + 4\,H^+ + 2\,e = H_2SeO_3 + H_2O$	1.15
489	$NpO_2^{2+} + e = NpO_2^+$	1.15
490	$ClO_2 + e = ClO_2^-$	1.16
491	$CCl_4 + 4\,H^+ + 4\,e = 4\,Cl^- + C + 4\,H^+$	1.18
492	$ClO_4^- + 2\,H^+ + 2\,e = ClO_3^- + H_2O$	1.19
493	$2\,ICl$ (soln.) $+ 2\,e = I_2$ (s) $+ 2\,Cl^-$	1.19
494	$IO_3^- + 6\,H^+ + 5\,e = {}^1/_2\,I_2 + 3\,H_2O$	1.195
495	$BrCl + 2\,e = Br^- + Cl^-$	1.20
496	$Pt^{2+} + 2\,e = Pt$	~1.2
497	PdO_3 (s) $+ H_2O + 2\,e = PdO_2$ (s) $+ 2\,OH^-$	1.2
498	$ClO_3^- + 3\,H^+ + 2\,e = HClO_2 + H_2O$	1.21
599	$O_2 + 4\,H^+ + 4\,e = 2\,H_2O$	1.229
500	$IO_3^- + 6\,H^+ + 2\,Cl^- + 4\,e = ICl_2^- + 3\,H_2O$	1.23
501	$S_2Cl_2 + 2\,e = 2\,S + 2\,Cl^-$	1.23
502	$MnO_2 + 4\,H^+ + 2\,e = Mn^{2+} + 2\,H_2O$	1.23
503	$O_3 + H_2O + 2\,e = O_2 + 2\,OH^-$	1.24
504	$Tl^{3+} + 2\,e = Tl^+$	1.25
505	$AmO^+ + 4\,H^+ + e = Am^{4+} + 2\,H_2O$	1.26
506	$N_2H_4^+ + 3\,H^+ + 2\,e = 2\,NH_4^+$	1.275
507	$ClO_2 + H^+ + e = HClO_2$	1.275
508	$PdCl_6^{2-} + 2\,e = PdCl_4^{2-} + 2\,Cl^-$	1.288
509	$2\,HNO_2 + 4\,H^+ + 4\,e = N_2O + 3\,H_2O$	1.29
510	$Au^{3+} + 2\,e = Au^+$	~1.29
511	$HBrO + H^+ + 2\,e = Br^- + H_2O$	1.33
512	$Cr_2O_7^{2-} + 14\,H^+ + 6\,e = 2\,Cr^{3+} + 7\,H_2O$	1.33
513	$ClO_4^- + 8\,H^+ + 7\,e = {}^1/_2\,Cl_2 + 4\,H_2O$	1.34
514	$NH_3OH^+ + 2\,H^+ + 2\,e = NH_4^+ + H_2O$	1.35
515	$Cl_2 + 2\,e = 2\,Cl^-$	1.3595

(continued)

No.	Electrode reaction	E^0, V
516	$Tl^{3+} + Cl^- + 2\,e = TlCl$	1.36
517	$IO_4^- + 8\,H^+ + 8\,e = I^- + 4\,H_2O$	1.4
518	$RhO^{2+} + 2\,H^+ + e = Rh^{3+} + H_2O$	1.4
519	$2\,NH_3OH^+ + H^+ + 2\,e = N_2H_4^+ + 2\,H_2O$	1.42
520	$BrO_3^- + 6\,H^+ + 6\,e = Br^- + 3\,H_2O$	1.44
521	$Au(OH)_3 + 3\,H^+ + 3\,e = Au + 3\,H_2O$	1.45
522	$ClO_3^- + 6\,H^+ + 6\,e = Cl^- + 3\,H_2O$	1.45
523	$HIO + H^+ + e = {}^1/_2\,I_2 + H_2O$	1.45
524	$PbO_2 + 4\,H^+ + 2\,e = Pb^{2+} + 2\,H_2O$	1.455
525	$ClO_3^- + 6\,H^+ + 5\,e = {}^1/_2\,Cl_2 + 3\,H_2O$	1.47
526	$HClO + H^+ + 2\,e = Cl^- + H_2O$	1.49
527	$Au^{3+} + 3\,e = Au$	1.50
528	$CeO_2 + 4\,H^+ + e = Ce^{3+} + 2\,H_2O$	1.4
529	$\mathbf{HO_2 + H^+ + e = H_2O_2}$	**1.5**
530	$Mn^{3+} + e = Mn^{2+}$	1.51
531	$MnO_4^- + 8\,H^+ + 5\,e = Mn^{2+} + 4\,H_2O$	1.51
532	$BrO_3 + 6\,H^+ + 5\,e = {}^1/_2\,Br_2 + 3\,H_2O$	1.52
533	$HClO_2 + 3\,H^+ + 4\,e = Cl^- + 2\,H_2O$	1.56
534	$HBrO + H^+ + e = {}^1/_2\,Br_2 + H_2O$	1.59
535	$2\,NO + 2\,H^+ + 2\,e = N_2O + H_2O$	1.59
536	$Bi_2O_4 + 4\,H^+ + 2\,e = 2\,BiO^+ + 2\,H_2O$	1.59
537	$H_5IO_6 + H^+ + 2\,e = IO_3^- + 3\,H_2O$	1.6
538	$Bk^{4+} + e = Bk^{3+}$	1.6
539	$Ce^{4+} + e = Ce^{3+}$	1.61
540	$2\,HClO + 2\,H^+ + 2\,e = Cl_2\,(g) + 2\,H_2O$	1.63
541	$AmO_2^{2-} + e = AmO_2^+$	1.64
542	$HClO_2 + 2\,H^+ + 2\,e = HClO + H_2O$	1.64
543	$NiO_2 + 4\,H^+ + 2\,e = Ni^{2+} + 2\,H_2O$	1.68
544	$PbO_2 + SO_4^{2-} + 4\,H^+ + 2\,e = PbSO_4 + 2\,H_2O$	1.685
545	$AmO^{2+} + 4\,H^+ + 3\,e = Am^{3+} + 2\,H_2O$	1.69
546	$Pb^{4+} + 2\,e = Pb^{2+}$	1.69
547	$MnO_4^- + 4\,H^+ + 3\,e = MnO_2 + 2\,H_2O$	1.695
548	$AmO_2^+ + 4\,H^+ + 2\,e = Am^{3+} + 2\,H_2O$	1.725
549	$\mathbf{H_2O_2 + 2\,H^+ + 2\,e = 2\,H_2O}$	**1.77**
550	$Co^{3+} + e = Co^{2+}$	1.82
551	$FeO_4^{2-} + 8\,H^+ + 3\,e = Fe^{3+} + 4\,H_2O$	1.9
552	$NH_3 + 3\,H^+ + 2\,e = NH_4^+ + H_2$	1.96
553	$Ag^{2+} + e = Ag^+$	1.98
554	$\mathbf{OH + e = OH^-}$	**2.0**
555	$S_2O_8^{2-} + 2\,e = 2\,SO_4^{2-}$	2.01
556	$O_3 + 2\,H^+ + 2\,e = O_2 + H_2O$	2.07
557	$F_2O + 2\,H^+ + 4\,e = H_2O + 2\,F^-$	2.1
558	$Am^{4+} + e = Am^{3+}$	2.18
559	$\mathbf{O\,(g) + 2\,H^+ + 2\,e = H_2O}$	**2.42**
560	$F_2 + 2\,e = 2\,F^-$	2.65
561	$\mathbf{OH + H^+ + e = H_2O}$	**2.8**
562	$H_2N_2O_2 + 2\,H^+ + 2\,e = N_2 + 2\,H_2O$	2.85
563	$F_2 + 2\,H^+ + 2\,e = 2\,HF\,(aq)$	3.06

Table 224

Standard potentials of the electrodes of the second order in aqueous solution

Electrode	E^0, V	Electrode	E^0, V
$Ag/(AgBr)Br^-$	0.0713	$Hg/(HgO)OH^-$	0.0976
$Ag/(AgCl)Cl^-$	0.2224	$Hg/(Hg_2SO_4)SO^{2-}$	0.6151
$Ag/(AgI)I^-$	−0.1523*	$(Pt)/(MnO_2)MnO_4, OH^-$	0.587
$Ag/(AgN_3)N_3^-$	0.2919	$(Pt)/(MnO_2)Mn^{2+}, H_3O^+$	1.236
$Ag/(AgSCN)SCN^-$	0.0947	$Pb/(PbO)OH^-$	−0.5785
$Hg/(Hg_2Br_2)Br^-$	0.1392	$Pb/(PbO_2)Pb^{2+}, H_3O^+$	1.467
$Hg/(Hg_2Cl_2)Cl^-$	0.267	$Pb/(PbO_2)(PbSO_4)SO_4^{2-}, H_3O^+$	1.6849
$Hg/(Hg_2I_2)I^-$	0.0405	$Pb/(PbSO_4)SO_4^{2-}$	−0.355

* The negative sign indicates that the electrode is the negative pole of the cell formed by the electrode of the second order and the hydrogen electrode.

Table 225

Standard potentials of metal sulphide (Me | MeS | H_2S) electrodes

Sulphide	E^0 (measured) V	E^0 (calculated) V	Sulphide	E^0, (measured) V	E^0, (calculated) V
Ag_2S	−0.0362	−0.0319	PbS	−0.2850	−0.3092
CdS	−0.5445	−0.557	SnS	−0.2566	−0.256
Cu_2S	−0.2467	−0.275	ZnS	−0.8387	−0.863
HgS	−0.0569	−0.0820			

Table 226

Standard electrode potentials of oxide electrodes *vs.* SHE
(Values calculated from the Gibbs free energy of the electrode reactions)

Electrode	E^0, V	Electrode	E^0, V
Au/Au_2O_3	+1.45	Sn/SnO_2	−0.11
Ag/Ag_2O	+1.18	Zn/ZnO	−0.42
$Pt/Pt(OH)_2$	+0.98	Cr/Cr_2O_3	−0.60
Ir/IrO_2	+0.93	Nb/Nb_2O_5	−0.65
Hg/HgO	+0.926	Na/Na_2O	−0.74
Pd/PdO	+0.87	Ta/Ta_2O_5	−0.81
Os/OsO_4	+0.85	Si/SiO_2	−0.86
Cu/Cu_2O	+0.42	Ti/TiO_2	−0.86
Bi/Bi_2O_3	+0.38	V/V_2O_3	−1.02
Pb/PbO	+0.25	Ge/GeO	−1.12
As/As_2O_3	+0.23	Ce/CeO_2	−1.13
Sb/Sb_2O_3	+0.15	Al/Al_2O_3	−1.35
Co/CoO	+0.10	Zr/ZrO_2	−1.43
Ni/NiO	+0.08	Hf/HfO_2	−1.57
Mn/MnO_2	+0.03	Be/BeO	−1.76
Cd/CdO	+0.01	Mg/MgO	−1.77
Mo/MoO_2	−0.04	Th/ThO_2	−1.79
Fe/Fe_3O_4	−0.08	Ca/CaO	−1.90

Table 227

Values of the 2.3026 $RT/F = 0.0001983\ T$ at various temperatures

t, °C	$0.0001983\ T$	t, °C	$0.0001983\ T$
0	0.05419	50	0.06412
5	0.05519	55	0.06511
10	0.05618	60	0.06610
15	0.05717	65	0.06710
18	0.05777	70	0.06809
20	0.05816	75	0.06909
25	0.05916	80	0.07008
30	0.06015	85	0.07107
35	0.06114	90	0.07205
40	0.06213	95	0.07305
45	0.06312	100	0.07404

Table 228

Potentials of the Ag | AgCl electrode in aqueous solution at various temperatures

t, °C	E^0, V	t, °C	E^0, V
0	0.2365	60	0.1963
5	0.2340	70	0.1878
10	0.2314	80	0.1787
15	0.2285	90	0.1695
20	0.2256	95	0.1651
25	0.2224	125	0.1330
30	0.2192	150	0.1032
35	0.2157	175	0.0708
38	0.2136	200	0.0348
40	0.2121	225	−0.0051
45	0.2083	250	−0.054
50	0.2044	275	−0.090
55	0.2004		

Table 229

Potentials of the Ag | AgI electrode in aqueous solution at various temperatures

t, °C	E^0, V	t, °C	E^0, V
5	−0.1472	25	−0.1523
10	−0.1481	30	−0.1540
15	−0.1493	35	−0.1559
20	−0.1507	40	−0.1579

Table 230

Potentials of calomel reference electrodes at various temperatures

t, °C	Electrolyte			t, °C	Electrolyte		
	0.1 N KCl	1 N KCl	satd. KCl		0.1 N KCl	1 N KCl	satd. KCL
	Potential, V				Potential, V		
0	0.3380	0.2888	0.2601	28	0.3363	0.2821	0.2418
1	0.3379	0.2886	0.2594	29	0.3363	0.2818	0.2412
2	0.3379	0.2883	0.2588	30	0.3362	0.2816	0.2405
3	0.3378	0.2881	0.2581	31	0.3361	0.2814	0.2399
4	0.3378	0.2878	0.2575	32	0.3361	0.2811	0.2393
5	0.3377	0.2876	0.2568	33	0.3360	0.2809	0.2386
6	0.3376	0.2874	0.2562	34	0.3360	0.2806	0.2379
7	0.3376	0.2871	0.2555	35	0.3359	0.2804	0.2373
8	0.3375	0.2869	0.2549	36	0.3358	0.2802	0.2366
9	0.3375	0.2866	0.2542	37	0.3358	0.2799	0.2360
10	0.3374	0.2864	0.2536	38	0.3357	0.2797	0.2353
11	0.3373	0.2862	0.2529	39	0.3357	0.2794	0.2347
12	0.3373	0.2859	0.2523	40	0.3356	0.2792	0.2340
13	0.3373	0.2857	0.2516	41	0.3355	0.2790	0.2334
14	0.3372	0.2854	0.2510	42	0.3355	0.2787	0.2327
15	0.3371	0.2852	0.2503	43	0.3354	0.2785	0.2321
16	0.3370	0.2850	0.2497	44	0.3354	0.2782	0.2314
17	0.3370	0.2847	0.2490	45	0.3353	0.2780	0.2308
18	0.3369	0.2845	0.2843	46	0.3352	0.2778	0.2301
19	0.3369	0.2842	0.2477	47	0.3352	0.2775	0.2295
20	0.3368	0.2840	0.2471	48	0.3351	0.2773	0.2288
21	0.3367	0.2838	0.2464	49	0.3351	0.2770	0.2282
22	0.3367	0.2835	0.2458	50	0.3350	0.2768	0.2275
23	0.3366	0.2833	0.2451	60	—	—	0.2199
24	0.3366	0.2830	0.2445	70	—	—	0.2124
25	0.3365	0.2828	0.2438	80	—	—	0.2047
26	0.3364	0.2826	0.2431	90	—	—	0.1967
27	0.3364	0.2823	0.2425	100	—	—	0.1885

Table 231

Potentials of the Hg | Hg_2Br_2 electrode (*vs.* SHE) at various temperatures
(Electrolyte solution 0.2 N HBr)

t, °C	E^0, V	t, °C	E^0, *V*
5	0.14095	30	0.13836
10	0.14078	35	0.13726
15	0.14041	40	0.13627
20	0.13985	45	0.13503
25	0.13917		

Table 232

Potentials of the Hg | Hg_2SO_4 electrode (*vs.* SHE) at various temperatures (Electrolyte solution H_2SO_4, $a_{SO_4^{2-}} = 1$)

t, °C	E^0, V	t, °C	E^0, V
0	0.63495	35	0.60701
5	0.63097	40	0.60305
10	0.62704	45	0.59900
15	0.62307	50	0.59487
20	0.61930	55	0.59051
25	0.61515	60	0.58659
30	0.61107		

Table 233

Potentials of Pb–Hg* | $PbSO_4$ and Pb | $PbSO_4$ electrodes (*vs.* SHE) at various temperatures (Electrolyte solution 0.2 N H_2SO_4)

t, °C	Pb–Hg | $PbSO_4$	Pb | $PbSO_4$
	E^0, V	
0	−0.3281	−0.3322
12.5	−0.3392	−0.3440
25	−0.3505	−0.3560
37.5	−0.3619	−0.3679
50	−0.3738	−0.3804

* Pb-content of the amalgam: 6%.

Table 234

Potentials of the PbO_2 | $PbSO_4$ electrode (*vs.* SHE) at various temperatures (Electrolyte solution 0.2 N H_2SO_4)

t, °C	E^0, V	t, °C	E^0, V
0	1.6769	35	1.6885
5	1.6785	40	1.6904
10	1.6799	45	1.6923
15	1.6816	50	1.6944
20	1.6832	55	1.6965
25	1.6849	60	1.6986
30	1.6867		

Table 235

Potential of thalamid electrode (*vs.* SHE) at various temperatures

Temperature, °C	Satd. KCl solution	1 N KCl	Temperature, °C	Satd. KCl solution	1 N KCl
	E^0, V			E^0, V	
0	−0.5694	−0.5434	60	−0.6191	−0.5662
10	−0.5666	−0.5424	70	−0.6289	−0.5729
20	−0.5844	−0.5449	80	−0.6391	−0.5799
30	−0.5925	−0.5493	90	−0.6490	−0.5870
40	−0.6009	−0.5545	95	−0.6539	−0.5904
50	−0.6100	−0.5602			

Table 236

Standard potential of the Ag | AgCl electrode in acetone–water mixtures (Electrolyte solution 1 N HCl)

Acetone, w. %	E^0, V
5	0.2190
10	0.2156
20	0.2079
40	0.1859
50	0.158
90	−0.034
100	−0.53

Table 237

Standard potential of the Ag | AgCl electrode in ethylene glycol–water mixtures (Electrolyte solution 1 N HCl)

Ethylene glycol w. %	E^0, V
5	0.2190
10	0.2161
20	0.2101
30	0.2036
40	0.1972
60	0.1807

Table 238

Standard potential of the Ag | AgCl electrode in ethanol–water mixtures (Electrolyte solution 1 N HCl)

Ethanol, w. %	E^0, V
10	0.2146
20	0.2075
30	0.2003
40	0.1945
50	0.1859
71.9	0.1554
88.5	0.1053
98	0.0215
100	−0.0081

Table 239

Standard potential of the Ag | AgCl electrode in methanol–water mixtures (Electrolyte solution 1 N HCl)

Methanol, w. %	E^0, V
10	0.2153
20	0.2090
40	0.1968
60	0.1818
80	0.1492
90	0.1135
94.2	0.0841
100	−0.0099

Table 240

Standard potential of the Ag | AgCl electrode in dioxan–water mixtures (Electrolyte solution 1 N HCl)

Dioxan w. %	E^0, V
20	0.2031
45	0.1635
70	0.0659
82	−0.0614

Table 241

Standard potential of the Ag | AgCl electrode in *d*-glucose solutions (Electrolyte solution 1 N HCl)

d-glucose, w. %	E^0, V
5	0.2186
10	0.2142
20	0.2045
30	0.1935
50	0.1634

Table 242

Standard potential of the Ag | AgCl electrode in isopropyl alcohol–water mixtures (Electrolyte solution 1 N HCl)

Isopropyl alcohol, w. %	E^0, V
5	0.2180
10	0.2138
20	0.2063

Table 243

Standard potential of the Ag | AgCl electrode in glycerol–water mixtures (Electrolyte solution 1 N HCl)

Glycerol, w. %	E^0, V
5	0.2196
10	0.2165
21.2	0.2084
30	0.2022
50	0.1940

Table 244

Standard potential of the $Hg \mid Hg_2Cl_2$ electrode in methanol–water mixtures (Electrolyte solution 1 N HCl)

Methanol, w. %	E^0, V
20.2	0.2545
43.1	0.2415
68.3	0.2173
99.3	0.1027

Table 245

Standard potential of the $Hg \mid Hg_2Cl_2$ electrode in dioxan–water mixtures (Electrolyte solution 1 N HCl)

Dioxan, w. %	E^0, V
20	0.2501
45	0.2104
70	0.1126
82	−0.0014

Table 246

Standard potential of the $Hg \mid Hg_2Cl_2$ electrode in ethylene glycol–water mixtures (Electrolyte solution 1 N HCl)

Ethylene glycol w. %	E^0, V
19.3	0.2570
50	0.2364
77.9	0.2012

Table 247

Potentials of the quinhydrone electrode in aqueous solution *vs.* SHE at 0–50°C

t, °C	E^0, V	*t*, °C	E^0, V
0	0.6807	26	0.6999
1	0.6814	27	0.7007
2	0.6822	28	0.7011
3	0.6829	29	0.7022
4	0.6837	30	0.7029
5	0.6844	31	0.7036
6	0.6851	32	0.7044
7	0.6859	33	0.7051
8	0.6866	34	0.7059
9	0.6874	35	0.7066
10	0.6881	36	0.7073
11	0.6888	37	0.7081
12	0.6896	38	0.7088
13	0.6903	39	0.7096
14	0.6911	40	0.7103
15	0.6918	41	0.7110
16	0.6925	42	0.7118
17	0.6933	43	0.7125
18	0.6940	44	0.7133
19	0.6948	45	0.7140
20	0.6955	46	0.7147
21	0.6962	47	0.7155
22	0.6970	48	0.7162
23	0.6977	49	0.7169
24	0.6985	50	0.7177
25	0.6992		

Table 248

Potential difference between the quinhydrone and various calomel electrodes at 0–50°C

t, °C	Calomel electrode			t, °C	Calomel electrode		
	0.1 N KCl	1.0 N KCl	satd. KCl		0.1 N KCl	1.0 N KCl	satd. KCl
	Potential difference, V				Potential difference, V		
0	0.3795	0.4287	0.4575	26	0.3618	0.4157	0.4551
1	0.3788	0.4282	0.4574	27	0.3611	0.4152	0.4550
2	0.3781	0.4277	0.4573	28	0.3605	0.4147	0.4549
3	0.3775	0.4272	0.4572	29	0.3598	0.4142	0.4548
4	0.3768	0.4267	0.4571	30	0.3591	0.4137	0.4548
5	0.3761	0.4262	0.4570	31	0.3584	0.4132	0.4547
6	0.3754	0.4257	0.4569	32	0.3577	0.4127	0.4546
7	0.3747	0.4252	0.4568	33	0.3571	0.4122	0.4545
8	0.3741	0.4247	0.4567	34	0.3564	0.4117	0.4544
9	0.3734	0.4242	0.4566	35	0.3557	0.4112	0.4543
10	0.3727	0.4237	0.4566	36	0.3550	0.4107	0.4542
11	0.3720	0.4232	0.4565	37	0.3543	0.4102	0.4541
12	0.3713	0.4227	0.4564	38	0.3537	0.4097	0.4540
13	0.3707	0.4222	0.4563	39	0.3530	0.4092	0.4539
14	0.3700	0.4217	0.4562	40	0.3523	0.4087	0.4539
15	0.3693	0.4212	0.4561	41	0.3516	0.4082	0.4538
16	0.3686	0.4207	0.4560	42	0.3509	0.4077	0.4537
17	0.3679	0.4202	0.4559	43	0.3503	0.4072	0.4536
18	0.3673	0.4197	0.4558	44	0.3496	0.4067	0.4535
19	0.3666	0.4197	0.4558	45	0.3489	0.4062	0.4534
20	0.3659	0.4187	0.4557	46	0.3482	0.4057	0.4533
21	0.3652	0.4182	0.4556	47	0.3475	0.4052	0.4532
22	0.3645	0.4177	0.4555	48	0.3469	0.4047	0.4531
23	0.3639	0.4172	0.4554	49	0.3462	0.4042	0.4530
24	0.3632	0.4167	0.4553	50	0.3455	0.4037	0.4530
25	0.3625	0.4162	0.4552				

Table 249

Standard redox potentials of some biological redox systems

Reduced form	Oxidized form	Redox potentials *vs.* SHE, V (pH = 7)
Adrenaline	Adrenaline oxidized	0.39
Ascorbic acid	Dehydro ascorbic acid	– 0.054
Cysteine	Cystine	~– 0.33
Cytochrome a	Cytochrome a oxidized	0.29
Cytochrome b	Cytochrome b oxidized	0.04
Cytochrome c	Cytochrome c oxidized	0.26
Ethanol	Acetaldehyde	– 0.22*
Hemocyanin	Methemocyanin	0.54
Hemoglobin	Methemoglobin	0.152
Isopropyl alcohol	Acetone	– 0.244*
Lactic acid	Pyruvic acid	– 0.18*
Lactoflavin reduced	Lactoflavin	– 0.21*
Parahematin	Hemochromogen	0.1
Pyocyanine reduced	Pyocyanine	– 0.034
Succinic acid	Fumaric acid	~– 0.001*

* Irreversible systems

Table 250

Electromotive force of the *Weston* normal cell at various temperatures

t, °C	EMF, V	t, °C	EMF, V
11	1.01874	21	1.01826
12	1 01868	22	1.01822
13	1.01863	23	1.01817
14	1.01858	24	1.01812
15	1.01853	25	1.01807
16	1.01848	26	1.01802
17	1.01843	27	1.01797
18	1.01839	28	1.01792
19	1.01834	29	1.01786
20	1.01830	30	1.01781

Remarks:

Two kinds of *Weston* cells are known. The "*normal*" or "*saturated*" *Weston* cell contains a saturated solution of $CdSO_4$, having an excess of $CdSO_4$. Its *EMF* is taken to be as 1.01830 international V (1.01864 absolute V) at 20°C. This cell is reproducible to better than 10 μV, and is therefore an international standard. It has a fairly large temperature coefficient. The cell must be handled with care and not subjected to strong vibrations. This cell must always be used and transported upright. The *Weston normal* cell is particularly suitable for precise scientific measurements.

The "*standard*" or "*unsaturetad*" *Weston* cell contains a solution of $CdSO_4$ that is saturated at 4°C, and hence is unsaturated at higher temperatures. It is neither as permanent nor as reproducible as the "*normal*" cell, but is portable and has a very low temperature coefficient. The *EMF* of the *Weston standard* cell is 1.0187 international V (1.0190 absolute V) between 0 and 30°C. This type of *Weston* cell is suitable for general laboratory use.

The newest types of *Weston* cell contain some heavy water (D_2O) in the electrolyte. These cells are less sensitive to temperature changes.

Table 251

Electromotive force of the *Clark* standard cell at various temperatures

t, °C	EMF, V	t, °C	EMF, V
0	1.4487	17	1.4300
5	1.4436	18	1.4288
10	1.4382	19	1.4275
15	1.4324	20	1.4263
16	1.4312	25	1.4198

Table 252

Electromotive force of the cell Pt | H_2 | HCl | AgCl | Ag at various temperatures

t, °C	Concentration of HCl		t, °C	Concentration of HCl	
	0.01 N	0.1 N		0.01 N	0.1 N
	EMF, V			EMF, V	
5	0.4595	0.3549	25	0.4642	0.3524
10	0.4608	0.3545	30	0.4650	0.3514
15	0.4621	0.3539	35	0.4657	0.3503
20	0.4632	0.3532			

Table 253

Electromotive force of the cell Ag | AgCl | KCl aq ($a = 1.0$) Hg_2Cl_2 | Hg at various temperatures

t, °C	EMF, V	t, °C	EMF, V
0	0.2741	40	0.2627
5	0.2728	45	0.2607
10	0.2719	50	0.2584
15	0.2708	55	0.2560
20	0.2695	60	0.2536
25	0.2680	65	0.2509
30	0.2665	70	0.2477
35	0.2647		

Table 254

Electromotive forces of chemical cells with fused salts*

Fused salt	t_1, °C	EMF_{t_1} V	Temperature coefficient, $\alpha \cdot 10^4$	Fused salt	t_1, °C	EMF_{t_1}, V	Temperature coefficient, $\alpha \cdot 10^4$
AgBr	500	0.787	2.9	$MgCl_2$	700	2.511	6.73
AgCl	500	0.900	2.9	$PbBr_2$	500	1.032	6.07
AgI	600	0.528	—	$PbCl_2$	500	1.274	6.25
$AlCl_3$	500	1.997	4.57	PbI_2	600	0.54	—
Al_2O_3	1118	2.215	5.7	$ZnBr_2$	500	1.270	6.82
$CdBr_2$	580	1.045	7.4	$ZnCl_2$	500	1.588	6.95
$CdCl_2$	600	1.342	6.3				

* *Examples:* Ag | AgCl fused | Cl_2(C)
Al | Al_2O_3 fused | O_2(Pt)
Pb | $PbCl_2$ fused | Cl_2(C)

$$EMF_{t_2} = EMF_{t_1} - \alpha(t_2 - t_1)$$

Table 255

Electromotive forces of galvanic cells with fused salts at various temperatures

Cell	*EMF*, V							
$-\mathrm{Cd} \mid \mathrm{CdCl_2} \vdots \mathrm{PbCl_2} \mid \mathrm{Pb}\,+$	570°C	600°C	650°C	700°C				
	0.1207	0.1230	0.1243	0.1265				
$-\mathrm{Cd} \mid \mathrm{CdCl_2} \vdots \mathrm{SnCl_2} \mid \mathrm{Sn}\,+$	0.157 (600°C)							
$-\mathrm{Mg} \mid \mathrm{MgCl_2} \vdots \mathrm{CdCl_2} \mid \mathrm{Cd}\,+$	$0.964 + 1.07\times10^{-3}(t - 720)$							
$-\mathrm{Mg} \mid \mathrm{MgCl_2} \vdots \mathrm{PbCl_2} \mid \mathrm{Pb}\,+$	$1.078 + 1.075\times10^{-3}(t - 720)$							
$-\mathrm{Mg} \mid \mathrm{MgCl_2} \vdots \mathrm{TlCl} \mid \mathrm{Tl}\,+$	$0.530 - 0.43\times10^{-3}(t - 720)$							
$-\mathrm{Mg} \mid \mathrm{MgCl_2} \vdots \mathrm{ZnCl_2} \mid \mathrm{Zn}\,+$	$0.759 + 0.73\times10^{-3}(t - 720)$							
$-\mathrm{Pb} \mid \mathrm{PbBr_2} \vdots \mathrm{AgBr} \mid \mathrm{Ag}\,+$	0.144 (800°C)							
$-\mathrm{Pb} \mid \mathrm{PbCl_2} \vdots \mathrm{AgCl} \mid \mathrm{Ag}\,+$	500°C	550°C	600°C	620°C	730°C	800°C	900°C	
	0.373	0.355	0.340	0.310	0.265	0.252	0.229	
$-\mathrm{Pb} \mid \mathrm{PbCl_2} \vdots \mathrm{SnCl_2} \mid \mathrm{Sn}\,+$	500°C	600°C						
	0.026	0 023						
$-\mathrm{Pb} \mid \mathrm{PbCl_2} \vdots \mathrm{CuCl} \mid \mathrm{Cu}\,+$	0.234 (500°C)							
$-\mathrm{Pb} \mid \mathrm{PbI_2} \vdots \mathrm{AgI} \mid \mathrm{Ag}\,+$	0.023 (600°C)							
$-\mathrm{Sn} \mid \mathrm{SnCl_2} \vdots \mathrm{AgCl} \mid \mathrm{Ag}\,+$	500°C	600°C						
	0.272	0.232						
$-\mathrm{Tl} \mid \mathrm{TlCl} \vdots \mathrm{CdCl_2} \mid \mathrm{Cd}\,+$	600°C	700°C						
	0.300	0.320						
$-\mathrm{Tl} \mid \mathrm{TlCl} \vdots \mathrm{PbCl_2} \mid \mathrm{Pb}\,+$	$0.365 + 0.39\times10^{-3}(t - 500)$							
$-\mathrm{Tl} \mid \mathrm{TlCl} \vdots \mathrm{SnCl_2} \mid \mathrm{Sn}\,+$	350°C	380°C	400°C	426°C	440°C	460°C	480°C	550°C
	0.356	0.361	0.364	0.370	0.378	0.386	0.385	0.403
$-\mathrm{Zn} \mid \mathrm{ZnCl_2} \vdots \mathrm{AgCl} \mid \mathrm{Ag}\,+$	540°C	600°C	620°C					
	0.481	0.427	0.405					
$-\mathrm{Zn} \mid \mathrm{ZnCl_2} \vdots \mathrm{CdCl_2} \mid \mathrm{Cd}\,+$	510°C	540°C	560°C	575°C	600°C	625°C		
	0.150	0.151	0.150	0.149	0.144	0.142		
$-\mathrm{Zn} \mid \mathrm{ZnCl_2} \vdots \mathrm{PbCl_2} \mid \mathrm{Pb}\,+$	$0.267 - 0\ 086\times10^{-3}(t - 500)$							
$-\mathrm{Zn} \mid \mathrm{ZnCl_2} \vdots \mathrm{SnCl_2} \mid \mathrm{Sn}\,+$	$0.306 - 0.1\times10^{-3}(t - 500)$							
$-\mathrm{Zn} \mid \mathrm{ZnCl_2} \vdots \mathrm{TlCl} \mid \mathrm{Tl}\,+$	$0.11 + 0.48\times10^{-3}(t - 500)$							

Table 256

Diffusion potentials at the boundary of the same aqueous electrolyte solutions of different concentrations

Electrolyte	c_1/c_2	E_d, mV
HCl	0.005/0.01	11.1
	0.005/0.04	33.3
KCl	0.005/0.01	−0.3
	0.005/0.04	−1.0
NaCl	0.005/0.01	−3.7
	0.005/0.04	−11.1

Table 257

Diffusion potentials at the boundary of different aqueous electrolyte solutions of the same concentration

Solution pairs	$c_1 = c_2$	E_d (measured) mV	E_d (calculated) mV
HCl ¦ KCl	0.1	26.8	28.5
	0.01	25.7	27.5
HCl ¦ LiCl	0.1	34.9	36.1
	0.01	33.8	34.6
HCl ¦ NaCl	0.1	33.1	33.4
	0.01	31.1	32.0
KCl ¦ LiCl	0.1	8.8	7.6
	0.01	8.2	7.1
NaCl ¦ LiCl	0.1	2.6	2.8
	0.01	2.6	2.5

Table 258

Zero charge potentials in aqueous electrolyte solutions with respect to the SHE at room temperature

Electrode	Electrolyte solution	E, V
Ag	0.1 N KNO_3	−0.05
	0.01 N Na_2SO_4	−0.70
C (graphite)	0.05 N NaCl	−0.07
C (active)	1 N H_2SO_4 + 1 N Na_2SO_4	0.0 ... + 0.2
Cd	0.001 N KCl	−0.90
Co	0.1 N H_2SO_4 + 0.02 N Na_2SO_4	−0.33
Cr	0.1 N NaOH	−0.45
Cu	0.02 N Na_2SO_4	−0.02
Fe	0.1 N H_2SO_4 + 0.02 N Na_2SO_4	−0.29
Ga	0.1 N HCl + 1 N KCl	−0.60
Hg	0.01 N NaF	−0.192
Ni	0.001 N HCl	−0.06
Pb	0.001 N KCl	−0.69
Pb O_2	0.01 N $HClO_4$	1.80
Pt (bright)	0.1 N H_2SO_4 + 1 N Na_2SO_4	0.27
Pt (platinized)	0.01 N H_2SO_4 + 1 N Na_2SO_4	0.4 ... 1.0
Te	1 N H_2SO_4	0.61
Tl	0.001 N KCl	−0.80
Tl(Hg)	1 N Na_2SO_4	−0.65
Zn	1 N Na_2SO_4	−0.63

Table 259

Zero charge potentials of mercury *vs.* NCE in aqueous electrolyte solutions at room temperature
(Potentials of the electrocapillary maximum)

Electrolyte	Concentration of electrolyte, N					
	E, V					
	0.001	0.01	0.1	0.5	1.0	3.0
$AlCl_3$	−0.50	−0.50	−0.51	—	—	—
$Al_2(SO_4)_3$	—	—	—	—	−0.47	—
$BaCl_2$	−0.50	−0.50	−0.51	—	−0.56	—
$Ba(OH)_2$	—	−0.45	−0.45	—	—	—
$CaCl_2$	—	—	−0.51	—	−0.56	—
$CoCl_2$	—	—	−0.51	—	—	—
CsCl	—	—	−0.51	—	−0.56	—
HCl	−0.51	−0.51	−0.53	—	—	—
H_2SO_4	—	—	—	—	−0.51	—
KBr	—	−0.54	−0.57	—	−0.65	—
KCNS	—	−0.57	−0.63	—	−0.71	−0.77
KCl	—	−0.48	−0.52	—	−0.55	—
$KClO_4$	—	—	−0.51	—	—	—
KF	—	—	−0.47	—	—	—
$KHCO_3$	—	—	−0.48	—	—	—
KI	−0.58	−0.66	−0.73	—	−0.82	−0.87
KNO_3	—	−0.52	−0.52	—	−0.56	—
KOH	—	—	−0.46	—	−0.47	—
K_2CO_3	—	—	−0.48	−0.48	−0.48	—
$K_2C_2O_4$	—	−0.51	−0.49	—	−0.50	—
K_2HPO_4	—	—	−0.48	—	−0.49	—
K_2SO_4	—	—	−0.47	−0.48	−0.48	—
K_3AsO_4	—	−0.48	−0.50	—	−0.50	—
$LaCl_3$	−0.50	−0.50	−0.51	—	—	—
LiCl	—	—	−0.52	—	−0.56	—
$MgCl_2$	—	—	−0.51	—	−0.55	—
$MgSO_4$	—	−0.48	−0.47	—	—	—
$MnCl_2$	—	—	−0.53	—	—	—
NH_4Cl	—	—	−0.53	—	—	—
NaBr	—	−0.58	−0.61	—	−0.65	−0.71
$NaCH_3COO$	—	−0.50	−0.50	—	−0.52	—
NaCNS	—	−0.59	−0.62	—	−0.72	—
NaCl	−0.52	−0.52	−0.53	—	−0.56	−0.60
$NaClO_4$	—	—	−0.51	—	—	—
NaF	−0.48	−0.48	−0.47	—	−0.47	—
NaI	—	—	−0.73	—	—	—
$NaNO_3$	—	—	−0.51	—	—	—
NaOH	—	—	—	—	−0.48	—
Na_2SO_4	—	—	−0.47	−0.48	−0.48	—
$NiCl_2$	—	—	−0.53	—	—	—
RbCl	—	—	−0.52	—	—	—
$SrCl_2$	—	—	−0.54	—	—	—
$ThCl_4$	−0.50	−0.50	−0.51	—	—	—

Table 260

Primary batteries

Name of cell	Construction and electrochemical reactions	*EMF*, V
Air cell	(–) Zn | 15–20% NaOH | special C (+) Reactions: $Zn + 2\,NaOH = Na_2ZnO_2 + H_2$ $2\,H_2 + O_2 = 2\,H_2O$	1.3–1.4
Bunsen cell	(–) Zn | 10w.% H_2SO_4 + cc. HNO_3 | C (+) Reaction: $Zn + H_2SO_4 + 2\,HNO_3 = ZnSO_4 + 2\,H_2O + 2\,NO_2$	~1.9
Clark standard cell	(–) Zn-amalgam (10% Zn) | satd. $ZnSO_4 \times 7\,H_2O$ | Hg_2SO_4 | Hg (+) Reaction: $Zn + Hg_2^{2+} = Zn^{2+} + 2\,Hg$	1.43 (see also Table 251)
Daniell cell	(–) Zn-amalgam | 5–10% $ZnSO_4$ or 20% H_2SO_4 | satd. $CuSO_4$ | Cu (+) At the positive pole: $Cu^{2+} + 2\,e = Cu$ At the negative pole: $Zn - 2\,e = Zn^{2+}$ Overall reaction: $Zn + CuSO_4 = ZnSO_4 + Cu$	1.05–1.10
Grove cell	(–) Zn-amalgam | 10% H_2SO_4 ‖ cc. HNO_3 Pt (+) At the positive pole: $2\,H^+ + 2\,HNO_3 + 2\,e = 2\,H_2O + 2\,NO_2$ At the negative pole: $Zn - 2\,e = Zn^{2+}$ Overall reaction: $Zn + H_2SO_4 + 2\,HNO_3 = ZnSO_4 + 2\,H_2O + 2NO_2$	1.9
Lalande–Edison cell	(–) Zn-amalgam | 15–20% NaOH | CuO (+) At the positive pole: $CuO + H_2O + 2\,e = Cu + 2\,OH^-$ At the negative pole: $Zn + 4\,OH^- - 2\,e = ZnO_2^{2-} + 2\,H_2O$ Overall reaction: $Zn + 2\,NaOH + CuO = Na_2ZnO_2 + Cu + H_2O$	0.95
Lead–perchloric acidic cell	(–) Pb | $HClO_4$ | PbO_2 (+) Reaction: $Pb + PbO_2 + 2\,HClO_4 = Pb(ClO_4)_2 + H_2O$	2.05

Leclanché cell	(−) Zn | 10–20% NH_4Cl, MnO_2 | C (+) At the positive pole: $2\,H^+ + 2\,MnO_2 + 2\,e = Mn_2O_3 + H_2O$ At the negative pole: $Zn - 2\,e = Zn^{2+}$ Overall reaction: $Zn + 2\,NH_4Cl + 2\,MnO_2 =$ $= Zn(NH_3)_2Cl_2 + Mn_2O_3 + H_2O$	1.4–1.5
Leclanché dry cell	(−) Zn-amalgam | gelled satd. $NH_4Cl + ZnCl_2$, MnO_2 | C (+) At the positive pole: $2\,H^+ + 2\,MnO_2 + 2\,e = Mn_2O_3 + H_2O$ At the negative pole: $Zn - 2\,e = Zn^{2+}$ Overall reaction: $Zn + 2\,NH_4Cl + 2\,MnO_2 =$ $= Zn(NH_3)_2Cl_2 + Mn_2O_3 + H_2O$	~1.5
Meidinger cell	(−) Zn | $ZnSO_4 + MgSO_4$ | satd. $CuSO_4$ | Cu (+) At the positive pole: $Cu^{2+} + 2\,e = Cu$ At the negative pole: $Zn - 2\,e = Zn^{2+}$ Overall reaction: $Zn + CuSO_4 = ZnSO_4 + Cu$	~1.1
Poggendorff cell	(−) Zn | 10% $K_2Cr_2O_7$ in 8–10% H_2SO_4 | C (+) At the positive pole: $Cr_2O_7^{2-} + 14\,H^+ + 6\,e = 2\,Cr^{3+} + 7\,H_2O$ At the negative pole: $Zn - 2\,e = Zn^{2+}$ Overall reaction: $3\,Zn + K_2Cr_2O_7 + 7\,H_2SO_4 =$ $= 3\,ZnSO_4 + K_2SO_4 + Cr_2(SO_4)_3 + 7\,H_2O$	2.0
Ruben–Mallory cell	(−) Zn-amalgam | gelled 35–40% KOH + 5% ZnO | HgO | Hg (+) At the positive pole: $HgO + H^+ + OH^- + 2\,e = Hg + 2\,OH^-$ At the negative pole: $Zn - 2\,e = Zn^{2+}$ Overall reaction: $Zn + HgO + H_2O = Zn(OH)_2 + Hg$	~1.3
Volta cell	(−) Zn | H_2SO_4 | Cu (+) At the positive pole: $Cu^{2+} + 2\,e = Cu$ At the negative pole: $Zn - 2\,e = Zn^{2+}$ Overall reaction: $Zn + CuSO_4 = ZnSO_4 + Cu$	~1
Weston standard cell	(−) Cd-amalgam (10–13% Cd) | satd. $CdSO_4$; Hg_2SO_4 | Hg (+) Reaction: $Cd + Hg_2^{2+} = Cd^{2+} + 2\,Hg$	1.018 (see also Table 250)

Table 261

Zero charge potentials* of liquid metals in fused KCl–LiCl eutectic mixture

Metal	t, °C	E^0, V	Metal	t, °C	E^0, V
Tellurium	550	0.60	Silver	1050	−0.30
Antimony	1050	0.20	Lead	1050	−0.38
	750	0.10	Gallium	450	−0.40
Mercury	420	−0.10	Lead	450	−0.47
Tin	450	−0.23	Zinc	450	−0.55
Aluminium	750	−0.30	Cadmium	450	−0.63
Bismuth	450	−0.30	Thallium	420	−0.65

* Liquid lead served as the reference electrode

Table 262

Internal resistances of galvanic cells (of approximately 1 litre volume)

Galvanic cell	Resistance, Ω	Galvanic cell	Resistance, Ω
Bunsen cell	0.1–0.2	Leclanché cell	0.05–0.2
Clark standard cell	20–100	Meidinger cell	1–2
Daniel cell	0.8–1.0	Poggendorff cell	0.08–0.3
Grove cell	0.1–0.2	Ruben–Mallory cell	0.03–0.05
Lalande–Edison cell	0.3–0.5	Weston standard cell	20–100

Table 263

Accumulators

Name of cell	Construction and electrochemical reactions	*EMF*, V
Lead accumulator	(−) Pb | 25–40% H_2SO_4 | PbO_2 on Pb (+) At the positive pole: $PbO_2 + 4\,H^+ = Pb^{4+} + 2\,H_2O$ $Pb^{4+} + 2e = Pb^{2+}$ $Pb^{2+} + SO_4^{2-} = PbSO_4$ At the negative pole: $Pb - 2e = Pb^{2+}$ $Pb^{2+} + SO_4^{2-} = PbSO_4$ Overall reaction: $Pb + PbO_2 + 2\,H_2SO_4 \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftharpoons}} 2\,PbSO_4 + 2\,H_2O$	~2

Table 263 (continued)

Name of cell	Construction and electrochemical reactions	*EMF*, V
Ni–Fe accumulator	(–) Fe | 20–25% KOH + 5% LiOH | Ni_2O_3 + Ni (+) At the positive pole: $2\,Ni(OH)_3 = 2\,Ni^{3+} + 6\,OH^-$ $2\,Ni^{3+} + 2e = 2\,Ni^{2+}$ $2\,Ni^{2+} + 4\,OH^- = 2\,Ni(OH)_2$ At the negative pole: $Fe - 2e = Fe^{2+}$ $Fe^{2+} + 2\,OH^- = Fe(OH)_2$ Overall reaction: $Fe + 2\,Ni(OH)_3 \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftharpoons}} Fe(OH)_2 + 2\,Ni(OH)_2$	~1.3
Ni–Cd accumulator	(–) Cd | 20% KOH + 5% LiOH | Ni_2O_3 + Ni (+) At the positive pole: $2\,Ni(OH)_3 = 2\,Ni^{3+} + 6\,OH^-$ $2\,Ni^{3+} + 2e = 2\,Ni^{2+}$ $2\,Ni^{2+} + 4\,OH^- = 2\,Ni(OH)_2$ At the negative pole: $Cd - 2e = Cd^{2+}$ $Cd^{2+} + 2\,OH^- = Cd(OH)_2$ Overall reaction: $Cd + 2\,Ni(OH)_3 \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftharpoons}} 2\,Ni(OH)_2 + Cd(OH)_2$	~1.3
Ag–Zn accumulator	(–) Zn | 40% KOH + K_2ZnO_2 satd. | Ag_2O_2 on Ag (+) At the positive pole: $Ag_2O_2 + 2\,H_2O + 4e = 2\,Ag + 4\,OH^-$ At the negative pole: $2\,Zn + 4\,OH^- - 4e = 2\,Zn(OH)_2$ Overall reaction: $Ag_2O_2 + 2\,Zn + 2\,H_2O \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftharpoons}} 2\,Ag + 2\,Zn(OH)_2$	1.5–1.6

Table 264

Preparation of 100 litres of accumulator acid of various concentrations

Accumulator acid		Required		Accumulator acid		Required	
°Bé	density, kg l^{-1}	96% H_2SO_4	distilled water	°Bé	density, kg l^{-1}	96% H_2SO_4	distilled water
		litre				litre	
22	1.18	16	84.30	28	1.24	22	78.42
23	1.19	17	83.32	29	1.25	23	77.44
24	1.20	18	82.34	30	1.26	24	76.46
25	1.21	19	81.36	31	1.27	25	75.48
26	1.22	20	80.30	32	1.28	26	74.47
27	1.23	21	79.40				

Table 265

Density conversion table
(Relation between density and Baumé and Twaddel scales)

°Bé	Sp. gr.	°Tw	°Bé	Sp. gr.	°Tw
0.00	1.00	0	42.16	1.41	82
1.44	1.01	2	42.89	1.42	84
2.84	1.02	4	43.60	1.43	86
4.22	1.03	6	44.31	1.44	88
5.58	1.04	8	45.00	1.45	90
6.91	1.05	10	45.68	1.46	92
8.21	1.06	12	46.36	1.47	94
9.49	1.07	14	47.03	1.48	96
10.74	1.08	16	47.68	1.49	98
11.97	1.09	18	48.33	1.50	100
13.18	1.10	20	48.97	1.51	102
14.37	1.11	22	49.60	1.52	104
15.54	1.12	24	50.23	1.53	106
16.68	1.13	26	50.84	1.54	108
17.81	1.14	28	51.45	1.55	110
18.91	1.15	30	52.05	1.56	112
20.00	1.16	32	52.64	1.57	114
21.07	1.17	34	53.23	1.58	116
22.12	1.18	36	53.80	1.59	118
23.15	1.19	38	54.38	1.60	120
24.17	1.20	40	54.94	1.61	122
25.16	1.21	42	55.49	1.62	124
26.15	1.22	44	56.04	1.63	126
27.11	1.23	46	56.58	1.64	128
28.06	1.24	48	57.12	1.65	130
29.00	1.25	50	57.65	1.66	132
29.92	1.26	52	58.17	1.67	134
30.83	1.27	54	58.69	1.68	136
31.72	1.28	56	59.20	1.69	138
32.60	1.29	58	59.71	1.70	140
33.46	1.30	60	60.20	1.71	142
34.31	1.31	62	60.70	1.72	144
35.15	1.32	64	61.18	1.73	146
35.98	1.33	66	61.67	1.74	148
36.79	1.34	68	62.14	1.75	150
37.59	1.35	70	62.61	1.76	152
38.38	1.36	72	63.08	1.77	154
39.16	1.37	74	63.54	1.78	156
39.93	1.38	76	63.99	1.79	158
40.68	1.39	78	64.44	1.80	160
41.43	1.40	80			

Table 266

Densities and conductivities of sulphuric acid solutions of various concentrations

Density, at 15°C kg l^{-1}	°Bé at 15°C	Concentration			Conductivity at 18°C, κ, Ω^{-1} m^{-1}
		H_2SO_4		N	
		w. %	g l^{-1}		
1.050	6.7	7.37	77	1.56	29
1.060	8.0	8.77	93	—	—
1.070	9.4	10.19	109	—	—
1.080	10.6	11.60	125	—	—
1.090	11.9	12.99	142	—	—
1.100	13.0	14.35	158	3.20	53
1.110	14.2	15.71	175	—	—
1.120	15.4	17.01	191	—	—
1.130	16.5	18.31	207	—	—
1.140	17.7	19.61	223	—	65
1.150	18.8	20.91	239	4.91	67
1.160	19.8	22.19	257	—	69
1.170	20.9	23.47	275	—	—
1.180	22.0	24.76	292	—	72
1.190	23.0	26.04	310	—	—
1.200	24.0	27.32	328	6.53	73
1.210	25.0	28.58	346	—	—
1.220	26.0	29.84	364	—	74
1.230	26.9	31.11	388	—	—
1.240	27.9	32.28	400	—	73
1.250	28.8	33.43	418	8.47	72
1.260	29.7	34.57	435	—	—
1.270	30.6	35.71	454	—	—
1.280	31.5	36.87	472	—	71
1.290	32.4	38.03	490	—	—
1.300	33.3	39.19	510	10.4	68
1.310	34.2	40.35	529	—	—
1.320	35.0	41.50	548	—	—
1.330	35.8	42.66	567	—	—
1.340	36.6	43.74	586	—	—
1.350	37.4	44.82	605	12.3	62
1.360	38.2	45.88	624	—	—
1.370	39.0	46.94	643	—	—
1.380	39.8	48.00	662	—	—
1.390	40.4	49.06	682	—	—
1.400	41.2	50.11	702	14.2	54

Table 267

Some properties of potassium hydroxide solutions

Density, kg l^{-1}	Concentration		Resistivity at 18°C, Ω m	Freezing point, °C
	w. %	N		
1.146	16	3.28	0.0227	−11
1.165	18	3.74	0.0216	−17
1.185	20	4.23	0.0197	−19
1.204	22	4.72	0.0193	−21
1.222	24	5.23	0.0189	−27
1.241	26	5.76	0.0186	
1.271	28	6.58	0.0185	
1.281	30	6.85	0.0186	

Table 268

Quantities of electric charge required for the oxidation and reduction of various lead compounds

Material	Reduction to lead	Oxidation to PbO_2
	Charge quantity $\times 10^{-5}$, As kg^{-1}	
Pb	—	18.50
$PbCl_2$	6.94	6.94
PbO	8.64	8.64
$PbSO_4$	6.34	6.34
Pb_3O_4	11.26	5.62

Table 269

Characteristics of silver accumulators

Characteristics	Average values
Cell voltage, V	1.5
Capacity, As kg^{-1}	$3.2 \cdot 10^5 - 3.4 \cdot 10^5$ (~90–95 Ah kg^{-1})
Capacity, kJ kg^{-1}	470–500 (~130–140 Wh kg^{-1})
Capacity, kJ l^{-1}	550–700 (~150–200 Wh l^{-1})
Energy efficiency, %	75–80
Voltage drop during discharge, %	15
Spontaneous discharge, %/month	4–20
Sensitivity to overcharge	insensitive
Sensitivity to overdischarge	insensitive
Sensitivity to shocks	insensitive
Life-time, number of discharges	150–200

Table 270

Comparison of acid and alkaline (Ni–Fe) accumulators

Characteristics	Accumulator	
	acid	alkaline
Energy efficiency, %	75	50
Voltage drop during discharge, %	15	33
Capacity, kJ kg^{-1}	108 (30 Wh kg^{-1})	90 (25 Wh kg^{-1})
Capacity, kJ l^{-1}	306 (85 Wh l^{-1})	144 (40 Wh l^{-1})
Short-circuit current, A/1 litre cell volume	1000	30
Spontaneous discharge, %/month	10–30	2–30
Sensitivity to overcharge	sensitive	insensitive
Sensitivity to overdischarge	sensitive	insensitive
Sensitivity in the discharged state	sensitive	insensitive
Sensitivity to shocks	sensitive	insensitive
Sensitivity over 30°C	sensitive	somewhat sensitive
Capacity under 0°C	decreases	decreases steeply
Maintenance	frequently	rarely
Life-time, years	1–10	10–20

VI

COULOMETRY, ELECTROGRAVIMETRY, DEPOSITION POTENTIALS, DECOMPOSITION POTENTIALS, POLAROGRAPHIC HALF-WAVE POTENTIALS

Table 271

Characteristic data of coulometers

Type	Electrolyte solution	Operating conditions	Accuracy, %
Iodine coulometer (titrimetric)	N KI solution	Anode: Ag $D_a \leqq 0.01$ A/cm^2 Cathode: Pt, Ir Evaluation: The iodine formed at the anode is titrated with standardized thiosulphate	0.002
Ag coulometer (gravimetric)	10–20% $AgNO_3$ solution	Anode: Ag rod $D_a \leqq 0.05$ A/cm^2 Cathode: Pt crucible $D_c \leqq 0.01$ A/cm^2 Evaluation: Measurement of cathode weight	0.01
Cu coulometer (gravimetric)	150 g $CuSO_4 \times 5\,H_2O$ 27 ml cc. H_2SO_4 (density = 1.84) 50 ml ethanol 1000 ml H_2O	Electrodes: Cu plates D_c : 0.002–0.02 A/cm^2 Evaluation: Measurement of cathode weight	0.1
KBr coulometer (titrimetric)	0.03 N KBr solution in 0.1 N K_2SO_4 solution	Anode: Ag wire Cathode: Pt plate Evaluation: The alkaline solution is titrated with 0.01 N acid 1 ml 0.01 N acid = 0.965 C	1
Hg coulometer	KI–HgI_2 solution	Anode: Hg Cathode: C or Ir Evaluation: By measuring the level of the mercury generated and collected in the measuring capillary	1

Table 272

Controlled potential separations and determination of some metals

Metal	Separation from	Electrolyte	Cathode potential *vs.* SCE, V
Ag	Cu	ammoniacal satd. with oxygen	−0.24
		acetic acid–acetate buffer	+0.1
Bi	Cu	alk. tartrate + KCN + NH_2OH	−0.75
	Pb, Sn, Sb	tartrate + N_2H_4 + Cl^-, pH = 6.0	−0.40
	Pb, Sn	HCl + $H_2C_2O_4$ + N_2H_4	−0.15
	Pb	HNO_2 + N_2H_4	−0.1
Cd	Zn	acetic acid–acetate, pH about 4	−0.80
		0.05 N HCl + NH_2OH, pH = 1.0	−0.80
		NH_3 + N_2H_4 + gelatine	−0.95
Cu	Bi, Sb, Pb, Sn, Ni	tartrate + N_2H_4 + Cl^-, pH = 5.2–6.0	−0.30
	Pb, Sn	0.5 N HCl + N_2H_4	−0.35
Ni	Al, Fe, Zn	ammoniacal tartrate, Na_2SO_3	−1.10
Pb	Cd, Sn, Ni, Al, Fe, Mn	tratrate + N_2H_4 pH = 4.0–6.0	−0.60
Rh	Ir	3.5 N NH_4Cl, 0.05 N HCl, NH_2OH	−0.25
Sb	Pb, Sn	HCl + N_2H_4 at 70°C	−0.35
	Sn	1 : 1 H_2SO_4, N_2H_4	−0.077
		Na_2S, NaOH, KCN at 60°C	−1.32
Sn	Cd, Zn, Fe, Mn	HCl + NH_2OH	−0.60

Table 273

Data for electrogravimetric determinations

Metal to be determined	Medium	Terminal voltage, V	Current, A	Temperature, °C	Measured form
Ag	Sulphuric acid	1.0–1.3	0.1	80–90	Ag
	Nitric acid	1.2–1.3	0.1–0.2	50–60	Ag
	Cyanide	2.5–2.7	0.05–0.10	60–70	Ag
Bi	Weakly nitric acidic	1.8–2.0	0.1	70–80	Bi
Cd	Alkaline cyanide	2.5–3.5	0.2–0.3	18–22	Cd
	Sulphuric acid	2.4–2.8	0.2–0.5	18–22	Cd
Co	Ammoniacal	2.2–2.4	0.3–0.5	70–80	Co
Cu	Cold sulphuric acid (slow electrolysis)	1.8–2.0	~0.5	18–22	Cu
	Warm sulphuric acid (rapid electrolysis)	3–6	2–4	70–80	Cu
	Ammoniacal	2.5–3.5	0.5–1.0	18–22	Cu
Hg	Nitric acid	2.5–3.5	0.5–1.0	30–40	Hg
Ni	Ammoniacal	4–6	2–3	70–80	Ni
Sn	Acidic, oxalate	2.5–3.8	1.0–1.5	60–70	Sn
Zn	Basic	3–4	0.8–1.0	18–22	Zn
Mn (anodic)	Sulphuric acid + ammonium acetate	3–4	0.6–0.9	75–80	MnO_2* (at the anode)
Pb (anodic)	Nitric acid	1.8–2.5	1.5–2.0	50–70	PbO_2 (at the anode)

* Or after heating in the anode platinum crucible, in the form of Mn_3O_4.

Table 274

Deposition potentials of some metals referred to the standard hydrogen electrode

Metal	J_c, A m^{-2}			
	0	23 000	46 000	91 000
	Deposition potential, V			
Cadmium	+0.44	+0.49	+0.50	—
Cobalt	+0.52	+0.56	+0.58	+0.59
Copper	−0.31	−0.27	−0.26	−0.24
Iron	+0.66	+0.71	+0.73	+0.75
Nickel	+0.60	+0.63	+0.65	+0.66
Zinc	+0.79	+0.84	+0.85	+0.88

Table 275

Decomposition potentials of electrolytes in normal solutions measured between platinum electrodes

Electrolyte	Formula	Decomposition potential, V
Ammonium hydroxide	NH_4OH	1.74
Barium nitrate	$Ba(NO_3)_2$	2.25
Cadmium chloride	$CdCl_2$	1.88
Cadmium nitrate	$Cd(NO_3)_2$	1.98
Cadmium sulphate	$CdSO_4$	2.03
Calcium nitrate	$Ca(NO_3)_2$	2.11
Chloroacetic acid	$ClCH_2COOH$	1.72
Cobalt chloride	$CoCl_2$	1.78
Cobalt sulphate	$CoSO_4$	1.91
Copper sulphate	$CuSO_4$	1.49
Dichloroacetic acid	$Cl_2CHCOOH$	1.66
Formic acid	$HCOOH$	0.95
Hydrochloric acid	HCl	1.34
Hydrogen bromide	HBr	0.94
Hydrogen iodide	HI	0.52
Lead nitrate	$Pb(NO_3)_2$	1.53
Lithium nitrate	$LiNO_3$	2.11
Malonic acid	$CH_2(COOH)_2$	1.68
Nickel chloride	$NiCl_2$	1.86
Nickel sulphate	$NiSO_4$	2.10
Nitric acid	HNO_3	1.69
Oxalic acid	$(COOH)_2$	0.95
Perchloric acid	$HClO_4$	1.65
Phosphoric acid	H_3PO_4	1.70
Potassium hydroxide	KOH	1.68
Potassium nitrate	KNO_3	2.17
Potassium sulphate	K_2SO_4	2.20
Silver nitrate	$AgNO_3$	0.70
Sodium chloride	$NaCl$	2.31
Sodium hydroxide	$NaOH$	1.69
Sodium nitrate	$NaNO_3$	2.15
Sodium sulphate	Na_2SO_4	2.21
Strontium nitrate	$Sr(NO_3)_2$	2.28
Sulphuric acid	H_2SO_4	1.67
Tartaric acid	$HOOC(CHOH)_2COOH$	1.62
Trichloroacetic acid	CCl_3COOH	1.51
Zinc bromide	$ZnBr_2$	1.80
Zinc chloride	$ZnCl_2$	2.28
Zinc sulphate	$ZnSO_4$	2.35

Table 276

Practical decomposition potentials of molten electrolytes

Electrolyte	Temperature, °C	Decomposition potential, V	Electrolyte	Temperature, °C	Decomposition potential, V
AgBr	700	0.73	LiCl	700	3.41
AgCl	700	0.84		800	3.17
AgI	700	0.68	LiF	1000	2.20
$AlBr_3$	700	1.20	LiI	700	2.56
$AlCl_3$	700	1.61	Li_3AlF_6	1100	2.30
AlI_3	700	0.70	$MgBr_2$	700	2.21
$BaBr_2$	700	3.25	$MgCl_2$	700	2.60
$BaCl_2$	700	3.62		800	2.50
	1000	3.14	MgF_2	1400	2.25
BaF_2	1400	2.58	MgI_2	700	1.60
$BeCl_2$	700	1.92	$MnBr_2$	700	1.46
$BiBr_3$	700	0.44	$MnCl_2$	700	1.87
$BiCl_3$	700	0.64	MnI_2	700	1.05
BiI_3	700	0.28	NaBr	700	2.98
$CaBr_2$	700	2.88		750	2.92
$CaCl_2$	700	3.38		800	2.85
	800	3.22		900	2.71
CaF_2	1400	2.40	NaCl	700	3.39
CaI_2	700	2.24		800	3.22
$CdBr_2$	700	1.09		820	3.15
$CdCl_2$	600	1.27		840	3 06
CdI_2	700	0.80	NaF	1000	2.76
$CeCl_3$	700	2.95	NaI	700	2.40
$CoBr_2$	700	0.68		780	2.31
$CoCl_2$	700	0.97		800	2.24
CoI_2	700	0.18		850	2.22
CsCl	700	3.68		900	2.10
CsI	700	2.40	NaOH	200	2.34
CuBr	700	0.70		300	2.27
CuCl	700	0.74	Na_2SO_4	900	2.50
CuI	700	0.44	Na_3AlF_6	1100	2.07
$HgBr_2$	700	0.54	$Na_4P_2O_7$	1000	0.71
$HgCl_2$	700	0.86	$NdCl_3$	700	1.74
HgI_2	700	0.24	$NiCl_2$	700	1.03
KBr	700	3.12	$PbBr_2$	700	0.91
	800	2.97	$PbCl_2$	600	1.28
KCl	700	3.53		700	1.15
	800	3.10	PbI_2	700	0.60
KF	1000	2.54	$RbBr_2$	700	2.73
KI	700	2.59	$RbCl_2$	720	3.62
	800	2.40	RbI_2	700	2.25
KOH	300	2.35	$SbBr_3$	700	0.42
K_3AlF_6	1100	2.12	$SbCl_3$	650	0.50
$LaCl_3$	700	3.17	SbI_3	600	0.20
LiBr	700	3.03	$SnBr_2$	650	0.80
	800	2.93	$SnCl_2$	620	1.10

Electrolyte	Temperature, °C	Decomposition potential, V	Electrolyte	Temperature, °C	Decomposition potential, V
SnI_2	700	0.64	TlCl	650	1.50
$SrBr_2$	650	3.10	TlI	600	1.10
$SrCl_2$	700	3.52	$ZnBr_2$	700	1.13
	800	3.30	$ZnCl_2$	400	1.96
SrF_2	1400	2.43		500	1.50
SrI_2	650	2.60		700	1.40
$ThCl_4$	700	2.22	ZnI_2	620	0.90
TlBr	700	1.32			

Table 277

Polarographic half-wave potentials (*vs.* SCE) of inorganic depolarizers
(For the general remarks on the use of the table see: p. 303)

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
	Ag			
Ag^+	In all solutions reduction of Ag^+ starts from the dissolution of mercury	$1 \rightarrow 0$	↑	c
	Al			
$Al^{3+} \cdot aq$	0.2M Li_2SO_4, $5 \cdot 10^{-3}$M H_2SO_4	$3 \rightarrow 0$ (?)	−1.64	c
	As			
$As^{V}Cl_x^{(5-x)+}$ (?)	11.5M HCl	$5 \rightarrow 0$ (?)	↑	c
		$0 \rightarrow (-3)$	−0.5	c
$As^{III}O_2^-$ (?)	1M H_2SO_4, 0.01%	$3 \rightarrow 0$	−0.7	c
		$0 \rightarrow (-3)$	−1.0	c
	1M HCl	$3 \rightarrow 0$	−0.43	c
	0.5M KOH	$0 \rightarrow (-3)$	(−0.6)	max.
	0.5M KOH	$3 \rightarrow 5$	−0.26	a
	Au			
$Au(OH)_4^-$	2M NaOH; KOH; LiOH	$3 \rightarrow 1$	↑ }	c*
			−0.48 }	c
$Au(en)_2^{3+}$	1M en-Tart, pH 5.7	$3 \rightarrow 0$	−0.08	c
$Au(CN)_4^-$	0.1M KCN	$3 \rightarrow 1$	↑	c
		$1 \rightarrow 0$	−1.4	c
$Au(CN)_2^-$	0.1M KCN	$1 \rightarrow 0$	−1.4	c

* The ratio of the wave heights is time-dependent. With increasing gelatine concentration, $E_{1/2}$ shifts to more negative potentials.

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		Ba		
$Ba^{2+}\cdot aq$	Et_4NI	$2\rightarrow 0$	−1.94	c
		Be		
$Be^{2+}\cdot aq$	?	(?)	−1.8	c
		Bi		
BiO^+	1N HNO_3, 0.01% ge	$3\rightarrow 0$	−0.01	c
$BiCl_4^-$	1M HCl, 0.01% ge	$3\rightarrow 0$	−0.09	cr
Bi^{III}(K)	0.5M Ac^-, nita, pH 4.6	$3\rightarrow 0$	−0.32	c
	0.5M Ac^-, edta, pH 4.6	$3\rightarrow 0$	−0.62	c
		Br		
$HBrO_3$	BR buffer, pH 2.0	$5\rightarrow(-1)$	−0.60	c
	BR buffer, pH 4.7	$5\rightarrow(-1)$	−1.16	c
BrO_3^-	0.1M KCl	$5\rightarrow(-1)$	−1.78	c
	0.1M $CaCl_2$	$5\rightarrow(-1)$	−1.51	c
	0.1M $BaCl_2$	$5\rightarrow(-1)$	-1.55_5	c
	0.07M KCl, 0.22M $LaCl_3$		−1.1*	
	4×10^{-3}M HCl			
		Ca		
$Ca^{2+}\cdot aq$	Me_4NCl	$2\rightarrow 0$	−2.22	c
	Me_4NCl, 80% ethanol	$2\rightarrow 0$	-2.1_3	c
		Cd		
$Cd^{2+}\cdot aq$	1M $HClO_4$, 0.01% ge	$1\rightarrow 0$	−0.62	c
$Cd_2^+\cdot aq$	1M HNO_3, 0.01% ge	$2\rightarrow 0$	−0.59	cr
	0.1M KNO_3	$2\rightarrow 0$	−0.578	cr
	0.5M H_2SO_4	$2\rightarrow 0$	−0.59	c
$Cd^{2+}\cdot aq$ (?)	0.4M Ac^-, pH 4.7	$2\rightarrow 0$	−0.61	c
$Cd(Cl)_x^{(2-x)+}$	0.1M KCl, 0.01% ge	$2\rightarrow 0$	−0.600	cr
	4M NaCl	$2\rightarrow 0$	−0.69	cr
$CdBr_x^{(2-x)+}$	0.5M KBr	$2\rightarrow 0$	−0.65	cr
	3M KBr	$2\rightarrow 0$	−0.70	cr
CdI_4^{2-}	0.1M KI	$2\rightarrow 0$	-0.65_5	cr
	3M KI_7	$2\rightarrow 0$	−0.80	cr
$Cd(CNS)_x^{(2-x)+}$	KNO_3, 0.1M KCNS, $I = 2$	$2\rightarrow 0$	-0.58_5	c
	2M KCNS	$2\rightarrow 0$	−0.664	c
$Cd(S_2O_3)_3^{4-}$	0.1M KNO_3, 1M $Na_2S_2O_3$, 0.01% ge	$2\rightarrow 0$	−0.78	c
$Cd(NH_3)_4^{2+}$	0.1M NH_4NO_3, 0.1M NH_3	$2\rightarrow 0$	−0.674	cr
	1M NH_4Cl, 1M NH_3	$2\rightarrow 0$	−0.81	c
Cd^{II}(K)	0.4M Ac^-, 0.1M nita	$2\rightarrow 0$	−0.87	c
$Cd(Cn)_4^{2-}$	0.1M KNO_3, 1M KCN, 0.01% ge	$2\rightarrow 0$	**−1.16**	c

* Potential of sudden rise.

Table 277

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		Ce		
$Ce^{4+} \cdot aq$	H_2SO_4	$4 \rightarrow 3$	↑	c
$Ce^{VI}(en)_x$	0.1M en	$4 \rightarrow 3$	−0.71	c
		Cl		
$NaClO_2$	0.1N Na_2SO_3, NaOH, pH 12.5	$3 \rightarrow (-1)$	−1.02	c
		Co		
$[Co(NH_3)_6]^{3+}$	0.1M $NaClO_4$	$3 \rightarrow 2$	−0.25	c
		$2 \rightarrow 0$	−1.23	c
	1M HNO_3	$3 \rightarrow 2$	−0.28	c
	1M H_2SO_4	$3 \rightarrow 2$	-0.38_5	c
	0.1M K_2SO_4	$3 \rightarrow 2$	−0.46	c
		$2 \rightarrow 0$	−1.23	c
	1M HCl	$3 \rightarrow 2$	−0.22	c
	1M KCl	$3 \rightarrow 2$	−0.20	c
	0.5M NaOH	$3 \rightarrow 2$	-0.35_5	c
	7M NH_3, 2M NH_4NO_3	$3 \rightarrow 2$	−0.29	c
$[Co\ en_3]^{3+}$	0.1M en	$3 \rightarrow 2$	-0.45_6	cr
$[Co(CN)_5H_2O]^{2-}$	1M KCN	$3 \rightarrow 1$	−1.45	c
$Co^{2+} \cdot aq$	0.05M K_2SO_4	$2 \rightarrow 0$	−1.21	c
	0.5M K_2SO_4	$2 \rightarrow 0$	−1.43	c
$CoCl_x^{(z-x)+}$	5M $CaCl_2$	$2 \rightarrow 0$	−0.82	c
$Co(NH_3)_6^{2+}$	4M NH_3, 0.05M NH_4Cl	$2 \rightarrow 0$	−1.45	c
$Co(NH_3)_5H_2O]^{2+}$	1.25M NH_3, 1M NH_4Cl	$2 \rightarrow 0$	−1.40	c
$Co(Py)_x^{2+}$	0.03M Py, 0.25M KCl	$2 \rightarrow 0$	−1.02	c
		Cr		
$Cr_2O_7^{2-}$	1M H_2SO_4	$6 \rightarrow 3$	↑	c
	1M KCl	$6 \rightarrow 3$	−0.28 }	c
			−0.96 }	
		$3 \rightarrow 2$	−1.50	c
		$2 \rightarrow 0$	−1.70	c
	1M KOH	$6 \rightarrow 3$	−1.03	c
	0.1M NH_3, 0.1M NH_4Cl	$6 \rightarrow 3$	−0.46	c
$Cr(H_2O)_6^{3+}$	1M K_2SO_4	$3 \rightarrow 2$	-1.03_5	c
		$2 \rightarrow 0$	−1.63	c
$CrCl_6^{3-}$	10M $CaCl_2$	$3 \rightarrow 2$	−0.51	cr
$Cr(NH_3)_x^{3+}$	1M NH_3, 1M NH_4Cl, 0.005% ge	$3 \rightarrow 2$	−1.42	c
$Cr(Py)_x^{3+}$	0.1M Py, 0.1M Py · HCl	$3 \rightarrow 2$	−0.95	c-
$Cr(CN)_6^{3-}$	1M KCN	$3 \rightarrow 2$	−1.38	cr
Cr^{2+}	0.1M Na_2SO_4	$2 \rightarrow 3$	−0.58	a-
$Cr(NH_3)_x^{2+}$	5M NH_4Cl, 0.1M NH_3	$2 \rightarrow 3$	-0.8_5	a-

(continued)

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		Cs		
$Cs^{+} \cdot aq$	0.1M Me_4NOH	$1 \to 0$	−2.09	cr
		Cu		
$Cu^{2+} \cdot aq$	0.5M H_2SO_4, 0.01% ge	$2 \to 0$	0.00	cr
$[CuCl_x]^{(2-x)+}$	1M KCl	$2 \to 1$	↑	c
		$1 \to 0$	−0.23	c
$[Cu(CNS)_x]^{(2-x)+}$	0.1M KCNS	$2 \to 1$	−0.02	c
		$1 \to 0$	−0.39	c
	1M KCNS	$2 \to 0$	−0.62	c
$Cu(Ox)_2^{2-}$	1.0F KOx, pH 5.7–10	$2 \to 0$	−0.27	c
Cu^{II}(nita)	0.5M Ac, pH 4.6, nita	$2 \to 0$	−0.16	c
Cu^{II}(edta)	0.25M edta, pH 5.0	$2 \to 0$	−0.320	c
$Cu(NH_3)_2^{+}$	1M NH_3, 1M NH_4Cl	$1 \to 2$	−0.25	ar
		$1 \to 0$	−0.54	cr
		Dy		
$Dy^{3+} \cdot aq$	?	$3 \to 0$ (?)	-1.8_5	c
		Er		
$Er^{3+} \cdot aq$	?	$3 \to 0$ (?)	-1.8_5	c
		Eu		
$Eu^{3+} \cdot aq$	1.75M $HClO_4$	$3 \to 2$	−0.76	c
	0.2M KCl	$3 \to 2$	−0.72	c
Eu^{III} (edta)	1M edta, pH 6–8	$3 \to 2$	−1.22	cr
$Eu^{2+} \cdot aq$	1.75M $HClO_4$	$2 \to 3$	−0.46	a
	0.2M KCl	$2 \to 3$	−0.54	a
		Fe		
$Fe^{III} \cdot$ (Cl)	1M–8M HCl	$3 \to 2$	↑	c
$Fe(Ox)_3^{3-}$	0.2F NaOx, pH 3.7–5.25	$3 \to 2$	−0.24	cr
Fe^{III}(H Tart)	0.5F Na Tart, pH 5.8	$3 \to 2$	−0.17	cr
		$2 \to 0$	−1.50	c
$[Fe(Sulphosalic)_3]^{6-}$	0.5M borate, 0.01M sulphosalic⁻, $NaClO_4$, $I = 1$	$3 \to 2$	-0.56_8	cr
		$2 \to 0$	−1.30	c
$Fe(K)_3^{2-}$	4M NaOH, 1M NaCl, 0.25M $N(CH_2CH_2OH)_3$	$3 \to 2$	−1.00	cr
Fe^{III}(nita)	0.4M Ac^-, pH 4.6 nita	$3 \to 2$	+0.03	c
Fe^{III}(edta)	0.04M edta, $HClO_4 + NaClO_4$, $I = 0.15$, pH 2	$3 \to 2$	−0.05	cr

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
	Fe			
Fe^{III} (edta) (cont.)	0.04 edta, $HClO_4 + NaClO_4$, $I = 0.15$, pH 7	$3 \rightarrow 2$	−0.15	cr
$Fe(CN)_6^{3-}$	0.1M H_2SO_4	$3 \rightarrow 2$	+0.24	cr
$Fe(Et)_2^+$	0.1M $HClO_4$	$3 \rightarrow 2$	+0.16	cr
$Fe^{2+} \cdot aq$	1M $NaClO_4$	$2 \rightarrow 0$	−1.43	c
	1M $BaCl_2$; 1M KCl	$2 \rightarrow 0$	−1.3	c
$Fe^{II}(X)$	1M NH_3, 1M NH_4Cl	$2 \rightarrow 0$	−1.52	c
$Fe(CO)_5$	0.4M Me_4NCl, ethanol	$0 \rightarrow (-2)$	−1.6	c
	Ga			
$Ga^{3+} \cdot aq$	0.1M KNO_3	$3 \rightarrow 0$	−1.12	c
GaF_6^{3-}	0.1M NaF	$3 \rightarrow 0$	−1.42	c
$[Ga(NH_3)_x]^{3+}$	1M NH_3, 1M NH_4Cl	$3 \rightarrow 0$	-1.58_5	c
	Gd			
$Gd^{3+} \cdot aq$	0.1M LiCl, 0.01% ge, $8 \cdot 10^{-4}$M Gd^{3+}	$3 \rightarrow 0$ (?)	−1.74	c
	Ge			
$Ge^{IV}(X)$	0.1M NH_3, 0.1M NH_4Cl	$4 \rightarrow 0$	$\left.\begin{matrix}-1.4\\-1.7\end{matrix}\right\}$	c
$Ge^{IV}(K)$	0.2M edta, pH 6–8	$4 \rightarrow 0$	−1.3	c
$Ge^{II}Cl_x^{(2-x)+}$	0.55M HCl, $2.4 \cdot 10^{-3}$M Ge^{2+}	$2 \rightarrow 0$	−0.42	c
Ge^{II}	4M H_2SO_4	$2 \rightarrow 4$	−0.10	a
	H			
H_3O^+	0.1M KCl; 0.1M $KClO_3$	$1 \rightarrow 0$	−1.58	c
	Hg			
$Hg^+ \cdot Hg^{2+}$	Free ions do not give separate waves			
	Hg^{2+} Complexes			
$Hg(OH)_2$	0.1M KNO_3, 1×10^{-3}M NaOH	$0 \rightarrow 2$	+0.08	a
$Hg(CNS)_2$	0.1M KNO_3, 1×10^{-3}M KCNS	$0 \rightarrow 2$	+0.18	a
$Hg(edta)^2$	Ac^- pH 4.65, 8×10^{-4}M $Hg(edta)^{2-}$	$2 \rightarrow 0$	+0.160	cr
	Ac^- pH 4.65, 8×10^{-4}M edta	$0 \rightarrow 2$	+0.162	ar
$Hg(CN)_2$	0.1M Clark–Lubs buffer 2×10^{-4}M $Hg(CN)_2$, pH 7	$2 \rightarrow 0$	−0.18	c

(continued)

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
	Hg^{2+} Complexes			
$Hg(CN)_2$ (cont.)	0.1M KCl, 2×10^{-4}M $Hg(CN)_2$, 0.1M NaOH	$2\rightarrow0$	-0.32	c
	0.1M NaOH, 5×10^{-4} KCN	$0\rightarrow2$	-0.45*	a
$Hg(SO_3)_2^{2-}$	0.1M KNO_3, 2×10^{-3}M Na_2SO_3	$0\rightarrow2$	-0.02	a
	Precipitated Hg_2^{2+}, (Hg^{2+}) 1×10^{-3}M anion			
Hg_2Cl_2	0.1M Na_2SO_4, 1×10^{-3}M H_2SO_4	$0\rightarrow1$	$+0.268$	a
Hg_2Br_2	0.1M K_2SO_4	$0\rightarrow1$	$+0.17$	a
Hg_2I_2	0.1M KNO_3	$0\rightarrow1$	-0.03	a
$Hg_2(N_3)_2$	0.1M K_2SO_4	$0\rightarrow1$	$+0.27$	a
HgS	2M NaOH	$0\rightarrow2$	-0.79	a
HgS	NaOH, pH 12	$0\rightarrow2$	-0.94	a
	Ho			
$Ho^{3+}\cdot aq$	?	$3\rightarrow0$	-1.8_5	c
	I			
$I^{VII}O_4^-$	In all media	$7\rightarrow5$	↑	c
		$5\rightarrow(-1)$	cf. IO_3^-	c
HIO_3	BR buffer pH 4.36	$5\rightarrow(-1)$	-0.45	c
IO_3^-	0.2M KNO_3; 0.2M KCl	$5\rightarrow(-1)$	-1.23	c
	0.1M KCl, 0.1M NaOH	$5\rightarrow(-1)$	-1.21	c
	0.2M $CaCl_2$	$5\rightarrow(-1)$	-0.98	c
	0.1M KCl, 0.1M $LaCl_3$	$5\rightarrow(-1)$	-0.38**	c
	In			
$In^{3+}\cdot aq$	$HClO_4\cdot H_2SO_4\cdot HNO_3$	$3\rightarrow0$	-1.0	c
$InCl_x^{(3-x)+}$	1M KCl	$3\rightarrow0$	-0.61_2	cr
$InBr_x^{(3-x)+}$	1M KBr	$3\rightarrow0$	-0.579	c
$InI_x^{(3-x)+}$	1.3M KI	$3\rightarrow0$	-0.56	c
	Ir			
$Ir^{IV}(F)$	0.5F Na_2F_2, 0.01% ge	$4\rightarrow?$	-1.4	c
	K			
$K^+\cdot aq$	0.1M Me_4NCl; 0.1M Me_4NOH	$1\rightarrow0$	-2.28	cr
	La			
La^{3+}	0.01M $La_2(SO_4)_3$	$3\rightarrow0$	-1.9	c

* Beginning of the wave. ** Potential rise.

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		Li		
$Li^+ \cdot aq$	0.1M Me_4NCl; 0.1M Me_4NOH	$1 \rightarrow 0$	-2.34_5	c
		Lu		
$Lu^{3+} \cdot aq$	?	$3 \rightarrow 0$ (?)	−1.8	c
		Mg		
$Mg^{2+} \cdot aq$	Me_4NCl	$2 \rightarrow 0$	−2.2	c
		Mn		
$Mn^{III}(K)$	1M NaCl, 4M NaOH, 0.2M $N(CH_2CH_2OH)_3$	$3 \rightarrow 2$	−0.45	cr
$Mn^{III}(K)$	0.2 NH_3, 0.2M NH_4Cl, 0.05N tiron	$3 \rightarrow 2$	−0.33	cr
$Mn(CN)_6^{3-}$	1.5M KCN	$3 \rightarrow 2$	↑	c
		$2 \rightarrow 0$	−1.4	c
$Mn^{2+} \cdot aq$	1M NaOH	$2 \rightarrow 0$	−1.7	c
	0.1M KCl	$2 \rightarrow 0$	−1.48	c
$Mn^{II}Cl$ (?)	6M LiCl	$2 \rightarrow 0$	−1.39	c
Mn^{II}	0.1M KCNS	$2 \rightarrow 0$	−1.50	c
$Mn^{II} \cdot$ (Tart)	2M NaOH, 5% KNaTart	$2 \rightarrow 0$	−1.70	c
		$2 \rightarrow 3$	−0.4	a
Mn^{II}	1M NH_3, 1M NH_4Cl, 0.005% ge	$2 \rightarrow 0$	−1.65	c
		Mo		
$Mo^{VI}O_4^-$	0.5M H_2SO_4	$6 \rightarrow 5$	−0.29	c
		$5 \rightarrow 3$	−0.84	c
	1M HCl	$6 \rightarrow 5$	−0.14	c
		$5 \rightarrow 3$	−0.53	c
Mo^{IV} (?)	0.8M HCl	$4 \rightarrow$ (?)	−0.15	a
Mo^{III} (?)	0.8M HCl	$3 \rightarrow$ (?)	−0.15	a
		N		
$N^VO_3^-$	0.1M Me_4NCl	$5 \rightarrow$ (?)	−2.1*	c
	0.1M $CaCl_2$		-1.7_4	c
	0.1M $CeCl_3$		−1.2	c
	0.1M $LaCl_3$		−1.2**	c

* Potential at the foot of the wave. ** Potential of sudden rise.

(continued)

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		N		
$HN^{III}O_2$	0.1M HCl, 0.2M NaCl	3 → (?)	−0.96	c
NO_2^-	0.1M $LaCl_3$	3 → (?)	−1.2**	c
$N^{II}O$	1M KCl, 0.1M HCl	(?)	−0.5	c
		(?)	−1.1	c
NH_2OH	Sörensen buffer pH 9	(−1) → 1	+0.04	a
	Sörensen buffer pH 12		−0.21	a
	BR buffer pH 4	(−1) → (−3)	−1.45	a
	BR buffer pH 9		−1.7	c
NH_2NH_2	1M NaOH, 3M NaCl	(−2) → 0	−0.29	a
NH_4^+	0.1M Me_4NCl	$NH_4^+ \rightarrow NH_4$	−2.03	c
	0.05M Me_4NOH		−2.22	c
		Na		
$Na^+ \cdot aq$	0.1M Me_4NCl; 0.1M Me_4NOH	1 → 0	−2.104	cr
		Nb		
NbO^{3+}	0.1M KCl, pH 2.6	5 → ?	−1.3	c
$NbCl_6^-$	12M HCl	5 → 4	−0.46	cr
$[NbCl_4 \cdot K]^-$	11.4M HCl, 5% ethyleneglycol	5 → 4	−0.42	cr
$Nb^{V}K$	0.1M edta, pH 3.05	5 → 4	−0.61	c
		4 → ?	−1.05	c
$Nb^{III} \cdot Cl$	12M HCl	3 → 5	−0.32	a
$Nb^{II} \cdot (?)$	10M HCl, 20% ethyleneglycol	2 → (?)	−0.53	a
		Nd		
Nd^{3+}	0.1M LiCl, $2 \cdot 10^{-3}$M H_2SO_4	3 → 0 (?)	−1.82	c
		Ni		
Et_2Ni^+	0.1M $NaClO_4$, 90% ethanol	3 → 2	−0.08	cr
$Ni^{2+} \cdot aq$	$HClO_4$, pH 0–2	2 → 0	−1.1	c
$Ni^{2+} \cdot aq$	1M KCl	2 → 0	−1.1	c
$Ni(CNS)_x^{(2-x)+}$	0.5M KCNS	2 → 0	−0.69	c
$Ni(NH_3)_6^{2+}$	1M NH_3, 1M NH_4Cl, 0.005% ge	2 → 0	−1.09	c
$Ni(Py)_6^{2+}$	1M KCl, 0.5M Py, 0.01% ge	2 → 0	−0.78	c
$Ni(CN)_4^{2-}$	0.1M KCl, 0.1M KCN	2 → 0	−1.42	c
$[Ni(CN)_3]_2^{4-}$	1M KCN	1 → 2	−0.80	a
		Np		
$Np^{4+} \cdot aq$	1M $HClO_4$	4 → 3	−0.10	c
	1M HCl	4 → 3	−0.10	cr
$Np^{3+} \cdot aq$	1M $HClO_4$	3 → 4	-0.06_4	a

** Potential of sudden rise.

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		O		
O_2	Buffers pH 1–10	$0 \rightarrow (-1)$	−0.05	c
		$(-1) \rightarrow (-2)$	−0.94	c
	0.1M NaOH	$0 \rightarrow (-1)$	−0.17	cr
H_2O_2	0.1M Li_2SO_4	$(-1) \rightarrow (-2)$	−0.88	c
	0.1M NaOH	$(-1) \rightarrow 0$	−0.17	ar
		Os		
$Os^{VIII}O_4$	$Ca(OH)_2$ satd.	$8 \rightarrow 6$	↑	c
		$6 \rightarrow 4$	−0.41	c
		$4 \rightarrow 3$	−1.16	c
		Pb		
$Pb^{2+} \cdot aq$	0.1M $HClO_4$	$2 \rightarrow 0$	-0.37_5	c
	0.1M $NaNO_3$	$2 \rightarrow 0$	−0.382	c
PbO_2^-	0.02M NaOH, 0.004% ge	$2 \rightarrow 0$	−0.626	cr
	1.94M NaOH	$2 \rightarrow 0$	−0.788	cr
$PbCl_x^{(2-x)+}$	0.1M KCl	$2 \rightarrow 0$	−0.386	cr
	4M KCl	$2 \rightarrow 0$	−0.506	cr
PbI_4^{2-}	0.8M KI	$2 \rightarrow 0$	−0.59	c
$Pb^{II}(CNS)$?	0.1M KCNS	$2 \rightarrow 0$	-0.38_5	c
$Pb(P_2O_7)^{2-}$	0.1M $Na_4P_2O_7$	$2 \rightarrow 0$	−0.69	c
$Pb^{II}Ac$	0.4M Ac^-, pH 4.7	$2 \rightarrow 0$	−0.43	c
$Pb(Ox)_2^{2-}$	1F Ox^-, pH 7.4–10.7	$2 \rightarrow 0$	-0.58_1	c
$Pb^{II}Cit$	1M NaCit	$2 \rightarrow 0$	−0.49	cr
$Pb_2(H\ Tart)_3^+$	0.05F $Tart^{2-}$, pH 4.5–6	$2 \rightarrow 0$	−0.44	cr
$Pb^{II}(nita)$	0.4M Ac^-, pH 4.6, nita	$2 \rightarrow 0$	−0.68	c
$Pb(CN)_4^{2-}$	1M KCN	$2 \rightarrow 0$	−0.72	c
		Pd		
$Pd^{II}(OH)$	2M NaOH; 2M KOH	$2 \rightarrow 0$	−1.41	c
$Pd(NH_3)_4^{2+}$	1M NH_3, 1M NH_4Cl, 2×10^{-4}M Pd^{2+}	$2 \rightarrow 0$	−0.72	c
$Pd(Py)_4^{2+}$	1M KCl, 0.1M Py	$2 \rightarrow 0$	−0.18	c
$Pd(en)_2^{2+}$	1M KCl, 0.1M en	$2 \rightarrow 0$	−0.65	c
$Pd(CN)_4^{2-}$	1M KCN	$2 \rightarrow 0$	−1.77	c
		Pr		
$Pr^{3+} \cdot aq$	0.1M LiCl, 0.01% ge, 2.5×10^{-3}M Pr^{3+}	$3 \rightarrow 0$	−1.75	c

(continued)

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		Pt		
Most Pt^{4+} and Pt^{2+} compounds are reduced starting from the potential for dissolution of mercury				
$[Pten(CNS)_2]$	0.5M KCNS, 0.05M en	$2 \to 0$	−0.51	c
		Pu		
Reduction $Pu^{IV} \to Pu^{III}$ studied at a Pt-electrode; $E_{1/2}$ is rather positive				
		Ra		
$Ra^{2+} \cdot aq$	KCl	$2 \to 0$	−1.84	c
		Rb		
$Rb^{+} \cdot aq$	0.1M Me_4NCl; 0.1M Me_4NOH	$1 \to 0$	−2.118	cr
		Re		
$Re^{VII}O_4^-$	2M KCl	$7 \to (-1)$	−1.43	c
$Re^{IV}Cl_6^{2-}$	2.4M HCl	$4 \to 3$	−0.53	c
$ReBr_3$	2M $HClO_4$	$3 \to 2$	−0.28	c
		$2 \to 0$	−0.46	c
		Rh		
$Rh(NH_3)_5Cl^{2+}$	1M $NaNO_3$; 0.05M K_2SO_4, 0.01% ge	$3 \to 1$	−0.96	c
	1M NH_3, 1M NH_4Cl	$3 \to 1$	−0.93	c
		Ru		
$Ru^{4+} \cdot aq$	5M $HClO_4$	$4 \to 3$	↑	c
		$3 \to 2$	−0.34	c
		S		
SO_2	BR buffer pH 1.87	$4 \to 2$	−0.42	c
	BR buffer pH 3.80		−0.56	c
			−0.91	c
			−1.23	c
$S_2O_4^{2-}$	0.5M $(NH_4)_2HPO_4$, 1M NH_3, 0.01% ge	$3 \to 4$	−0.43	a
			−1.03	c

Table 277

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		S		
$S_4O_6^{2-}$	0.1M K_2SO_4, $6 \cdot 10^{-4}$M $S_4O_6^{2-}$	*	−0.28	
	0.1M KCl		−0.29	
	0.1M KBr		−0.40	
	0.1M KI		−0.73	c
S_x	0.1M HAc, 0.1M NaAc, methanol–benzene 1 : 1, pH 6.3	$0 \rightarrow (-2)$	−0.58	c
		Sb		
Sb^{V}	0.2M HCl, 6M $HClO_4$, 0.005% ge	$5 \rightarrow 3$	↑	c
		$3 \rightarrow 0$	−0.16	c
SbO^+	1M HNO_3, 0.01% ge	$3 \rightarrow 0$	−0.30	c
SbO^+Cl	0.5M HCl	$3 \rightarrow 0$	−0.18	c
SbO_2^-	0.1M NaOH	$3 \rightarrow 5$	−0.34	a
		$3 \rightarrow 0$	−1.07	c
Sb^{III}(nita)	0.5M Ac^-, pH 4.6, nita	$3 \rightarrow 0$	−0.44	c
$Sb^{III} \cdot$ K	0.4M Ac^-, pH 4.6, chanta	$3 \rightarrow 0$	−0.85	c
Sb^{III}(CN)	KCN	$3 \rightarrow 0$	−1.13	c
		Se		
$Se^{VI}O_3^{2-}$	0.1M NH_4Cl, 0.003% ge, pH 6.8	$4 \rightarrow (-2)$?	−1.50	Se
		Sm		
$Sm^{3+} \cdot$ aq	0.1M LiCl, 5×10^{-3}M Sm^{3+}	$3 \rightarrow 2$	−1.81	c
		Sn		
$SnCl_x^{(4-x)+}$	1M HCl, 4M NH_4Cl, 0.005% ge	$4 \rightarrow 2$	−0.25	c
		$2 \rightarrow 0$	−0.52	c
$SnBr_x^{(4-x)+}$	4M NH_4Br, 0.005% ge	$4 \rightarrow 2$	↑	c
		$2 \rightarrow 0$	−0.50	c
$Sn^{IV} \cdot$ (X)	1% $(NH_4)_2Ox$	$4 \rightarrow 2$	−0.45	c
$Sn^{2+} \cdot$ aq	1M $HClO_4$	$2 \rightarrow 4$	$+0.13_6$	a
	2M $HClO_4$	$2 \rightarrow 0$	−0.447	c
	1M H_2SO_4	$2 \rightarrow 0$	−0.46	c
SnO_2^-	1M NaOH, 0.01% ge	$2 \rightarrow 4$	−0.73	a
		$2 \rightarrow 0$	−1.22	c
Sn^{II}	0.4M $NaAc^-$, pH 4.6	$2 \rightarrow 4$	−0.17	a
		$2 \rightarrow 0$	−0.50	c

* $S_2O_3^-$ is formed during the reduction.

(continued)

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		Sr		
$Sr^{2+} \cdot aq$	Et_4NI	$2 \rightarrow 0$	-1.94	c
		Ta		
Ta^{V}	0.86M HCl	$5 \rightarrow (?)$	-1.16	c
		Tb		
$Tb^{3+} \cdot aq$	0.1M LiCl, 0.005% ge	$3 \rightarrow (?)$	-1.8_5	c
		Te		
TeO_4^{2-}	0.1M NaOH, 0.03% ge	$6 \rightarrow (-2)$	-1.66	c
	Ac^-, 0.003% ge, pH 5.6	$6 \rightarrow (-2)$	-1.18	c
	0.1M $NH_4Cl + NH_3$, pH 9.2	$6 \rightarrow (-2)$	-1.34	c
	0.1M KCN	$6 \rightarrow (-2)$	-1.54	c
TeO_3^{2-}	0.1M NaOH, 0.003% ge	$4 \rightarrow (-2)$	-1.22	c
	1M $NH_4Cl + NH_3$, pH 9.4, 0.003% ge	$4 \rightarrow (0)$?	-0.67	c
		Ti		
TiO^{2+}	0.065M H_2SO_4	$4 \rightarrow 3$	-0.768	c
$TiCl_6^{2-}$ (?)	$CaCl_2$ satd.	$4 \rightarrow 3$	-0.11	cr
Ti^{IV} (?)	0.1M KCNS	$4 \rightarrow 3$	-0.45	cr
$TiO(Ox)_2^{2-}$	0.2M H_2Ox, pH 1.2	$4 \rightarrow 3$	-0.30	cr
$Ti^{IV} \cdot (Cit)$	0.2M H_3Cit	$4 \rightarrow 3$	-0.37	cr
$Ti^{IV} \cdot (Tart)$	0.2M H_2Tart	$4 \rightarrow 3$	-0.38	cr
$Ti \cdot K$	0.1M Gly, 5×10^{-3}M edta, 0.01% ge, pH < 2	$4 \rightarrow 3$	-0.22	cr
$[TiOK]^{2-}$	0.1M edta, pH 4	$4 \rightarrow 3$	-0.35	cr
$[TiEt_2]^{2+}$	0.1M $HClO_4$	$4 \rightarrow 3$	-0.44	cr
		Tl		
$Tl^+ \cdot aq$	0.1M $NaNO_3$; 0.1M KCl	$1 \rightarrow 0$	-0.455	cr
	1M $NaNO_3$	$1 \rightarrow 0$	-0.479	cr
	0.1M Na_2SO_4	$1 \rightarrow 0$	-0.465	c
	0.1M NH_3, 0.1M NH_4Cl	$1 \rightarrow 0$	-0.463	c
$Tl(P_2O_7)^{3-}$	0.2M NaOH, 0.18M $Na_4P_2O_7$	$1 \rightarrow 0$	-0.55	c
TlK	0.1M KOH, 10^{-2}M edta	$1 \rightarrow 0$	-0.737	cr
		Tm		
$Tm^{3+} \cdot aq$	?	$3 \rightarrow 0$ (?)	-1.8_5	c

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
		U		
$UO_2^{2+} \cdot aq$	0.1M $HClO_4$, 0.9M $NaClO_4$	$6 \rightarrow 5$	-0.17_5	cr
		$5 \rightarrow 3$	-0.84	c
	0.1M HCl	$6 \rightarrow 5$	-0.17_6	cr
		$5 \rightarrow 3$	-0.82	c
	2M Ac^-, pH 4.7	$6 \rightarrow 5$	-0.45	c
		(?)	-1.2	c
$U^{4+} \cdot aq$	0.1M $HClO_4$, 0.9M $NaClO_4$	$4 \rightarrow 3$	-0.86_3	cr
	0.1M HCl, 0.9M KCl	$4 \rightarrow 3$	-0.88_6	cr
		V		
VO_3^-	0.05M H_2SO_4, 0.005% ge	$5 \rightarrow 4$	↑	c
		$4 \rightarrow 2$	-0.98	c
	1M NH_3, 1M NH_4Cl, 0.005% ge	$5 \rightarrow 4$	-0.97	c
		$4 \rightarrow 2$	-1.26	c
VO^{2+}	0.1M H_2SO_4, 0.005% ge	$4 \rightarrow 2$	-0.85	c
V^{IV}	2M NaOH	$4 \rightarrow 5$	-0.44	a
V^{IV}	1M $NH_3 \cdot$ 1M NH_4Cl	$4 \rightarrow 5$	-0.32	a
		$4 \rightarrow 2$	-1.28	c
$V^{3+} \cdot aq$	0.5M H_2SO_4; 1M $HClO_4$; 1M HCl	$3 \rightarrow 2$	-0.508	cr
$V^{III}(CNS)$	1M KCNS	$3 \rightarrow 2$	-0.46	cr
$V(Ox)_x^{(3-x)+}$	1F KOx, pH 4.5	$3 \rightarrow 2$	-1.13_6	cr
		$3 \rightarrow 4$	-0.05	a
		W		
$WO_2Cl_3^-$	12M HCl	$6 \rightarrow 5$	↑	c
		$5 \rightarrow 3$	-0.54	c
W^{VI} (?)	0.5M en-Tart, 0.5M HAc	(?)	-1.34	c
		Y		
$Y^{3+} \cdot aq$	0.01M $Y_2(SO_4)_3$	$3 \rightarrow 0$ (?)	-1.76 } -1.84 }	c
		Yb		
$Yb^{3+} \cdot aq$	0.1M LiCl, 0.005% ge	$3 \rightarrow 2$	-1.17	c
		Zn		
$Zn^{2+} \cdot aq$	0.2M $KClO_3$	$2 \rightarrow 0$	-0.998	c
	0.1M Na_2SO_4	$2 \rightarrow 0$	-1.015	c
	0.5M Na_2SO_4, 0.005% ge	$2 \rightarrow 0$	-1.048	c
	1M KNO_3	$2 \rightarrow 0$	-1.12	c

(continued)

Depolarizer	Supporting electrolyte	Reaction	$E_{1/2}$	Remarks
	Zn			
$Zn^{2+}aq$	1M NaAc, pH 4.7	$2 \rightarrow 0$	-1.04	c
ZnO_2^{2-}	0.1M NaOH	$2 \rightarrow 0$	-1.38	c
	4M NaOH	$2 \rightarrow 0$	-1.55	c
$Zn^{II}(Cl)$?	0.1M KCl	$2 \rightarrow 0$	-0.99_5	c
	1M KCl	$2 \rightarrow 0$	-1.02_2	c
$Zn(CNS)_x^{(2-x)+}$	1M KCNS	$2 \rightarrow 0$	-1.04_3	c
$[Zn(NH_3)_x]^{2+}$	1M NH_3, 0.2M NH_4Cl, 0.005% ge	$2 \rightarrow 0$	-1.33	c
	Zr			
ZrO^{2+}	0.1M KCl, pH 3, 10^{-3}M Zr^{4+}	$4 \rightarrow 0$ (?)	-1.65	c

GENERAL REMARKS ON THE USE OF THE TABLE OF POLAROGRAPHIC HALF-WAVE POTENTIALS

Table 277 comprises half-wave potentials of a number of inorganic depolarizers arranged alphabetically according to the symbols of the active elements. The arrangement corresponds to that used by A. A. Vlček in his Tables (*Chem. Listy*, *50*, 400, 1956). Vlček's tables are the most comprehensive lists of this kind. Only some of his data are given here, our tables containing about one-sixth of the values compiled by Vlček. The half-wave potentials of all depolarizers that behave reversibly at the dropping mercury electrode and appear in Vlček's tables are, however, given here. The half-wave potentials of other depolarizers are listed for the more common media.

The "depolarizer" column gives the species that probably prevail in the solution. When the component of the solution that reacts with the active ion is not known, the depolarizer is denoted as $Me^a(X)$, where a is the valency of the ion. If the component of the solution that reacts with the active ion is known, but the final form is unknown, the symbol $Me^a(K)$ is used. K is also a general symbol for the complex-forming agent.

In the column "supporting electrolyte", the experimental conditions are given as precisely as possible. For a given depolarizer, the individual media start with the most indifferent media (*e.g.* ClO_4^-) and are followed by those with gradually increasing complex-forming activity. The concentration of the individual components is expressed as molar (M) or formal (F). With buffers, the concentration of the salts and the pH-value are given. The name of the salt or its abbreviation is not qualified by the term "buffer" in this column.

In the "reaction" column the valency changes are given for the individual waves. These changes refer to the atoms or ions of the elements forming the nucleus of the particle active at the electrode.

The half-wave potentials measured against a SCE at temperature 20–25°C are given in the column headed "$E_{1/2}$". The symbol ↑ indicates that the depolarizer is reduced directly at the potential of the dissolution of mercury. If the valency change occurs in several waves for different species of the depolarizer (or of the product), the corresponding half-wave potentials are connected by a bracket. A series of subsequent changes in valency are given without brackets in both the "reaction" and the "$E_{1/2}$" columns.

The "remark" column states whether an anodic "a" or a cathodic "c" current is observed and indicates the reversibility of the process "ar" – anodically reversible or "cr" – cathodically reversible. If only a single change in valency was reported in the original paper, but additional transitions can be assumed, "a" or "c" are followed by a hyphen ("a-" or "c-").

SYMBOLS AND ABBREVIATIONS

↑	in the "$E_{1/2}$" column: the reduction of the depolarizer starts at zero applied voltage
→	in the "$E_{1/2}$" column: no wave is observed before the reduction of the supporting electrolyte
?	uncertain data
Ac	acetate
aq ($Me^{a}aq$)	hydrated ion
BR	Britton–Robinson buffer
Bu	butyl
chanta	cyclohexanediaminetetraacetic acid
Cit	citrate
edta	ethylendiaminetetraacetic acid
en	ethylenediamine
Et	ethyl
ge	gelatine
Gly	glycine
K	complex-forming agents in general
Me	methyl
nita	nitrilotriacetic acid
Ox	oxalate
Py	pyridine
sat.	saturated
Sulphosalic	sulphosalicylate
Tart	tartrate
X	uncertain component of the solution

Table 278

Polarographic half-wave potentials (*vs.* SCE) of organic compounds*

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Acenaphthene	0.175M Bu_4NI + 75% dioxan	—	2.58	—	—
Acetaldehyde	buffer	3.9	−1.61	—	—
		7.0	−1.83	—	—
Acetone		2.0	−1.28	—	—
	2.5 N NH_3 + 5N $(NH_4)_2SO_4$ + + 0.025M Me_4NI	9.3	−1.48	—	—
Acetophenone	McIlvaine	1.3	−1.08	—	—
	McIlvaine	4.9	−1.33	—	—
	McIlvaine	7.2	−1.58	—	—
	McIlvaine	11.3	−1.64	—	—
Aconitic acid	buffer	7.0	−2.1	—	—
Acridine	citrate	2.0	−0.34	—	—
	citrate	4.0	−0.36	—	—
	phosphate	7.3	−0.51		−1.25
	borate	11.8	−0.93		−1.26
Acridone	citrate	4.0		−0.52	—
	phosphate	7.3	—	−1.39	—
Acrolein	buffer	4.5	−1.36	—	—
		5.8	−1.02	—	—
		9.0	−1.1	—	—
Acrylonitrile	0.05M Et_4NI	—	−1.94	—	—
Adenine	$HClO_4$ + $KClO_4$	1.3	−1.09	—	—
Adenosine	$HClO_4$ + $KClO_4$	2.2	−1.17	—	—
Adenylic acid	$HClO_4$ + $KClO_4$	2.2	−1.13	—	—
Adrenaline		1.8	+0.15	—	—
		3.5	+0.11	—	—
		5.9	−0.07	—	—
		7.0	−0.13	—	—
Adrenochrome	BR	4.53	−0.08	—	—
	BR	5.91	−0.14	—	—
	BR	8.33	−0.29	—	—
Alizarin	acetate + 1% ethanol	7.0	−0.70	—	—
	borate + 1% ethanol	8.0	−0.73	—	—
	borax + 1% ethanol	11.0	−0.87	—	—
Alizarin red S	acetate + 1% ethanol	4.0	−0.60	—	—
	phosphate + 1% ethanol	6.0	−0.70	—	—
	borate + 1% ethanol	8.0	−0.80	—	—
	borax + 1% ethanol	11.0	−0.90	—	—
Allene	0.05M Et_4NBr + 75% dioxan	—	−2.29	—	—
l-Allose	phosphate	7.0	−1.74	—	—
Alloxan	BR	1.8	+0.10	—	—
	BR	4.5	−0.04	—	—
	BR	7.0	−0.10	—	—
	BR	9.0	−0.20	—	—
	BR	10.7	−0.30	—	—

* For the explanation of symbols see p. 303

Table 278

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Allyl bromide	0.05M Et_4NBr + 75% dioxan	—	−1.29	—	—
Allyl chloride	0.05M Et_4NBr + 75% dioxan	—	−1.91	—	—
p-Aminophenol	BR	6.3	+0.14	—	—
	BR	8.6	−0.04	—	—
	BR	12.0	−0.16	—	—
Aneurin	0.1N LiOH	—	−0.46	—	—
	phosphate	7.2	−1.26	(catal. wave)	
p-Anisaldehyde	McIlvaine	2.2	−0.93	—	—
	McIlvaine	5.0	−1.10	—	−1.26
	McIlvaine	8.0	—	−1.27	—
	McIlvaine	11.0	—	−1.39	—
Anthracene	0.175M Bu_4NI + 75% dioxan	—	−1.94	—	—
Anthraquinone	acetate + 40% dioxan	5.6	−0.51	—	—
	phosphate + 40% dioxan	7.9	−0.71	—	—
Anthrone	buffer + 50% ethanol	2.0	−0.93	—	—
	borax + 40 % dioxan	11.5	−0.79	—	—
l-Arabinose	phosphate	7.0	−1.54	—	—
Ascorbic acid	BR	1.8	+0.22	—	—
	BR	3.4	+0.17	—	—
	BR	7.0	−0.06	—	—
Auramine	phosphate + 50% ethanol	7.0	−1.21	—	—
	BR	10.7	−0.19	—	—
Aureomycin	phosphate	8.1	−1.16	−1.41	—
Aurine (70°C)	buffer + 30% ethanol	7.0	−0.76	−1.20	—
Azobenzene	buffer + 48% ethanol	4.0	−0.20	—	—
	buffer + 10% ethanol	6.3	−0.30	—	—
	buffer + 48% ethanol	7.0	−0.50	—	—
	buffer + 48% ethanol	9.0	−0.60	—	—
p-Azophenol	borate + 50% ethanol	9.2	+0.21	—	—
Azoxybenzene	buffer + 20% ethanol	6.3	−0.63	—	—
Azulene	Et_4NI + 75% dioxan	—	−1.66	−2.36	−2.56
Barbaloin	acetate + 1% ethanol	4.0	−1.33	—	—
	phosphate + 1% ethanol	6.0	−1.42	—	—
	borate + 1% ethanol	8.0	−1.35	—	—
	phosphate + 1% ethanol	11.0	−1.41	—	—
Barbituric acid	borate	9.3	−0.04	—	—
Benzalacetone	buffer + 50% ethanol	1.3	−0.72	—	—
	buffer + 50% ethanol	8.6	−1.27	—	—
Benzaldehyde	50% ethanol	1.2	0.94	—	—
	McIlvaine	2.2	−0.96	—	−1.32
	McIlvaine	3.9	−1.3	—	—
	McIlvaine	8.0	−1.33	—	−1.41
	McIlvaine	11.3	—	−1.44	—
Benzanthrone	0.1N H_2SO_4 + 75% methanol	—	−0.96	—	—
Benzoin	McIlvaine	1.3	−0.90	—	—
	McIlvaine	2.0	−0.95	—	—
	McIlvaine	3.9	−1.19	—	—

(continued)

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
	McIlvaine	7.2	−1.36	—	—
	McIlvaine	8.6	−1.49	—	—
	McIlvaine	11.3	−1.51	—	—
Benzoin 1-oxime	buffer	2.0	−0.88	—	—
	buffer	5.6	−1.08	—	—
	buffer	8.2	−1.67	—	—
Benzophenone	McIlvaine	1.3	−0.94	—	—
	McIlvaine	4.9	−1.16	—	—
	McIlvaine	7.2	−1.29	—	—
	McIlvaine	8.6	−1.36	—	—
	McIlvaine	11.3	−1.42	—	—
o-Benzoquinone	BR	7.0	+0.20	—	—
		9.0	+0.08	—	—
Benzotrichloride	0.05M Et_4NBr + 75% dioxan	—	−0.68	−1.65	−2.00
Benzoyl acetone	buffer	0.6	−1.10	—	—
	buffer	2.6	−1.60	—	—
	buffer	5.3	−1.68	—	—
	buffer	7.6	−1.67	—	—
	buffer	9.7	−1.72	—	—
Benzoylhydrazine	0.13N NaOH	13.0	−0.30	—	—
Benzoyl peroxide	0.3N LiCl + 50% methanol + + 50% benzene	—	0.00	—	—
Benzyl	McIlvaine	1.3	−0.27	—	—
	McIlvaine	4.9	−0.50	—	—
	McIlvaine	7.2	−0.64	—	—
	McIlvaine	8.6	−0.80	—	—
	McIlvaine	11.3	−0.75	—	—
Benzyl chloride	0.05M Et_4NBr + 75% dioxan	—	−1.81	—	—
Berberine	acetate	3.0	—	−1.08	—
	acetate	5.0	−1.01	−1.17	—
	borate	8.0	−0.98	−1.17	—
Bilirubin	buffer	7.0	−1.29	—	—
		11.0	−1.41	—	—
Brilliant green	HCl + KCl	2.0	−0.2	−0.5	—
Bromoacetic acid		1.1	−0.54	—	—
Bromoacetone	0.1N NH_4Cl	—	−0.30	—	—
	0.1N LiCl	—	−0.29	—	—
Bromobenzene	0.05M Et_4NBr + 75% dioxan	—	−2.32	—	—
1-Bromobutane	0.05M Et_4NBr + 75% dioxan	—	−2.27	—	—
Bromoform	0.05M Et_4NBr + 75% dioxan	—	−0.64	−1.47	—
α-Bromopropionic acid		2.0	−0.39	—	—
Bufagin	0.1N LiOH	—	−1.78	—	—
1,3-Butadiene	0.05M Me_4NBr + 75% dioxan	—	−2.59	—	—
Butyl bromide	0.05M Et_4NBr + 75% dioxan	—	−2.27	—	—
Capri blue	phosphate + 1% ethanol	7.0	−0.22	—	—
Carbon tetrabromide	0.05M Et_4NBr + 75% dioxan	—	−0.3	−0.75	−1.49
Carbon tetrachloride	0.05M Me_4NBr + 75% dioxan	—	−0.78	−1.71	—

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Carminic acid	acetate + 1% ethanol	4.0	−0.7	—	—
	phosphate + 1% ethanol	6.0	−0.9	—	—
	borate + 1% ethanol	8.0	−0.8	—	—
Carvone	0.1M Et_4NI + 80% ethanol	—	−1.71	—	—
Chalcone	McIlvaine	1.3	−0.53	−0.96	—
	McIlvaine	7.2	−0.89	−1.09	−1.56
	McIlvaine	11.3	−1.15	—	−1.64
Chloral hydrate	0.1N KCl + 50% ethanol	—	−1.55	—	—
Chloramine-T	0.5M K_2SO_4	—	−0.13	—	—
Chloroacetone	0.1N NH_4Cl	—	−1.13	—	—
	0.1N LiCl	—	−1.18	—	—
Chloroform	0.05 M Me_4NBr + 75% dioxan	—	−1.63	—	—
Chlorophyll	0.1 M Me_4NBr + dioxan	—	−1.9	—	—
Cinchonine	BR	12.0	−1.65	—	—
Cinchoninic acid	HCl + KCl	2.0	−0.66	—	—
	glycine	8.0	−1.06	—	—
Cinchophene	0.1 N LiOH	—	−1.28	−1.51	−1.70
Cinnamaldehyde	buffer + ethanol	6.0	−0.9	−1.5	−1.8
Citral	0.1 M Et_4NI	—	−1.56	—	−2.22
Citronellal	0.1 M Et_4NI	—	—	—	−2.23
Codeinone	BR	7.5	−0.94	−1.58	—
Colchiceine	McIlvaine	2.2	−1.01	—	—
	McIlvaine	5.0	−1.20	−1.45	—
	McIlvaine	11.0	—	−1.59	−1.71
Colchicine	McIlvaine	2.0	−0.95	—	—
	McIlvaine	5.0	−1.11	—	−1.44
	McIlvaine	11.0	—	−1.40	—
Cotarnine	acetate	3.0	—	−1.06	—
	acetate	5.0	—	−1.20	—
	borate	8.0	—	−1.10	—
	borate	10.0	−0.96	−1.19	—
Coumarin	phthalate	6.8	−1.60	—	—
	phosphate	7.4	−1.50	—	—
Coumarone	0.1M Bu_4NI + 75% dioxan	—	−2.80	—	—
Cresyl blue	phosphate + 1% ethanol	7.0	−0.21	—	—
Crotonaldehyde	acetate + 50% dioxan	1.3	−0.92	—	—
	acetate + 50% dioxan	2.0	−0.93	—	—
	NH_3 + NH_4Cl + 50% dioxan	8.0	−1.30	—	—
	NH_3 + NH_4Cl + 50% dioxan	11.0	−1.46	—	—
Crotonic acid	0.1N LiOH	—	−2.1	—	—
	0.05M Et_4NI + 75% dioxan	—	−1.94	—	—
Cupron	buffer	2.0	−0.9	—	—
		5.6	−1.1	—	—
		8.2	−1.7	—	—
Cyanidin	tartrate	3.0	−0.36	—	—
Cyanin	tartrate	3.0	−0.37	—	—
Cyclohexanone	0.05M Et_4NI + 75% dioxan	—	−2.45	—	—

(continued)

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
	2.5N NH_3 + 2.5N $(NH_4)_2SO_4$	9.3	−1.50	—	—
Cyclooctatetraene	0.1M Et_4NOH + 50% ethanol	—	−1.51	—	—
Cymarin	glycine	9.3	−1.46	—	—
Cysteine	acetate	3.8	−0.26	—	—
	phosphate	7.0	−0.46	—	—
Cystine	acetate	3.8	−0.68	—	—
	phosphate	6.5	−0.79	—	—
	NH_3 + NH_4Cl	9.5	−1.01	—	—
DDT	0.01M Me_4NBr + 80% ethanol	—	−0.80	—	—
Diacetyl	0.1N HCl	—	−0.84	—	—
Diacetylene	0.05M Et_4NBr + 78% dioxan	—	−2.27	—	—
Dibenzanthracene	0.175M Bu_4NI + 75% dioxan	—	−2.28	−2.38	—
Dibenzoylmethane	buffer + 50% ethanol	1.3	−0.59	—	—
		11.3	−1.30	−1.62	—
Dibromoacetic acid		1.1	−0.03	−0.59	—
p-Dibromobenzene	0.05M Et_4NBr + 75% dioxan	—	−2.10	—	—
1,2-Dibromobutane	1% Na_2SO_3 + 50% methanol	—	−1.45	—	—
2,6-Dibromophenol-indophenol	phosphate	6.67	0.00	—	—
Dichloroacetic acid		8.19	−1.57	—	—
m-Dichlorobenzene	0.05M Et_4NBr + 75% dioxan	—	−2.48	—	—
o-Dichlorobenzene	0.05M Et_4NBr + 75% dioxan	—	−2.51	—	—
p-Dichlorobenzene	0.05M Et_4NBr + 75% dioxan	—	−2.49	—	—
2,6-Dichlorophenol-indophenol	phosphate	6.67	+0.03	—	—
Diethyl fumarate	buffer	3.97	−0.84	—	—
Diethyl maleate	buffer	3.98	−0.95	—	—
Digitoxin	Me_4NI + 2-propanol	—	−2.2	—	—
1,2-Dihydronaphthalene	0.175M Bu_4NI + 75% dioxan	—	−2.57	—	—
3,5-Diiodotyrosine	1% Me_4NBr + 0.25M Na_4CO_3 + + 20% 2-propanol	11.3	−1.51	−1.72	—
Dimethylfulvene	0.175M Bu_4NI + 75% dioxan	—	−1.89	—	—
Dimethylglyoxime	2N NH_3 + 2N NH_4Cl	9.6	−1.63	—	—
2,3-Dimethyl-naphthoquinone	buffer + 50% methanol	5.4	−0.216	—	—
o-Dinitrobenzene	HCl + KCl + 8% ethanol	0.5	−0.01	−0.16	—
	phthalate	2.5	−0.12	−0.32	−1.26
	borate	9.2	−0.38	−0.74	—
m-Dinitrobenzene	HCl + KCl + 8% ethanol	0.5	−0.03	−0.12	—
	phthalate	2.5	−0.17	−0.29	—
	borate	9.2	−0.46	−0.68	—
p-Dinitrobenzene	HCl + KCl + 8% ethanol	0.5	−0.01	−0.18	—
	phthalate	2.5	−0.12	−0.33	—
	borate	9.2	−0.35	−0.80	—
Dioxy acetone	0.1N KOH	—	−0.13	—	—
Diphenyl	0.175M Bu_4NI + 75% dioxan	—	−2.70	—	—
Diphenylacetylene	0.175M Bu_4NI + 75% dioxan	—	−2.20	—	—

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Dithiodiglycolic acid	buffer + 0.002% ge	3.0	−0.37	—	—
Dithizone	buffer + ethanol	7.0	−0.6	—	—
Duroquinone	acetate + 50% ethanol	5.4	−0.09	—	—
Ethyl bromide	0.05M Et_4NBr + 75% dioxan	—	−2.08	—	—
Ethyl iodide	0.05M Et_4NBr + 75% dioxan	—	−1.67	—	—
Ethyl methacrylate	0.1N LiCl + 25% ethanol	—	−1.9	—	—
Ethyl peroxide	0.02N HCl	—	−0.2	—	—
Flavanol	acetate + 50% 2-propanol	5.6	−1.25	—	—
	phosphate + 50% 2-propanol	7.7	−1.40	—	—
	borate + 50% 2-propanol	10.4	−1.41	—	—
Flavanone	acetate + Me_4NOH +	6.1	−1.30	—	—
	+ 50% 2-propanol	7.5	−1.40	—	—
		9.6	−1.51	—	—
Flavone	acetate + Me_4NOH +	6.1	−1.26	−1.38	—
	+ 50% 2-propanol	9.6	−1.42	—	−1.75
Fluorene	0.175M Bu_4NI + 75% dioxan	—	−2.65	—	—
Fluorescein	acetate	2.0	−0.50	—	—
	phthalate	5.0	−0.65	—	—
	borate	10.1	−1.18	−1.44	—
Folic acid	BR	7.61	−0.73	—	—
Formaldehyde	0.05N KOH + 0.1N KCl	—	−1.59	—	—
Formic acid	0.1N KCl	—	−1.66	—	—
Fructose	0.02N LiCl	—	−1.76	—	—
Fumaric acid		1.0	−0.54	—	—
	HCl + KCl	2.6	−0.83	—	—
	acetate	4.0	−0.93	—	—
	acetate	5.9	−1.20	—	—
	acetate + NH_3	7.8	−1.60	—	—
	NH_3 + NH_4Cl	9.5	—	—	−1.62
Furfurol	BR	2.0	−0.96	—	—
	BR	5.8	−1.38	—	−1.70
	BR	6.5	−1.50	—	−1.70
	BR	12.0	−1.43	—	—
d-Galactose	phosphate	7.0	−1.55	—	—
Gallic acid	phosphate	2.9	+0.50	—	—
		6.0	+0.34	+0.28	—
		8.8	+0.1	—	—
		11.2	−0.04	—	—
Gallocyanine	buffer	7.0	−0.22	—	—
d-Glucose	phosphate	7.0	−1.55	—	—
		10.8	−1.68	—	—
Glutathione	BR	1.8	−0.08	—	—
	BR	9.0	−0.43	—	—
	BR	12.0	−0.46	−0.16	—
Glyceraldehyde	BR	5.0	−1.47	—	—
	BR	8.0	−1.55	—	—
	BR	12.0	−1.67	—	—

(continued)

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Glycolaldehyde	0.1N NaOH	—	−1.70	—	—
Glyoxal	0.1N NH_4Cl	—	−1.50	—	—
Haematin	borate	7.9	−0.41	—	—
		12.2	−0.66	—	—
Haematoporphyrin	0.1M Me_4NOH	—	−1.16	−1.46	—
α-Heptachlorocyclohexane	0.1M Et_4NI + 80% ethanol	—	−0.95	—	—
Hexabromo benzene	0.05M Me_4NBr + 75% dioxan	—	−0.8	−1.5	—
Hexachloro benzene	0.05M Me_4NBr + 75% dioxan	—	−1.4	−1.7	—
α-Hexachlorocyclohexane	0.1M Et_4NI + 80% ethanol	—	−1.98	—	—
β-Hexachlorocyclohexane	0.1M Et_4NI + 80% ethanol	—	−2.11	—	—
γ-Hexachlorocyclohexane	0.1M Et_4NI + 80% ethanol	—	−1.57	−2.54	—
δ-Hexachlorocyclohexane	0.1M Et_4NI + 80% ethanol	—	−2.04	—	—
Hydrastine	acetate	5.0	−1.1	—	—
	phosphate	7.0	−1.2	—	—
Hydrazine	BR	9.3	−0.09	—	—
Hydroquinone/Quinone	acetate + 50% methanol	5.4	+0.10	—	—
	phosphate buffer	6.67	−0.01	—	—
	phosphate + 50% methanol	7.97	−0.05	—	—
o-Hydroxyacetophenone	0.1N NH_4Cl + 50% ethanol	—	−1.36	—	—
p-Hydroxyacetophenone	0.1N NH_4Cl + 50% ethanol	—	−1.45	—	—
p-Hydroxabenzaldehyde	buffer + 50% ethanol	1.81	−1.16	—	—
		11.98	−1.85	—	—
Hydroxylamine	BR	4.6	−1.42	—	—
	BR	9.2	−1.65	—	—
α-Hydroxyphenazine	BR	4.0	−0.24	—	—
	BR	10.6	−0.64	—	—
8-Hydroxyquinoline	acetate	5.0	−1.12	—	—
	phosphate	8.0	−1.18	−1.71	—
	borate	10.0	−1.46	−1.81	—
Indene	0.1M Bu_4NI + 75% dioxan	—	−2.81	—	—
Indigo carmine	buffer	2.5	−0.24	—	—
Indigo disulphonate	buffer	7.0	−0.37	—	—
Indigo tetrasulphonate	buffer	7.0	−0.30	—	—
Indigo trisulphonate	buffer	7.0	−0.33	—	—
Iodoacetic acid		1.1	−0.16	—	—
Iodobenzene	0.05M Et_4NBr + 75% dioxan	—	−1.62	−1.09	−1.50
Iodoform	0.05M Me_4NBr + 75% dioxan	—	−0.45	−1.05	−1.46
α-Ionone	0.1M Et_4NI + 80% ethanol	—	−1.59	—	−2.08
β-Ionone	0.1M Et_4NI + 80% ethanol	—	−1.46	—	−1.82
Isatin	phosphate + citrate	2.9	−0.3	−0.5	—
		4.3	−0.3	−0.5	−0.8
		5.4	—	—	−0.8

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Isonicotinic acid	BR	6.1	−1.14	—	—
		9.0	−1.39	−1.68	—
Jasmone	0.1M Et_4NI + 80% ethanol	—	−1.96	—	−2.45
α-Ketoglutaric acid	HCl + KCl	1.8	−0.59	—	—
	NH_3 + NH_4Cl	8.2	−1.30	—	—
Kynurine	BR	1.8	−0.94	—	—
		10.9	−1.56	—	—
Lactoflavine	phosphate	7.2	−0.40	—	—
Lobelanine	BR	1.8	−1.13	—	—
		8.0	−1.32	—	—
Lobeline	BR	1.8	−1.08	−1.12	—
		8.0	−1.31	−1.40	—
Lumichrome	BR	1.8	−0.30	—	—
	BR	4.1	−0.44	—	—
	BR	7.9	−0.64	—	—
Malachite green G	HCl + KCl	2.0	−0.2	−0.5	—
Maleic acid	BR	2.0	−0.70	—	—
		4.0	−0.97	—	—
		6.0	−1.11	—	−1.30
		10.0	—	—	−1.51
Maltose	0.3M KCl + KOH	9.0	−1.60	—	—
d-Mannose	phosphate	7.0	−1.51	—	—
Meconic acid	BR	2.43	−0.79	—	—
		11.88	—	−1.58	−1.78
Mesityl oxide	McIlvaine + 50% ethanol	1.3	−1.014	—	—
		11.3	−1.604	—	—
Metanil yellow	phosphate + 1% ethanol	7.0	−0.51	—	—
Methacrylic acid	0.1N LiCl + 50% ethanol	—	−1.69	—	—
o-Methoxybenzaldehyde		1.81	−1.03	—	—
p-Methoxybenzaldehyde		1.81	−1.07	—	—
		11.98	−1.60	—	—
Methyl bromide	0.05M Et_4NBr + 75% dioxan	—	−1.63	—	—
Methyl chloride	0.05M Me_4NBr + 75% dioxan	—	−2.23	—	—
3-Methylcholanthrene	0.175M Bu_4NI + 75% dioxan	—	−2.07	−2.46	—
Methylene blue	BR	4.9	−0.15	—	—
		9.24	−0.30	—	—
Methylene bromide	0.05M Et_4NBr + 75% dioxan	—	−1.48	—	—
Methylene chloride	0.05M Me_4NBr + 75% dioxan	—	−1.60	—	—
Methylene green	phosphate + 1% ethanol	7.0	−0.12	—	—
Methylene iodide	0.05M Et_4NBr + 75% dioxan	—	−1.12	−1.53	—
Methylglyoxal		4.5	−0.83	—	—
	buffer	7.0	−1.32	—	—
Methyl iodide	0.05M Et_4NBr + 75% dioxan	—	−1.63	—	—
α-Methylnaphthalene	0.175M Bu_4NI + 75% dioxan	—	−2.46	—	—
β-Methylnaphthalene	0.175M Bu_4NI + 75% dioxan	—	−2.46	—	—
2-Methyl-1,4-naphthoquinone	BR	4.3	−0.10	—	—
		8.6	−0.35	—	—
		12.0	−0.47	—	—

(continued)

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Methyl-*m*-nitrobenzoate	buffer + 10% ethanol	2.0	−0.24	−0.68	—
Methyl-*o*-nitrobenzoate	buffer + 10% ethanol	2.0	−0.25	−0.74	—
Methyl-*p*-nitrobenzoate	buffer + 10% ethanol	2.0	−0.20	−0.73	—
Methyl orange	phosphate + 1% ethanol	7.0	−0.51	—	—
β-Methylstyrene	0.175M Bu_4NI + 75% dioxan	—	−2.54	—	—
Methyl-vinyl ketone	0.1N KCl	—	−1.42	—	—
Morin	acetate + 50% 2-propanol	6.3	−1.6	—	—
	phosphate + 50% 2-propanol	7.6	−1.7	—	—
	borate + 50% 2-propanol	12.0	−2.1	—	—
Muconic acid	0.1N Na acetate + HCl	4.5	−0.97	—	—
Naphthalene	0.175M Bu_4NI + 75% dioxan	—	−2.46	—	—
α-Naphthoquinone	phosphate	5.0	−0.03	—	—
		7.0	−0.13	—	—
β-Naphthoquinone	BR	7.0	−0.07	—	—
		9.0	−0.19	—	—
Narceine	acetate	3.0	−1.20	—	—
	acetate	5.0	−1.40	—	—
	acetate	7.0	−1.50	—	—
	borate	10.0	−1.50	—	—
Neutral blue	phosphate + 1% ethanol	7.0	−0.57	—	—
Neutral red	BR	2.0	−0.21	—	—
	BR	7.0	−0.57	—	—
	BR	10.0	−0.72	—	—
Nicotinic acid	0.1N HCl	—	−1.08	—	—
Ninhydrin	BR	2.5	—	−0.67	−0.83
	BR	4.5	—	−0.73	−1.01
	BR	6.8	−0.10	−0.90	−1.20
	BR	9.2	—	—	−1.35
p-Nitroacetophenone	BR	2.2	−0.16	−0.61	−1.09
		10.0	−0.51	−1.40	−1.73
m-Nitroaniline	BR	1.8	−0.2	−0.6	—
	BR	4.3	−0.3	−0.8	—
	BR	7.2	−0.5	—	—
	BR	9.2	−0.7	—	—
o-Nitroaniline	0.03N LiCl + 0.02M benzoic acid in ethanol	—	−0.88	—	—
p-Nitroaniline	buffer	2.0	−0.36	—	—
	acetate	4.6	−0.5	—	—
m-Nitroanisole	buffer + 10% ethanol	2.0	−0.28	−0.69	—
		10.0	—	−0.71	—
o-Nitroanisole	buffer + 10% ethanol	2.0	−0.29	−0.58	—
		10.0	—	−0.76	—
p-Nitroanisole	buffer + 10% ethanol	2.0	−0.35	−0.64	—
		10.0	—	−0.80	—
1-Nitroanthraquinone	BR	7.0	−0.16	—	—
m-Nitrobenzaldehyde	buffer + 10% ethanol	2.0	−0.28	−1.20	—
Nitrobenzene	HCl + KCl + 8% ethanol	0.5	−0.16	−0.76	—

Table 278

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
	phthalate	2.5	−0.30	—	—
	phthalate	7.4	−0.58	—	—
	borate	9.2	−0.70	—	—
m-Nitrobenzoic acid	buffer + 10% ethanol	2.0	−0.20	−0.70	—
	phosphate + citrate	6.0	−0.5	—	—
	glycine	10–12	−0.8	−1.3	—
o-Nitrobenzoic acid	buffer + 10% ethanol	2.0	−0.23	−0.73	—
	phosphate + citrate	6.0	−0.6	—	—
	glycine	10.0	−1.1	—	—
	glycine	12.2	−1.2	—	—
p-Nitrobenzoic acid	buffer + 10% ethanol	2.0	−0.17	−0.74	—
Nitroethane	0.1N H_2SO_4	—	−0.7	—	—
	BR + 30% methanol	1.8	−0.7	—	—
	BR + 30% methanol	4.6	−0.8	—	—
	BR + 30% methanol	7–11	−0.9	—	—
2-Nitro-*p*-cresol	phosphate + citrate	2.2	−0.3	—	—
	phosphate + citrate	5.4	−0.5	—	—
	phosphate + citrate	8.0	−0.6	—	—
	phosphate + citrate	11.3	−0.8	—	—
3-Nitro-*o*-cresol	phosphate + citrate	2.2	−0.2	—	—
	phosphate + citrate	5.4	−0.4	—	—
	phosphate + citrate	8.0	−0.6	—	—
	phosphate + citrate	11.3	−0.8	—	—
3-Nitro-*p*-cresol	BR	2.2	−0.3	—	—
	BR	5.4	−0.4	—	—
	BR	8.0	−0.6	—	—
	BR	11.3	−0.7	—	—
4-Nitro-*m*-cresol	phosphate + citrate	2.2	−0.2	—	—
	phosphate + citrate	5.4	−0.4	—	—
	phosphate + citrate	8.0	−0.6	—	—
	phosphate + citrate	11.3	−0.7	—	—
4-Nitro-*o*-cresol	phosphate + citrate	2.2	−0.3	—	—
	phosphate + citrate	5.4	−0.5	—	—
	phosphate + citrate	8.0	−0.6	—	—
	phosphate + citrate	11.3	−0.8	—	—
5-Nitro-*o*-cresol	phosphate + citrate	2.2	−0.3	—	—
	phosphate + citrate	5.4	−0.5	—	—
	phosphate + citrate	8.0	−0.7	—	—
	phosphate + citrate	11.3	−0.8	—	—
6-Nitro-*m*-cresol	phosphate + citrate	2.2	−0.4	—	—
	phosphate + citrate	5.4	−0.6	—	—
	phosphate + citrate	8.0	−0.7	—	—
	phosphate + citrate	11.3	−1.0	—	—
2-Nitrohydroquinone	phosphate + citrate	2.1	−0.2	—	—
	phosphate + citrate	5.2	−0.4	—	—
	phosphate + citrate	8.0	−0.5	—	—
	phosphate + citrate	11.3	−0.8	—	—

(continued)

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Nitromethane	0.1N H_2SO_4	—	−0.7	—	—
	BR + 30% methanol	1.8	−0.80	—	—
	BR + 30% methanol	3.3	−0.83	—	—
	BR + 30% methanol	4.6	−0.85	—	—
	BR + 30% methanol	8–11	−0.90	—	—
m-Nitrophenol	BR + 8% ethanol	2.0	−0.37	—	−1.10
	BR + 8% ethanol	4.0	−0.40	—	—
	BR + 8% ethanol	8.0	−0.64	—	—
	BR + 8% ethanol	10.0	−0.76	—	—
o-Nitrophenol	BR + 10% ethanol	2.0	−0.23	—	—
	BR + 10% ethanol	4.0	−0.4	—	—
	BR + 10% ethanol	8.0	−0.65	—	—
	BR + 10% ethanol	10.0	−0.80	—	—
	BR + 10% ethanol	11.9	−0.91	—	—
p-Nitrophenol	BR + 8% ethanol	2.0	−0.35	—	—
	BR + 8% ethanol	4.0	−0.50	—	—
	BR + 8% ethanol	8.0	−0.82	—	−1.24
	BR + 8% ethanol	11.9	−0.96	—	−1.65
1-Nitropropane	0.1N H_2SO_4	—	−0.65	—	—
	BR + 30% methanol	1.8	−0.73	—	—
	BR + 30% methanol	4.6	−0.88	—	—
	BR + 30% methanol	8.0	−0.95	—	—
2-Nitropropane	McIlvaine	2.1	−0.53	—	—
		5.1	−0.81	—	—
Nitrosobenzene	McIlvaine	6.0	−0.03	—	—
	McIlvaine	8.0	−0.14	—	—
	glycine	10.0	−0.27	—	—
α-Nitroso-β-naphthol	buffer + 48% ethanol	4.0	+0.02	—	—
	buffer + 48% ethanol	7.0	−0.20	—	—
	buffer + 48% ethanol	9.0	−0.31	—	—
N-Nitrosophenyl-hydroxylamine		2.0	−0.84	—	—
m-Nitrotoluene	HCl + KCl + 8% ethanol	0.5	−0.15	—	—
	phthalate	2.5	−0.30	−0.56	—
	phthalate	7.4	−0.59	−1.06	—
	borate	9.2	−0.71	—	—
o-Nitrotoluene	HCl + KCl + 8% ethanol	0.5	−0.20	—	—
	phthalate	2.5	−0.35	−0.66	—
	phthalate	7.4	−0.60	−1.06	—
	borate	9.2	−0.75	—	—
p-Nitrotoluene	HCl + KCl + 8% ethanol	0.5	−0.10	—	—
	phthalate	2.5	−0.30	−0.51	—
	phthalate	7.4	−0.58	−1,06	—
	borate	9.2	−0.69	—	—
Norlobelanine	BR	1.8	−1.08	—	—
	BR	8.0	−1.31	—	—
Oxalic acid	buffer	5.4–6.1	−1.80	—	—

Table 278

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Oxamide	acetate	—	−1.55	—	—
Oxine	acetate	2.0	−1.03	—	—
Pantothenic acid	0.1N Me_4NBr	—	−1.8	−2.0	—
Parabanic acid	BR	4.3	−0.84	—	—
Penicillinic acid	acetate	4.7	+0.69	—	—
Phenanthrene	0.175M Bu_4NI + 75% dioxan	—	—	−2.46	−2.71
Phenolphthalein	phthalate	2.5	−0.67	—	—
	phthalate	4.7	−0.80	—	—
	phthalate	9.6	−0.98	−1.35	—
	phthalate + 50% ethanol	10.1	−1.01	−1.33	—
Phenosafranine	buffer	7.0	−0.48	—	—
Phenylacetylene	0.175M Bu_4NI + 75% dioxan	—	−2.37	—	—
Phenylglyoxylic acid	BR	2.2	−0.48	—	—
Phenylglyoxylic acid	BR	5.5	−0.85	—	−1.26
	BR	7.2	−0.98	—	−1.25
	BR	9.2	—	—	−1.25
		12.0	—	—	−1.32
Phenylhydrazine	0.13N NaOH	13.0	−0.36	—	—
3-Phenylindene	0.175M Bu_4NI + 75% dioxan	—	−2.33	—	—
Phenyl-propyl ketone	0.1N NH_4Cl + 50% ethanol	—	−1.55	—	—
Phthalide	0.1M Bu_4NI + 50% dioxan	—	−2.03	—	—
Phthalimide	buffer	1.9	−0.9	—	—
	buffer	4.2	−1.1	−1.5	—
	buffer	9.7	−1.2	−1.4	—
β-Picoline	0.1N LiCi + 50% ethanol	—	−1.76	—	—
γ-Picoline	0.1N LiCl + 50% ethanol	—	−1.87	—	—
Picolinic acid	veronal + acetate	4.05	−1.10	—	—
	veronal + acetate	6.0	−1.20	—	—
	veronal + acetate	9.3	−1.48	−1.94	—
Picric acid	buffer	4.2	−0.34	—	—
	buffer	11.7	−0.36	−0.56	−0.96
Picrolonic acid	acetate buffer	3.6	−0.34	−0.75	—
Piperine	BR	2.0	−1.29	—	—
	BR	4.0	−1.50	—	—
	BR	6.0	−1.52	−1.73	—
	BR	10.0	—	−1.71	—
Piperonal	HCl	—	−0.95	—	—
Porphyrin-C	0.1M Me_4NOH	—	−1.22	−1.52	—
Progesterone	BR + 50% ethanol	2.6	−1.19	—	—
	BR + 50% ethanol	7.0	−1.48	—	—
	BR + 50% ethanol	8.8	−1.55	−1.78	—
Propionaldehyde	0.1N LiOH	—	−1.93	—	—
Protocatechuic acid	phosphate	9.4	+0.19	—	—
Pulegone	0.1M Et_4NI + 80% ethanol	—	−1.74	—	—
Purpurin	acetate + 1% ethanol	7.0	−0.5	−0.7	—
	phosphate + 1% ethanol	8.0	−0.6	−0.8	—
Pyocyanine	phosphate	3.4	−0.11	—	—
	phosphate	7.16	−0.26	—	—

(continued)

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Pyridine		2.9	−1.49	—	—
Pyrimidine	0.09N HCl + KCl	1.2	−0.68	—	—
	citrate	3.6	−0.92	−1.24	—
Pyrogallol	BR	3.1	+0.35	—	—
	BR	6.5	+0.10	—	—
	BR	9.5	−0.10	—	—
Pyrrole aldehyde	0.1N HCl + 50% ethanol	—	−1.25	—	—
Pyruvic acid	BR	5.6	−1.17	—	—
	BR	6.8	−1.22	−1.53	—
	BR	9.7	—	−1.51	—
	BR	10.7	—	−1.44	—
Quercetin	acetate + 50% 2-propanol	5.6	−1.53	—	—
	phosphate + 50% 2-propanol	7.7	−1.70	—	—
	borate + 50% 2-propanol	10.4	−1.90	—	—
Quercitrin	acetate + 50% 2-propanol	5.6	−1.46	—	—
	phosphate + 50% 2-propanol	7.7	−1.60	—	—
	borate + 50% 2-propanol	10.4	−1.90	—	—
Quinalidinic acid	buffer + 8% ethanol + ge	4 0	−0.86	−1.19	—
Quinalizarin	phosphate + 1% ethanol	8.0	−0.56	—	—
	borax + 1% ethanol	11.0	−0.69	—	—
Quinhydrone	acetate + 50% methanol	5.4	+0.10	—	—
	phosphate buffer	6.67	+0.03	—	—
	phosphate + 50% methanol	7.97	−0.05	—	—
Quinidine	BR	12.0	−1.6	—	—
Quinine	BR	5.1	−1.27	—	—
	BR	11.4	−1.60	—	—
Quinoline	buffer + 50% ethanol + + 0.04 ge	6.51	−1.23	—	—
Quinoline-8-carboxylic acid		9.0	−1.11	−1.75	—
Quinotoxine	BR	3.0	−0.46	—	—
	BR	11.0	−1.06	—	—
	phosphate	8.30	−0.34	—	—
Reductone	BR	1.8	+0.23	—	—
	BR	3.4	+0.10	—	—
	BR	5.2	+0.01	—	—
	BR	9.0	−0.10	—	—
	RB	10.7	−0.18	—	—
Riboflavin	BR	1.81	−0.16	—	—
	BR	4.10	−0.30	—	—
	BR	7.96	−0.47	—	—
	BR	11.98	−0.64	—	—
d-Ribose	phosphate	7.0	−1.77	—	—
Rosinduline G	McIlvaine	2.17	−0.28	—	—
	McIlvaine	6.17	−0.46	—	—
	McIlvaine	8.0	−0.63	—	—
Rubeanic acid	NH_4OH	—	−0.4	−0.6	—

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Rutin	acetate + 50% 2-propanol	6.3	−1.46	—	—
	phosphate + 50% 2-propanol	7.6	−1.60	—	—
	borate + 50% 2-propanol	12.9	−1.90	—	—
Saccharin	0.05N HCl	—	−0.96	—	—
Salicylaldehyde	McIlvaine	2.2	−0.99	—	−1.23
	McIlvaine	5.0	−1.20	—	−1.30
	McIlvaine	8.0	—	−1.32	—
	McIlvaine	13.0	—	−1.63	—
Salicylaldoxime	phosphate buffer	5.4	−1.02	—	—
Santonin	BR	1.8	−1.04	—	—
	BR	5.2	−1.26	−1.61	—
Sorbose	0.1N LiCl	—	−1.76	—	—
Stilbene	0.175M Bu_4NI + 75% dioxan	—	−2.26	—	—
Streptomycin	3% Me_4NOH	13.8	−1.41 ?	—	—
Strophantidin	Me_4NI + 2-propanol	—	−2.2	—	—
	glycine	9.3	−1.46	—	—
Styrene	0.175M Bu_4NI + 75% dioxan	—	−2.35	—	—
Sulphanilic acid	0.05N Me_4NI	—	−1.58	—	—
Testosterone	BR + 50% ethanol	2.6	−1.20	—	—
	BR + 50% ethanol	5.8	−1.40	—	—
	BR + 50% ethanol	7.0	−1.47	—	—
	BR + 50% ethanol	8.8	−1.53	−1.79	—
Tetrachloro-*p*-benzoquinone	buffer + 50% dioxan	4.8	−0.10	—	—
Tetranitromethane		12.0	−0.41	—	—
Tetraphenylethylene	0.175M Bu_4NI + 75% dioxan	—	−2.05	—	—
Thebainone	BR	7.1	−1.23	—	—
Thioglycollic acid	acetate buffer	6.75	−0.38	—	—
Thiosemicarbazide	borate buffer	9.3	—	−0.26	—
Thyroxine	1% Me_4NBr + 0.25M Na_4CO_3 + + 20% 2-propanol	11.3	−1.12	−1.30	−1.51
α-Tocopherol	aniline + $HClO_4$ + 75% ethanol	1.7	+0.37	—	—
	aniline + $HClO_4$ + 75% ethanol	4.0	+0.25	—	—
p-Toluquinone	acetate + 50% ethanol	5.40	+0.09	—	—
Trichloroacetic acid	phosphate buffer	4.0	−0.90	—	—
	NH_3 + NH_4Cl	8.19	−0.84	−1.57	—
	phosphate buffer	10.4	−0.9	−1.6	—
Trigonelline	BR	8.0	−1.40	—	—
1,3,5-Trinitrobenzene	HCl + KCl + 8% ethanol	0.5	+0.04	−0.01	−0.07
	phthalate	4.1	−0.20	−0.29	−0.34
	borate	9.2	−0.34	−0.48	−0.65
Trinitrotoluene	HCl + KCl + 8% ethanol	0.5	−0.01	−0.08	−0.14
	phthalate	4.1	−0.19	−0.31	−0.45
	borate	9.2	−0.40	−0.55	−0.73
Triphenylmethane	0.175M Bu_4NI + 75% dioxan	—	−1.01	−1.68	−1.96
Tropone	BR + 80% ethanol	3.0	−0.80	—	—
	BR+80% ethanol	9.3	1.36	−1.82	—

(continued)

Depolarizer	Supporting electrolyte	pH	Half-wave potentials, V		
Trypaflavine		7.0	−1.01	—	—
Vanilin	McIlvaine	2.2	−1.05	—	—
	McIlvaine	5.0	−1.16	—	−1.36
	McIlvaine	8.0	−1.47	—	—
	McIlvaine	11.98	−1.70	—	—
Veratramine	McIlvaine	2.2	—	−1.20	—
	McIlvaine	5.2	—	−1.43	—
Veratrosine	McIlvaine	2.2	—	−1.24	—
	McIlvaine	4.2	−0.84	−1.36	—
Veronal	borate	9.3	0.00	—	—
Vinylacetylene	0.05M Et_4NBr + 75% dioxan	—	−2.40	—	—
Vitamin B_1	0.1N LiOH	—	−0.46	—	—
	phosphate	7.2	−1.26	(catal. wave)	
	Sörensen	11.0	−0.38	(anod. wave)	
Vitamin B_2	phosphate	7.2	−0.40	—	—
Vitamin B_6	0.1N Me_4NBr	—	−1.96	—	—
Vitamin B_{12}	acetate	4.7	−1.66	(catal. wave)	
Vitamin C	phosphate	7.0	−0.06	(anod. wave)	
Vitamin E	acetate + aniline + $HClO_4$	3.6	+0.29	(anod. wave)	
Vitamin K_1	KCl + 2-propanol	—	−0.54	—	—
Vitamin K_5	BR	6.3	−0.07	—	—
Xanthocillin	0.1N LiOH	—	−2.03	—	—
Xanthopterin	phosphate + NaOH	11.3	−1.16	—	—
m-Xyloquinone	acetate + 50% ethanol	5.40	+0.04	—	—
p-Xyloquinone	acetate + 50% ethanol	5.40	+0.04	—	—
d-Xylose	phosphate	7.0	−1.50	—	—

VII

ELECTROKINETIC DATA, ISOELECTRIC POINTS

Table 279

Electrophoretic migration rate of suspended particles of some materials and their electrokinetic potentials in water

Material	u, ms^{-1}/Vm^{-1}	ζ, V
Arsenic trisulphide	2.2×10^{-8}	−0.032
Berlin blue	4.4×10^{-8}	−0.058
Bismuth	1.1×10^{-8}	+0.016
Gold	4.0×10^{-8}	−0.058
Iron	1.9×10^{-8}	+0.028
Iron(III) hydroxide	3.0×10^{-8}	+0.044
Kaolin	2.5×10^{-8}	−0.037
Lead	1.2×10^{-8}	+0.018
Oil	3.2×10^{-8}	−0.046
Platinum	2.0×10^{-8}	−0.030
Quartz	2.2×10^{-8}	−0.032
Silver	2.4×10^{-8}	−0.034

Table 280

Electrophoretic migration rate of suspended particles of some materials and their electrokinetic potentials in organic liquids

Suspended material	Organic liquid	ε	u, ms^{-1}/Vm^{-1}	ζ, V
Bismuth	Methanol	33.6	1.1×10^{-8}	+0.021
Lead	Methanol	33.6	2.2×10^{-8}	+0.046
Lead	Ethanol	25	0.45×10^{-8}	+0.024
Tin	Ethanol	25	0.36×10^{-8}	+0.019
Zinc	Ethanol	25	0.28×10^{-8}	+0.015
Gold	Ethyl malonate	10.7	0.14×10^{-8}	−0.033
Platinum	Ethyl malonate	10.7	0.23×10^{-8}	−0.054
Silver	Ethyl malonate	10.7	0.17×10^{-8}	−0.040

Table 281

Isoelectric points of some proteins in aqueous solution at 25°C

Denomination	Isoelectric point, pH	Denomination	Isoelectric point, pH
Caseine	4.7	Hemoglobin	6.8
Collagen	5.1	Lecithin	1.7–2.7
Egg albumin	4.8–4.9	Muscle protein	6.7
Fibrin	6.8–6.9	Nucleic acids	0.7
Fibrinogen	4.9–5.0	Oxyhemoglobin	6.7
Gelatine	4.7	Protamines	9.7–12.4
Gliadin	6.5	Serum albumin	4.7–4.9
Globin	8.1	Serum globulin	5.4

Table 282

Dissociation constants and pH values
at the isoelectric points of the amino acids in water at 25°C

Amino acid	pK_{ac_1}	pK_{ac_2}	pK_{b_1}	pK_{b_2}	pI
dl-Alanine	9.87	—	11.65	—	6.11
l-Arginine	12.48	—	4.96	11.99	10.76
l-Aspartic acid	3.86	9.82	11.93	—	2.98
l-Cystine	8.00	10.25	11.95	12.96	5.02
Diiodo-*l*-tyrosine	6.48	7.82	11.88	—	4.29
l-Glutamic acid	4.07	9.47	11.90	—	3.08
Glycine	9.78	—	11.65	—	6.06
l-Histidine	9.18	—	7.90	12.23	7.64
Hydroxy-*l*-proline	9.73	—	12.08	—	5.82
dl-Isoleucine	9.76	—	11.68	—	6.04
dl-Leucine	9.74	—	11.67	—	6.04
l-Lysine	10.53	—	5.05	11.82	9.47
dl-Methionine	9.21	—	11.72	—	5.74
dl-Phenylalanine	9.24	—	11.42	—	5.91
l-Proline	10.60	—	12.0	—	6.3
dl-Serine	9.15	—	11.79	—	5.68
l-Tryptophan	9.39	—	11.62	—	5.88
l-Tyrosine	9.11	10.07	11.80	—	5.63
dl-Valine	9.72	—	11.71	—	6.00

VIII

SOME IMPORTANT BOOKS ON ELECTROCHEMISTRY AND RELATED TOPICS

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SUBJECT INDEX

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