Skyline High School
Reference Tables for Chemistry
"DATA BOOK"

Physical Constants and Conversions Factors

Name	Symbol	Value or Conversion Factor	Units
Absolute Zero (temperature)	K or °C	K = °C + 273 or °C = K – 273	0 K (Kelvin) is -273 °C (deg. Celsius)
Angstrom unit (length)	Å	1 Å = 1×10^{-10} m	meter
Atomic mass unit	μ (amu)	1 amu = 1.66×10^{-24} g	gram
Avogadro's number of particles	N_A	1 mol = 6.02214×10^{23} particles	atoms, molecules, f. u., ions
Charge of an electron	e	1.60×10^{-19} C	C = coulomb
Electron volt	eV	1.60×10^{-19} J	joule
Heat in calories or joules	cal	1 cal = 4.18 J	joule
Molarity (concentration)	M	M = mol/L	moles per liter
Mole conversion: L (of a gas)	**mol** (of gas)	1 mol = 22.4 L of a **gas** (at **STP**)	L (liters of a gas)
Mole conversion: particles	**mol**	1 mol = 6.02×10^{23} particles	atoms, molecules, f. u., ions
Mole conversion: mass	**mol**	1 mol = molar mass	g/mol (atomic/formula mass in g)
Planck's constant	h	6.63×10^{-34} J•s	joule•second
	h	1.58×10^{-37} kcal•s	kilocalorie•second
Speed of light	c	3.00×10^{8} m/s	meters/second
Standard Pressure (1 atm),	atm	1 atm = 101.3 kPa	atm or kiloPascals
1 Atmosphere	atm	1 atm = 760 mm Hg = 760 torr	atm or mm Hg or torr
Standard Temperature & Pressure	**STP**	0 °C and 1 atm	°C or K atm, kPa, mm Hg or torr
Standard Volume, 1 liter	L	1 L = 1×10^{3} cm^3 = 1 dm^3	cm^3 and dm^3
1 mL	mL	1 mL = 1 cm^3	mL and cm^3
Universal Gas Constant	R	0.0821 atm•L/mol•K 8.314 kPa•L/mol•K 62.36 torr•L/mol•K	atm•liter/mol•K kPa•liter/mol•K torr•liter/mol•K

Commonly Used Units

Symbol	Name	Quantity		Symbol	Name	Quantity
m	meter	length		mol	mole	amount of substance
g	gram	mass		s	second	time
L	liter	volume		Pa	pascal	pressure
°C	degrees C	Celsius temperature		cal	calorie	quantity of heat
K	Kelvin	absolute temperature		J	joule	quantity of heat, energy, work,
V	volt	electric potential or potential difference		C	coulomb	quantity of electrical charge

Metric Relationships and Conversion Factors

Symbol	Prefix	Factor (x unit)			Prefix and Unit		Unit (g, m, L)
G	giga	10^9			1 Gm	=	1 000 000 000 m
M	mega	10^6			1 Mm	=	1 000 000 m
k	kilo	10^3	1000		1 Km	=	1 000 m
h	hecto	10^2	100		1 hm	=	100 m
da	deca	10	10		1 dam	=	10 m
(g, m, L)	**(unit)**	**1**	**1**		**1 m** (g, m, L)	=	**1 m** (g, m, L)
d	deci	10^{-1}	0.1		10 dm	=	1 m
c	centi	10^{-2}	0.01		100 cm	=	1 m
m	milli	10^{-3}	0.001		1 000 mm	=	1 m
μ	micro	10^{-6}			1 000 000 μm	=	1 m
n	nano	10^{-9}			1 000 000 000 nm	=	1 m

Adapted from the N. Y. State Reagent's Exam Reference Tables Rev. 02/17

Physical Constants for Water

Specific heat capacity (**c**) of H_2O (**liquid**).....1.000 cal/g°C .....**or**.....4.186 j/g°C **Q = mcΔT**

Heat of fusion (H_f)	Heat of Solidification (H_s)	Heat of vaporization (H_v)	Heat of condensation (H_c)
79.72 cal/g **or** 333.5 j/g	-79.72 cal/g **or** -333.5 j/g	539.4 cal/g **or** 2257 j/g	-539.4 cal/g **or** -2257 j/g
Q = mH_f	**Q = mH_s**	**Q = mH_v**	**Q = mH_c**

Specific heat capacity (c) of H_2O (**gas**).....0.480 cal/g°C.....2.010 j/g°C
Specific heat capacity (c) of H_2O (**solid**).....0.502 cal/g°C.....2.100 j/g°C
Molal freezing point depression.....1.86 °C/m
Molal boiling point elevation.....0.52 °C/m

Alphabetical List of the 118 Elements of the Periodic Table

Element	Symbol	Atomic Number
actinium	Ac	89
aluminum	Al	13
americium	Am	95 * ¤
antimony	Sb	51
argon	Ar	18
arsenic	As	33
astatine	At	85 ¤
barium	Ba	56
berkelium	Bk	97 * ¤
beryllium	Be	4
bismuth	Bi	83
bohrium	Bh	107 * ¤
boron	B	5
bromine	Br	35
cadmium	Cd	48
calcium	Ca	20
californium	Cf	98 * ¤
carbon	C	6
cerium	Ce	58
cesium	Cs	55
chlorine	Cl	17
chromium	Cr	24
cobalt	Co	27
copernicium	Cn	112 * ¤
copper	Cu	29
curium	Cm	96 * ¤
darmstadtium	Ds	110 * ¤
dubnium	Db	105 * ¤
dysprosium	Dy	66
einsteinium	Es	99 * ¤
erbium	Er	68
europium	Eu	63
fermium	Fm	100 * ¤
flerovium	Fl	114 * ¤
fluorine	F	9
francium	Fr	87 ¤
gadolinium	Gd	64
gallium	Ga	31
germanium	Ge	32
gold	Au	79
hafnium	Hf	72
hassium	Hs	108 * ¤
helium	He	2
holmium	Ho	67
hydrogen	H	1
indium	In	49
iodine	I	53
iridium	Ir	77
iron	Fe	26
krypton	Kr	36
lanthanum	La	57
lawrencium	Lr	103 * ¤
lead	Pb	82
lithium	Li	3
livermorium	Lv	116 * ¤
lutetium	Lu	71
magnesium	Mg	12
manganese	Mn	25
meitherium	Mt	109 * ¤
mendelevium	Md	101 * ¤
mercury	Hg	80
molybdenum	Mo	42
moscovium	Mc	115 * ¤
neodymium	Nd	60
neon	Ne	10
neptunium	Np	93 * ¤
nickel	Ni	28
nihonium	Nh	113 * ¤
niobium	Nb	41
nitrogen	N	7
nobelium	No	102 * ¤
oganesson	Og	118 * ¤
osmium	Os	76
oxygen	O	8
palladium	Pd	46
phosphorus	P	15
platinum	Pt	78
plutonium	Pu	94 * ¤
polonium	Po	84 ¤
potassium	K	19
praseodymium	Pr	59
promethium	Pm	61
protactinium	Pa	91 ¤
radium	Ra	88 ¤
radon	Rn	86 ¤
rhenium	Re	75
rhodium	Rh	45
roentgenium	Rg	111 * ¤
rubidium	Rb	37
ruthenium	Ru	44
rutherfordium	Rf	104 * ¤
samarium	Sm	62
scandium	Sc	21
seaborgium	Sg	106 * ¤
selenium	Se	34
silicon	Si	14
silver	Ag	47
sodium	Na	11
strontium	Sr	38
sulfur	S	16
tantalum	Ta	73
technetium	Tc	43 ¤
tellurium	Te	52
tennessine	Ts	117 * ¤
terbium	Tb	65
thallium	Tl	81
thorium	Th	90 ¤
thulium	Tm	69
tin	Sn	50
titanium	Ti	22
tungsten	W	74
uranium	U	92 ¤
vanadium	V	23
xenon	Xe	54
ytterbium	Yb	70
yttrium	Y	39
zinc	Zn	30
zirconium	Zr	40
Man-made Elements		*
Radioactive Elements		¤

M

Solubility Products	
Compound	K_{sp}
$AgBr$	5.0×10^{-13}
$AgCl$	1.8×10^{-10}
Ag_2CrO_4	1.1×10^{-12}
AgI	8.3×10^{-17}
$BaSO_4$	1.1×10^{-10}
$Ca(OH)_2$	1.0×10^{-8}
$CaSO_4$	9.1×10^{-6}
$CuSO_4$	1.60
$KClO_4$	1.05×10^{-2}
$NaCl$	3.72×10^{1}
$NaOH$	1.10×10^{2}
Li_2CO_3	2.5×10^{-2}
LiF	1.84×10^{-3}
$PbCl_2$	1.6×10^{-5}
$PbCO_3$	7.4×10^{-14}
$PbCrO_4$	2.8×10^{-13}
PbI_2	7.1×10^{-9}
$SrSO_4$	3.2×10^{-7}
$ZnCO_3$	1.4×10^{-11}

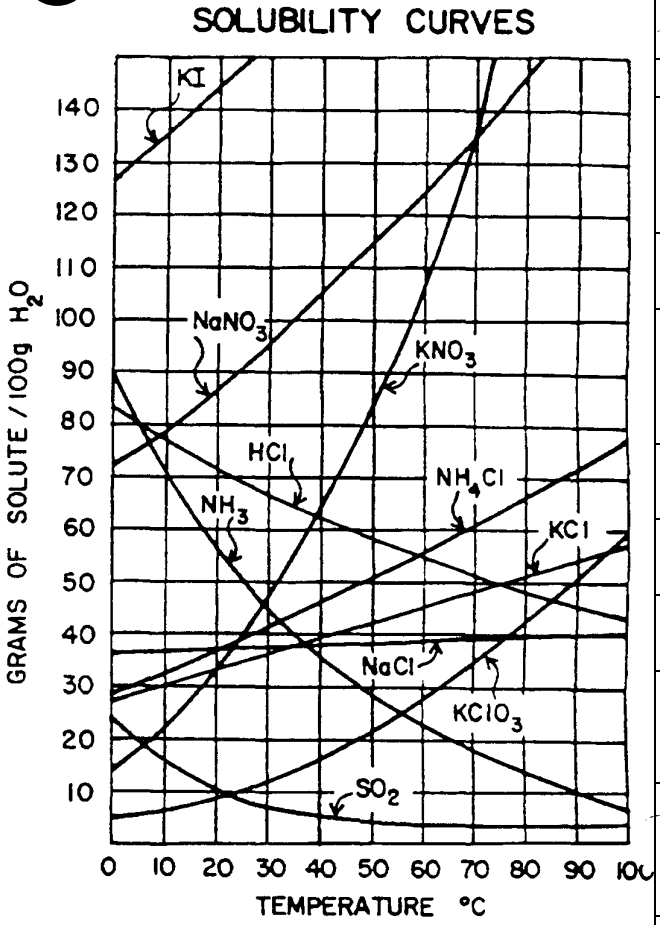
E

Table of Solubility in Water

i - **insoluble** (forms **solid** precipitate) **(s)**
aq - soluble **(aq)**
ss - slightly soluble (= **mostly insoluble**)
d* - decomposes

	acetate	bromide	carbonate	chloride	chromate	dichromate	hydroxide	iodide	nitrate	phosphate	sulfate	sulfide
Aluminum	ss	aq	i	aq	i	i	i	aq	aq	i	aq	d*
Ammonium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq
Barium	aq	aq	i	aq	i	ss	aq	aq	aq	i	i	aq
Calcium	aq	aq	i	aq	aq	i	ss	aq	aq	i	ss	ss
Copper (II)	aq	aq	i	aq	i	i	i	i	aq	i	aq	i
Hydrogen (acids)	aq	aq	aq	aq	aq	aq	H_2O (ℓ)	aq	aq	aq	aq	ss (g)
Iron (II)	aq	aq	i	aq	i	i	i	aq	aq	i	aq	i
Iron (III)	aq	aq	i	aq	i	i	i	aq	aq	i	ss	i
Lead (II)	aq	ss	i	ss	i	i	i	ss	aq	i	i	i
Magnesium	aq	aq	i	aq	aq	i	i	aq	aq	i	aq	i
Mercury (I)	ss	i	i	i	ss	i	i	i	aq	i	ss	i
Mercury (II)	aq	ss	i	aq	ss	i	i	i	aq	i	d*	i
Potassium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq
Silver	ss	i	i	i	ss	i	i	i	aq	i	ss	i
Sodium	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq	aq
Zinc	aq	aq	i	aq	aq	i	i	aq	aq	i	aq	i

D



Solubility of Some Ionic Compounds in Water

(Soluble means more than 0.1 mole will dissolve per liter

Negative Ions (anions)	Positive Ions (cations)	Compounds which are:
All	Alkali ions*, H^+ and NH_4^+	Soluble (aq)
Acetate, CH_3COO^- Nitrate, NO_3^- Chlorate, ClO_3^- Perchlorate, ClO_4^-	All	Soluble (aq)
Fluoride, F^-	Alkali ions*, H^+ and NH_4^+ All others	Soluble (aq) Not Soluble
Chloride, Cl^- Bromide, Br^- Iodide, I^-	Ag^+, Pb^{2+}, Hg_2^{2+}, Cu^+ All others	Not Soluble Soluble (aq)
Chromate, CrO_4^{2-}	Alkali ions*, Mg^{2+}, Ca^{2+}, H^+, NH_4^+ All others	Soluble (aq) Not Soluble
Dichromate, $Cr_2O_7^{2-}$	Alkali ions*, H^+ and NH_4^+ All others	Soluble (aq) Not Soluble
Sulfate, SO_4^{2-}	Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{+2}, All others	Not Soluble Soluble (aq)
Hydroxide, OH^- Sulfide, S^{2-}	Alkali ions*, H^+ and NH_4^+ Ca^{2+}, Sr^{2+}, Ba^{2+} All others	Soluble (aq) Soluble (aq) Not Soluble
Phosphate, PO_4^{3-} Carbonate, CO_3^{2-} Sulfite, SO_3^{2-}	Alkali ions*, H^+ and NH_4^+ All others	Soluble (aq) Not Soluble

*Alkali ions include: Li^+, Na^+, K^+, Rb^+, Cs^+ (Alkali metals, Group 1)

F SELECTED POLYATOMIC IONS

POSITIVE POLYATOMIC IONS (CATIONS)

Charge = 1+	
ammonium	NH_4^+
hydrogen, hydronium	H^+, H_3O^+

Charge = 2+	
mercury (I), dimercury (I), mercurous	Hg_2^{2+}

NEGATIVE POLYATOMIC IONS (ANIONS)

acetate	CH_3COO^-
or	$C_2H_3O_2^-$
bicarbonate, hydrogen carbonate	HCO_3^-
borate	BO_3^{3-}
carbonate	CO_3^{2-}
chlorate	ClO_3^-
chlorite	ClO_2^-
chromate	CrO_4^{2-}
cyanide	CN^-
dichromate	$Cr_2O_7^{2-}$
dihydrogen phosphate	$H_2PO_4^-$
ferricyanide	$Fe(CN)_6^{3-}$
hydrogen oxalate, binoxalate	$HC_2O_4^-$
hydrogen sulfate, bisulfate	HSO_4^-
hydrogen sulfide, bisulfide	HS^-
hydrogen sulfite, bisulfite	HSO_3^-
hydroxide	OH^-
hypochlorite	ClO^-
monohydrogen phosphate	HPO_4^{2-}
nitrate	NO_3^-
nitrite	NO_2^-
oxalate	$C_2O_4^{2-}$
perchlorate	ClO_4^-
permanganate	MnO_4^-
phosphate	PO_4^{3-}
sulfate	SO_4^{2-}
sulfite	SO_3^{2-}
thiocyanate	SCN^-
thiosulfate	$S_2O_3^{2-}$

SELECTED NEGATIVE IONS (ANIONS)

Charge = 1- (Group 17)	
fluoride	F^-
chloride	Cl^-
bromide	Br^-
iodide	I^-
Charge = 2- (Group 16)	
oxide	O^{2-}
sulfide	S^{2-}
selenide	Se^{2-}
telluride	Te^{2-}
Charge = 3- (Group 15)	
nitride	N^{3-}
phosphide	P^{3-}
arsenide	As^{3-}

O Vapor Pressure of Water

°C	Torr	°C	Torr
0	4.6	26	25.2
5	6.5	27	26.7
10	9.2	28	28.3
15	12.8	29	30.0
16	13.6	30	31.8
17	14.5	40	55.3
18	15.5	50	92.5
19	16.5	60	149.4
20	17.5	70	233.7
21	18.7	80	355.1
22	19.8	90	525.8
23	21.1	100	760.0
24	22.4	105	906.1
25	23.8	110	1074.6

G Heat of Formation Reactions, ΔH_f

Compound	Formation Reaction	ΔH_f (kJ)
$AlCl_3(s)$	$Al(s) + 3/2\ Cl_2(g) \rightarrow AlCl_3(s) + 705.6\ kJ$	-705.6
$Br_2(g)$	$Br_2(l) + 30.91\ kJ \rightarrow Br_2(g)$	30.91
$CH_4(g)$	$C(s) + 2H_2(g) \rightarrow CH_4(g) + 74.86\ kJ$	-74.86
$C_2H_6(g)$	$2C(s) + 3H_2(g) \rightarrow C_2H_6(g) + 84.68\ kJ$	-84.68
$C_3H_8(g)$	$3C(s) + 4H_2(g) \rightarrow C_3H_8(g) + 103.85\ kJ$	- 103.85
$CH_3OH(l)$	$C(s) + \frac{1}{2}\ O_2(g) + 2H_2(g) \rightarrow CH_3OH(l) + 238.5\ kJ$	-238.5
$CO(g)$	$C(s) + \frac{1}{2}\ O_2(g) \rightarrow CO(g) + 110.5\ kJ$	-110.5
$CO_2(g)$	$C(s) + O_2(g) \rightarrow CO_2(g) + 393.5\ kJ$	-393.5
$CaO(s)$	$Ca(s) + \frac{1}{2}\ O_2(g) \rightarrow CaO(s) + 635.1\ kJ$	-635.1
$Ca(OH)_2(s)$	$Ca(s) + O_2(g) + H_2(g) \rightarrow Ca(OH)_2(s) + 986.2\ kJ$	-986.2
$Fe_2O_3(s)$	$2Fe(s) + 3/2\ O_2(g) \rightarrow Fe_2O_3(s) + 822.1\ kJ$	-822.1
$H_2O(g)$	$H_2(g) + \frac{1}{2}\ O_2(g) \rightarrow H_2O(g) + 241.8\ Kj$	-241.8
$H_2O(l)$	$H_2(g) + \frac{1}{2}\ O_2(g) \rightarrow H_2O(l) + 285.8\ kJ$	-285.8
$H_2O_2(l)$	$H_2(g) + O_2(g) \rightarrow H_2O_2(l) + 187.8\ kJ$	-187.8
$HBr(g)$	$\frac{1}{2}\ H_2(g) + \frac{1}{2}\ Br_2(g) \rightarrow HBr(g) + 36.2\ kJ$	-36.2
$HCl(g)$	$\frac{1}{2}\ H_2(g) + \frac{1}{2}\ Cl_2(g) \rightarrow HCl(g) + 92.31\ kJ$	-92.31
$H_2S(g)$	$H_2(g) + S(s) \rightarrow H_2S(g) + 20.1\ kJ$	-20.1
$NH_3(g)$	$\frac{1}{2}\ N_2(g) + 3/2\ H_2(g) \rightarrow NH_3(g) + 46.19\ kJ$	-46.19
$NO(g)$	$\frac{1}{2}\ N_2(g) + \frac{1}{2}\ O_2(g) + 90.37\ kJ \rightarrow NO(g)$	90.37
$NOCl(g)$	$\frac{1}{2}\ N_2(g) + \frac{1}{2}\ O_2(g) + \frac{1}{2}\ Cl_2(g) + 52.6\ kJ \rightarrow NOCl(g)$	52.6
$NO_2(g)$	$\frac{1}{2}\ N_2(g) + O_2(g) + 33.85\ kJ \rightarrow NO_2(g)$	33.85
$N_2O_4(g)$	$N_2(g) + 2O_2(g) + 9.66\ kJ \rightarrow N_2O_4(g)$	9.66
$NaBr(s)$	$Na(s) + \frac{1}{2}\ Br_2(g) \rightarrow NaBr(s) + 361.4\ kJ$	- 361.4
$NaCl(s)$	$Na(s) + \frac{1}{2}\ Cl_2(g) \rightarrow NaCl(s) + 407.0\ kJ$	-407.0
$O_3(g)$	$3/2\ O_2(g) + 142.2\ kJ \rightarrow O_3(g)$	142.2
$SO_2(g)$	$S(s) + O_2(g) \rightarrow SO_2(g) + 296.8\ kJ$	-296.8
$SO_3(g)$	$S(s) + 3/2\ O_2(g) \rightarrow SO_3(g) + 395.7\ kJ$	-395.7

I Heats of Reaction at 1 atm and 25°C

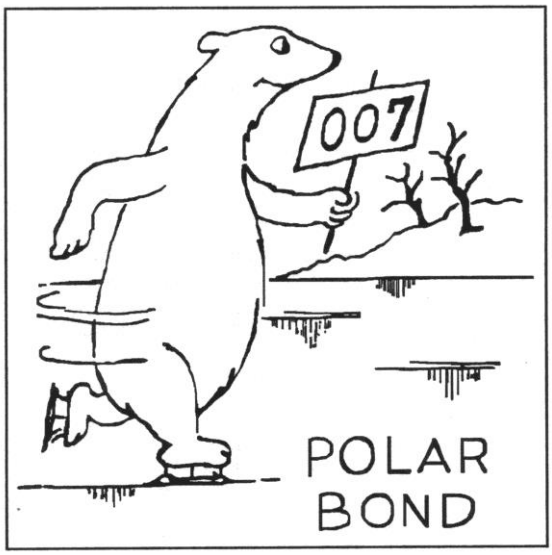
Reaction	ΔH (kcal)
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$	-212.8
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$	-530.6
$CH_3OH(l) + 3/2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$	-173.6
$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$	-669.9
$CO(g) + \frac{1}{2}\ O_2(g) \rightarrow CO_2(g)$	-67.7
$C_8H_{18}(l) + 25/2\ O_2(g) \rightarrow 8CO_2(g) + 9H_2O(l)$	-1302.7
$KNO_3(s) \xrightarrow{H_2O} K^+(aq) + NO_3^-(aq)$	+8.3
$NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$	-10.6
$NH_4Cl(s) \xrightarrow{H_2O} NH_4^+(aq) + Cl^-(aq)$	+3.5
$NH_4NO_3(s) \xrightarrow{H_2O} NH_4^+(aq) + NO_3^-(aq)$	+6.1
$NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^-(aq)$	+0.9
$KClO_3(s) \xrightarrow{H_2O} K^+(aq) + ClO_3^-(aq)$	+9.9
$LiBr(s) \xrightarrow{H_2O} Li^+(aq) + Br^-(aq)$	1.7
$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$	-13.8

J Table of Isotopes

Particle	Mass (amu)	Abundance
$^{0}_{-1}e$	0.00055	---
$^{1}_{1}p$	1.00728	---
$^{1}_{0}n$	1.00867	---
$^{1}_{1}H$	1.00782	99.995%
$^{2}_{1}H$	2.01410	0.015%
$^{3}_{1}H$	3.01605	---
$^{3}_{2}He$	3.01603	.0001%
$^{4}_{2}He$	4.00260	99.9999%
$^{6}_{3}Li$	6.01512	7.42%
$^{7}_{3}Li$	7.01600	92.58%
$^{12}_{6}C$	12.00000	98.90%
$^{13}_{6}C$	13.00336	1.10%
$^{24}_{12}Mg$	23.98505	78.90%
$^{25}_{12}Mg$	24.91584	10.00%
$^{26}_{12}Mg$	25.98260	11.10%
$^{35}_{17}Cl$	34.96885	57.77%
$^{37}_{17}Cl$	36.96590	24.23%
$^{63}_{29}Cu$	62.92980	67.17%
$^{65}_{29}Cu$	64.92779	30.83%

K Ionization Energy and Electronegativity Values

1							18
313 **H** 2.2	← First Ionization Energy (Kcal/mol of atoms) ← Electronegativity (based on Fluorine = 4.0)						567 **He**
	2	13	14	15	16	17	
125 **Li** 1.0	215 **Be** 1.5	191 **B** 2.0	260 **C** 2.6	336 **N** 3.1	314 **O** 3.5	402 **F** 4.0	497 **Ne**
119 **Na** 0.9	176 **Mg** 1.2	138 **Al** 1.5	188 **Si** 1.9	242 **P** 2.2	239 **S** 2.6	300 **Cl** 3.2	363 **Ar**
100 **K** 0.8	141 **Ca** 1.0	138 **Ga** 1.6	182 **Ge** 1.9	226 **As** 2.0	225 **Se** 2.5	273 **Br** 2.9	323 **Kr**
96 **Rb** 0.8	131 **Sr** 1.0	133 **In** 1.7	169 **Sn** 1.8	199 **Sb** 2.1	208 **Te** 2.3	241 **I** 2.7	280 **Xe**
90 **Cs** 0.7	120 **Ba** 0.9	141 **Tl** 1.8	171 **Pb** 1.8	168 **Bi** 1.9	194 **Po** 2.0	**At** 2.2	248 **Rn**
Fr 0.7	122 **Ra** 0.9						



Relative Strengths of Acids in Aqueous Solutions at Room Temperature

All acids are aqueous (aq)

$HB \rightleftharpoons H^+(aq) + B^-(aq)$

$K_A = \frac{[H^+][B^-]}{[HB]}$

Acid	Strength	Reaction	K_a
perchloric acid	Very Strong	$HClO_4 \rightarrow H^+ + ClO_4^-$	Very large
hydroiodic acid		$HI \rightarrow H^+ + I^-$	Very large
hydrobromic acid		$HBr \rightarrow H^+ + Br^-$	Very large
hydrochloric acid		$HCl \rightarrow H^+ + Cl^-$	Very large
nitric acid		$HNO_3 \rightarrow H^+ + NO_3^-$	Very large
sulfuric acid	Strong	$H_2SO_4 \rightarrow H^+ + HSO_4^-$	Large
orange IV		$H(ind) \rightarrow H^+ + Ind^-$	$\sim 10^{-2}$
oxalic acid		$HOOCCOOH \rightarrow H^+ + HOOCCOO^-$	5.4×10^{-2}
sulfurous acid		$H_2SO_3 \rightarrow H^+ + HSO_3^-$	1.7×10^{-2}
hydrogen sulfate ion		$HSO_4^- \rightarrow H^+ + SO_4^{-2}$	1.3×10^{-2}
phosphoric acid	Weak	$H_3PO_4 \rightarrow H^+ + H_2PO_4^-$	7.1×10^{-3}
ferric ion		$Fe(H_2O)_6^{+3} \rightarrow H^+ + Fe(H_2O)_5(OH)^{+2}$	6×10^{-3}
hydrogen telluride		$H_2Te \rightarrow H^+ + HTe^-$	2.3×10^{-3}
citric acid		$H_3C_6H_5O_7 \rightarrow H^+ + H_2C_6H_5O_7^-$	7.4×10^{-4}
methyl orange		$H(ind) \rightarrow H^+ + Ind^-$	$\sim 10^{-4}$
hydrofluoric acid	Weaker	$HF \rightarrow H^+ + F^-$	6.7×10^{-4}
nitrous acid		$HNO_2 \rightarrow H^+ + NO_2^-$	5.1×10^{-4}
hydrogen selenide		$H_2Se \rightarrow H^+ + HSe^-$	1.7×10^{-4}
chromic ion		$Cr(H_2O)_6^{+3} \rightarrow H^+ + Cr(H_2O)_5(OH)^{+2}$	1×10^{-4}
benzoic acid		$C_6H_5COOH \rightarrow H^+ + C_6H_5COO^-$	6.6×10^{-5}
hydrogen oxalate ion		$HOOCCOO^- \rightarrow H^+ + OOCCOO^{-2}$	5.4×10^{-5}
acetic acid		$CH_3COOH \rightarrow H^+ + CH_3COO^-$	1.8×10^{-5}
dihydrogen citrate		$H_2C_6H_5O_7^- \rightarrow H^+ + HC_6H_5O_7^{-2}$	1.7×10^{-5}
aluminum ion		$Al(H_2O)_6^{+3} \rightarrow H^+ + Al(H_2O)_5(OH)^{+2}$	1×10^{-5}
carbonic acid		$H_2CO_3 \rightarrow H^+ + HCO_3^-$	4.4×10^{-7}
hydrogen citrate		$HC_6H_5O_7^{-2} \rightarrow H^+ + C_6H_5O_7^{-3}$	4.0×10^{-7}
hydrogen sulfide		$H_2S \rightarrow H^+ + HS^-$	1.0×10^{-7}
dihydrogen phosphate ion		$H_2PO_4^- \rightarrow H^+ + HPO_4^{-2}$	6.3×10^{-8}
hydrogen sulfite ion		$HSO_3^- \rightarrow H^+ + SO_3^{-2}$	6.2×10^{-8}
phenolphthalein		$H(ind) \rightarrow H^+ + Ind^-$	$\sim 10^{-9}$
alizarin yellow		$H(ind) \rightarrow H^+ + Ind^-$	$\sim 10^{-10}$
ammonium ion		$NH_4^+ \rightarrow H^+ + NH_3$	5.7×10^{-10}
boric acid		$H_3BO_3 \rightarrow H^+ + H_2BO_3^-$	5.8×10^{-10}
hydrogen telluride ion		$HTe^- \rightarrow H^+ + Te^{-2}$	1×10^{-11}
hydrogen carbonate ion		$HCO_3^- \rightarrow H^+ + CO_3^{-2}$	4.7×10^{-11}
indigo carmine		$H(ind) \rightarrow H^+ + Ind^-$	$\sim 10^{-12}$
hydrogen peroxide		$H_2O_2 \rightarrow H^+ + HO^{2-}$	2.4×10^{-12}
monohydrogen phosphate ion		$HPO_4^{-2} \rightarrow H^+ + PO_4^{-3}$	4.4×10^{-13}
hydrogen sulfate ion		$HS^- \rightarrow H^+ + S^{-2}$	1.3×10^{-13}
water	Very Weak	$H_2O \rightarrow H^+ + OH^-$	1.8×10^{-16}
hydroxide ion		$OH^- \rightarrow H^+ + O^{-2}$	$< 10^{-36}$
ammonia		$NH_3 \rightarrow H^+ + NH^{2-}$	very small

Standard Reduction Potentials for Half Reactions

Ionic concentrations, 1M in water at 25°C

	Reduced Chemical				Oxidized Chemical	volts	
Very Strong Oxidizing Agents	$F_{2\,(g)}$	+	$2e^-$	→	$2F^-$	+2.87	Very Weak Reducing Agents
	$H_2O_2 + 2H^+$	+	$2e^-$	→	$2H_2O$	+1.77	
	$4H^+ + SO_4^{2-} + PbO_2$	+	$2e^-$	→	$PbSO_4 + 2H_2O$	+1.68	
	$MnO_4^{-1} + 8H^+$	+	$5e^-$	→	$Mn^{2+} + 4H_2O$	+1.52	
	Au^{3+}	+	$3e^-$	→	Au	+1.50	
	$Cl_{2\,(g)}$	+	$2e^-$	→	$2Cl^-$	+1.36	
	$Cr_2O_7^{2-} + 14H^+$	+	$6e^-$	→	$2Cr^{3+} + 7H_2O$	+1.33	
	$MnO_2 + 4H^+$	+	$2e^-$	→	$Mn^{2+} + 2H_2O$	+1.28	
	$O_{2(g)} + 4H^+$	+	$4e^-$	→	$2H_2O$	+1.23	
	$Br_{2\,(l)}$	+	$2e^-$	→	$2Br^-$	+1.06	
	$AuCl_4^-$	+	$3e^-$	→	$Au + 4Cl^-$	+1.00	
	$NO_3^- + 4H^+$	+	$3e^-$	→	$NO + 2H_2O$	+0.96	
	$ClO^- + H_2O$	+	$2e^-$	→	$Cl^- + 2OH^-$	+0.90	
	Ag^+	+	e^-	→	Ag	+0.80	
	Hg_2^{2+}	+	$2e^-$	→	$2Hg_{(l)}$	+0.79	
	Hg^{2+}	+	$2e^-$	→	$Hg_{(l)}$	+0.78	
	$NO_3^- + 2H^+$	+	e^-	→	$NO_{2(g)} + H_2O$	+0.78	
	Fe^{+3}	+	e^-	→	Fe^{2+}	+0.77	
	$O_{2(g)} + 2H^+$	+	$2e^-$	→	H_2O_2	+0.68	
	$I_{2\,(s)}$	+	$2e^-$	→	$2I^-$	+0.53	
	Cu^{2+}	+	$2e^-$	→	Cu	+0.34	
	$SO_4^{2-} + 4H^+$	+	$2e^-$	→	$SO_{2(g)} + 2H_2O$	+0.17	
	Cu^{2+}	+	e^-	→	Cu^+	+0.15	
	Sn^{4+}	+	$2e^-$	→	Sn^{2+}	+0.15	
	$2H^+$	+	$2e^-$	→	H_2	-0.00	
	Fe^{3+}	+	$3e^-$	→	Fe	-0.04	
	Pb^{2+}	+	$2e^-$	→	Pb	-0.13	
	Sn^{2+}	+	$2e^-$	→	Sn	-0.14	
	Ni^{2+}	+	$2e^-$	→	Ni	-0.25	
	Co^{2+}	+	$2e^-$	→	Co	-0.28	
	$PbSO_4$	+	$2e^-$	→	$Pb + SO_4^{2-}$	-0.36	
	$1/8Se_8 + 2H^+$	+	2e-	→	H_2Se	-0.40	
	Cr^{3+}	+	$1e^-$	→	Cr^{2+}	-0.41	
	Fe^{2+}	+	$2e^-$	→	Fe	-0.44	
	Ag_2S	+	$2e^-$	→	$2Ag + S^{2-}$	-0.69	
	Cr^{3+}	+	$3e^-$	→	Cr	-0.74	
	Zn^{2+}	+	$2e^-$	→	Zn	-0.76	
	$2H_2O_{(l)}$	+	$2e^-$	→	$H_{2(g)} + 2OH^-$	-0.83	
	Mn^{2+}	+	$2e^-$	→	Mn	-1.18	
	Al^{3+}	+	$3e^-$	→	Al	-1.66	
	Mg^{2+}	+	$2e^-$	→	Mg	-2.37	
	Na^+	+	e^-	→	Na	-2.71	
	Ca^{2+}	+	$2e^-$	→	Ca	-2.87	
	Sr^{2+}	+	$2e^-$	→	Sr	-2.89	
	Ba^{2+}	+	$2e^-$	→	Ba	-2.90	
Very Weak Oxidizing Agents	Cs^+	+	e^-	→	Cs	-2.92	Very Strong Reducing Agents
	K^+	+	$2e^-$	→	K	-2.92	
	Rb^+	+	e^-	→	Rb	-2.92	
	Li^+	+	e^-	→	Li	-3.00	

Selected* Oxidation Numbers

(Created 2/9/06)

1																	18
1 H 1±	2											13	14	15*	16*	17*	2 He 0
3 Li 1+	4 Be 2+	← Oxidation Number(s)										5 B 3+	6 C 2+ 4±	7 N 3-	8 O 2-	9 F 1-	10 Ne 0
11 Na 1+	12 Mg 2+	3	4	5	6	7	8	9	10	11	12	13 Al 3+	14 Si 2+ 4±	15 P 3-	16 S 2-	17 Cl 1-	18 Ar 0
19 K 1+	20 Ca 2+	21 Sc 3+	22 Ti 2+ 3+ 4+	23 V 2+ 3+ 4+ 5+	24 Cr 2+ 3+ 6+	25 Mn 2+ 3+ 4+ 7+	26 Fe 2+ 3+	27 Co 2+ 3+	28 Ni 2+ 3+	29 Cu 1+ 2+	30 Zn 2+	31 Ga 3+	32 Ge 2+ 4±	33 As 3-	34 Se 2-	35 Br 1-	36 Kr 0 2+
37 Rb 1+	38 Sr 2+	39 Y 3+	40 Zr 4+	41 Nb 3+ 5+	42 Mo 2+ 3+ 6+	43 Tc 2+ 4+ 6+ 7+	44 Ru 2+ 3+ 4+ 6+	45 Rh 2+ 3+ 4+	46 Pd 2+ 4+	47 Ag 1+	48 Cd 2+	49 In 3+	50 Sn 2+ 4+	51 Sb 3± 5+	52 Te 2-	53 I 1-	54 Xe 0 2+ 4+ 6+
55 Cs 1+	56 Ba 2+	57 La 3+	72 Hf 4+	73 Ta 5+	74 W 6+	75 Re 4+ 6+ 7+	76 Os 2+ 3+ 4+ 6+	77 Ir 2+ 3+ 4+ 6+	78 Pt 2+ 4+	79 Au 1+ 3+	80 Hg 1+ 2+	81 Tl 1+ 3+	82 Pb 2+ 4+	83 Bi 3+ 5+	84 Po 2+ 4+	85 At 1-	86 Rn 0
87 Fr 1+	88 Ra 2+	89 Ac 3+	104 Rf 4+	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

58 Ce 3+ 4+	59 Pr 3+	60 Nd 3+	61 Pm 3+	62 Sm 3+ 2+	63 Eu 2+ 3+	64 Gd 3+	65 Tb 3+	66 Dy 3+	67 Ho 3+	68 Er 3+	69 Tm 3+	70 Yb 2+ 3+	71 Lu 3+
90 Th 4+	91 Pa 4+ 5+	92 U 3+ 4+ 5+ 6+	93 Np 3+ 4+ 5+ 6+	94 Pu 3+ 4+ 5+ 6+	95 Am 3+ 4+ 5+ 6+	96 Cm 3+	97 Bk 3+ 4+	98 Cf 3+	99 Es 3+	100 Fm 3+	101 Md 2+ 3+	102 No 2+ 3+	103 Lr 3+

Skyline High School

Periodic Table for General Chemistry

Skyine High School

Period Number ↓

KEY

1 <--Group number

Atomic Number
Symbol
Element Name
Atomic Mass

<---Weighted average mass of all isotopes

Mass in ( ) = most common isotope

Group number--> 13 14 15 16 17 18

Things to know: Metals Non-Metals Transition Metals Metalloids
Groups: Alkali Metals Alkaline Earth Metals Halogens Noble Gases

Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen 1.008																	2 He Helium 4.003
2	3 Li Lithium 6.94	4 Be Beryllium 9.01											5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18
3	11 Na Sodium 22.99	12 Mg Magnesium 24.31											13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.95
4	19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.87	23 V Vanadium 50.95	24 Cr Chromium 52.00	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.41	31 Ga Gallium 69.72	32 Ge Germanium 72.64	33 As Arsenic 74.92	34 Se Selenium 78.96	35 Br Bromine 79.90	36 Kr Krypton 83.80
5	37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.94	☢ 43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29
6	55 Cs Cesium 132.91	56 Ba Barium 137.33	57 La* Lanthanum 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	☢ 84 Po Polonium (209)	☢ 85 At Astatine (210)	☢ 86 Rn Radon (222)
7	☢ 87 Fr Francium (223)	☢ 88 Ra Radium (226)	☢ 89 Ac** Actinium (227)	☢ 104 Rf Rutherfordium (261)	☢ 105 Db Dubnium (262)	☢ 106 Sg Seaborgium (266)	☢ 107 Bh Bohrium (264)	☢ 108 Hs Hassium (277)	☢ 109 Mt Meitnerium (268)	☢ 110 Ds Darmstadtium (271)	☢ 111 Rg Roentgenium (272)	☢ 112 Cn Copernicium (285)	☢ 113 Nh Nihonium (286)	☢ 114 Fl Flerovium (289)	☢ 115 Mc Moscovium (289)	☢ 116 Lv Livermorium (293)	☢ 117 Ts Tennessine (294)	☢ 118 Og Oganesson (294)

*Lanthanide Series	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.27	☢ 61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.5	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97
**Actinide Series	☢ 90 Th Thorium 232.04	☢ 91 Pa Protactinium 231.04	☢ 92 U Uranium 238.03	☢ 93 Np Neptunium (237)	☢ 94 Pu Plutonium (244)	☢ 95 Am Americium (243)	☢ 96 Cm Curium (247)	☢ 97 Bk Berkelium (247)	☢ 98 Cf Californium (251)	☢ 99 Es Einsteinium (252)	☢ 100 Fm Fermium (257)	☢ 101 Md Mendelevium (258)	☢ 102 No Nobelium (259)	☢ 103 Lr Lawrencium (262)

☢ Radioactive element ☢