

General Chemistry Reference Sheet

This reference sheet addresses some of the more peculiar pieces of information that need to be memorized in a general chemistry course. It also contains a simple set of essential formulas in chemistry with cautions, explanations, and general tips.

This sheet is meant to be as concise as possible, and many informations in the textbook is left out in favor of cautions and tips. This sheet is, therefore, best used as a supplement to, not a replacement of, the textbook.

SI Fundamental Units

Mass	Kilogram (kg)
Length	Meter (m)
Time	Second (s)
Temperature	Kelvin (K)
Amount of substance	Mole (mol)
Electric current	Ampere (A)
Luminous intensity	Candela (cd)

Atomic Experiments and Models

J. J. Thomson	Discovered e^- ; Cathode ray
	Plum pudding model
R. A. Millikan	Measured charge of e^- ; Oil drop
H. Becquerel/M. Curie	Discovered radioactivity
E. Rutherford	Discovered α , β , and γ rays
	Discovered nucleus; Gold foil experiment
J. Chadwick	Discovered neutrons
N. Bohr	Bohr model (electron orbits)
Quantum mechanists	Quantum model

Polyatomic Ions

NH_4^+	ammonium	OH^-	hydroxide
CN^-	cyanide	$\text{C}_2\text{O}_4^{2-}$	oxalate
O_2^{2-}	peroxide	CNO^-	cyanate
HSO_3^-	hydrogen sul- fate	$\text{C}_2\text{H}_3\text{O}_2^-$	acetate
SCN^-	thiocyanate	NO_3^-	nitrate
SO_3^{2-}	sulfite	ClO_4^-	perchlorate
CO_3^{2-}	carbonate	ClO_3^-	chlorate
PO_4^{3-}	phosphate	ClO_2^-	hypochlorite
$\text{S}_2\text{O}_4^{2-}$	dithionite	HPO_4^{2-}	hydrogen phosphate
CrO_4^{2-}	chromate	H_2O^+	hydronium
$\text{Cr}_2\text{O}_7^{2-}$	dichromate	PO_3^{2-}	phosphite
MnO_4^-	permanganate	Hg_2^{2+}	mercury (I)
N_3^-	azide	C_4^{4-}	carbide
$\text{C}_4\text{H}_4\text{O}_6^{2-}$	tartarate	S_2^{2-}	disulfide
O_2^-	superoxide	AsO_3^{3-}	arsenite
PO_3^{3-}	hypophosphite	AsO_4^{3-}	arsenate
SiO_3^{2-}	silicate	$\text{P}_3\text{O}_9^{3-}$	pyrophosphate

Ionic Solubility Chart

Soluble	Exceptions
NO_3^-	None
CH_3COO^-	None
Cl^-	Ag^+ , Hg_2^{2+} , Pb^{2+}
Br^-	Ag^+ , Hg_2^{2+} , Pb^{2+}
I^-	Ag^+ , Hg_2^{2+} , Pb^{2+}
SO_4^{2-}	Sr^{2+} , Ba^{2+} , Hg_2^{2+} , Pb^{2+}
Insoluble	Exceptions
S^{2-}	NH_4^+ , alkali metal cations, Ca^{2+} , Sr^{2+} , Ba^{2+}
CO_3^{2-}	NH_4^+ , alkali metal cations
PO_4^{3-}	NH_4^+ , alkali metal cations
OH^-	NH_4^+ , alkali metal cations, Ca^{2+} , Sr^{2+} , Ba^{2+}

Strong Acids and Bases

Strong acids and bases dissociate in water completely.

Strong Acids	Strong Bases	
HCl	HClO_4	Alkali metal hydroxides
HBr	HNO_3	Ca(OH)_2
HI	H_2SO_4	Sr(OH)_2
HClO_3	Ba(OH)_2	

Activity Series

Metals below H^+ cannot react with acids to form H_2 . More active metals are better reducing agents.

From most active to least active:

Li^+ , K^+ , Ba^{2+} , Ca^{2+} , Na^+ , Mg^{2+} , Al^{3+} , Mn^{2+} , Zn^{2+} , Cr^{3+} , Fe^{2+} , Co^{2+} , Ni^{2+} , Sn^{2+} , Pb^{2+} , H^+ , Cu^{2+} , Ag^+ , Hg^{2+} , Pt^{2+} , Au^{3+}

Flame Colors

Calcium	Brick red
Copper (I)	Blue
Copper (II)	Green or blue-green
Potassium	Lilac
Lithium	Dark red
Sodium	Bright yellow
Strontium	Red
Barium	Light green
Iron (III)	Gold
Cesium	Blue-Violet
Iodine	Blue
Lead	Blue
Rubidium	Red-Violet

Phase Changes

	From solid	From liquid	From gas
To solid	-	freezing	deposition
To liquid	melting	-	condensation
To gas	sublimation	evaporation	-

Solution Colors

Copper (II)	Blue
Nickel	Green
Permanganate	Purple
Chromate	Yellow
Dichromate	Orange
Iron (II)	Light blue
Iron (III)	Rusty yellow

Thermodynamic Laws

First Law: Energy cannot be created nor destroyed. It can only be transferred in the form of either heat or work.

Second Law: Any spontaneous reaction increases the entropy of the universe.

Third Law: An ideal solid crystal at 0 K has an entropy of 0.

Thermodynamic Formulas

Standard thermodynamic conditions	298 K; 1 atm; 1 M
Kinetic energy	$K = mv^2/2$
Electrostatic potential energy	$U_E = (k_e Q_1 Q_2)/d$
Internal energy	$\Delta E = q + w$
Enthalpy	$H = E + PV$
Specific heat	$s = q/(m \cdot \Delta T)$
Entropy in reversible reaction	$\Delta S_{\text{system}} = (\Delta H)/T$ $\Delta S_{\text{surroundings}} = -(\Delta H)/T$
Micestate-entropy relationship	$S = k \ln W$
Gibbs free energy	$G = H - TS$
Gibbs free energy change	$\Delta G = \Delta H - T \Delta S$ $\Delta G = \Delta G^\circ + RT \ln Q$ $\Delta H_{\text{total}} = T \Delta S_{\text{total}}$
Hess's Law	

Constants

Boltzmann's constant	$k_B = 1.381 \times 10^{-23} \text{ m}^2\text{kg} \cdot \text{s}^{-2}\text{K}^{-1}$
Coulomb's constant $k_C = 1/(4\pi\epsilon_0)$	$= 8.988 \times 10^9 \text{ J} \cdot \text{m}^2/\text{C}^2$
Avogadro's number	$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
Faraday's constant	$F = 9.648 \times 10^4 \text{ C/mol}$
Planck's constant	$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$
Ideal gas constants	$R = 0.0821 \text{ (L} \cdot \text{atm)/mol} \cdot \text{K}$ $R = 8.314 \text{ J/mol} \cdot \text{K}$
Vacuum permittivity $\epsilon_0 = 1/(\mu_0 c^2)$	$= 8.854 \times 10^{-12} \text{ F/m}$
Vacuum permeability	$\mu_0 = 1.257 \times 10^{-6} \text{ N}\cdot\text{A}^{-2}$
Atomic mass	$1 \text{ amu} = 1.661 \times 10^{-24} \text{ g}$
Electron charge	$e = 1.602 \times 10^{-19} \text{ C}$
Electronvolt	$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$
Atmospheric pressure	$1 \text{ atm} = 1.013 \times 10^5 \text{ Pa}$
Absolute zero	$0 \text{ K} = -273.15^\circ\text{C}$
Speed of light in vacuum	$c = 2.998 \times 10^8 \text{ m/s}$

Quantum Mechanical Formulas

Energy of a quantum	$E = hf$
Wavelength-frequency relationship	$c = \nu \cdot \lambda$
Probability distribution	$P_V = \iint \psi(x,y,z) ^2 dx dy dz$

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Lingsheng Yao



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Chemical Technicians' Ready Reference Handbook Gershon J. Shugar, Jack T. Ballinger, 1996-06 The definitive reference of laboratory safety analytic procedures and instrumentation techniques for the modern chemical laboratory Cited in BCL3 the new edition contains expanded chapters on gas chromatography GC and high performance liquid chromatography HPLC and physical properties and testing methods with a new chapter on thermal analytic methods as well as on electrophoresis Also includes up to date information on the role of chemical laboratory technicians and chemical process operators in industry and current data on laboratory safety chemical waste disposal government regulations and ISO 9000 Explains in detail the day to day procedures techniques and formulas of today's chemical laboratory The new edition 2nd was 1981 emphasizing the importance of safety has been expanded to include additional information on material safety data sheets chemical waste disposal Right to Know regulations and the National Fire Protection Association codes Also new is material on such topics as gas chromatography high performance liquid chromatography infrared spectroscopy atomic absorption spectroscopy and computers in the laboratory *Fullerenes* Elena Sheka, 2011-02-16 At the interface between chemistry biology and physics fullerenes were one of the first objects to be dissected scanned and studied by the modern multi specialty biotech community and are currently thriving in both research and practical application Other members of the

sp² nanocarbon family such as nanotubes and graphene are currently being

Data for Process Design and Engineering Practice Donald R. Woods, 1995 Contains necessary required for selecting equipment for process engineering and design KEY TOPICS This off the shelf look up book contains data needed by practicing engineers covering the properties of materials liquids gases and includes an index to chemicals with cross referencing for synonyms For engineers

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