PERIODIC TABLE OF THE ELEMENTS

PERIOD	GROUP 1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 1.008 H HYDROGEN																	2 4.0026 He HELIUM
2	3 6.94 Li LITHIUM	4 9.0122 Be BERYLLIUM											5 10.81 B BORON	6 12.011 C CARBON	7 14.007 N NITROGEN	8 15.999 O OXYGEN	9 18.998 F FLUORINE	10 20.180 Ne NEON
3	11 22.990 Na SODIUM	12 24.305 Mg MAGNESIUM											13 26.982 Al ALUMINIUM	14 28.085 Si SILICON	15 30.974 P PHOSPHORUS	16 32.06 S SULPHUR	17 35.45 Cl CHLORINE	18 39.948 Ar ARGON
4	19 39.098 K POTASSIUM	20 40.078 Ca CALCIUM	21 44.956 Sc SCANDIUM	22 47.867 Ti TITANIUM	23 50.942 V VANADIUM	24 51.996 Cr CHROMIUM	25 54.938 Mn MANGANESE	26 55.845 Fe IRON	27 58.933 Co COBALT	28 58.693 Ni NICKEL	29 63.546 Cu COPPER	30 65.38 Zn ZINC	31 69.723 Ga GALLIUM	32 72.64 Ge GERMANIUM	33 74.922 As ARSENIC	34 78.971 Se SELENIUM	35 79.904 Br BROMINE	36 83.798 Kr KRYPTON
5	37 85.468 Rb RUBIDIUM	38 87.62 Sr STRONTIUM	39 88.906 Y YTTRIUM	40 91.224 Zr ZIRCONIUM	41 92.906 Nb NIOBIUM	42 95.95 Mo MOLYBDENUM	43 (98) Tc TECHNETIUM	44 101.07 Ru RUTHENIUM	45 102.91 Rh RHODIUM	46 106.42 Pd PALLADIUM	47 107.87 Ag SILVER	48 112.41 Cd CADMIUM	49 114.82 In INDIUM	50 118.71 Sn TIN	51 121.76 Sb ANTIMONY	52 127.60 Te TELLURIUM	53 126.90 I IODINE	54 131.29 Xe XENON
6	55 132.91 Cs CAESIUM	56 137.33 Ba BARIUM	57-71 La-Lu Lanthanide	72 178.49 Hf HAFNIUM	73 180.95 Ta TANTALUM	74 183.84 W TUNGSTEN	75 186.21 Re RHENIUM	76 190.23 Os OSMIUM	77 192.22 Ir IRIDIUM	78 195.08 Pt PLATINUM	79 196.97 Au GOLD	80 200.59 Hg MERCURY	81 204.38 Tl THALLIUM	82 207.2 Pb LEAD	83 208.98 Bi BISMUTH	84 (209) Po POLONIUM	85 (210) At ASTATINE	86 (222) Rn RADON
7	87 (223) Fr FRANCIUM	88 (226) Ra RADIUM	89-103 Ac-Lr Actinide	104 (267) Rf RUTHERFORDIUM	105 (268) Db DUBNIUM	106 (271) Sg SEABORGIUM	107 (272) Bh BOHRIUM	108 (277) Hs HASSIUM	109 (276) Mt MEITNERIUM	110 (281) Ds DARMSTADTIUM	111 (280) Rg ROENTGENIUM	112 (285) Cn COPERNICIUM	113 (285) Nh NIHONIUM	114 (287) Fl FLEROVIUM	115 (289) Mc MOSCOVIUM	116 (291) Lv LIVERMORIUM	117 (294) Ts TENNESSINE	118 (294) Og OGANESSON

LANTHANIDE	57 138.91 La LANTHANUM	58 140.12 Ce CERIUM	59 140.91 Pr PRASEODYMIUM	60 144.24 Nd NEODYMIUM	61 (145) Pm PROMETHIUM	62 150.36 Sm SAMARIUM	63 151.96 Eu EUROPIUM	64 157.25 Gd GADOLINIUM	65 158.93 Tb TERBIUM	66 162.50 Dy DYSPROSIUM	67 164.93 Ho HOLMIUM	68 167.26 Er ERBIUM	69 168.93 Tm THULIUM	70 173.05 Yb YTTERBIUM	71 174.97 Lu LUTETIUM
ACTINIDE	89 (227) Ac ACTINIUM	90 232.04 Th THORIUM	91 231.04 Pa PROTACTINIUM	92 238.03 U URANIUM	93 (237) Np NEPTUNIUM	94 (244) Pu PLUTONIUM	95 (243) Am AMERICIUM	96 (247) Cm CURIUM	97 (247) Bk BERKELIUM	98 (251) Cf CALIFORNIUM	99 (252) Es EINSTEINIUM	100 (257) Fm FERMIUM	101 (258) Md MENDELEVIUM	102 (259) No NOBELIUM	103 (262) Lr LAWRENCIUM

Important Equations

$$\text{Molarity } (M) = \frac{\text{No. of } \textit{moles} \text{ of solute}}{\text{Volume of solution (in liter)}}$$

$$\text{Normality (N)} = \frac{\text{No. of gram equivalent of solute}}{\text{Volume of solution (in liter)}}$$

$$\text{No. of gram equivalent of solute} = \frac{\text{mass of solute}}{\text{Equivalent mass}}$$

$$\text{Equivalent mass} = \frac{\text{molar mass}}{\text{valance}}$$

$$\text{so Normality (N)} = \frac{\text{n of solute} * \text{valance of solute}}{\text{Volume of solution (in liter)}}$$

Or Normality (N) = Valance * Molarity (M)

where valance (K) is an integer constant ≥ 1 and can be as follow:

matter	K	Molar mass	Equivalent mass
HCl	1	36.5	36.5
H_2SO_4	2	98.1	49.0
NaOH	1	40	40
$Al(OH)_3$	3	78	26
K_2SO_4	2	174.3	87.2

$$\text{Molality (m)} = \frac{\text{No. of moles of solute}}{\text{Mass of solvent (in Kg)}}$$

Mass Percent,

$$\%\ (w/w) = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100\%$$

Volume Percent,

$$\%\ (v/v) = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100\%$$

Mole fraction,

$$X_i = \frac{\text{Mole of a component}}{\text{Total moles of components in solution}}$$

Practical Exercises Involving Solution Concentration

(1) A 0.750 L aqueous solution contains 90.0 g of ethanol, C_2H_5OH. Calculate the molar concentration of the solution in $mol.L^{-1}$. **(M= 2.61 mole/L)**

(2) What mass of NaCl should be dissolved in 152 mL of a solution so that the concentration of the solution is 0.364 M? **(mass = 3.23 g).**

(3) A patient has a cholesterol count of 206 mg/dL. What is the molarity of cholesterol in this patient's blood if the molecular mass of cholesterol is 386.64 g/mol? (1L = 10 dL). **(M = 0.005 mol/L)** **(Note: 1 mg = 10^{-3} g)**

(4) What the molality of solution if 15.0 g of dextrose, $C_6H_{12}O_6$, is dissolved in 200 mL water? (m = **0.42 mole/Kg solvent).**

(5) A mass of 98 g of sulfuric acid, H_2SO_4, is dissolved in water to prepare a 0.500 N solution. What is the volume of the solution? **(V = 4.0 L).**

(6) What is the mass of HNO_3 dissolved in one liter of solution of a molality of 0.5 $mol.\ Kg^{-1}$ (knowing that the density of solution is 0.997 g/mL)? **In this problem replace the word solution with the word solvent**

(mass = 31.4 g).

(7) A solution of sodium carbonate, Na_2CO_3, contains 53.0 g of solute in 215 mL of solution. What is its molarity and normality?

(M = 2.33 mole/L, N = 4.66 g.eq./L).

(8) What the mass of copper(II) nitrate, $Cu(NO_3)_2$, is present in 50.00 mL of a 5% of aqueous solution? **Assume that d of solution = 1.0 g/mL, i.e. its volume = its mass (mass = 2.5 g)**

(9) Antifreeze is a solution of ethylene glycol, $C_2H_6O_2$ in water. If 4.50 L of antifreeze contains 27.5 g of ethylene glycol, what is the mole fraction of ethylene glycol? **Assume that d of antifreeze solution = 1.0 g/mL, i.e. its volume = its mass (X = 0.002)**

(10) A 7.5 % potassium chloride solution is prepared by dissolving enough of the salt to give 100.0 g of solution. What is the mass of water required? **(mass of water 92.5 g)**