PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
IA	IIA	IIIB	IVB	VB	VIB	VIIB	------	VIIIB	------	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 181.0	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	89 **Ac** 227.0	104 **Rf** (261)	105 **Ha** (262)	106 **Sg** (263)	107 **Ns** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Ds** (269)	111 **Rg** (272)	112 **Cn** (277)	113 **Nh** (284)	114 **Fl** (289)	115 **Mc** (290)	116 **Lv** (293)	117 **Ts** (294)	118 **Og** (294)

58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Henry's Law: $C = kP$

Raoult's Law: $P_{solvent} = P^{\circ}_{solvent} \bullet X_{solvent}$ and $\Delta P = P^{o}_{solv} - P_{solv} = X_{solute}P^{o}_{solv}$

Boiling Point Elevation: $\Delta T_B = k_B m$

Freezing Point Depression: $\Delta T_F = k_F m$

Osmotic Pressure: $\Pi = MRT$ 760 torr = 1 atm

$R = 0.0821$ L•atm/mol•K $R = 8.314$ J/mol•K

$0\ ^{\circ}C = 273.15$ K

$N_A = 6.022 \times 10^{23}$ mol^{-1}

$1\ m = 100\ cm = 1000\ mm = 10^6\ \mu m = 10^9\ nm = 10^{10}$ Å

density of water: $\rho = 1.00$ g/ml = 1.00 kg/L

$$aA + bB \rightleftharpoons cC + dD \qquad K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b} \qquad Q = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$K_p = K_c(RT)^{\Delta n}$

$ay^2 + by + c = 0$

$[H_3O^+][OH^-] = 1 \times 10^{-14} = K_w$

$pH + pOH = 14.00 = pK_w$

$pH = -\log[H_3O^+]$ $[H_3O^+] = 10^{-pH}$

$pOH = -\log[OH^-]$ $[OH^-] = 10^{-pOH}$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} \qquad K_b = \frac{[BH^+][OH^-]}{[B]} \quad or \quad \frac{[HA][OH^-]}{[A^-]}\ \frac{[HA][OH^-]}{[A^-]}$$

$K_a K_b = K_w \quad pK_a + pK_b = pK_w$

$$pH = pK_a + \log\frac{n_b}{n_a} = pK_a + \log\frac{C_b}{C_a}$$

$aA + bB \rightarrow cC + dD$ $\quad \text{rate} = -\frac{\Delta[A]}{a\Delta t} = -\frac{\Delta[B]}{b\Delta t} = +\frac{\Delta[C]}{c\Delta t} = +\frac{\Delta[D]}{d\Delta t}$
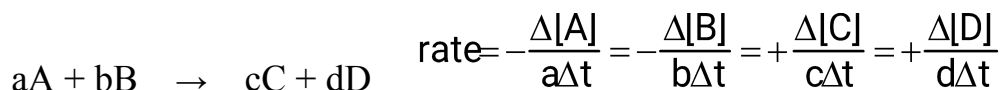
$rate = k[A]^x[B]^y$

$rate = k[A]^0$ $\qquad [A] = [A]_0 - kt$ $\qquad t_{1/2} = [A]_0/2k$

$rate = k[A]^1$ $\qquad [A] = [A]_0\, e^{-kt}$

$\ln[A] = \ln[A]_0 - kt$ $\qquad\qquad t_{1/2} = 0.693/k$

$rate = k[A]^2$

$k = Ae^{(-Ea/RT)}$ $\qquad\qquad \ln(k) = \ln(A) - E_a/R\,(1/T)$

$$\ln\frac{k_1}{k_2} = \frac{-E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$w = -P\Delta V$ $\qquad\qquad$ 1 L• atm = 101.3 J $\qquad\qquad q_{surr} = -q_{system}$

$\Delta E = q + w$ $\qquad \Delta H = \Delta E + P\Delta V$ $\qquad \Delta H = \Delta E + \Delta nRT$

$\Delta G = \Delta H - T\Delta S$ $\qquad \Delta G = \Delta G° + RT\ln Q$

$\Delta G° = -RT\ln K_{eq}$ $\qquad K_{eq} = e^{-\Delta G°/RT}$

$$\ln K_{eq} = \frac{\Delta S°}{R} - \frac{\Delta H°}{RT} \qquad\qquad \ln\left(\frac{K_1}{K_2}\right) = \frac{\Delta H^0}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

1 V = 1 J/C $\qquad \Delta G° = -nFE°$ $\qquad\qquad$ 1F = 96,485 C/mol e-

$$E° = \frac{RT}{nF}\ln K_{eq} \qquad\qquad E = E° - \frac{RT}{nF}\ln Q \qquad\qquad \text{at 298K, } E = E° - (0.0591/n)\log Q$$