international baccalaureate chemistry periodic table

1 valence electron → +1 alkali metals (group 1)

2 valence electrons → +2 alkaline earth metals (group 2)

valence electrons: 3, 4, 5, 6, 7, 8 (noble gases, group 18)

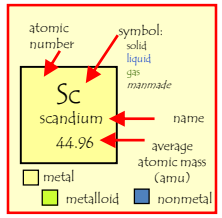
common charges: +3, −3, −2, −1 halogens

metal / nonmetal

	group 1	group 2	group 3	group 4	group 5	group 6	group 7	group 8	group 9	group 10	group 11	group 12	group 13	group 14	group 15	group 16	group 17	group 18
1s	1 H hydrogen 1.008 (H is a nonmetal)																	2 He helium 4.00
2s	3 Li lithium 6.94	4 Be beryllium 9.012											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
3s	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
4s	19 K potassium 39.10	20 Ca calcium 40.08	21 Sc scandium 44.96	22 Ti titanium 47.90	23 V vanadium 50.94	24 Cr chromium 52.00	25 Mn manganese 54.94	26 Fe iron 55.85	27 Co cobalt 58.93	28 Ni nickel 58.71	29 Cu copper 63.55	30 Zn zinc 65.37	31 Ga gallium 69.72	32 Ge germanium 72.59	33 As arsenic 74.92	34 Se selenium 78.96	35 Br bromine 79.91	36 Kr krypton 83.80
5s	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 96.91	44 Ru ruthenium 101.07	45 Rh rhodium 102.91	46 Pd palladium 106.40	47 Ag silver 107.87	48 Cd cadmium 112.40	49 In indium 114.82	50 Sn tin 118.69	51 Sb antimony 121.75	52 Te tellurium 127.60	53 I iodine 126.90	54 Xe xenon 131.30
6s	55 Cs cesium 132.91	56 Ba barium 137.33	71 Lu lutetium 174.97	72 Hf hafnium 178.49	73 Ta tantalum 180.95	74 W tungsten 183.85	75 Re rhenium 186.21	76 Os osmium 190.20	77 Ir iridium 192.22	78 Pt platinum 195.09	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.37	82 Pb lead 207.19	83 Bi bismuth 208.980	84 Po polonium 208.982	85 At astatine 209.99	86 Rn radon 222.02
7s	87 Fr francium 223.02	88 Ra radium 226.03	103 Lr lawrencium 262.11	104 Rf rutherfordium 267.12	105 Db dubnium 268.13)	106 Sg seaborgium 171.13	107 Bh bohrium 270.13	108 Hs hassium 277.15	109 Mt meitnerium 278.16	110 Ds darmstadtium 281.17	111 Rg roentgenium 281.16	112 Cn copernicium 285.18	113 Nh nihonium 286.19	114 Fl flerovium 289.19	115 Mc moscovium 289.19	116 Lv livermorium 293.20	117 Ts tennessine 294	118 Og oganesson 294

transition metals: 3d, 4d, 5d, 6d

to 4f / to 5f



4f	57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium (144.91)	62 Sm samarium 150.41	63 Eu europium 151.96	64 Gd gadolinium 157.25	65 Tb terbium 158.92	Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.04	to 5d
5f	89 Ac actinium 227.03	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium 237.05	94 Pu plutonium 244.06	95 Am americium 243.06	96 Cm curium 247.07	97 Bk berkelium 247.07	98 Cf californium 251.08	99 Es einsteinium 252.08	100 Fm fermium 257.10	101 Md mendelevium 258.10	102 No nobelium 259.10	to 6d

common ions

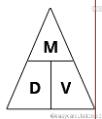
acetate $CH_3CO_2^-$	bisulfite HSO_3^-	chlorite ClO_2^-	hydroxide OH^-	nitrite NO_2^-	phosphide P^{3-}
ammonium NH_4^+	bromide Br^-	chromate CrO_4^{2-}	hypochlorite ClO^-	oxide O^{2-}	sulfate SO_4^{2-}
bromide Br^-	carbonate CO_3^{2-}	cyanide CN^-	iodide I^-	perchlorate ClO_4^-	sulfide S^{2-}
bicarbonate HCO_3^-	chlorate ClO_3^-	dichromate $Cr_2O_7^{2-}$	nitrate NO_3^-	permanganate MnO_4^-	sulfite SO_3^{2-}
bisulfate HSO_4^-	chloride Cl^-	fluoride F^-	nitride N^{3-}	phosphate PO_4^{3-}	thiosulfate $S_2O_3^{2-}$

chemistry equations

1. introduction to chemistry

d = density; m = mass in g; v = volume in mL

$$d = \frac{m}{V}$$



SI unit prefixes

giga	billion (10^9)
mega	million (10^6)
kilo	thousand (10^3)
deka	ten (10^0)
deci	tenth (10^{-1})
centi	hundredth (10^{-2})
milli	thousandth (10^{-3})
micro	millionth (10^{-6})
nano	billionth (10^{-9})
pico	trillionth (10^{-12})

2. data

$$\%\ \text{yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$\%\ \text{error} = \frac{\text{error}}{\text{accepted valued}} \times 100$$

temperature: $K = {}^\circ C + 273.15$

$${}^\circ C = ({}^\circ F - 32) \times \frac{5}{9} \qquad {}^\circ F = \frac{9}{5}{}^\circ C + 32$$

3. matter, 4. atom: no formulas

5. electrons

s = wf e = hf e = hs/w w = hs/e

s = the speed of light = 3×10^8 m/s
w = wavelength in meters
f = frequency, per second.
e = energy in joules
h = Plancks constant = 6.626×10^{-34} j sec

Balmer formula :

$$w_{nm} = \frac{1}{0.01097\left(\frac{1}{\text{inner}^2} - \frac{1}{\text{outer}^2}\right)}$$

w = wavelength in nanometers
inner = inner shell #; outer = outer shell #.
similarly:

$$E = 2.18 \times 10^{-18}\text{joules}\left(\frac{1}{\text{inner}^2} - \frac{1}{\text{outer}^2}\right)$$

9. the mole:

is an amount! = 6.02×10^{23}

mol-mol conversions:

$$\text{mol A} \times \frac{\text{mol B}}{\text{mol A}} = \text{mol B}$$

gram – mol conversions:

$$\text{gA} \times \frac{\text{mol A}}{\text{gA}} \times \frac{\text{mol B}}{\text{mol A}} = \text{mol B}$$

mol – g conversions:

$$\text{mol A} \times \frac{\text{mol B}}{\text{mol A}} \times \frac{\text{g B}}{\text{mol B}} = \text{g B}$$

g– g conversions:

$$\text{gA} \times \frac{\text{mol A}}{\text{gA}} \times \frac{\text{molB}}{\text{mol A}} \times \frac{\text{gB}}{\text{molB}} = \text{gB}$$

10. gas laws

units

P pressure
V = volume (L)
T = Kelvin Temp (K)
n = # of moles (mol)
R = 0.0821 L atm/mol K
M = molar masses (g/mol)
d = density

1 atm = 14.7 psi = 760 mm Hg or Torr = 101 3 kPa

STP = standard temp and pressure = 1 atm, 273.15 K

formulas

boyles: $P_1V_1 = P_2V_2$ charles: $\frac{T_1}{V_1} = \frac{T_2}{V_2}$ gay-lussac: $\frac{T_1}{P_1} = \frac{T_2}{P_2}$ combined: $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

must use K for temperature; other units must cancel

ideal gas law:

$$PV = nRT$$ must use L atm mol K

avogadro's law: 22.4 L = 1 mole gas at STP

density formula: $d = \frac{PM}{RT}$

graham's law: $\frac{\text{rate}_1}{\text{rate}_2} = \sqrt{\frac{M_2}{M_1}}$

partial pressure

$$\text{partial pressure of gas a} = \frac{\text{moles of gas a}}{\text{total moles of gas}} \times \text{total pressure}$$

6. periodic table; 7. bonding 8. reactions: no formulas ☺

11. energy:

q = mcΔT

q = heat, m = mass, c = specific heat (J/g°C), ΔT = temp change in °C.

energy needed to melt and boil water:

$c_{water(l)} = 4.184$ J/g °C
$c_{water(s)} = 2.03$ J/g°C
$c_{water(g)} = 2.01$ J/g°C
$\Delta H_{vap\ water} = 2260$ J/g; $\Delta H_{fus\ water} = 334$ J/g
$\Delta H_{fus\ water} = 334$ J/g
$\Delta H_{vap\ water} = 2260$ J/g
water boils/condenses at 100°C
water melts/freezes at 0°C

1 Nutritional Calorie = 4184 Joules = 4 BTU = 1000 calories = 0.0016 kilowatt hours

$\Delta G = \Delta H - T\Delta S$

ΔG = change in free energy
ΔH = change in enthalpy
T = temperature
ΔS = change in entropy

15. acids and bases

K_a for example of HCl $= [H+][Cl^-]/[HCl]$

$K_w = [H+][OH^-] = 10^{-14}$

titration:

$pH = -\log[H+]$
$10^{-pH} = [H^+]$
$pOH = -\log[OH^-]$
$10^{-pOH} = [OH^-]$
$pH + pOH = 14$

$$\text{molarity}_{\text{unknown}} = \frac{(\text{volume}_{\text{standard}})(\text{molarity}_{\text{standard}})}{\text{volume}_{\text{unknown}}}$$

14. equilibrium

for:

$$aA + bB \rightleftarrows cC + dD$$

$$K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

omit liquids and solids

13. rates

reaction rate = $\Delta_{concentration}/\Delta_{time}$

M = Molarity = moles per liter = moles/liter

$$\Delta_{concentration}{}^{order} = \Delta_{rate}$$

$$E_a = \frac{(\ln\frac{K_1}{K_2})R}{\frac{1}{T_2} - \frac{1}{T_1}}$$

E_a = activation energy (j/mol)
K_1, K_2 =rate constants
T_1, T_2, = temperatures (K)
R = 8.314 j/k mol

12. solutions

1. percent concentration by volume (%v/v)
= volume of solute x 100
volume of solution
2. percent concentration by mass (%m/m)
= mass of solute x 100
mass of solution
3. Molarity (M)
= moles of solute
Liters of solution
4. molality (m)
= moles of solute
Kilograms of solvent
5. mole fraction (X)
= moles of solute
moles of solution
6. concentration and dilution
6. $C_1V_1 = C_2V_2$
where C_1 and C_2 are concentrations;
and V_1 and V_2 are volumes
7. Henry's Law:
Solubility is proportional to Pressure
$S_1/P_1 = S_2/P_2$

8. pressure and volume units units:
1 **atm** = 760 mm Hg = 14.7 psi = 101.3 KPa
1 **L** = 1000 mL

9. boiling point elevation (ΔT_b) and freezing point depression (ΔT_f) of solutions

$\Delta T_f = K_f m \cdot pm$
$\Delta T_b = k_b m \cdot pm$

ΔT_f= change in freezing temp; ΔT_b = change in boiling temperature; K_f = freezing point constant; K_b = boiling point constant; m = molality; pm = particle molality (ion count)
(K_f is for the solvent; pm is for the solute)