$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14} 6d^{10} 7p^6$

Periodic Table of Elements

$R_{\text{gas-law}} = 0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} = 62.4 \frac{\text{L} \cdot \text{mmHg}}{\text{mol} \cdot K} = 8.314 \frac{\text{L} \cdot \text{kPa} \vee \text{J}}{\text{mol} \cdot \text{K}}$

$\frac{453.6\ \text{g}}{1\ \text{lb}} = \frac{2.54\ \text{cm}}{1\ \text{in}} = \frac{0.946\ \text{L}}{1\ \text{qt}} = \frac{6.022 \times 10^{23}\ \text{units}}{\text{mol}} = \frac{22.4\ \text{L}}{\text{mol}}$

$\frac{1\ \text{g}_{\text{water}}}{1\ \text{mL}_{\text{water}}} = \frac{P_{\text{sea}}}{101325\ \text{Pa}} = \frac{1\ \text{atm}}{760\ \text{mmHg}} = \frac{1\ \text{atm}}{14.7\ \text{psi}} = \frac{1\ \text{kcal}}{4.184\ \text{kJ}}$

$°\text{C} = \frac{5}{9}(°\text{F} - 32)$ and $°\text{F} = \frac{9}{5}°\text{C} + 32$

$h = 6.626 \times 10^{-34}\text{Js} \vee \text{kgm}^2\text{s}^{-1}$ and $c = 3.00 \times 10^8\ \text{ms}^{-1}$

[J]= kg $m^2 s^{-2}$, [N] = kg m s^{-1},
[Pa] = N m^{-2} = kg $(ms)^{-1}$

$PV = nRT$ and $\left[P + \frac{an^2}{V^2}\right][V - nb] = nRT$
$PV \propto 1$ and $VT \propto 1$ (Boyle and Charle).
$M = \frac{\text{moles solute}}{\text{L solution}}$ and $m = \frac{\text{moles solute}}{\text{kg solvent}}$
$X_{\text{mol fraction}} = \frac{\text{mol component}}{\text{mol total}}$.

$k = Ae^{-\frac{E_a}{RT}}$
$[A]_t = [A]_0 - kt$
$[A]_t = [A]_0 e^{-kt}$
$[A]_t = \frac{1}{kt + \frac{1}{[A]_0}}$

Ion	Soluble with	Precipitates with
NO_3^- Nitrate	Most cations	No common cations
ClO_4^-	Most cations	No common cations
ClO_3^-	Most cations	No common cations
$C_2H_3O_2^-$	Most cations	Ag^+, Hg_2^{2+}
F^-	Most cations	Cr^{3+}
Cl^-	Most cations	$(Ag,\ Tl)^+, Pb^{2+,4+}, Hg_2^{2+}$
Br^-	Most cations	$(Ag,\ Tl)^+, Pb^{2+,4+}, Hg_2^{2+}$
I^-	Most cations	$(Ag,\ Tl)^+, Pb^{2+,4+}, Hg_2^{2+}$
SO_4^{2-}	Most cations	$Ag^+, Ba^{2+}, Sr^{2+}, Pb^{2+,4+}, Ca^{2+}, Hg_2^{2+}$
CrO_4^{2-}	Most cations	$Ba^{2+}, Sr^{2+}, Pb^{2+,4+}, Ca^{2+}, Hg_2^{2+}$
S^{2-}	$Na^+, K^+, NH_4^+, Li^+, Sr^{2+}$	Most other cations
OH^-	$Na^+, K^+, NH_4^+, Li^+, Sr^{2+}, Ba^{2+}, Ca^{2+}$	Most other cations
CO_3^{2-}	$(Na, K, NH_4, Li)^+$	Most other cations
PO_4^{3-}	Na^+, K^+, NH_4^+	Most other cations
O^{2-}	No_{common} cations	Most cations
$(Na,K,NH_4)^+$	Most Anions	$(NH_4)_2C_2O_4$
Bi^{3+}	Nothing	Most anions
As^{3+}	I^-	Most anions
Sb^{3+}	Cl^-	Most anions

$\triangle H_{\text{vap}} = 40.67\text{kJ mol}^{-1}$
$\triangle H_{\text{fus}} = 6.01\text{kJ mol}^{-1}$ $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$
$C_{\text{ice}} = 2.11\text{J (gK)}^{-1}$
$C_{\text{water}} = 4.184\text{J (gK)}^{-1}$ $v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$
$C_{\text{steam}} = 1.865\text{J (gK)}^{-1}$

$K_a = \frac{[H_3O^+][A^-]}{[HA]}$ and $K_b = \frac{[HB][OH^-]}{[B^-]}$, in water, $K_aK_b = 1.0 \times 10^{-14}$
$\text{pH} = -\log_{10}[H^+]$, $\text{pOH} = -\log_{10}[OH^-]$, $\text{pK}_a = -\log_{10}[K_a]$
$\text{pH} + \text{pOH} = 14$, and $K_c = \frac{[\text{product}]}{[\text{reactant}]}$, K_{eq}, $K_{\text{sp}} \leftrightarrow K_p = K_c(RT)^{\triangle n}$
$K_{\text{a-acetic}} = 1.8 \times 10^{-5}$, and **in buffer** $\text{pH} = \text{pK}_a + \log_{10}\left(\frac{[A^-]}{[HA]}\right)$.

$E_{\text{photon}} = hf = \frac{hc}{\lambda}$ and $\lambda = \frac{h}{mv}$
$E_n = -\frac{R_H}{n^2}$
$R_{H_{\text{Rydberg}}} = 2.18 \times 10^{-18}$ J
$\triangle E = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$

i = Van't Hoff
$(K_b, K_f) = (0.512, 1.86)°\text{C/m}$
$\triangle T_f = K_f mi$ and $\triangle T_b = K_b mi$
$\Pi = iMRT$ and $S_g = kP_g$

$\triangle E = q + w = q - P\triangle V$ and $\triangle H = \triangle E + P\triangle V$
Isotherm, $\triangle S = \frac{q_{\text{rif-reverse}}}{T}$, or $S = k \ln W$ (micro-state)
$k = 1.38 \times 10^{-23}$ JK^{-1}
$\triangle S = k \ln\left(\frac{W_{\text{final}}}{W_{\text{initial}}}\right)$ and $\triangle S_{\text{surr.}} = -\frac{\triangle H°}{T}$
$-T\triangle S_{\text{universe}} = \triangle H_{\text{system}} - T\triangle S_{\text{system}}$
$\triangle G := -T\triangle S_{\text{universe}} = \triangle H° - T\triangle S°$
$\triangle G = \triangle G° + RT\ln(Q)$, so at eq., $K_{\text{eq}} = e^{-\triangle G°/RT}$

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

1 IA	2 IIA	3 IIIA	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 **H** 2.20 Hydrogen 1.01																	2 **He** Helium 4.00
3 **Li** 0.98 Lithium 6.94	4 **Be** 1.57 Beryllium 9.01											5 **B** 2.04 Boron 10.81	6 **C** 2.55 Carbon 12.01	7 **N_2** 3.14 Nitrogen 14.01	8 **O_2** 3.44 Oxygen 116.00	9 **F_2** 3.98 Fluorine 19.00	10 **Ne** Neon 20.18
11 **Na** 0.93 Sodium 22.99	12 **Mg** 1.31 Magnesium 24.31											13 **Al** 1.61 Aluminium 26.98	14 **Si** 1.90 Silicon 28.09	15 **P** 2.19 Phosphorus 30.97	16 **S** 2.38 Sulphur 32.10	17 **Cl_2** 3.16 Chlorine 35.45	18 **Ar** Argon 39.95
19 **K** 0.82 Potassium 39.10	20 **Ca** 1.00 Calcium 40.08	21 **Sc** 1.36 Scandium 44.96	22 **Ti** 1.54 Titanium 47.87	23 **V** 1.63 Vanadium 50.94	24 **Cr★** 1.66 Chromium 52.00	25 **Mn** 1.55 Manganese 54.94	26 **Fe** 1.83 Iron 55.85	27 **Co** 1.88 Cobalt 58.93	28 **Ni** 1.91 Nickel 58.69	29 **Cu★** 1.90 Copper 63.55	30 **Zn** 1.65 Zinc$^{(2+)}$ 65.39	31 **Ga** 1.81 Gallium 69.72	32 **Ge** 2.01 Germanium 72.64	33 **As** 2.18 Arsenic 74.92	34 **Se** 2.55 Selenium 78.96	35 **Br_2** 2.96 Bromine 79.90	36 **Kr** 3.00 Krypton 83.80
37 **Rb** 0.82 Rubidium 85.47	38 **Sr** 0.95 Strontium 87.62	39 **Y** 1.22 Yttrium 88.91	40 **Zr** 1.33 Zirconium 91.22	41 **Nb★** 1.6 Niobium 92.91	42 **Mo★** 2.16 Molybdenum 95.94	43 **Tc** 1.9 Technetium (98)	44 **Ru★** 2.2 Ruthenium 101.07	45 **Rh★** 2.28 Rhodium 102.91	46 **Pd★** 2.20 Palladium 106.42	47 **Ag** 1.93 Silver$^{(1+)}$ 107.87	48 **Cd** 1.69 Cadmium 112.41	49 **In** 1.78 Indium 114.82	50 **Sn★** 1.96 Tin 118.71	51 **Sb** 2.05 Antimony 121.76	52 **Te** 2.1 Tellurium 127.60	53 **I_2** 2.86 Iodine 126.90	54 **Xe** 2.60 Xenon 131.29
55 **Cs** 0.79 Caesium 132.91	56 **Ba** 0.89 Barium 137.33	57-71 **La-Lu** Lanthanide	72 **Hf** 1.3 Hafnium 178.49	73 **Ta** 1.5 Tantalum 180.95	74 **W** 2.36 Tungsten 183.84	75 **Re** 1.9 Rhenium 186.21	76 **Os** 2.2 Osmium 190.23	77 **Ir** 2.20 Iridium 192.22	78 **Pt** 2.28 Platinum 195.08	79 **Au★** 2.54 Gold 196.97	80 **Hg** 2.00 Mercury 200.59	81 **Tl** 1.62 Thallium 204.38	82 **Pb** 1.87 Lead 207.2	83 **Bi** 2.02 Bismuth 208.98	84 **Po** 2.0 Polonium (209)	85 **At** 2.2 Astatine (210)	86 **Rn** 2.2 Radon (222)
87 **Fr** 0.7 Francium (223)	88 **Ra** 0.9 Radium (226)	89-103 **Ac-Lr** Actinide	104 Ruther-fordium **Rf** (267)	105 Dubnium **Db** (268)	106 Seaborgium **Sg** (269)	107 Bohrium **Bh** (270)	108 Hassium **Hs** (277)	109 Meitnerium **Mt** (278)	110 Darm-stadtium **Ds** (281)	111 Roent-genium **Rg** (282)	112 Coper-nicium **Cn** (285)	113 Nihonium **Nh** (286)	114 Flerovium **Fl** (289)	115 Moscovium **Mc** (290)	116 Liver-morium **Lv** (293)	117 Tennessine **Ts** (294)	118 Ogannesson **Og** (294)

57 **La** 1.1 Lanthanum 138.91	58 **Ce** 1.12 Cerium 140.12	59 **Pr** 1.13 Praseodymium 140.91	60 **Nd** 1.14 Neodymium 144.24	61 **Pm** 1.13 Promethium (145)	62 **Sm** 1.17 Samarium 150.36	63 **Eu** 1.2 Europium 151.96	64 **Gd** 1.2 Gadolinium 157.25	65 **Tb** 1.1 Terbium 158.93	66 **Dy** 1.22 Dysprosium 162.50	67 **Ho** 1.23 Holmium 164.93	68 **Er** 1.24 Erbium 167.26	69 **Tm** 1.25 Thulium 168.93	70 **Yb** 1.1 Ytterbium 173.05	71 **Lu** 1.27 Lutetium 174.97
89 **Ac** 1.1 Actinium (227)	90 **Th** 1.3 Thorium 232.04	91 **Pa** 1.5 Protactinium 231.04	92 **U** 1.38 Uranium 238.03	93 **Np** 1.36 Neptunium (237)	94 **Pu** 1.28 Plutonium (244)	95 **Am** 1.13 Americium (243)	96 **Cm** 1.28 Curium (247)	97 **Bk** 1.3 Berkelium (247)	98 **Cf** 1.3 Californium (251)	99 **Es** 1.3 Einsteinium (252)	100 **Fm** 1.3 Fermium (257)	101 **Md** 1.3 Mendelevium (258)	102 **No** 1.3 Nobelium (259)	103 **Lr** 1.3 Lawrencium (266)

Gas
CO
CO_2
CH_4
C_2H_6
C_3H_8
C_4H_{10}
NO NO_2
N_2O NH_3
SO_3 SO_2
H_2S HCl

Super[7]
HI
HBr
HCl
HNO_3
H_2SO_4
$HClO_3$
$HClO_4$

Alkali Metal
Alkaline-Earth
Metal
Metalloid
Non-metal
Halogen
Noble Gas
Lanthanide/Actinide

Z E.N. **Sym** Name mass

EN, IE, EA, & $\mathbb{Z}_{eff}$ increase →↑

Radius & Metallic increase ←↓