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

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 $°\text{F} = \frac{9}{5}°\text{C} + 32$ and $1\text{V} = \frac{\text{J}}{\text{C}}$

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

[J]= kg m^{2}s^{-2}, [N] = kg m s^{-1},
[Pa] = N m^{-2}, kg(ms)$^{-1}$, [V] = JC^{-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 $m = \frac{\text{moles solute}}{\text{kgs solvent}}$
$X_{\text{mol fraction}} = \frac{\text{mol component}}{\text{mol total}}$.

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

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

$\varepsilon = E°_{\text{cell}} = E°_{\text{red}}(\text{cathode}) - E°_{\text{red}}(\text{anode})$, and $E°_{\text{cell}_{\text{voltaic}}} > 0$.
$\triangle G = -nFE$, where $F = 96485$ C(mol)$^{-1} = 96485$J (Vmol)$^{-1}$.
$-nFE = -nFE° + RT \ln Q$, so $E = E° - \frac{RT}{nF} \ln Q$ (Nernst).
$\triangle G = w_{\text{max}} = -nFE$. And $w = nFE_{\text{applied}}$. Also, $Q = It$.

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

$K_a = \frac{[H_3O^+][A^-]}{[HA]}$ and $K_b = \frac{[HB][OH^-]}{[B^-]}$, in water, $K_aK_b = 1.0 \times 10^{-14}$
$\text{pH} = -\log_{10}[H^+]$, $\text{pOH} = -\log_{10}[OH^-]$, $\text{pK}_a = -\log_{10}[K_a]$
pH + 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, $\triangle S = \frac{q_{\text{if-reverse}}}{T}$, 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 2.20 **H_2** Hydrogen 1.01																	2 **He** Helium 4.00
3 0.98 **Li** Lithium 6.94	4 1.57 **Be** Beryllium 9.01											5 2.04 **B** Boron 10.81	6 2.55 **C** Carbon 12.01	7 3.14 **N_2** Nitrogen 14.01	8 3.44 **O_2** Oxygen 16.00	9 3.98 **F_2** Fluorine 19.00	10 **Ne** Neon 20.18
11 0.93 **Na** Sodium 22.99	12 1.31 **Mg** Magnesium 24.31											13 1.61 **Al** Aluminium 26.98	14 1.90 **Si** Silicon 28.09	15 2.19 **P** Phosphorus 30.97	16 2.38 **S** Sulphur 32.10	17 3.16 **Cl_2** Chlorine 35.45	18 **Ar** Argon 39.95
19 0.82 **K** Potassium 39.10	20 1.00 **Ca** Calcium 40.08	21 1.36 **Sc** Scandium 44.96	22 1.54 **Ti** Titanium 47.87	23 1.63 **V** Vanadium 50.94	24 1.66 **Cr★** Chromium 52.00	25 1.55 **Mn** Manganese 54.94	26 1.83 **Fe** Iron 55.85	27 1.88 **Co** Cobalt 58.93	28 1.91 **Ni** Nickel 58.69	29 1.90 **Cu★** Copper 63.55	30 1.65 **Zn** Zinc$^{(2+)}$ 65.38	31 1.81 **Ga** Gallium 69.72	32 2.01 **Ge** Germanium 72.63	33 2.18 **As** Arsenic 74.92	34 2.55 **Se** Selenium 78.97	35 2.96 **Br_2** Bromine 79.90	36 3.00 **Kr** Krypton 83.80
37 0.82 **Rb** Rubidium 85.47	38 0.95 **Sr** Strontium 87.62	39 1.22 **Y** Yttrium 88.91	40 1.33 **Zr** Zirconium 91.22	41 1.6 **Nb★** Niobium 92.91	42 2.16 **Mo★** Molybdenum 95.95	43 1.9 **Tc** Technetium (98)	44 2.2 **Ru★** Ruthenium 101.07	45 2.28 **Rh★** Rhodium 102.91	46 2.20 **Pd★★** Palladium 106.42	47 1.93 **Ag★** Silver$^{(1+)}$ 107.87	48 1.69 **Cd** Cadmium 112.41	49 1.78 **In** Indium 114.82	50 1.96 **Sn** Tin 118.71	51 2.05 **Sb** Antimony 121.76	52 2.1 **Te** Tellurium 127.60	53 2.86 **I_2** Iodine 126.90	54 2.60 **Xe** Xenon 131.29
55 0.79 **Cs** Caesium 132.91	56 0.89 **Ba** Barium 137.33	57-71 **La-Lu** Lanthanide	72 1.3 **Hf** Hafnium 178.49	73 1.5 **Ta** Tantalum 180.95	74 2.36 **W** Tungsten 183.84	75 1.9 **Re** Rhenium 186.21	76 2.2 **Os** Osmium 190.23	77 2.20 **Ir** Iridium 192.22	78 2.28 **Pt** Platinum 195.08	79 2.54 **Au★** Gold 196.97	80 2.00 **Hg** Mercury 200.59	81 1.62 **Tl** Thallium 204.38	82 1.87 **Pb** Lead 207.2	83 2.02 **Bi** Bismuth 208.98	84 2.0 **Po** Polonium (209)	85 2.2 **At** Astatine (210)	86 2.2 **Rn** Radon (222)
87 0.7 **Fr** Francium (223)	88 0.9 **Ra** Radius (226)	89-103 **Ac-Lr** Actinide	104 **Rf** Rutherfordium (267)	105 **Db** Dubnium (268)	106 **Sg** Seaborgium (269)	107 **Bh** Bohrium (270)	108 **Hs** Hassium (277)	109 **Mt** Meitnerium (278)	110 **Ds** Darmstadtium (281)	111 **Rg** Roentgenium (282)	112 **Cn** Copernicium (285)	113 **Nh** Nihonium (286)	114 **Fl** Flerovium (289)	115 **Mc** Moscovium (290)	116 **Lv** Livermorium (293)	117 **Ts** Tennessine (294)	118 **Og** Oganneson (294)

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

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

Super^7 HI, HBr, HCl, HNO_3, H_2SO_4, $HClO_3$, $HClO_4$

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

Alkali Metal
Alkaline-Earth
Metal
Metalloid
Non-metal
Halogen
Noble Gas
Lanthanide/Actinide
Synthetic
★Aufbau Exception

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