

$$R_{\text{gas-law}} = 0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} = 62.4 \frac{\text{L} \cdot \text{mmHg}}{\text{mol} \cdot \text{K}} = 8.314 \frac{\text{L} \cdot \text{kPa} \cdot \text{V}}{\text{mol} \cdot \text{K}}$$
$$\frac{453.6 \text{ g}}{1 \text{ lb}} = \frac{2.54 \text{ cm}}{1 \text{ in}} = \frac{0.946 \text{ L}}{1 \text{ qt}} = \frac{6.022 \times 10^{23} \text{ units}}{\text{mol}} = \frac{22.4 \text{ L}}{\text{mol}}$$
$$\frac{1 \text{ g}_{\text{water}}}{1 \text{ mL}_{\text{water}}} = \frac{P_{\text{sea}}}{101325 \text{ Pa}} = \frac{1 \text{ atm}}{760 \text{ mmHg}} = \frac{1 \text{ atm}}{14.7 \text{ psi}}$$
$$^{\circ}\text{C} = \frac{5}{9}(^{\circ}\text{F} - 32) \text{ and } ^{\circ}\text{F} = \frac{9}{5}^{\circ}\text{C} + 32$$
$$h = 6.626 \times 10^{-34} \text{ Js} \vee \text{kgm}^2\text{s}^{-1} \text{ and } c = 3.00 \times 10^8 \text{ ms}^{-1}$$

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

$$k = Ae^{-\frac{E_a}{RT}}$$
$$[A]_t = [A]_0 - kt$$
$$[A]_t = [A]_0e^{-kt}$$
$$[A]_t = \frac{1}{kt + \frac{1}{[A]_0}}$$

1 IA													18 VIIIA																
1	1 2.20 H₂ Hydrogen 1.01		<div>$\Delta H_{\text{vap}} = 40.67\text{kJ mol}^{-1}$ $\Delta H_{\text{fus}} = 6.01\text{kJ mol}^{-1}$ $C_{\text{ice}} = 2.11\text{J (gK)}^{-1}$ $C_{\text{water}} = 4.184\text{J (gK)}^{-1}$ $C_{\text{steam}} = 1.865\text{J (gK)}^{-1}$ $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$ $v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$</div> <div>$K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}$ and $K_b = \frac{[\text{HB}][\text{OH}^-]}{[\text{B}^-]}$, in water, $K_aK_b = 1.0 \times 10^{-14}$ $\text{pH} = -\log_{10}[\text{H}^+]$, $\text{pOH} = -\log_{10}[\text{OH}^-]$, $\text{pK}_a = -\log_{10}[K_a]$ $\text{pH} + \text{pOH} = 14$, and $K_c = \frac{[\text{product}]}{[\text{reactant}]}$, K_{eq}, $K_{\text{sp}} \leftrightarrow K_{\text{p}} = K_{\text{c}}(RT)^{\Delta n}$ $K_{\text{a-acetic}} = 1.8 \times 10^{-5}$, and in buffer $\text{pH} = \text{pK}_a + \log_{10}\left(\frac{[\text{A}^-]}{[\text{HA}]}\right)$.</div>													2 He Helium 4.00													
	2 IIA		<div>$E_{\text{photon}} = hf = \frac{hc}{\lambda}$ and $\lambda = \frac{h}{mv}$ $E_n = -\frac{R_H}{n^2}$ $R_{H\text{Rydberg}} = 2.18 \times 10^{-18} \text{ J}$ $\Delta E = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$</div> <div>$i = \text{Van't Hoff}$ $(K_b, K_f) = (0.512, 1.86)^\circ\text{C/m}$ $\Delta T_f = K_fmi$ and $\Delta T_b = K_bmi$ $\Pi = iMRT$ and $S_g = kP_g$</div>																										
2	3 0.98 Li Lithium 6.94	4 1.57 Be Beryllium 9.01	<div>$\Delta E = q + w = q - P\Delta V$ and $\Delta H = \Delta E + P\Delta V$ Isotherm, $\Delta S = \frac{q_{\text{ir-reverse}}}{T}$, or $S = k \ln W$ (micro-state) $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$ $\Delta S = k \ln\left(\frac{W_{\text{final}}}{W_{\text{initial}}}\right)$ and $\Delta S_{\text{surr.}} = -\frac{\Delta H^\circ}{T}$ $-T\Delta S_{\text{universe}} = \Delta H_{\text{system}} - T\Delta S_{\text{system}}$ $\Delta G := -T\Delta S_{\text{universe}} = \Delta H^\circ - T\Delta S^\circ$</div>										13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	10 Ne Neon 20.18											
	3		3										5 2.04 B Boron 10.81	6 2.55 C Carbon 12.01	7 3.14 N₂ Nitrogen 14.01	8 3.44 O₂ Oxygen 116.00	9 3.98 F₂ Fluorine 19.00												
3	11 0.93 Na Sodium 22.99	12 1.31 Mg Magnesium 24.31	3 IIIA										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 Cl₂ Chlorine 35.45	18 Ar Argon 39.95											
	4		4										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⁺⁾ 65.39	31 1.81 Ga Gallium 69.72	32 2.01 Ge Germanium 72.64	33 2.18 As Arsenic 74.92	34 2.55 Se Selenium 78.96	35 2.96 Br₂ Bromine 79.90
5	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 95.94	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 I₂ 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)											
7	87 0.7 Fr Francium (223)	88 0.9 Ra 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)											
	Gas		Z E.N.										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									
Super ⁷ HI HBr HCl HNO ₃ H ₂ SO ₄ HClO ₃ HClO ₄		Alkali Metal Alkaline-Earth Metal Metalloid Non-metal Halogen Noble Gas Lanthanide/Actinide										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							
NO NO ₂ N ₂ O NH ₃ SO ₃ SO ₂ H ₂ S HCl		EN, IE, EA, & \mathbb{Z}_{eff} increase $\rightarrow \uparrow$ Radius & Metallic increase $\leftarrow \downarrow$										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)			