

### Formulas and Constants

$$\begin{array}{llll}
 R = 0.08206 \text{ L atm K}^{-1} \text{ mol}^{-1} = 8.314 \text{ J K}^{-1} \text{ mol}^{-1} & R_H = 2.178 \times 10^{-18} \text{ J} & 1 \text{ J} = 1 \text{ CV} \\
 1 \text{ F} = 96,485 \text{ C mol}^{-1} = 96,485 \text{ J V}^{-1} \text{ mol}^{-1} & N_A = 6.022 \times 10^{23} \text{ mol}^{-1} & \\
 h = 6.626 \times 10^{-34} \text{ J s} & c = 2.998 \times 10^8 \text{ m s}^{-1} & \\
 K_w = 1.00 \times 10^{-14} & 0^\circ\text{C} = 273.15 \text{ K} & 1 \text{ atm} = 760 \text{ torr} = 1.0133 \text{ bar} = 1.0133 \times 10^5 \text{ Pa} \\
 e = 1.602 \times 10^{-19} \text{ C} & m_e = 9.109 \times 10^{-31} \text{ kg} & 1 \text{ \AA} = 1 \times 10^{-10} \text{ m} = 100 \text{ pm}
 \end{array}$$

$$\Delta E_{\text{H-atom}} = R_H \left( \frac{1}{n_i^2} - \frac{1}{n_f^2} \right) \quad \tilde{\nu} = \frac{1}{\lambda} \quad \Delta E = \frac{hc}{\lambda} = hc\tilde{\nu} \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$E = hv = \frac{1}{2} m v^2 + BE \quad p = \frac{h}{\lambda} \quad \lambda = \frac{h}{mv} \quad p = mv \quad \Delta x \Delta p \geq \frac{h}{4\pi}$$

$$[\text{gas(aq)}]_{\text{eq}} = K_H (P_{\text{gas}})_{\text{eq}} \quad v_{\text{solution}} = X_{\text{solvent}} v_{\text{pure solvent}}$$

$$\Delta T_f = K_f m \quad \Delta T_b = K_b m \quad \Pi V = nRT \quad \Pi = MRT$$

$$[A] = [A]_0 - kt \quad \ln [A] = \ln [A]_0 - kt \quad \ln \left( \frac{[A]}{[A]_0} \right) = -kt \quad \frac{1}{[A]} = \frac{1}{[A]_0} + kt$$

$$t_{1/2} = \frac{0.693}{k} \quad t_{1/2} = \frac{1}{k [A]_0} \quad \ln \left( \frac{k_2}{k_1} \right) = -\frac{E_a}{R} \left( \frac{1}{T_2} - \frac{1}{T_1} \right) \quad \ln \left( \frac{k_2}{k_1} \right) = \frac{E_a}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\text{pH} = \text{p}K_a + \log \left( \frac{c_B}{c_A} \right) \quad \Delta G = \Delta G^\circ + RT \ln Q \quad \Delta G = -nFE_{\text{cell}}$$

$$\ln \left( \frac{K_{T_2}}{K_{T_1}} \right) = -\frac{\Delta H^\circ}{R} \left( \frac{1}{T_2} - \frac{1}{T_1} \right) \quad \ln \left( \frac{K_{T_1}}{K_{T_2}} \right) = \frac{\Delta H^\circ}{R} \left( \frac{1}{T_2} - \frac{1}{T_1} \right)$$

$$E = E^\circ - \frac{RT}{nF} \ln Q \quad E = E^\circ - \frac{0.0257 \text{ V}}{n} \ln Q \quad E = E^\circ - \frac{0.0592 \text{ V}}{n} \log Q$$

1 <u>H</u> 1.008	2 <u>He</u> 4.003																
3 <u>Li</u> 6.941	4 <u>Be</u> 9.012											5 <u>B</u> 10.81	6 <u>C</u> 12.01	7 <u>N</u> 14.01	8 <u>O</u> 16.00	9 <u>F</u> 19.00	10 <u>Ne</u> 20.18
11 <u>Na</u> 22.99	12 <u>Mg</u> 24.31											13 <u>Al</u> 26.98	14 <u>Si</u> 28.09	15 <u>P</u> 30.97	16 <u>S</u> 32.07	17 <u>Cl</u> 35.45	18 <u>Ar</u> 39.95
19 <u>K</u> 39.10	20 <u>Ca</u> 40.08	21 <u>Sc</u> 44.96	22 <u>Ti</u> 47.88	23 <u>V</u> 50.94	24 <u>Cr</u> 52.00	25 <u>Mn</u> 54.94	26 <u>Fe</u> 55.85	27 <u>Co</u> 58.47	28 <u>Ni</u> 58.69	29 <u>Cu</u> 63.55	30 <u>Zn</u> 65.39	31 <u>Ga</u> 69.72	32 <u>Ge</u> 72.59	33 <u>As</u> 74.92	34 <u>Se</u> 78.96	35 <u>Br</u> 79.90	36 <u>Kr</u> 83.80
37 <u>Rb</u> 85.47	38 <u>Sr</u> 87.62	39 <u>Y</u> 88.91	40 <u>Zr</u> 91.22	41 <u>Nb</u> 92.91	42 <u>Mo</u> 95.94	43 <u>Tc</u> (98)	44 <u>Ru</u> 101.1	45 <u>Rh</u> 102.9	46 <u>Pd</u> 106.4	47 <u>Ag</u> 107.9	48 <u>Cd</u> 112.4	49 <u>In</u> 114.8	50 <u>Sn</u> 118.7	51 <u>Sb</u> 121.8	52 <u>Te</u> 127.6	53 <u>I</u> 126.9	54 <u>Xe</u> 131.3
55 <u>Cs</u> 132.9	56 <u>Ba</u> 137.3	57 <u>La*</u> 138.9	72 <u>Hf</u> 178.5	73 <u>Ta</u> 180.9	74 <u>W</u> 183.9	75 <u>Re</u> 186.2	76 <u>Os</u> 190.2	77 <u>Ir</u> 190.2	78 <u>Pt</u> 195.1	79 <u>Au</u> 197.0	80 <u>Hg</u> 200.5	81 <u>Tl</u> 204.4	82 <u>Pb</u> 207.2	83 <u>Bi</u> 209.0	84 <u>Po</u> (210)	85 <u>At</u> (210)	86 <u>Rn</u> (222)

1 H Hydrogen

2 He Helium

3 Li Lithium

4 Be Beryllium

5 B Boron

6 C Carbon

7 N Nitrogen

8 O Oxygen

9 F Fluorine

10 Ne Neon

11 Na Sodium

12 Mg Magnesium

13 Al Aluminum

14 Si Silicon

15 P Phosphorus

16 S Sulfur

17 Cl Chlorine

18 Ar Argon

19 K Potassium

20 Ca Calcium

21 Sc Scandium

22 Ti Titanium

23 V Vanadium

24 Cr Chromium

25 Mn Manganese

26 Fe Iron

27 Co Cobalt

28 Ni Nickel

29 Cu Copper

30 Zn Zinc

31 Ga Gallium

32 Ge Germanium

33 As Arsenic

34 Se Selenium

35 Br Bromine

36 Kr Krypton

37 Rb Rubidium

38 Sr Strontium

39 Y Yttrium

40 Zr Zirconium

41 Nb Niobium

42 Mo Molybdenum

43 Tc Technetium

44 Ru Ruthenium

45 Rh Rhodium

46 Pd Palladium

47 Ag Silver

48 Cd Cadmium

49 In Indium

50 Sn Tin

51 Sb Antimony

52 Te Tellurium

53 I Iodine

54 Xe Xenon ...

77 Ir Iridium

78 Pt Platinum

79 Au Gold

80 Hg Mercury

81 Tl Thallium

82 Pb Lead