

Formulas and Constants (you may remove this page)

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1} \quad h = 6.626 \times 10^{-34} \text{ J s} \quad c = 2.998 \times 10^8 \text{ m s}^{-1}$$

$$e = 1.602 \times 10^{-19} \text{ C} \quad m_e = 9.109 \times 10^{-31} \text{ kg} \quad g = 9.81 \text{ m s}^{-2}$$

$$1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2} \quad 1 \text{ J} = 1 \text{ V C} \quad 1 \text{ \AA} = 1 \times 10^{-10} \text{ m}$$

$$1.00 \text{ atm} = 760 \text{ mm Hg} = 101.325 \text{ kPa} = 1.01325 \text{ bar} \quad q = C \Delta T = m C_s \Delta T$$

$$\Delta E = q_v \quad \Delta H = \Delta E + P\Delta V = q_p \quad \Delta H_{\text{rxn}} = \sum m \Delta H_f(\text{products}) - \sum n \Delta H_f(\text{reactants})$$

$$E_K = \frac{1}{2} m v^2 \quad V = \frac{\kappa Q_1 Q_2}{d} \quad \kappa = 8.99 \times 10^9 \text{ J m C}^{-2} \quad E = h\nu = \frac{1}{2} m v^2 + E_b$$

$$p = mv \quad \Delta E = \frac{hc}{\lambda} \quad p = \frac{h}{\lambda} \quad \lambda = \frac{h}{mv} \quad \Delta x \Delta p \geq \frac{h}{4\pi} \quad \Delta x \Delta(\text{mv}) \geq \frac{h}{4\pi}$$

$$\frac{1}{\lambda} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \quad R_H = 1.097 \times 10^7 \text{ m}^{-1} \quad E = hcR_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) = 2.178 \times 10^{-18} \text{ J} \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

| | | | | | | | | | | | | | | | | | |
|----|-----|------|-----|----|-----|-------|-----|------|-----|----|-----|------|-----|----|-----|------|-------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| IA | IIA | IIIB | IVB | VB | VIB | VIIIB | --- | VIII | --- | IB | IIB | IIIA | IVA | VA | VIA | VIIA | VIIIA |
| 1A | 2A | 3B | 4B | 5B | 6B | 7B | --- | 8 | --- | 1B | 2B | 3A | 4A | 5A | 6A | 7A | 8A |

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|--------------------------|--------------------------|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 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) |

Metal Activity Series:

| | | | |
|-----------|---|----------|---|
| Lithium | $\text{Li (s)} \rightarrow \text{Li}^+ \text{ (aq)} + \text{e}^-$ | Iron | $\text{Fe (s)} \rightarrow \text{Fe}^{3+} \text{ (aq)} + 3\text{e}^-$ |
| Potassium | $\text{K (s)} \rightarrow \text{K}^+ \text{ (aq)} + \text{e}^-$ | Tin | $\text{Sn (s)} \rightarrow \text{Sn}^{2+} \text{ (aq)} + 2\text{e}^-$ |
| Calcium | $\text{Ca (s)} \rightarrow \text{Ca}^{2+} \text{ (aq)} + 2\text{e}^-$ | Lead | $\text{Pb (s)} \rightarrow \text{Pb}^+ \text{ (aq)} + \text{e}^-$ |
| Sodium | $\text{Na (s)} \rightarrow \text{Na}^+ \text{ (aq)} + \text{e}^-$ | Hydrogen | $\text{H}_2 \text{ (s)} \rightarrow 2\text{H}^+ \text{ (aq)} + 2\text{e}^-$ |
| Magnesium | $\text{Mg (s)} \rightarrow \text{Mg}^{2+} \text{ (aq)} + 2\text{e}^-$ | Copper | $\text{Cu (s)} \rightarrow \text{Cu}^{2+} \text{ (aq)} + 2\text{e}^-$ |
| Aluminum | $\text{Al (s)} \rightarrow \text{Al}^{3+} \text{ (aq)} + 3\text{e}^-$ | Silver | $\text{Ag (s)} \rightarrow \text{Ag}^+ \text{ (aq)} + \text{e}^-$ |
| Zinc | $\text{Zn (s)} \rightarrow \text{Zn}^{2+} \text{ (aq)} + 2\text{e}^-$ | Platinum | $\text{Pt (s)} \rightarrow \text{Pt}^{2+} \text{ (aq)} + 2\text{e}^-$ |