

General Conversions, Formulas, and Constants

$$K = ^\circ\text{C} + 273 \quad M = \frac{\text{mol solute}}{\text{L soln}} \quad PV = nRT \quad R = 8.314 \text{ J/mol}\cdot\text{K} \quad F = 96,500 \text{ J/V}\cdot\text{mol}$$

A quadratic equation of the form $ax^2 + bx + c = 0$, has the solutions: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Thermodynamics Equations

$$\Delta G_{\text{rxn}}^\circ = \Sigma n \Delta G_f^\circ (\text{products}) - \Sigma n \Delta G_f^\circ (\text{reactants})$$

$$\Delta H_{\text{rxn}}^\circ = \Sigma n \Delta H_f^\circ (\text{products}) - \Sigma n \Delta H_f^\circ (\text{reactants})$$

$$\Delta S_{\text{rxn}}^\circ = \Sigma n S^\circ (\text{products}) - \Sigma n S^\circ (\text{reactants})$$

$$\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ$$

$$\Delta S_{\text{univ}} = \Delta S_{\text{sys}} + \Delta S_{\text{surr}}$$

$$\Delta S_{\text{surr}} = \frac{-\Delta H_{\text{sys}}}{T}$$

Kinetics Equations

$$\text{Rate} = \frac{\Delta[\text{conc}]}{\Delta t}$$

$$\text{Rate} = k[\text{A}]^x[\text{B}]^y$$

First-Order

$$\ln[\text{A}]_t = -kt + \ln[\text{A}]_0$$

$$t_{\frac{1}{2}} = \frac{0.693}{k}$$

$$\ln\left(\frac{[\text{A}]_t}{[\text{A}]_0}\right) = -kt$$

Second-Order

$$\frac{1}{[\text{A}]_t} = kt + \frac{1}{[\text{A}]_0}$$

$$t_{\frac{1}{2}} = \frac{1}{k[\text{A}]_0}$$

Zeroth-Order

$$[\text{A}]_t = -kt + [\text{A}]_0$$

$$t_{\frac{1}{2}} = \frac{[\text{A}]_0}{2k}$$

Arrhenius Equation

$$k = A e^{\frac{-E_a}{RT}}$$

$$\ln k = \left(\frac{-E_a}{R}\right)\left(\frac{1}{T}\right) + \ln A$$

$$\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Equilibrium/Reaction Constants

$$K_c = \frac{[\text{products}]^x}{[\text{reactants}]^y}$$

$$Q_c = \frac{[\text{products}]_0^x}{[\text{reactants}]_0^y}$$

$$K_p = K_c(0.0821 T)^{\Delta n}$$

$$K_c = \frac{k_f}{k_r}$$

$$K_c = K_{c1}K_{c2}\dots \text{ (for multistep reactions)}$$

$$K_c = e^{\frac{-\Delta G^\circ}{RT}}$$

Acid/Base Equations

$$\text{pH} = -\log[\text{H}^+]$$

$$[\text{H}^+] = 10^{-\text{pH}}$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$[\text{OH}^-] = 10^{-\text{pOH}}$$

$$\text{pH} + \text{pOH} = 14, \text{ at } 25^\circ\text{C}$$

$$K_w = K_a K_b$$

$$K_w = [\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

$$\text{Percent Ionization} = \frac{[\text{H}^+]}{[\text{HA}]_0} \times 100$$

$$\text{pH} = \text{p}K_a + \log \frac{[\text{base}]}{[\text{acid}]}$$

Electrochemistry

$$\Delta G^\circ = -nF E_{\text{cell}}^\circ$$

$$E_{\text{cell}}^\circ = E_{\text{cathode}}^\circ - E_{\text{anode}}^\circ$$

$$E_{\text{cell}}^\circ = \frac{RT}{nF} \ln K$$

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{RT}{nF} \ln Q$$

$$E_{\text{cell}}^\circ = \frac{0.0257 \text{ V}}{n} \ln K \text{ at } 25^\circ\text{C}$$

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{0.0257 \text{ V}}{n} \ln Q \text{ at } 25^\circ\text{C}$$