General Chemistry II Equation Sheet

Think about how to set up the problem first, then apply the needed principles and formulas.

Phase Changes

$\Delta T_b = iK_b m$

$\Delta T_f = iK_f m$

$\pi = iMRT$

$c = kP$

$\frac{c_1}{p_1} = \frac{c_2}{p_2}$

$P_{solution} = \chi_{solvent} P^\circ_{solvent}$

$\Delta P = P^\circ_{solvent} - P_{solution} = \chi_{solute} P^\circ_{solvent}$

Cells

$E = E^\circ - \frac{RT}{nF}\ln(Q)$

$E = E^\circ - \frac{0.0592}{n}\log(Q)$ (at 25°C)

$\Delta G = -nFE_{cell}$

$\Delta G^\circ = -nFE^\circ_{cell}$

$E^\circ_{cell} = \frac{RT}{nF}\ln(K)$

$E^\circ_{cell} = \frac{0.0592V}{n}\log(K)$ (at 25°C)

USE ONE:

$E^\circ_{cell} = E^\circ_{cathode(red.)} - E^\circ_{anode(red.)}$

$E^\circ_{cell} = E^\circ_{cathode(red.)} + E^\circ_{anode(ox.)}$

Thermodynamics

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

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

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

$\Delta S^\circ_{rxn} = \Sigma S^\circ_{products} + \Sigma S^\circ_{reactants}$

$\Delta G^\circ_{rxn} = \Sigma \Delta G^\circ_{products} + \Sigma \Delta G^\circ_{reactants}$

Concentrations

molality $= \frac{moles_{solute}}{mass_{solvent(kg)}}$

% by mass $= \frac{moles_{solute}}{mass_{solute}+mass_{solvent}} \times 100\%$

parts per million $= \frac{moles_{solute}}{mass_{solute}+mass_{solvent}} \times 10^6$

parts per billion $= \frac{moles_{solute}}{mass_{solute}+mass_{solvent}} \times 10^9$

Acids and Bases

$K_w = [H_3O^+][OH^-] = K_a \times K_b$

$pOH = -\log[OH^-]$

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

$pH + pOH = pK_a + pK_b = 14.00$ (at 25°C)

$pH = pK_a + \log\frac{[A^-]}{[HA]}$

$pOH = pK_b + \log\frac{[BH^+]}{[B]}$

% ionization $\frac{[H_3O^+]_{eq}}{[HA]_0} \times 100\%$

$pK_a = -\log(K_a)$

$pK_b = -\log(K_b)$

$K_a = 10^{-pK_a}$

$K_b = 10^{-pK_b}$

Equilibria

$Q_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$

$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$

$Q_p = \frac{P_D^d \cdot P_C^c}{P_A^a \cdot P_B^b}$

$K_p = \frac{P_D^d \cdot P_C^c}{P_A^a \cdot P_B^b}$

$K_p = K_c[R \times T]^{\Delta n}$

$\Delta G = \Delta G^\circ + RT\ln(Q)$

$\Delta G^\circ = -RT\ln(K)$

rate $= k[A]^x[B]^y$

$k = Ae^{-\frac{E_a}{RT}}$

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

half life $= \frac{\ln(2)}{k}$ (1st order reactions only)

$[A]_t = -kt + [A]_o$

$\ln([A]_t) = -kt + \ln([A]_o)$

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

Burdge, J., & Overby, J. (2018). *Chemistry: Atoms First.* McGraw-Hill Education.