CHM2046 Formulas

Constants

Planck's Constant: $h = 6.626\,069 \times 10^{-34}\ \mathrm{m^2 \cdot kg/s}$
Coulomb's Constant: $k_e = 8.987\,551 \times 10^{9}\ \mathrm{N \cdot m^2/s^2}$
Gas Constant $\begin{cases} R = 0.082\,057\ \mathrm{L \cdot atm \cdot mol^{-1} \cdot K^{-1}} \\ R = 8.314\,462\ \mathrm{J \cdot K^{-1} \cdot mol^{-1}} \end{cases}$
Faraday's Constant: $\mathscr{F} = 96\,485\ \mathrm{C \cdot mol^{-1}}$
$K_w = 1.00 \times 10^{-14}$ at 25°C
$\mathrm{pH} + \mathrm{pOH} = 14.00$ at 25°C
$RT/\mathscr{F} = 0.025\,693$ at 25°C

General

Coulomb's Law:

$$F_e = k_e \frac{Q_1 Q_2}{r^2}$$

Kinetic Energy:

$$E_k = \frac{1}{2} m v^2$$

Quadratic Formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Arrhenius Equation:

$$k = A e^{-E_a/RT}$$

Conversions:

$$1\ \mathrm{V} = 1\ \mathrm{J/C} \quad \& \quad 1\ \mathrm{A} = 1\ \mathrm{C/s}$$

Thermodynamics

Heat Transfer:

$$q = mc\Delta T$$

Enthalpy of Reaction:

$$\Delta H^\circ_{rxn} = \sum n \Delta H^\circ_f(\text{products}) - \sum n \Delta H^\circ_f(\text{reactants})$$

Gibbs Free Energy:

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

$$\Delta G^\circ_{rxn} = \sum \Delta G^\circ_f(\text{products}) - \sum \Delta G^\circ_f(\text{reactants})$$

Clausius-Clapeyron Relation:

$$\ln\left(\frac{P_1}{P_2}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Equilibria

Definition of pH, pOH, & pKa:

$$\mathrm{pH} = -\log[\mathrm{H_3O^+}]$$

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

$$\mathrm{pK_a} = -\log K_a$$

ΔG at equilibrium:

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

Electrochemistry

Cell Voltage:

$$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$$

Nernst Equation:

$$E_{cell} = E^\circ_{cell} - \frac{RT}{n\mathscr{F}} \ln Q$$

$$E_{cell} = E^\circ_{cell} - \frac{0.059\,160}{n} \log Q \quad \text{at } 25^\circ\mathrm{C}$$

Relationship between K, ΔG°, and E°_{cell}

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

$$E^\circ_{cell} = \frac{RT}{n\mathscr{F}} \ln K$$

$$\Delta G^\circ = -n\mathscr{F} E^\circ_{cell}$$