CHM2045 Formulas

Constants

Planck's Constant: $h = 6.626\,069 \times 10^{-34}\ \mathrm{m^2 \cdot kg/s}$
Coulomb's Constant: $k_e = 8.987\,551 \times 10^{9}\ \mathrm{N \cdot m^2/s^2}$
Rydberg Constant: $R_H = 1.097\,373 \times 10^{7} \mathrm{m^{-1}}$
Gas Constant $\begin{cases} R = 0.082\,057\ \mathrm{L \cdot atm \cdot mol^{-1} \cdot K^{-1}} \\ R = 8.314\,462\ \mathrm{J \cdot K^{-1} \cdot mol^{-1}} \end{cases}$

General

Coulomb's Law:

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

Kinetic Energy:

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

Atomic Theory

Energy of a photon:

$$E = h\nu$$

Wave relation:

$$c = \lambda\nu$$

DeBroglie Relationship:

$$\lambda = \frac{h}{mv}$$

Rydberg Equation:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

Bohr Equation:

$$\Delta E = -2.178 \times 10^{-8} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

Thermodynamics

Heat Transfer:

$$q = m\, c\, \Delta T$$

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:

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

Clausius-Clapeyron Relation:

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

Solutions, Liquids, & Gases

Ideal Gas Law:

$$P\,V = n\,R\,T$$

Van der Waals Equation:

$$\left[P + a\left(\frac{n}{V}\right)^2\right](V - nb) = nRT$$

Rauolt's Law:

$$P_{vap} = x_i\,P^{\circ}_{vap}$$

Dalton's Law of Partial Pressures:

$$P_{Tot} = \sum_{i=1}^{n} P_i$$

$$\text{where } P_i = y_i\,P_{Tot}$$

RMS speed of molecules:

$$v_{rms} = \sqrt{\frac{3RT}{\mathscr{M}}}$$

Garham's Law of Effusion:

$$\frac{rate_A}{rate_B} = \sqrt{\frac{\mathscr{M}_B}{\mathscr{M}_A}}$$

Boiling Point Elevation:

$$\Delta T = i\,K_b\,m$$

Freezing Point Depression:

$$\Delta T = i\,K_f\,m$$

Osmotic Pressure:

$$\Pi = MRT$$