

CHM2046 Formulas

Constants

Planck's Constant: $h = 6.626\,069 \times 10^{-34} \text{ m}^2 \cdot \text{kg/s}$

Coulomb's Constant: $k_e = 8.987\,551 \times 10^9 \text{ N} \cdot \text{m}^2/\text{s}^2$

Gas Constant $\begin{cases} R = 0.082\,057 \text{ L} \cdot \text{atm} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \\ R = 8.314\,462 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1} \end{cases}$

Faraday's Constant: $\mathcal{F} = 96\,485 \text{ C} \cdot \text{mol}^{-1}$

$K_w = 1.00 \times 10^{-14}$ at 25°C

$\text{pH} + \text{pOH} = 14.00$ at 25°C

$RT/\mathcal{F} = 0.025\,693$ at 25°C

General

Coulomb's Law:

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

Kinetic Energy:

$$E_k = \frac{1}{2}mv^2$$

Quadratic Formula:

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

Conversions:

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

Thermodynamics

Heat Transfer:

$$q = mc\Delta T$$

Enthalpy of Reaction:

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

Gibbs Free Energy:

$$\begin{aligned} \Delta G^\circ &= \Delta H^\circ - T\Delta S^\circ \\ \Delta G_{rxn}^\circ &= \sum \Delta G_f^\circ(\text{products}) - \sum \Delta G_f^\circ(\text{reactants}) \end{aligned}$$

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:

$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$

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

$$\text{pK}_a = -\log K_a$$

ΔG at equilibrium:

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

Electrochemistry

Cell Voltage:

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

Nernst Equation:

$$E_{cell} = E_{cell}^{\circ} - \frac{RT}{n\mathcal{F}} \ln Q$$

$$E_{cell} = E_{cell}^{\circ} - \frac{0.059160}{n} \log Q \quad \text{at } 25^{\circ}\text{C}$$

Relationship between K , ΔG , and E_{cell}°

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

$$E_{cell}^{\circ} = \frac{RT}{n\mathcal{F}} \ln K$$

$$\Delta G = -n\mathcal{F} E_{cell}^{\circ}$$