General Chemistry Cheat Sheet

1. Stoichiometry Moles

- **Mole Concept:** 1 mol = 6.022×10^{23} particles(N_A).
- **Molar Mass (M):** Mass per mole (g/mol). $n = \frac{m}{M}$
- **Concentration:** $M = \frac{n}{V} = \frac{\text{moles}}{\text{liters}}$
- **Ideal Gas Law:** $PV = nRT$ ($R = 0.08206$ L $\cdot$ atm/(mol $\cdot$ K))

2. Atomic Structure

- **Subatomic Particles:** Protons (p^+), Neutrons (n^0), Electrons (e^-).
- **Energy of Photon:**

$$E = h\nu = \frac{hc}{\lambda}$$

($h = 6.626 \times 10^{-34}$ J $\cdot$ s)

- **Quantum Numbers:**
  - n: Principal ($1, 2, 3, \dots$)
  - l: Angular momentum (0 to $n-1$)
  - m_l: Magnetic ($-l$ to $+l$)
  - m_s: Spin ($\pm\frac{1}{2}$)

3. Thermochemistry

- **Enthalpy Change:** $\Delta H = H_{\text{products}} - H_{\text{reactants}}$
- **Heat Transfer:** $q = mc\Delta T$
- **Hess's Law:** $\Delta H_{\text{rxn}} = \sum \Delta H_f^\circ(\text{prod}) - \sum \Delta H_f^\circ(\text{react})$
- **Gibbs Free Energy:** $\Delta G = \Delta H - T\Delta S$
- **Spontaneity:** $\Delta G < 0$ (Spontaneous), $\Delta G > 0$ (Non-spontaneous).

4. Chemical Equilibrium

- **Equilibrium Constant (K_c):** For $aA + bB \rightleftharpoons cC + dD$,

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

- **Relationship with K_p:** $K_p = K_c(RT)^{\Delta n}$
- **Reaction Quotient (Q):**
  - $Q < K$: Shift right
  - $Q > K$: Shift left
  - $Q = K$: Equilibrium

5. Acids and Bases

- **pH and pOH:**

$$\text{pH} = -\log[H^+], \quad \text{pOH} = -\log[OH^-]$$

$$\text{pH} + \text{pOH} = 14$$

- **Acid Dissociation (K_a):**

$$K_a = \frac{[H^+][A^-]}{[HA]}, \quad \text{p}K_a = -\log K_a$$

- **Buffer Solutions (Henderson-Hasselbalch):**

$$\text{pH} = \text{p}K_a + \log\left(\frac{[\text{Base}]}{[\text{Acid}]}\right)$$

6. Electrochemistry

- **Cell Potential:**

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

- **Gibbs Cell Potential:**

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

($F = 96485$ C/mol)

- **Nernst Equation:**

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