Ionic Equilibrium

- Electrolytes and Non-electrolytes
  - Electrolytes: strong and weak; dissociation in water
  - Non-electrolytes: no ionization in solution
- Degree of Ionization (α)
  - α = fraction of molecules ionized
  - α increases with dilution
  - For weak electrolytes: α = √(K/C)
- Ostwald's Dilution Law
  - Applies to weak electrolytes
  - α = √(K/C), valid only if α is small
- Ionic Product of Water (K_iw_i)
  - $K_iw_i = [H^+][OH^-] = 1 \times 10^{-14}$ at 25°C
  - K_iw_i increases with temperature
- pH and pOH
  - pH = −log[H^+], pOH = −log[OH^-]
  - pH + pOH = 14 at 25°C
- Weak Acids and Bases
  - Ka and Kb define acid/base strength
  - Ka × Kb = Kw
  - pKa = −log(Ka), pKb = −log(Kb)
- Common Ion Effect
  - Suppresses ionization of weak electrolytes
  - Example: $CH_3COOH + CH_3COO^-$ → reduced ionization
- Buffer Solutions
  - Resist pH change upon dilution or small acid/base addition
  - Acidic buffer: weak acid + salt of acid
  - Basic buffer: weak base + salt of base
  - Henderson–Hasselbalch: Acidic: pH = pKa + log([salt]/[acid]) ; Basic: pOH = pKb + log([salt]/[base])
- Salt Hydrolysis
  - Salt + water → acidic/basic solution
  - Cases:
    - Strong acid + strong base: neutral
    - Strong acid + weak base: acidic
    - Weak acid + strong base: basic
    - Weak acid + weak base: depends on Ka and Kb
- Hydrolysis Constant and pH
  - For salt of weak acid: $K_h = K_iw_i / K_ia_i$ & $[H^+] = \sqrt{(K_iw_iKa)}$
  - For salt of weak base: $K_h = K_iw_i / K_ib_i$ & $[OH^-] = \sqrt{(K_iw_iKb)}$
  - For salt of weak acid and weak base: $K_h = K_iw_i / \sqrt{(KaKb)}$
- Solubility and Solubility Product (K_{sp})
  - $K_{sp} = [cation]^m \times [anion]^n$
  - Saturated: product = K_{sp}
  - Precipitation if ionic product > K_{sp}
- Factors Affecting Solubility
  - Common ion: decreases solubility
  - Complex formation: increases solubility
  - pH: affects salts of weak acids/bases
- Titrations and Indicators
  - Strong acid + strong base: equivalence pH = 7
  - Weak acid + strong base: pH > 7 at equivalence
  - Weak base + strong acid: pH < 7 at equivalence
  - Indicator choice based on expected equivalence pH

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