Cram Review → AP Chemistry

Quick Study Reference

- Coulomb's Law
    - $F \propto \frac{q_1 q_2}{r^2}$ where q is the electrical charge of each particle
    - Larger particle, larger charge
    - More core electrons
        - ↑ Atomic radius
        - ↓ ionization energy
        - ↓ electronegativity
- Electrons
    - Electron Configuration
        - s-block: Groups 1 & 2
        - d-block: Groups 3→13
        - p-block: Groups 13→18
    - Energy
        - Add electron to an atom, energy is released
        - Take away an electron, energy is added
- Periodic Trends
    - Greater effective charge, more ionization energy
    - Left to right
        - Effective charge ↑
        - Ionization energy ↑
        - Electronegativity ↑
        - Atomic radius ↓
    - Top to bottom
        - Atomic radius ↓
        - Ionization energy ↓

- Types of Metals and Nonmetals
  - Metals
    - Conduct electricity, solid at room temperature
    - Lattice
      - 3D repeating pattern of ions
      - Lattice energy → energy needed to pull apart ions
    - Alloys
      - Mixture of metals
      - Communal pool of electrons
    - Interstitial alloys
      - Large size difference
      - Ex) Steel (Iron & Carbon)
    - Substitutional alloys
      - Same size
      - Ex) Zinc and Copper
    - Special case
      - Stainless steel is BOTH an interstitial and substitutional alloy
  - Nonmetals
    - Don't conduct electricity, gas at room temperature
- VSPER and Hybridization
  - Formal charge
    - $Formal\ Charge = (\#\ of\ e_{valence\ in\ neutral\ atom}) - (\#\ of\ e_{valence\ allocared\ to\ bonded\ atom})$
    - $\#\ of\ e_{valence\ allocared\ to\ bonded\ atom} = (\#\ of\ e_{lone\ pair}) + \frac{1}{2}(\#\ of\ e_{shared})$
  - Bonds
    - Sigma (σ) bonds
      - One per bond including counting each in a double or triple bond
    - Pi (π) bonds
      - One per double bond and two per triple bond
  - Steric number
    - Number of orbitals needed
    - $(\#\ of\ \sigma\ bonds) + (\#\ of\ lone\ pairs)$

- Intermolecular Forces
  - The greater the IMF...
    - Greater surface tension
    - Greater viscosity
  - London Dispersion Forces (LDF)
    - Dipole-Dipole Moment
      - Breif movement with δ^+ and δ^- if more electrojs are at one side in a given moment
      - Greater polarizability with a larger electron cloud
      - Dipole-Dipole can lead to an induced dipole moment
    - Ion-dipole force
      - Occur between polar-covalent molecules and an ion
      - The stronger the ion charge, the stronger the ion-dipole force
      - Greater dipole moment, stronger force
  - Hydrogen bond
    - Must have a lone pair and hyrdogen
    - Use NOF to remember determine if it is a hydrogen bond
      - Nitrogen, Oxygen, and Florine
- Le Chatelier's Principle
  - Soluble salts: $K_{sp} > 1$
  - Check if a precipitate can form...
    - Q_{sp} from initial concentration
    - $Q_{sp} < K_{sp} \rightarrow$ <u>no</u> precipitate
    - $Q_{sp} > K_{sp} \rightarrow$ precipitate
  - Common Ion Effect
    - In presence of common ion, solubility decreases

- Equilibrium
  - Reaction quotient
    - Which direction equilibrium points to
    - Ratio of products to reactants
    - Given: $aA + bB \rightarrow cC + dD$
      - $Q_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$
    - In the gas phase…
      - $Q_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$
    - REMEMBER $Q_c \neq Q_p$
  - Equalibrium constant
    - Tells us if more products or reactents are at equilibrium
    - $K_p = K_c(RT)^{\Delta n}$
  - $Q > K$
    - Products decreases
    - Reverse reaction favored
  - $Q < K$
    - Products increase
    - Forward reaction favored

- Acids & Bases
  - Strong acids
    - $HCl, HBr, HI, HNO_3, H_2SO_4, HClO_4$
    - Reaction lies to the right, produces useless conjugate base
    - High polarity and low bond strength
  - Strong bases
    - Group 1 and 2 hydroxides
    - Reaction lies to the right, produces useless conjugate acid
  - Percent ionization
    - Indicates what % of an ion reacted with H_2O
    - As % ionization increases, molarity decrease
  - Buffers
    - Buffer solution
      - Weak acid + conjugate base
      - Weak base + conjugate acid
    - Ways to make a buffer
      - Partial neutralization of a weak acid with a strong base
      - Partial neutralization of a weak base with a strong acid
      - Weak acid + salt of conjugate base
      - Weak base + salt of conjugate acid
    - Larger inital concentration, bigger buffer
    - If buffer capacity is exceeded, there will be a rapid change in pH
  - Titration curve
    - Half equivalence
      - All of acid is equal to conjugate base
    - Equivlence point
      - $n_{base} = n_{acid}$
      - Moles of base equal moles of acid
      - All acid is converted to conjugate base

- Batteries
  - Galvanic (voltaic) cell
    - Thermodynamically favorable reaction
    - Positive voltage
    - Anode
      - Oxidation
      - Anions to anode
    - Cathode
      - Reduction
      - Cations to cathode
    - Salt bridge → allows flow of ions
  - Electrolytic cell
    - Thermodynamically unfavorable reaction
    - Negative voltage
    - Needs a power source
    - Electrolysis→ plating metals
  - Calculating electric potential difference in any electrochemical cell
    - More voltage, more favorable
    - $E^°_{cell} = E^°_{cathode} - E^°_{anode}$
      - DO NOT NEGATE THE $E^°_{anode}$