A.P. Chemistry Final Exam Review Topics

1. Matter and Measurement (ch 1)
   1. Matter
      1. Pure Substances (constant composition)
         1. Elements
         2. Compounds
      2. Mixtures (variable composition)
         1. Homogeneous Mixtures (solutions)
         2. Heterogeneous Mixtures
      3. Properties
         1. Physical Properties
         2. Chemical Properties
      4. Law of Constant Composition
   2. Scientific Method
   3. Measurement
      1. SI Units
      2. Significant Figures
      3. Density
      4. Temperature Scale (°F, °C, K)
      5. Dimensional Analysis
2. Matter Structure of the Atom (ch 2)
   1. Development of the atomic theory
      1. Discovery of
         1. Atoms
         2. Subatomic particles – protons, neutrons, & electrons
         3. JJ Thomson’s cathode ray experiment
         4. Ernest Rutherford’s gold foil experiment
         5. Millikan’s oil drop experiment
      2. Atomic Structure
         1. # protons, neutrons, & electrons in an atom
         2. isotopes
         3. atomic number
         4. atomic weight
         5. mass number
      3. Periodic Table
         1. Groups and periods
            1. Alkli metals
            2. Alkaline earth metals
            3. Noble gases
            4. Halogens
            5. Transition metals
            6. Inner transition metals
         2. Metals, nonmetals, and metalloids
      4. Chemical Formulas
         1. Ionic and covalent formulas and names
         2. Naming simple alkanes
3. The Periodic Table (ch 7)
   1. Valence orbitals in an atom (valence e-)
      1. All atoms in a group have the same # of valence e-
      2. All reactions come from valence electrons
   2. Effective nuclear charge Zeff
      1. Simple way: Zeff = Z – S
         1. Z = # electrons (charge in the nucleus)
         2. S = # core electrons
      2. Slater’s rules: Zeff = Z – S
         1. S = ( e- with same n as electron of interest × 0.35) + (e- with n-1 × 0.85)+ (e- with even smaller n × 1)
   3. Periodic Trends
      1. Atomic radius
      2. Ionization energy
      3. Electron affinity
      4. Electronegativity
4. Electronic Structure of Atoms (Ch 6)
   1. Electromagnetic radiation
      1. Speed of light = wavelength × frequency
      2. Energy = Planck’s constant × frequency
         1. Photons
      3. Ground state vs excited state electrons
      4. Orbitals
      5. Electron configurations
5. Chemical Reactions (ch 3)
   1. Writing equations
   2. Balancing equations
   3. Types of reactions
6. Stoichiometry (ch 3)
   1. Molar Mass
   2. Mass, moles, molecules, and volume calculations
   3. Determining Empirical and Molecular formulas
   4. Solving stoichiometry problems
   5. Limiting reactant problems w/theoretical yield
7. Chemical Bonding (ch 8 & 9)
   1. Ionic Bonding
      1. Lattice energy
      2. Transferring electrons
   2. Covalent Bonding
      1. Lewis Structures
         1. Including resonance
      2. Polar molecules
         1. Dipoles
         2. Formal charge
   3. Molecular Geometry & Bonding Theories
      1. VSEPR models
         1. Bond angles
         2. Bonding pairs
         3. Lone pairs (nonbonding pairs)
      2. Electron – domain geometry
      3. Valence bond theory- overlapping orbitals
         1. Sigma (σ) & pi (π) bonds
         2. Hybrid orbitals
            1. Paramagnetic vs diamagnetic
8. Gases (Ch 10)
   1. Pressure conversions (mmHg, torr, atm, Pa, kPa)
   2. Gas Laws
      1. Boyle’s Law – P1V1 = P2V2
      2. Charles’s Law - V1/T1 = V2/T2
      3. Avogadro’s Law – n1/V1 = n2/V2
      4. Gay-Lussac’s Law – P1/T1 = P2/T2
      5. Ideal Gas Law – PV = nRT
         1. Density – n/v = RT/P
         2. Molar Mass – MM = mRT/PV
      6. Standard Temperature & Pressure (STP)
      7. Dalton’s Law of Partial PRessurs - Ptot = P1 + P2 + P3 + …
      8. Mole Fraction – X1 = n1/ntot
   3. Kinetic Molecular Theory
      1. Molecules are in continuous chaotic motion. The volume of gas molecules is negligible compared to the volume of their container. The gas molecules have no attractive/repulsive forces for one another. Collisions are elastic. The average kinetic energy of the gas molecules is proportional to its absolute temperature.
      2. Root mean square speed (u) u = √3RT/M
   4. Real Gases
      1. Van der Waal’s equation (P + n2a/V2)(v – nb) = nRT
9. Intermolecular Forces (Ch11)
   1. Dipole-dipole forces
   2. London dispersion forces
   3. Hydrogen bonding
   4. Ion-dipole forces
   5. polarizability
10. Solids and Liquids (ch 11)
    1. Phase change diagrams
       1. Melting/freezing
       2. Evaporating/condensing
       3. Heat of fusion
       4. Heat of vaporization
    2. Liquids
       1. Viscosity
       2. Surface tension
       3. Vapor pressure
       4. Volatility
    3. Solids
       1. Crystalline solid, atomic solid, metallic solid, ionic solid, network covalent solid
11. Solutions (ch 13)
    1. Solvation
       1. Solute and solvent
       2. Like dissolves like (miscible vs. immiscible)
       3. Unsaturated, saturated, supersaturated solutions
       4. Henry’s Law: Solubility of a gas – Sgas = kPgas
       5. Measuring concentration (molarity)
          1. M = n/V
12. Kinetics (ch 14)
    1. Reaction rates
       1. Factors that affect reaction rates
          1. Physical state of reactants
          2. Concentration of reactants
          3. Temperature
          4. Presence of a catslyst
       2. Instantaneous rate = -Δ[reactant]/ Δt = + Δ[product]/ Δt
       3. Rate Laws
          1. Order
             1. Zero order
             2. 1st order
             3. 2nd order
          2. Change in concentration with time
             1. 1st order

rate = - Δ[A]/ Δt or rate = k[A

ln[At] = -kt + ln[A0]

graphing lnA vs time gives a straight line with slope = -k and y-intercept = ln[A0]

* + - * 1. 2nd order

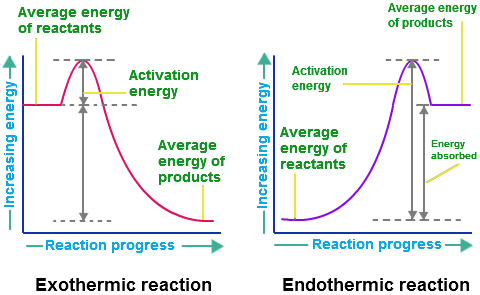
rate – k[A]2

1/[At] = kt + 1/[A0]

graphing 1/[A] vs time gives a straight line with slope = k and y-intercept = 1/[A0]

* + - 1. Half-Life
         1. 1st order – t1/2 = .693/k
         2. 2nd order – t1/2 = 1/k[A0]
      2. Temperature and Rate
         1. Collision theory
         2. Orientation – having the correct orientation
         3. Activation energy (Ea)

Activated complex



fraction of molecules that have enough energy to react – ƒ = e-Ea/RT

Arrhenius equation – k = Ae-Ea/RT

Determining activation energy

ln k = -Ea/RT + lnA

graphing ln K vs 1/T gives a straight line with slope = -Ea/R and y-intercept = ln A

* + 1. Reaction Mechanisms
       1. Elementary Reactions
          1. Molecularity

Unimolecular

Bimolecular

Termolecular – very rare

* + - * 1. Rate laws
      1. Multistep Mechanisms
         1. Rate determining step for multistep reactions

Mechanism with a slow initial step

Mechansim with a fast initial step

* + 1. Catalysts

1. Equilibrium (ch 15)
   1. Dynamic equilibrium
   2. Equilibrium expression
      1. Concentration Kc = [C]c[D]d/[A]a[B]b
      2. Pressure Kp = (Pc)c(PD)d/(PA)a(PB)b
      3. Kp= Kc(RT)Δn
      4. Reaction Quotient – if not at equilibrium (same equation as for equilibrium except it equals Q not K.
         1. Q = K? @ equilibrium
         2. Q < K? reaction moves toward products
         3. Q > K? reaction moves toward reactants
      5. LeChâtlier’s Principle – shifting equilibrium
         1. I.C.E. problems
2. Acid-Base Equilibrium (ch 16)
   1. Arrhenius acids and bases
   2. Brønsted-Lowry acids and bases
      1. Conjugate acids and bases too
   3. Strong vs weak acids and bases
   4. Autoionization of water H2O <-> H+ + OH-
      1. Kw = [H+][OH-] = 1 ×10-14
   5. The pH Scale
      1. 0 --------------------7--------------------14

acidic basic

* + 1. pH = -log[H+]
    2. pOH = -log [OH-]
    3. pH + pOH = 14
    4. [H+] = 10-pH
  1. Weak Acids HA <-> H+ + A-
     1. Ka = [H+][A-]/[HA]
        1. The larger Ka is, the stronger the acid is
        2. Use Ka to calculate pH, just like in equilibrium
     2. Polyprotic acids (lose more than one H+ )
        1. If Ka difference between losing each H+ is grater than 103, then most of the H+ comes from the 1st H+ dissociating and you can ignore the others
  2. Weak Bases B + H2O <-> BH+ + OH-
     1. Kb = [BH+][OH-]/[B]