Chem 30A: Exam 3 Topics to Review (Tro Chpts 11-14)

Chpt 11. Gases

1. Units of pressure: Be able to convert between different units of pressure. Know standard atmospheric pressure = 1 atm = 760 mmHg = 760 torr.
2. Know basic assumptions of the Kinetic Molecular Theory, and that avg kinetic energy $\propto$ T (Kelvin).
3. Understand the simple gas laws through Kinetic Molecular Theory:
    a. The relationship between V and P is inverse ($V \propto 1/P$ when T, n fixed: Boyles Law)
    b. The relationship between V and T is direct ($V \propto T$, when P, n fixed: Charles's Law)
    c. The relationship between V and n is direct ($V \propto n$, when P, T fixed: Avogadro's Law)
4. Use "useful forms" of gas laws to calculate new values of P, V, and/or T, when gas state changes.
    a. $P_1V_1 = P_2V_2$
    b. $V_1/T_1 = V_2/T_2$
    c. $P_1V_1/T_1 = P_2V_2/T_2$ (Combined Gas Law: This law can used in place of a and b above.)
    d. $V_1/n_1 = V_2/n_2$
5. Use the ideal gas equation **PV = nRT** to calculate any one of the gas properties, given values of the other three. (Given on exam: R = 0.0821 L-atm/mol-K)
6. Gas mixtures
    a. Partial pressure: pressure contributed by a gas in a mixture to the total pressure of the mixture
    b. Know that total pressure of a mixture of gases is equal to the sum of the partial pressure of the component gases: $P_{Tot} = P_1 + P_2 + P_3 + \ldots$ (Dalton's Law of Partial Pressures)
    c. Know that partial pressure of gas 1 is equal to its molar fraction times the total pressure: $P_1 = X_1P_{Tot}$ (X_1 = molar fraction of gas 1)
    d. Thus: $P_{Tot} = X_1P_{Tot} + X_2P_{Tot} + X_2P_{Tot} + \ldots$

Memorize

1. 1 atm = 760 mmHg = 760 torr
2. Gas Laws:
    a. Relationship between V and P is inverse ($V \propto 1/P$)
    b. Relationship between V and T is direct ($V \propto T$)
    c. Relationship between V and n is direct ($V \propto n$)
3. "Useful forms" of gas laws:
    a. $P_1V_1 = P_2V_2$
    b. $V_1/T_1 = V_2/T_2$
    c. $P_1V_1/T_1 = P_2V_2/T_2$ (Combined Gas Law: This law can memorized instead of a and b above.)
    d. $V_1/n_1 = V_2/n_2$
4. Ideal Gas Equation: **PV = nRT**
5. $P_{Tot} = P_1 + P_2 + P_2 + \ldots$
6. $P_1 = X_1P_{Tot}$ (X_1 = molar fraction of gas 1)
7. K = °C + 273 (Temperature must be in Kelvin when calculating gas problems!)

Chpt 12. Liquids, Solids, and Intermolecular Forces

1. Intermolecular forces
    a. Understand that physical state of matter (gas, liquid, solid) depends primarily on the magnitude of intermolecular forces (attractive forces between molecules).
    b. Distinguish between <u>inter</u>molecular force and <u>intra</u>molecular force (chemical bond).
    c. Know the three types of intermolecular forces: dipole-dipole, hydrogen bonding, and London dispersion. Know their relative strengths, and that all three are weaker than chemical bonds.
    d. State the types of intermolecular forces available to a given substance.

i. Must be able to determine whether a molecule is polar (a dipole) or nonpolar.
ii. If molecule is polar, it has dipole-dipole force.
iii. If the polar molecule also has a hydrogen atom on a highly electronegative atom (N, O, F), it can do hydrogen-bonding.
iv. London dispersion force is available to all molecules and atoms. However, it is the only intermolecular force available to nonpolar molecules. London dispersion force increases with increasing molar mass and surface area of molecule.

e. Predict relative boiling points of substances based on intermolecular forces: Greater the total magnitude of intermolecular forces of a molecule, higher the boiling point of the molecule.

2. Phase changes
   a) Know definitions of melting (fusion), freezing, vaporization, condensation, sublimation, and deposition. Know whether each process is endothermic or exothermic, and its sign of enthalpy change (ΔH).
   b) Heating Curve
      i. Identify melting point, boiling point
      ii. Know what is happening on molecular basis at difference regions of a heating curve: (1) Within a single phase: Temperature is changing with added heat, as heat is increasing average kinetic energy of particles (making particles move faster); (2)phase change: Temperature is not changing with added heat, as the heat is breaking the intermolecular forces.
      iii. Know definitions for these heats:
         - Heat of fusion (ΔH_{fusion}): quantity of heat required to completely melt one mole of a substance once it has reached its melting point
         - Heat of vaporization ($\Delta H_{vaporization}$): quantity of heat required to completely vaporize one mole of a liquid once it has reached its boiling point.
      iv. Calculate heat involved in phase changes between solid and liquid using the equation q = moles x $\Delta H_{fusion.}$
      v. Calculate heat involved in phase changes between liquid and gas using the equation q = moles x $\Delta H_{vaporization.}$
3. Identify the three types of crystalline solids: molecular, ionic, and atomic.

Memorize
q = moles x $\Delta H_{fusion.}$
q = moles x $\Delta H_{vaporization}$

Chpt 13. Solutions

1. Know the difference between saturated, unsaturated, and supersaturated solutions.
2. Predict whether two substances can make a solution (one can dissolve the other) based on the "Like dissolves like" principle: Substances with similar intermolecular forces form solutions with one another. Polar solvents dissolve polar and ionic solutes. Nonpolar solvents dissolve nonpolar solutes.
3. Do calculations using expressions for concentration:
   i. Mass percent = (mass of solute/mass of solution) x 100
   ii. Molarity (M) = mols solute/L solution
   - Calculate molarity, moles of solute, solution volume, or **grams of solute** given relevant information.
   - Know how to make standard solutions of given concentration and volume.
4. Know how to make dilutions using $M_cV_c = M_dV_d$ equation.
5. Know how to calculate ion concentrations from concentration of ionic compound.
6. Osmosis

a) Know definition of osmosis.
b) Know definitions of isotonic, hypertonic, and hypotonic solutions, and their effect on cells, which have semipermeable membranes.

Memorize
1. Mass percent = (mass of solute/mass of solution) x 100
2. Molarity M = mols solute/L solution

Chpt 14. Acids and Bases

1. Recognize acids and bases from chemical formulas.
2. Conjugate acid-base pairs:
   a. Write chemical formula for conjugate base given an acid, and conjugate acid given a base.
   b. Given equation for an acid-base reaction, identify acid, base, conjugate base, conjugate acid.
3. Do solution stoichiometry problems for acid-base reactions (acid-base titration problems).
4. Recognize common strong and weak acids, and strong and weak bases (need to memorize).
5. Calculate pH, pOH, $[H_3O^+]$, and/or $[OH^-]$ using following equations:
   a. $pH = -\log[H^+]$ and $pOH = -\log[OH^-]$
   b. $\text{Inv log}[-pH] = [H^+]$ and $\text{Inv log}[-pOH] = [OH^-]$
   c. $K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14}$ (ion product constant of water)
   d. $14.00 = pH + pOH$
6. Understand the relationship among pH, relative $[H_3O^+]$ and $[OH^-]$ values, and acidity (Know table!)

pH	$[H^+]$ and $[OH^-]$	Acidity
pH 7	$[H^+] = [OH^-]$	Neutral
pH < 7	$[H^+] > [OH^-]$	Acidic
pH > 7	$[H^+] < [OH^-]$	Basic

Memorize
1. List of common acids and bases.

Strong Acids	Strong Bases
HCl	Metal Hydroxides of:
HBr	Group 1A cations [LiOH, NaOH, KOH, etc.]
HI	*and*
HNO_3	Heavier Group 2A cations [$Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$]
H_2SO_4	
$HClO_4$	

Common Weak Acids	Common Weak Base
$HC_2H_3O_2$ or CH_3COOH	NH_3 ammonia
H_2CO_3 carbonic acid	

2. $pH = -\log[H^+]$ and $pOH = -\log[OH^-]$
3. $\text{Inv log}[-pH] = [H^+]$ and $\text{Inv log}[-pOH] = [OH^-]$
4. $K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14}$
5. $14.00 = pH + pOH$