**Review for First Exam:**

**Chapter 13**

Definition of solution; solvent, solute; kinds of solutions
Solubility in mass solute per mass solvent; molar solubility
Soluble and insoluble; miscible and immiscible
Thermodynamics of solution formation
    Entropy (S) and disorder; how entropy favors solution formation
    Enthalpy of solution ($\Delta H_{soln}$); how this depends on interparticle attractive forces
    Origin of the observation "like dissolves like"
Unsaturated solution, saturated solution, supersaturated solution
Effect of temperature on the solubility of a solid in a liquid
Solubility of gases in liquids; Henry's law and its use
Dependence of gas solubility on temperature
Concentration units - molarity, molality, mole fraction, mass percent, ppm by mass and so forth
Calculation of concentration in different units; converting from one unit to another unit
Solutions of volatile liquids; Raoult's law and its use in calculations
Raoult's law and ideal solution behavior; ideal behavior as $X_A \rightarrow 1$
Vapor pressure vs mole fraction plots for ideal and nonideal solutions
    Colligative properties; general characteristics
    Vapor pressure lowering
    Boiling point elevation and freezing point depression; phase diagram
    Osmotic pressure; semipermeable membranes
van't Hoff factor; definition, relationship to ionization or dissociation of a solute
Simple calculations using colligative properties
Molecular mass by colligative properties
Reverse osmosis; osmosis and cell shape
Colloids; definition and simple examples

**Chapter 14**

Review of thermodynamics - work, heat, internal energy, enthalpy
Sign conventions; state functions
First law of thermodynamics
Spontaneous processes; the need for a second law for thermodynamics
Entropy (S), properties and interpretation of entropy
$\Delta S_{syst}$, $\Delta S_{surr,}$ $\Delta S_{univ}$
The second law of thermodynamics and its meaning
Finding $\Delta S_{syst}$, $\Delta S_{surr,}$ $\Delta S_{univ}$ for chemical reactions
Entropy for solids, liquids, and gases
Qualitative prediction of $\Delta S_{syst}$ for chemical reactions
Trends in entropy based on size of molecules, dissolving substances in solvents
The third law of thermodynamics
Free energy (G); definition of free energy
Relationship between $\Delta G$ and spontaneous processes (for T, p constant)
Method for calculating $\Delta G_{rxn}$
Find $T_{eq}$ for processes; finding the range of temperatures for which processes are spontaneous

**Chapter 15**

Definition of equilibrium; equilibrium as a dynamic process
Equilibrium constant; $K_C$ and $K_p$; significance of the equilibrium constant
Properties of equilibrium constant
- Lack of units for $K_C$ and $K_p$
- Relationship between $K_C$ and $K_p$
- Relationship between K and the way a reaction is written
- Things that do not appear in K (solids, pure liquids, solvents)

Finding numerical values for K
Using K to find equilibrium concentrations
- ICE method (initial, change, equilibrum)
- Quadratic equation; quadratic formula
- Conditions where x in ICE method can be assumed small

Trends in K; equilibrium when $K >> 1$ or $K << 1$
Reaction quotient (Q); definition, relationship between Q and K
Use of reaction quotient to predict how systems will approach equilibrium
Le Chatlier's principle and its applications
Definition of the thermodynamic reaction quotient (Q) and equilibrium constant (K)
Free energy change for non-standard conditions
Use of thermodynamic data to find the value for K (equilibrium constant)
Temperature dependence of K