Chapter One.

Scientific notation. Significant figures. Conversion factors. Factor-label system. Density.

Chapter Five. Classification and Balancing of Chemical Reactions.

Double displacement reactions – What are the factors that favor the reaction to take place? Precipitation, gas formation, formation of water or other weakly ionized product.

Net ionic equation. Balancing mass and charge.

Redox reactions. Single replacement reaction. Oxidation numbers. The more reactive metal replaces the less reactive. The more reactive metals lie to the left and down in the Periodic Table.

Solubility rules. (Good to know even though they will be given on the test).

What is a strong acid? Strong base? Neutralization: Acid + Base → Salt + water.

Typical questions: how would you make silver chloride using a double displacement reaction. Balance an equation like (copper +1) + (manganese +4) goes to (copper +2) + (manganese +2).

Chapter Six. Mole and Mass Relationships.

The mole. Avogadro's number = number of atoms/ions/molecules/units per mole = 6.02×10^{23}.

Know how to convert mass to moles; know how to convert moles to mass. Recall units: MWt is g/mol.

Stoichiometry: See Figure 6.2. Mass to moles; moles to moles; moles to mass. The importance of the mole ratio which comes from the balanced chemical equation.

Expect a limiting reagent question. Percent yield.

Conservation of mass. (Moles are not conserved).

Experiment 11 – Empirical formula of an Oxide of Magnesium.

Chapter Seven. Energy, Rates and Equilibrium

Bond dissociation energy. Calculating heat of reaction, given bond dissociation energies. Endothermic and exothermic reactions. Combustion.

Factors that increase the rate of a reaction: increasing the concentration of reactants, increasing the temperature, catalysis.

Kinetics is a study of the rate of reaction and how A gets to B. Thermodynamics is only concerned with the properties of the initial state A and the final state B. Many reactions are energetically favorable or spontaneous (in a thermodynamic sense) but do not take place because the energy barrier separating A and B is too high.

Free energy, enthalpy and entropy. The free energy is a combination of enthalpy (heat) and entropy. The sign of the free energy of a chemical system determines whether a reaction is spontaneous (negative free energy) or non-spontaneous (positive free energy). A reaction may be favored by a large negative enthalpy or by a large positive entropy. Most spontaneous reactions are enthalpy-driven. Some are entropy driven (example: frying of an egg).

Equilibrium. At equilibrium, the rate of the forward reaction = rate of reverse reaction. Know how to write the equilibrium constant expression, given the balanced chemical equation. Equilibrium is a dynamic process in which the rate of the forward reaction equals the rate of the reverse reaction. All systems in the universe are tending toward a state of equilibrium – this is the second Law of Thermodynamics, measured by S or entropy. It is possible to create order but it takes energy to do so. In the long run, entropy (disorder) always wins out.

Simple summary of the three laws of thermodynamics:
    First law: the best one can do in the energy game is to break even.
    Second law: you can break even but only at a temperature of absolute zero.
    Third law: it is impossible to achieve a temperature of absolute zero.

Terms to know: activation energy, catalysis, reaction coordinate diagram, LeChatelier's principle, spontaneous reaction, reversibility. Study the reaction coordinate diagram shown on pg 193 (Figure 7.4). Note that the y-axis may be either free energy or enthalpy.

LeChatelier's principle. If the equilibrium condition is disturbed, the system adjusts in a way that will restore equilibrium. Example: A simple reaction, $A + B = C$, is at equilibrium so that K (the equilibrium constant) is given by $K = [A][B]/[C]$. If more A is added, some B will react with A to give more C in order to reestablish the equilibrium condition. If more C is added, some of it will back-react to give more A and B for the same reason, to reestablish equilibrium.

More terms: exergonic (negative free energy change); endergonic (positive free energy change). The instructor does not use these terms.

Function	Usual units	If negative?	If positive?
ΔG (free energy)	Kcal/mol	Spontaneous rx	Nonspontaneous rx
ΔH (enthalpy or heat)	Kcal/mol	Exothermic rx	Endothermic rx
ΔS (entropy)	Cal/mol-K	More order, fewer particles	Less order, more particles

Example of a spontaneous and exothermic reaction that chemists have not been able to replicate in the laboratory: photosynthesis.

Breakdown of questions": Chap 1, 15%; Chap 5, 45%, Chap 6, 25%, Chap 7, 15%.