CHM 110: Chapter 5 Study Guide / Learning Objectives

Chapter 5 in the textbook concerns gases, and contains both empirical (from experiment) relations between the properties of gases and a theoretical explanation of gas properties called the kinetic theory. In addition, we discussed stoichiometric problems dealing with the volume of gaseous substances (rather than the mass).

At the end of this chapter, you should be able to:

[Terminology]
- Describe the three important gas properties: pressure, volume, and temperature, and give appropriate units for each.
- Define the gas laws: Boyle's law, Charles's law, the combined gas law, Avogadro's law, and the ideal gas equation.
- Define standard temperature and pressure (STP).

[Gas basics - The empirical gas laws]
- Explain how a simple barometer works.
- Describe the physical characteristics of gases.
- Convert among the different units of pressure, volume, and temperature given the conversion factors *(hint: this is really a chapter 1 skill)*
- Apply Boyle's law to relate the pressure or volume of a gas at one set of conditions to the pressure or volume at another set of conditions (Example: Given a gas at 1.0 atm pressure with a volume of 15 L, calculate the pressure of the gas if the volume is increased to 150L, assuming temperature is constant).
- Apply Charles's law to relate the temperature or volume of a gas at one set of conditions to the temperature or volume at another set of conditions (Example: Given a gas at 298K with volume of 15 L, calculate the volume of the gas at 398K, assuming pressure is constant).
- Apply the combined gas law to relate pressure, volume, and temperature of a gas at one set of conditions to another set of conditions. (Example: Given a gas at 298K, 1.00 atm with a volume of 15L, calculate the pressure of the gas if the temperature is increased to 398K while volume is decreased to 10L.)
- Show how the combined gas law reduces to either Boyle's law or Charles's law at constant temperature or pressure.
- Select which gas law to use from the data given in a problem.

[The ideal gas law]
- State the volume of a mole of gas at STP.
- Solve the ideal gas equation for P, V, n, or T.
- Use the ideal gas equation to calculate any one of the variables P, V, n, or T given the others. (Example - Calculate the number of moles of N_2 gas in a 255 L sample at 150 °C and 365 mm Hg pressure) *(remember to convert to units that match your value of R!)*

[Kinetic theory and real gases]

- Describe the five postulates of kinetic theory.
- Draw a simple diagram illustrating the postulates of kinetic theory (or tell what part of kinetic theory is being described by a diagram)
- Show how the relations between gas properties described by the gas laws agree with those predicted by kinetic theory.
- Predict what will happen (qualitatively) to one gas property when the others are changed.
- List conditions where kinetic theory and the gas laws break down and conditions where they apply.

[Stoichiometry and gases]

- Determine the volume of a gaseous reagent consumed or product produced in a chemical reaction. *(hint: use the ideal gas law for the gas volume and treat the rest as a chapter 3 stoichiometry problem!)*

[Old skills to review]

- Solve the stoichiometry problems from chapter 3 in your book and notes.
- Calculate formula weights quickly and accurately. *(hint: you don't actually need to calculate the formula weight of a gaseous reactant or product unless you need information about its mass.)*

[Suggested review problems from the text]

- 5.39, 5.45, 5.47, 5.51, 5.53, 5.59, 5.61, 5.65, 5.67, 5.73, 5.75, 5.77, 5.79, 5.121