Lesson 16: Kinetic Theory, Dalton's and Graham's Laws

text: 200-210

what to know:

-concept of partial pressure and its applications (Dalton's law), §5-6
-mole fraction concept, §5-6
-kinetic theory, its underlying assumptions and how it explains the properties of gases, §5-7
-relationship of mass to the rate of diffusion and effusion (Graham's law), §5-7
-the relationship of real and ideal gases, §5-8
-Van der Waals equation of state and when you'd use it

questions:

1. A 20.0 L container is filled with a H_2-He mixture. The total pressure of the gases is 1.60 atm. The container has 0.30 moles of H_2 and the partial pressure of the H_2 is 0.40 atm.
   a. What is then partial pressure of the He?
   b. What is the mole fraction of the H_2?
   c. How many moles of He atoms are in the container?
2. The vapor pressure of water in a sample of air at temperature T is 29 mm Hg. The total pressure of the gas is 0.93 atm. What is the mole fraction of the water vapor in the air sample?
3. Cylinder A contains He(4) gas and cylinder B contains N_2(28) gas. Both gases are at the same temperature and have a pressure of 10.0 atm. Both cylinders have identical valves for gas effusion.
   a. What is the ratio of the average translational rate of the He atom to the that of the N_2 molecule?
   b. If both valves are opened at the same time and it takes exactly 8.0 minutes for the pressure of the He to go from 10.0 atm to 1.0 atm, how many minutes would it take for the pressure of the N_2 to go from 10.0 atm to 1.0 atm?
   c. What effect would an increase in the T have on the effusion times?
4. Using the kinetic molecular theory, explain the relationship of P and V under conditions of constant T and n.
5. A He-filled balloon deflates faster when opened than an identical air-filled balloon of comparable initial size and T. Explain.
6. When the temperature of a gas is increased at constant volume, the molecules hit the wall (more often, less often, at the same rate) (with more force, with less force, with the same force).
7. When the volume of a gas is increased at constant T, the gas molecules hit the wall (more often, less often, at the same rate) (with more force, with less force, with the same force).
8. Which of the following statements are true?
   a. One third(1/3) of the molecules of a mixture of N_2 and O_2 molecules are nitrogen, the molar masses are 28 and 32 g/mole respectively and the total pressure of the mixture is 2.10 atm. The partial pressure of nitrogen in this mixture is 2.10 x 28/32 x 1/3.
   b. On the average, a H_2(2) molecule hits the wall of a container with 2 of the force of a He(4) atom at the same temperature.
   b. According to the kinetic theory of gases, a H_2(2) molecule in a container at 0 ^oC, will hit the wall of the container with less force on the average than a H_2 molecule at 100 ^oC.
   d. The Kinetic Theory of gases explains Boyle's Law (PV = k at constant T), in that as the volume increases the gas particles hit the wall less often thus exerting less pressure on the wall.
   e. Real gases deviate more from Boyles Law (PV = k at constant T) at low pressures than at high pressures.