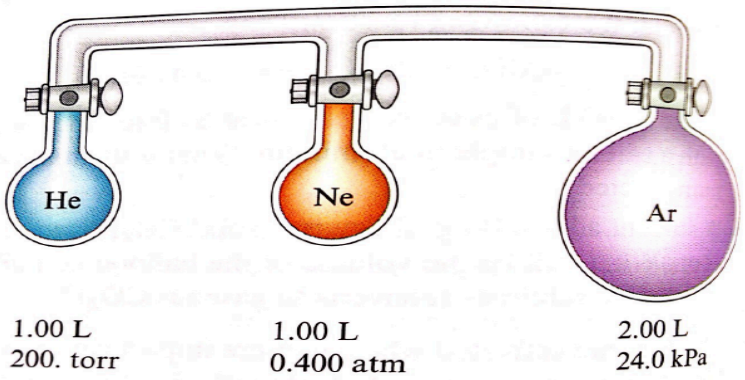
Review Set - Gas Stoichiometry

1. Answer the following on a molecular level based on the kinetic molecular theory:
    a. What is pressure? How can it be increased or decreased? Draw a molecular level picture showing movement of molecules and explain how the pressure is changed.
    b. What is temperature? How does it relate to kinetic energy? How does it relate to molecular speed? Draw a molecular level picture showing movement of molecules of xenon at 250 K, neon at 250 K, xenon at 500 K, and neon at 500 K.

2. What is assumed about ideal gases?
    a. Under what conditions is a real gas under most ideal conditions? Why?
    b. Which of the following gases is most ideal at 330 K: C_2H_6, SF_4, Ar, or OCl_2? Why?
    c. What is the assumed volume of gas particles in a container? How does the van der Waal's equation account for real gases' volume?
    d. What else does van der Waal's equation account for? Explain how it accounts for this where the ideal gas law does not.

3. Answer the following questions regarding gas laws:
    a. What is the volume of a gas at standard temperature and 1.43 atm, if its volume at 142°C and 476 torr is 38.0 mL?
    b. Body temperature is about 308 K. On a cold day, what volume of air at -12°C must a person with a lung capacity of 2.00 L breathe in to fill the lungs?
    c. A fixed quantity of gas at 21°C exhibits a pressure of 752 torr and occupies a volume of 5.12 L. Calculate the volume the gas will occupy if the pressure is increased to 1.88 atm while the temperature is held constant.
    d. A scuba diver's tank contains 0.29 kg of O_2 compressed into a volume of 2.3 L. Calculate the gas pressure inside the tank at 9°C.
    e. Calculate the number of molecules in a deep breath of air whose volume is 2.25 L at body temperature, 37°C, and a pressure of 735 torr.
    f. A 2.10-L vessel contains 4.65 grams of a gas at 1.00 atm and 27.0°C. Calculate the density of the gas, and then determine the molar mass of the gas.

4. Answer the following questions regarding partial pressure:
    a. A deep-sea diver uses a gas cylinder with a volume of 10.0 L and a content of 51.2 grams of O_2 and 32.6 grams of He. Calculate the total pressure if the temperature of the gas is 19°C.
    b. Consider the three flasks in the diagram below. Assuming the connecting tubes have negligible volume, what is the partial pressure of each gas and the total pressure after all the stopcocks are opened?



    c. A mixture of gases contains 0.75 mol N_2, 0.30 mol O_2, and 0.15 mol CO_2. If the total pressure of the mixture is 2.15 atm, what is the partial pressure of each component?

5. Answer the following gas stoichiometry questions:
    a. Nitrogen dioxide gas is formed from nitrogen monoxide and oxygen gas. If 9.0 L of NO are reacted with excess O_2 at STP, what is the volume in liters of NO_2 produced?
    b. Glucose converts to ethanol and carbon dioxide during fermentation of yeast. If 5.97 g of glucose are reacted and 1.44 L of carbon dioxide are collected at 293 K and 0.984 atm, what is the percent yield of the reaction?
    c. Iodine pentafluoride gas is produced in a 5.00 L flask from the reaction of 10.0 g of iodine solid and 10.0 g of fluorine gas. After the reaction is completed, the temperature in the flask is 125°C. Determine the following:
        i. The limiting and excess reactant.
        ii. The theoretical yield of IF_5.
        iii. The partial pressure of IF_5 in the flask.
        iv. The total masses of reactants and products in the flask upon reaction completion.
6. The molar mass of a volatile substance was determined by the Dumas-bulb method (using a sealed flask in a hot water bath to vaporize a volatile liquid). The unknown vapor had a mass of 0.846 g; the volume of the bulb was 354 cm^3, pressure 752 torr, and temperature 100.°C. Calculate the molar mass of the unknown vapor.

7. A sample of solid impure potassium chlorate ($KClO_3$) was heated in a test tube (see the figure below) and decomposed by the following reaction:

$$2\ KClO_3\ (s) \rightarrow 2\ KCl\ (s) + 3\ O_2\ (g)$$

The oxygen produced was collected by displacement of water at 22°C at a total pressure of 754 torr. The volume of gas collected was 0.650 L (assuming the water levels inside and outside the tube have been equalized) , and the vapor pressure of water at 22°C is 21 torr. Calculate the percent by mass of $KClO_3$ in the test tube if the mixture of potassium chlorate and manganese (IV) oxide had a mass of 4.00 grams.