***Worksheet 20 Solution** Applications of ideal gas law: Partial pressures*

1. Define the term partial pressure. State Dalton's law of partial pressures.
   Partial pressure is the pressure exerted by a single component of a gaseous mixture at the same temperature and volume as the mixture.
   The total pressure of a mixture of gases is equal to the sum of the individual pressures the gases would exert if present in the same container alone.

2. Can the partial pressures of the components of an enclosed mixture of gases be measured with a manometer? If not, how are the partial pressures determined?
   No. Only the total pressure of a gaseous mixture can be measured by a manometer, not the partial pressures of the components. The partial pressure of a gaseous component is directly related to the moles of that gas in the mixture. Thus, the moles of a component are measured stoichiometrically and partial pressure is then calculated from moles.

3. Consider a mixture of two gases, A and B, confined to a close vessel. A quantity of a third gas, C, is added to the same vessel at the same temperature. How does the addition of gas C affect the following: a. the partial pressure of gas b. the total pressure in the container c. the mole fraction of gas B?
   a. ***The partial pressure of gas A is not affected by the addition of gas C. The partial pressure of A depends only on moles of A, volume of container and conditions; none of these factors change when gas C is added.***
   b. ***The total pressure in the vessel increases when gas C is added, because the total number of moles of gas increases.***
   c. ***The mole fraction of gas B decreases when gas C is added. The moles of gas B stay the same, but the total moles increase, so the mole fraction of B (n_B/n_{total}) decreases.***

4. A mixture containing 0.538 mol of He(g), 0.135 mol Ne(g), and 0.103 mol Ar(g) is confined in a 7.00 L vessel at 25°C. Calculate the partial pressure of each of the gases in the mixture. Calculate the total pressure of the mixture.
   P_{He} = 1.88 atm; P_{Ne} = 0.472 atm; P_{Ar} = 0.360 atm; P_{total} = 2.71 atm

5. A mixture of 1.00 g H_2 and 1.00g He is placed in a 1.00 L container at 27°C. Calculate the partial pressure of each gas and the total pressure.
   P_{H2} = 12.2 atm; P_{He} = 6.15 atm; P_{total} = 18.4 atm

6. A mixture containing 4.00 g each of CH_4(g), C_2H_4(g) and C_4H_{10}(g) is contained in a 1.50 L flask at a temperature of 0°C. Calculate the partial pressure of each of the gases in the mixture. Calculate the total pressure of the mixture.
   P_{CH4}= 3.72 atm; P_{C2H4} = 2.13 atm; P_{C4H10} =1.03 atm; P_{total} = 6.88 atm

7. A mixture of gases contains 0.55 mol N_2, 0.20 mol O_2, and 0.10 mol CO_2. If the total pressure of the mixture is 1.32 atm, what is the partial pressure of each component?
   P_{N2} = 0.85 atm; P_{O2} = 0.31 atm; P_{CO2} = 0.16 atm

8. A mixture of gases contains 3.50 g of N_2, 2.15 g of H_2, and 5.27 g of NH_3. If the total pressure of the mixture is 2.50 atm, what is the partial pressure of each component?

P_{N2} = 0.208 atm; P_{H2} = 1.78 atm; P_{NH3} = 0.515 atm

9. A 5.00 L vessel contains a mixture of 6.00 g SO_2(g) and 7.50 g SO_3 (g) at 18°C. If the vessel is heated to 60°C, calculate the change (if any) in the following quantities: a. the partial pressure of SO_2 b. the total pressure of the mixture c. the mole fraction of SO_3

a. change in P_{SO2} = +0.065 atm
b. change in P_{total} = 0.13 atm
c. no change in mole fraction

10. Consider the flasks in the following diagram. What are the final partial pressures of H_2 and N_2 after the stopcock between the two flasks is opened? (Assume the final volume is 3.00 L) What is the total pressure (in torr)?

Total pressure = 368 torr

11. Consider the flask apparatus in Exercise 10, which now contains 2.00 L of H_2 at a pressure of 360. torr and 1.00 L of N_2 at an unknown pressure. If the total pressure in the flasks is 320. torr after the stopcock is opened, determine the initial pressure of N_2 in the 1.00 L flask.

Final Partial pressure of hydrogen = 240 torr
Final Partial pressure of nitrogen = 80 torr
Initial pressure of nitrogen = 240 torr

12. Helium is collected over water at 25°C and 1.00 atm total pressure. What total volume of gas must be collected to obtain 0.586 g of helium?

3.69 L

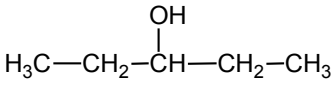
13. The hydrogen gas formed in a chemical reaction is collected over water at 30.0°C at a total pressure of 732 mm Hg. What is the partial pressure of the hydrogen gas collected in this way? If the total volume of gas collected is 722 mL, what mass of hydrogen gas is collected?

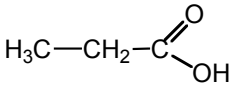
Partial pressure of hydrogen gas = 700. mm Hg
Mass of hydrogen gas collected = 0.0539 g

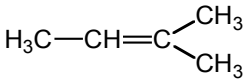
14. The air in a bicycle tire is bubbled through water and collected at 25°C. If the total volume of gas collected is 5.45 L at a temperature of 25°C and a pressure of 745 torr, how many moles of gas were in the bicycle tire?

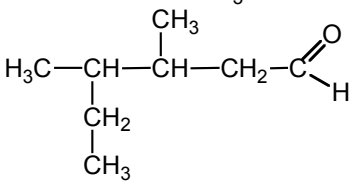
0.211 moles

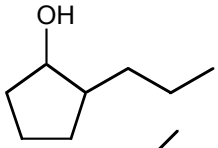
15. Give the names for the following chemical compounds:

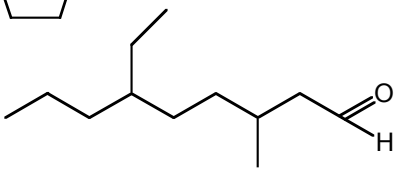
a).  *3-pentanol*

b).  *propanoic acid*

c).  *2-methyl-2-butene*

d).  *3,4 dimethyl hexanal*

e).  *2-propyl cylopentanol*

f).  *6-ethyl-3-methyl nonanal*