Key

Unit 9: Problem Set 4

1. In your own words, state Dalton's Law of Partial pressure.
   The sum of the pressures of each gas give the total pressure.

2. How would the number of particles of two gases compare if their partial pressures in the container were identical? - Same number of particles

$P_{O_2} + P_{Ar} + P_{N_2} = 98.5\,kPa$

3. A gaseous mixture consisting of nitrogen, argon and, oxygen in a 3.5-L vessel at 25 °C. Determine the number of moles of oxygen if the total pressure is 98.5 kPa and the partial pressures of nitrogen and argon are 22.0 kPa and 50.0 kPa, respectively.

① $P_T = P_1 + P_2 + etc$ $\quad 98.5\,kPa = 22.0\,kPa + 50\,kPa + X$

$P_{O_2} = X = 26.5\,kPa$

② a) $PV = nRT$

b) $P = 26.5\,kPa$ $\quad R = 8.31\ \frac{L\,kPa}{mK}$

$V = 3.5\,L$ $\quad T = 25°C + 273 = 298K$

$n = X$

c) $n = \frac{26.5\,kPa \cdot 3.5\,L}{8.31\ \frac{L\,kPa}{mK} \cdot 298K}$

d) $n = .037\,moles\ O_2$

4. What distinguishes effusion from diffusion? How are these process similar?
   Effusion: gases escape from a hole
   Diffusion: gases spread from areas of high concentration to low
   Both: gases spread out to new volumes + shapes

5. Why does a balloon filled with helium deflate more quickly than a balloon filled with air (75% N_2)?
   Particles with lower masses (He) move more quickly than those with high masses.

6. Calculate the ratio of effusion rates of O_2 (molar mass, 32.0 g/mol) and Cl_2 (molar mass 71.0 g/mol).

$\frac{rate\ A}{rate\ B} = \frac{\sqrt{mass\ B}}{\sqrt{mass\ A}}$ (A = low, B = high)

$\frac{Rate\ O_2}{Rate\ Cl_2} = \frac{\sqrt{71.0\ g/mol}}{\sqrt{32.0\ g/mol}} =$

O_2 is 1.49 times faster than Cl_2.

7. Calculate the ratio of the velocity of helium atoms to Fluorine molecules at the same temperature.
   He 4.00 g/mol $\quad F_2$ 38.0 g/mol

$\frac{rate\ He}{rate\ F_2} = \frac{\sqrt{38.0\ g/mol}}{\sqrt{4.0\ g/mol}} = 3.08 \Rightarrow 3.1$

He is 3.08 / 3.1 times faster than F_2