CHAPTER 10

Name: _____

1. Calcium carbonate, $CaCO_3(s)$, decomposes upon heating to give $CaO(s)$ and $CO_2(g)$. A sample of $CaCO_3$ is decomposed and the carbon dioxide is collected in a 250-ml flask. After the decomposition is complete, the gas has a pressure of 1.3atm at a temperature of 31°C. How many moles of CO_2 gas were generated?

2. The gas pressure in an aerosol can is 1.5atm at 25°C. Assuming that the gas inside obeys the ideal gas equation, what would the pressure be if the can were heated to 450°C?

3. An inflated balloon has a volume of 6.0L at sea level (1.0atm) and is allowed to ascend in altitude until the pressure is 0.45atm. During the ascent the temperature of the gas falls from 22°C to –21°C. Calculate the volume of the balloon at its final altitude.

4. What is the density of carbon tetrachloride vapour at 714 torr and 125°C?

5. A series of measurements are made to determine the molar mass of an unknown gas. First, a large flask is evacuated and found to weight 134.567g. It is then filled with the gas to a pressure of 735torr at 31°C and reweighed. Its mass is now 137.456g. Finally the flask is filled with water at 31°C and found to weigh 1067.9g. (The density of the water at this temperature is 0.997 g/mL) Assume that the idea-gas equation applies, and calculate the molar mass of the unknown gas.

6. The safety air bags in automobiles are inflated by nitrogen gas generated by the rapid decomposition of sodium azide, NaN_3:

   $2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$

   If an air bag has a volume of 36L and is to be filled with nitrogen gas at a pressure of 1.15atm at a temperature of 26.0°C, how many grams of NaN_3 must be decomposed.

7. A gaseous mixture made 6.00g O_2 and 9.00g CH_4 is placed in a 15.0L vessel at 0°C. What is the partial pressure of each has and what is the total pressure in the vessel?

8. A study of the effects of certain gases on plant growth requires a synthetic atmosphere composed of 1.5mol percent CO_2, 18.0mol percent O_2, and 80.5mol percent Ar. (a) Calculate the partial pressure of O_2 in the mixture if the total pressure of the atmosphere is 745torr. (b) If this atmosphere is to be held in a 121L space at 295K, how many moles of O_2 are needed? (mol percent means moles out of 100)

9. A sample of $KClO_3$ is partially decomposed producing O_2 gas that is collected over water. The volume of gas collected is 0.250L at 26°C and 765torr total pressure. (a) How many moles of O_2 are collected? (b) How many grams of $KClO_3$ were decomposed?
$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$

10. An unknown gas composed of homonuclear diatomic molecules effuses at a rate that is only 0.355 times that of O_2 at the same temperature. Calculate the molar mass of the unknown, and identify it.

$$\frac{r_x}{r_{O_2}} = \sqrt{\frac{M_{O_2}}{M_X}}$$

11. If 1.000mol of an ideal gas were confined to 22.41L at 0.0°C, it would exert a pressure of 1.000atm. Use the van der Waals equation and the constants below to estimate the pressure exerted by 1.000mol of $Cl_2(g)$ in 22.41L at 0.0°C

TABLE 10.3 ■ van der Waals Constants for Gas Molecules

Substance	*a* (L^2-atm/mol^2)	*b* (L/mol)
He	0.0341	0.02370
Ne	0.211	0.0171
Ar	1.34	0.0322
Kr	2.32	0.0398
Xe	4.19	0.0510
H_2	0.244	0.0266
N_2	1.39	0.0391
O_2	1.36	0.0318
Cl_2	6.49	0.0562
H_2O	5.46	0.0305
CH_4	2.25	0.0428
CO_2	3.59	0.0427
CCl_4	20.4	0.1383