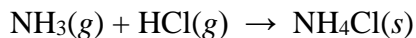


## CHAPTER 10 PROBLEM SET

- Chlorine is widely used to purify municipal water supplies and to treat swimming pool waters. Suppose that the volume of a particular sample of  $\text{Cl}_2$  gas is 8.70 L at 895 torr and  $24^\circ\text{C}$ . **(a)** How many grams of  $\text{Cl}_2$  are in the sample? **(b)** What volume will the  $\text{Cl}_2$  occupy at STP? **(c)** At what temperature will the volume be 15.00 L if the pressure is  $8.76 \times 10^2$  torr? **(d)** At what pressure will the volume equal 5.00 L if the temperature is  $58^\circ\text{C}$ ?
- The metabolic oxidation of glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ , in our bodies produces  $\text{CO}_2$ , which is expelled from our lungs as a gas:  
$$\text{C}_6\text{H}_{12}\text{O}_6(\text{aq}) + 6 \text{O}_2(\text{g}) \rightarrow 6 \text{CO}_2(\text{g}) + 6 \text{H}_2\text{O}(\text{l})$$
**(a)** Calculate the volume of dry  $\text{CO}_2$  produced at body temperature ( $37^\circ\text{C}$ ) and 0.970 atm when 24.5 g of glucose is consumed in this reaction. **(b)** Calculate the volume of oxygen you would need, at 1.00 atm and 298 K, to completely oxidize 50.0 g of glucose.
- A sample of 5.00 mL of diethylether ( $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$ , density = 0.7134 g/mL) is introduced into a 6.00-L vessel that already contains a mixture of  $\text{N}_2$  and  $\text{O}_2$ , whose partial pressures are  $P_{\text{N}_2} = 0.751$  atm and  $P_{\text{O}_2} = 0.208$  atm. The temperature is held at  $35.0^\circ\text{C}$ , and the diethylether totally evaporates. **(a)** Calculate the partial pressure of the diethylether. **(b)** Calculate the total pressure in the container.
- A sample of 3.00 g of  $\text{SO}_2(\text{g})$  originally in a 5.00-L vessel at  $21^\circ\text{C}$  is transferred to a 10.0-L vessel at  $26^\circ\text{C}$ . A sample of 2.35 g of  $\text{N}_2(\text{g})$  originally in a 2.50-L vessel at  $20^\circ\text{C}$  is transferred to this same 10.0-L vessel. **(a)** What is the partial pressure of  $\text{SO}_2(\text{g})$  in the larger container? **(b)** What is the partial pressure of  $\text{N}_2(\text{g})$  in this vessel? **(c)** What is the total pressure in the vessel?
- (a)** Place the following gases in order of increasing average molecular speed at  $25^\circ\text{C}$ : Ne, HBr,  $\text{SO}_2$ ,  $\text{NF}_3$ , CO. **(b)** Calculate the rms speed of  $\text{NF}_3$  molecules at  $25^\circ\text{C}$ . **(c)** Calculate the most probable speed of an ozone molecule in the stratosphere, where the temperature is 270 K.
- Arsenic(III) sulfide sublimes readily, even below its melting point of  $320^\circ\text{C}$ . The molecules of the vapor phase are found to effuse through a tiny hole at 0.28 times the rate of effusion of Ar atoms under the same conditions of temperature and pressure. What is the molecular formula of arsenic(III) sulfide in the gas phase?
- Assume that an exhaled breath of air consists of 74.8%  $\text{N}_2$ , 15.3%  $\text{O}_2$ , 3.7%  $\text{CO}_2$ , and 6.2% water vapor. **(a)** If the total pressure of the gases is 0.985 atm, calculate the partial pressure of each component of the mixture. **(b)** If the volume of the exhaled gas is 455 mL and its temperature is  $37^\circ\text{C}$ , calculate the number of moles of  $\text{CO}_2$  exhaled. **(c)** How many grams of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) would need to be metabolized to produce this quantity of  $\text{CO}_2$ ? (The

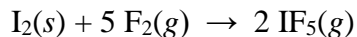
chemical reaction is the same as that for combustion of  $C_6H_{12}O_6$ . See Section 3.2 and Problem 10.57.)

8. Ammonia and hydrogen chloride react to form solid ammonium chloride:



Two 2.00-L flasks at 25 °C are connected by a valve, as shown in the drawing on the next page. One flask contains 5.00 g of  $NH_3(g)$ , and the other contains 5.00 g of  $HCl(g)$ . When the valve is opened, the gases react until one is completely consumed. **(a)** Which gas will remain in the system after the reaction is complete? **(b)** What will be the final pressure of the system after the reaction is complete? (Neglect the volume of the ammonium chloride formed.) **(c)** What mass of ammonium chloride will be formed?

9. Gaseous iodine pentafluoride,  $IF_5$ , can be prepared by the reaction of solid iodine and gaseous fluorine:



A 5.00-L flask containing 10.0 g of  $I_2$  is charged with 10.0 g of  $F_2$ , and the reaction proceeds until one of the reagents is completely consumed. After the reaction is complete, the temperature in the flask is 125 °C. **(a)** What is the partial pressure of  $IF_5$  in the flask? **(b)** What is the mole fraction of  $IF_5$  in the flask **(c)** Draw the Lewis structure of  $IF_5$ . **(d)** What is the total mass of reactants and products in the flask?