********CHAPTER 11 PROBLEMS********

Use molar volume to solve problems 1-4:

1. Find the density of Xe gas at STP.

2. What is the molar mass of a gas if 9.71 g occupies 560.0 ml at 22.0°C and 740.0 mm Hg?

3. Find the volume, in ml, of 42.5 grams of N_2O at STP.

4. Find the molar mass of a gas if 2.80 L has a mass of 8.0 g at STP.

Use the ideal gas law to solve problems 5-8:

5. What temperature would be needed to keep 190.0 g of carbon dioxide in a 575.0 ml container at a pressure of 735.5 mm Hg?

6. Calculate the density of hydrogen gas at 35.00°C and 0.850 atm.

7. Dr. Zygoo performed a reaction in which an unknown gas was produced. The reaction yielded 248.0 ml of gas with a mass of 0.300 g and a pressure of 729.00 mm Hg at a temp of 25.0°C. What is the molar mass of the gas?

8. 48.0 g of oxygen gas was confined at a pressure of 4.58 atm at 78.6°C. What was the volume of the gas?

Stoichiometry

9. What mass of hydrochloric acid must be reacted with calcium carbonate to make 50.0 ml of carbon dioxide at 24.0°C and 1.15 atm?

$$2\,HCl + CaCO_3 \rightarrow H_2O + CO_2 + CaCl_2$$

10. Ammonia (NH_3) reacts with oxygen to make nitrogen gas and water. What volume (in liters) of nitrogen would be produced from the reaction of 5.00 kg of ammonia with 8.00 kg of oxygen at STP?

11. 65.10 g of magnesium at 25.0°C and 735.0 mm Hg was reacted with oxygen gas. How many liters of oxygen would have been required to completely react with the magnesium ?

Molar Volume

1. Xe $131.29\ \frac{g}{mol}\left(\frac{1\ mol}{22.414\ L}\right) = 5.8575\ \frac{g\ Xe}{L}$

2. $d = \frac{m}{V} = \frac{9.71\ g}{\frac{560.0\ ml}{504.5\ ml}}\left(\frac{1000\ ml}{1.0\ L}\right)\left(\frac{22.414\ L}{1\ mol}\right) = 431\ \frac{g}{mol}$

$$V_2 = \frac{V_1 P_1 T_2}{T_1 P_2} = \frac{(560.0\ ml)(740.0\ mm\ Hg)(273.15\ K)}{(295.2\ K)(760.0\ mm\ Hg)} = 504.5\ ml$$

3. $42.5\ g\ N_2O\left(\frac{1\ mol\ N_2O}{44.02\ g\ N_2O}\right)\left(\frac{22.414\ L\ N_2O}{1\ mol\ N_2O}\right)\left(\frac{1000\ ml}{1\ L}\right) = 21{,}600\ ml\ N_2O$

4. $d = \frac{m}{V} = \frac{8.0\ g}{2.80\ L}\left(\frac{22.414\ L}{1\ mol}\right) = 64\ \frac{g}{mol}$

---

5. $PV = nRT$

$$T = \frac{PV}{nR} = \frac{(0.9677\ atm)(0.5750\ L)}{(4.317\ mol\ CO_2)\left(0.08206\ \frac{L \cdot atm}{K \cdot mol}\right)} = 1.571\ K$$

$190.0\ g\ CO_2\left(\frac{1\ mol\ CO_2}{44.01\ g\ CO_2}\right) = 4.317\ mol\ CO_2$

6. $PV = nRT \qquad PV = \left(\frac{m}{mm}\right)RT \qquad \frac{(mm)P}{RT} = \frac{m}{V} = d$

$$\frac{\left(2.016\ \frac{g}{mol}\right)(0.850\ atm)}{\left(0.08206\ \frac{L \cdot atm}{K \cdot mol}\right)(308.2\ K)} = 0.0678\ \frac{g\ H_2}{L}$$

7. $$mm = \frac{mRT}{PV} = \frac{(0.300\ g)\left(0.08206\ \frac{L \cdot atm}{K \cdot mol}\right)(298.1\ K)}{(0.9592\ atm)(0.2460\ L)} = 30.8\ g/mol$$

8. $48.0\ g\ O_2\left(\frac{1\ mol\ O_2}{32.00\ g\ O_2}\right) = 1.50\ mol\ O_2$

$$PV = nRT \qquad V = \frac{nRT}{P} = \frac{(1.50\ mol\ O_2)\left(0.08206\ \frac{L \cdot atm}{K \cdot mol}\right)(351.8\ K)}{(4.3\ atm)} = 9.75\ L\ O_2$$

9. $2HCl + CaCO_3 \rightarrow H_2O + CO_2 + CaCl_2$ 24.0°C, 1.15 atm

g? 50.0 mL

$PV = nRT \quad n = \frac{PV}{RT} = \frac{(1.15\,atm)(0.0500\,L\,CO_2)}{(0.08206\,\frac{L \cdot atm}{K \cdot mol})(297.2\,K)} = 0.00236\,mol\,CO_2$

$0.00236\,mol\,CO_2\left(\frac{2\,mol\,HCl}{1\,mol\,CO_2}\right)\left(\frac{36.46\,g\,HCl}{1\,mol\,HCl}\right) = 0.172\,g\,HCl$

10. $4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$ STP

5.00 kg, 8.00 kg, L?

$5.00\,kg\,NH_3\left(\frac{1000\,g\,NH_3}{1\,kg}\right)\left(\frac{1\,mol\,NH_3}{17.04\,g\,NH_3}\right)\left(\frac{2\,mol\,N_2}{4\,mol\,NH_3}\right)\left(\frac{22.4\,L\,N_2}{1\,mol\,N_2}\right) = 3,280\,L\,N_2$

$8.00\,kg\,O_2\left(\frac{1000\,g\,O_2}{1\,kg}\right)\left(\frac{1\,mol\,O_2}{32.00\,g\,O_2}\right)\left(\frac{2\,mol\,N_2}{3\,mol\,O_2}\right)\left(\frac{22.4\,L\,N_2}{1\,mol\,N_2}\right) = 3,740\,L\,N_2$

11. $2Mg + O_2 \rightarrow 2MgO$

65.10 g, L?

25.0°C, 735.0 mmHg

$65.10\,g\,Mg\left(\frac{1\,mol\,Mg}{24.31\,g\,Mg}\right)\left(\frac{1\,mol\,O_2}{2\,mol\,Mg}\right) = 1.339\,mol\,O_2$

$PV = nRT$

$V = \frac{nRT}{P} = \frac{(1.339\,mol\,O_2)(0.08206\,\frac{L \cdot atm}{K \cdot mol})(298.2\,K)}{(0.967\,atm)}$

$= 33.68\,L\,O_2$