

Gas Stoich Problems

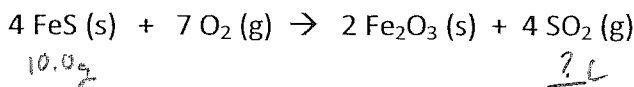
1. (5 pts) How many liters of methane are present in 37.4 grams of methane, CH₄, at STP?

$$37.4 \text{ g CH}_4 \times \frac{1 \text{ mol CH}_4}{16.04 \text{ g CH}_4} \times \frac{22.4 \text{ L CH}_4}{1 \text{ mol CH}_4} = \underline{52.2 \text{ L CH}_4}$$

2. (5 pts) How many chlorine gas molecules are present in 3.27 L of chlorine gas at STP?

$$3.27 \text{ L Cl}_2 \times \frac{1 \text{ mol Cl}_2}{22.4 \text{ L Cl}_2} \times \frac{6.02 \times 10^{23} \text{ molecules Cl}_2}{1 \text{ mol Cl}_2} = \underline{8.79 \times 10^{22} \text{ Cl}_2 \text{ molecules}}$$

3. (7 pts) Burning 10.0 g of iron (II) sulfide produces how many liters of sulfur dioxide at STP?



$$10.0 \text{ g FeS} \times \frac{1 \text{ mol FeS}}{87.91 \text{ g FeS}} \times \frac{4 \text{ mol SO}_2}{4 \text{ mol FeS}} \times \frac{22.4 \text{ L SO}_2}{1 \text{ mol SO}_2} = \underline{2.55 \text{ L SO}_2}$$

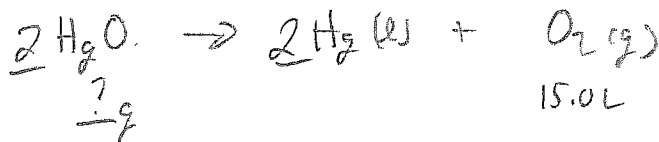
4. (7 pts) How many molecules of magnesium carbonate are needed to produce 75.1 L of carbon dioxide gas at STP? MgCO₃ (s) → MgO (s) + CO₂ (g)



$$75.1 \text{ L} \times \frac{1 \text{ mol CO}_2}{22.4 \text{ L CO}_2} \times \frac{1 \text{ mol MgCO}_3}{1 \text{ mol CO}_2} \times \frac{6.02 \times 10^{23} \text{ MgCO}_3 \text{ molecules}}{1 \text{ mol MgCO}_3} = \underline{2.02 \times 10^{24} \text{ MgCO}_3 \text{ molecules}}$$

5. (10 pts) Mercury (II) oxide decomposes into liquid mercury and oxygen gas. How many grams of mercury (II) oxide are needed to make 15.0 L of oxygen gas at STP?

mercury(II)oxide → mercury + oxygen



$$15.0 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.4 \text{ L O}_2} \times \frac{2 \text{ mol HgO}}{1 \text{ mol O}_2} \times \frac{216.6 \text{ g HgO}}{1 \text{ mol HgO}} = \underline{290. \text{ g HgO}}$$

6. (12 pts) A mixture of 1.00 g hydrogen gas and 1.00 g helium gas were placed in a 1.00 L container at 27°C. Calculate the partial pressure of each gas and the total pressure.

$$P_{H_2} = \frac{\left(1.00 \text{ g } H_2 \times \frac{1 \text{ mol } H_2}{2.016 \text{ g } H_2}\right) \left(\frac{0.0821 \text{ atm} \cdot \text{L}}{\text{mol} \cdot \text{K}}\right) (300. \text{ K})}{1.00 \text{ L}} = 12.2 \text{ atm}$$

$$P_{He} = \frac{\left(1.00 \text{ g } He \times \frac{1 \text{ mol } He}{4.003 \text{ g } He}\right) \left(\frac{0.0821 \text{ atm} \cdot \text{L}}{\text{mol} \cdot \text{K}}\right) (300. \text{ K})}{1.00 \text{ L}} = 6.15 \text{ atm}$$

$$P_{\text{Total}} = P_{H_2} + P_{He} = 12.2 \text{ atm} + 6.2 \text{ atm} = 18.4 \text{ atm}$$

7. (8 pts) The method used by Joseph Priestly to obtain oxygen made by thermal decomposition of mercury (II) oxide:



What volume of oxygen gas, measured at 30°C and 725 torr, can be produced from the complete decomposition of 4.10 g of mercury (II) oxide?

$$4.10 \text{ g } HgO \times \frac{1 \text{ mol } HgO}{216.6 \text{ g } HgO} \times \frac{1 \text{ mol } O_2}{2 \text{ mol } HgO} = 0.00946 \text{ mol } O_2$$

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(0.00946 \text{ mol}) \left(\frac{0.0821 \text{ atm} \cdot \text{L}}{\text{mol} \cdot \text{K}}\right) (303 \text{ K})}{\left(725 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}}\right)} = 0.247 \text{ L } O_2$$

8. (10 pts) A gas consisting of only carbon and hydrogen has an empirical formula of CH_2 . The gas has a density of 1.65 g/L at 27°C and 734 torr. Determine the molar mass and molecular formula of the gas.

$$\text{molar mass} = \frac{1.65 \text{ g}}{Q \text{ mol}}$$

$$n = \frac{PV}{RT} = \frac{\left(734 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}}\right) (1 \text{ L})}{\left(\frac{0.0821 \text{ atm} \cdot \text{L}}{\text{mol} \cdot \text{K}}\right) (300. \text{ K})} = 0.0392 \text{ mol}$$

$$\text{molar mass} = \frac{42.32 \text{ g/mol}}{14} = 3$$

$$CH_2 = 14$$

$$CH_2 \times 3 = C_3H_6 \text{ molecular formula}$$