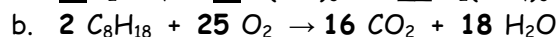
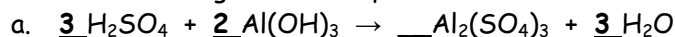
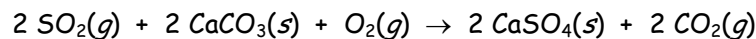


Part 1: Chemical Equations

1. Balance and the following chemical equations.

**Part 2: Stoichiometry**

2. Sulfur dioxide, a pollutant produced by burning coal and oil in power plants, can be removed by reaction with calcium carbonate.

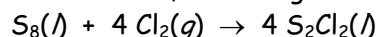
a. For every 3 moles of SO_2 reacting, how many moles of CO_2 are being produced?

$$3 \text{ mol SO}_2 \times \frac{2 \text{ mol CO}_2}{2 \text{ mol SO}_2} = 3 \text{ mol CO}_2$$

b. How many moles of O_2 is required to react with 15.5 grams of SO_2 ?

$$15.5 \text{ g SO}_2 \times \frac{1 \text{ mol SO}_2}{64.1 \text{ g SO}_2} = 0.242 \text{ mol SO}_2$$

$$0.242 \text{ mol SO}_2 \times \frac{1 \text{ mol O}_2}{2 \text{ mol SO}_2} = 0.121 \text{ mol O}_2$$

3. Disulfur dichloride, S_2Cl_2 , is used to vulcanize rubber. It can be made by treating molten sulfur with gaseous chlorine, according to the following chemical reaction:Starting with a mixture of 32.0 grams of sulfur (S_8) what is the maximum amount of S_2Cl_2 that can be produced (in grams)?**Method 1:**

$$32.0 \text{ g S}_8 \times \frac{1 \text{ mol S}_8}{256.8 \text{ g S}_8} \times \frac{4 \text{ mol S}_2\text{Cl}_2}{1 \text{ mol S}_8} \times \frac{135.2 \text{ g S}_2\text{Cl}_2}{1 \text{ mol S}_2\text{Cl}_2} = 67.4 \text{ g S}_2\text{Cl}_2$$

Method 2: Using molar masses, convert chemical equation to gram to gram relationship:

$$32.0 \text{ g S}_8 \times \frac{540.8 \text{ g S}_2\text{Cl}_2}{256.8 \text{ g S}_8} = 67.4 \text{ g S}_2\text{Cl}_2$$

Part 2: Unit Conversions

4. Convert the following:

a. 12.3 cm^3 to L $12.3 \text{ cm}^3 \times \frac{1 \text{ L}}{1000 \text{ cm}^3} = 0.0123 \text{ L}$

b. 233 kPa to mmHg $233 \text{ kPa} \times \frac{760 \text{ mm Hg}}{101.3 \text{ kPa}} = 1750 \text{ mm Hg}$

c. 14°F to Kelvin $^\circ\text{C} = \frac{32 - 14}{1.8} = -10.^\circ\text{C}$, $\text{K} = 273 + -10. = 263 \text{ K}$

d. $2.5 \text{ grams Neon gas}$ to L at STP $2.5 \text{ g Ne} \times \frac{1 \text{ mol Ne}}{20.2 \text{ g Ne}} \times \frac{22.4 \text{ L Ne}}{1 \text{ mol Ne}} = 2.8 \text{ L Ne}$

Part 2: Gas Laws

5. A gas occupies a volume of 180 mL at a pressure of 450 torr. If the gas is transferred to a 2.00 L container at the same temperature, what will be the new pressure?

$$P_2 = \frac{P_1 V_1}{V_2} = \frac{(450 \text{ torr} \times 0.18 \text{ L})}{2.00 \text{ L}} = 40.5 \text{ torr} = 41 \text{ torr}$$

6. A gas occupies a volume of 26.5 mL at 300°C. While being held at constant pressure, its volume decreases to 0.0157 liters. What has the temperature of the gas become (in °C)?

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{(0.0157 \text{ L} \times 573 \text{ K})}{0.0265 \text{ L}} = 339 \text{ K}, \quad 339 - 273 = 66^\circ \text{C}$$

7. If a sample of a gas occupies 265 mL at 920. torr and 37°C, what volume will it occupy at STP?

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1} = \frac{(920. \text{ torr} \times 265 \text{ mL} \times 273 \text{ K})}{(760. \text{ torr} \times 310. \text{ K})} = 283 \text{ mL}$$

8. What volume would 28 grams of oxygen occupy at 800. torr and 27°C?

$$28 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32.0 \text{ g O}_2} = 0.88 \text{ mol O}_2, \quad 800. \text{ torr} \times \frac{1.00 \text{ atm}}{760. \text{ torr}} = 1.05 \text{ atm}$$

$$V = \frac{nRT}{P} = \frac{(0.88 \text{ mol} \times 0.0821 \frac{\text{atm L}}{\text{mol K}} \times 300. \text{ K})}{1.05 \text{ atm}} = 21 \text{ L}$$

9. Calculate the density of N₂ at STP.

$$D = \frac{M_m P}{RT} = \frac{(28.0 \frac{\text{g}}{\text{mol}} \times 1.00 \text{ atm})}{(0.0821 \frac{\text{atm L}}{\text{mol K}} \times 273 \text{ K})} = 1.25 \text{ g/L} \quad \text{ALSO : } \frac{28.0 \text{ g}}{1 \text{ mol}} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = 1.25 \text{ g/L}$$

10. Butane, from a cigarette lighter, has a density of 2.30 g/L at 22°C and 730. torr. What is the molar mass of butane?

$$M_m = \frac{DRT}{P} = \frac{(2.30 \text{ g/L} \times 0.0821 \frac{\text{atm L}}{\text{mol K}} \times 295 \text{ K})}{0.961 \text{ atm}} = 58.0 \text{ g/mol}$$

Part 3: Molarity

11. Calculate the molarity of a 550. mL solution containing 32.3 grams of H₂SO₄.

$$32.3 \text{ g H}_2\text{SO}_4 \times \frac{1 \text{ mol H}_2\text{SO}_4}{98.1 \text{ g H}_2\text{SO}_4} = 0.329 \text{ mol}, \quad M = \frac{\text{mol}}{\text{L}} = \frac{0.329 \text{ mol}}{0.550 \text{ L}} = 0.598 \text{ M H}_2\text{SO}_4$$

12. 350. mL of a 5.6 M solution of NiCl₂ was diluted to a 500. mL solution. What is the concentration of the diluted solution?

$$M_2 \frac{M_1 V_1}{V_2} = \frac{(5.6 \text{ M} \times 350. \text{ mL})}{500. \text{ mL}} = 3.92 \text{ M}$$