

Chemistry – Unit 8 Worksheet 2

1. What volume does 16.0 g of O₂ occupy at STP?

$$PV = nRT$$

$$(101.1 \text{ kPa})(V) = \left(\frac{16.0 \text{ g}}{32.0 \text{ g/mol}}\right) \left(8.31 \frac{\text{KPa L}}{\text{mol K}}\right) (273 \text{ K})$$

11.2 L

2. A mixture contains 5.00 g each of O₂, N₂, CO₂, and Ne gas. Calculate the volume of this mixture at STP

$$\frac{5.00 \text{ g}}{32.0 \text{ g/mol}} = .16 \text{ mol O}_2 \quad \frac{5.00 \text{ g}}{28.0 \text{ g/mol}} = .18 \text{ mol N}_2$$

$$\frac{5.00 \text{ g}}{44.01 \text{ g/mol}} = .11 \text{ mol CO}_2$$

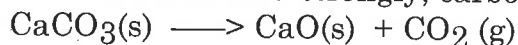
$$\frac{5.00 \text{ g}}{20.18 \text{ g/mol}} = .25 \text{ mol Ne}$$

$$(101.1 \text{ kPa})(V) = (.16 + .18 + .11 + .25) \left(8.31 \frac{\text{KPa L}}{\text{mol K}}\right) (273 \text{ K})$$

15.7 L

3. A 250 mL flask of hydrogen gas is collected at 763 mm and 35°C by displacement of water from the flask. The vapor pressure of water at 35°C is 42.2 mmHg. How many moles of hydrogen gas are in the flask?

4. When calcium carbonate is heated strongly, carbon dioxide gas is evolved.



If 4.74 g of calcium carbonate is heated, what volume of CO₂ (g) would be produced when collected at STP?

$$4.74 \text{ g CaCO}_3 \times \frac{1 \text{ mol}}{100.1 \text{ g}} \times \frac{1 \text{ mol CO}_2}{1 \text{ mol CaCO}_3} = 0.047 \text{ mol CO}_2$$

$$PV = nRT$$

$$(101.1 \text{ kPa})(V) = (0.047 \text{ mol}) \left(8.31 \frac{\text{KPa L}}{\text{mol K}}\right) (273 \text{ K})$$

$$\underline{1.05 \text{ L CO}_2}$$

5. Zinc metal reacts vigorously with chlorine gas to form zinc chloride. What volume of chlorine gas at 25°C and 1.00 atm is required to react completely with 1.13 g of zinc?



$$1.13 \text{ g Zn} \times \frac{1 \text{ mol Zn}}{65.4 \text{ g}} \times \frac{1 \text{ mol Cl}_2}{1 \text{ mol Zn}} = 0.017 \text{ mol Cl}_2$$

$$PV = nRT$$

$$(101.1 \text{ kPa})(V) = (0.017 \text{ mol}) \left(8.31 \frac{\text{KPa} \cdot \text{L}}{\text{mol} \cdot \text{K}} \right) (298 \text{ K})$$

$$0.42 \text{ L Cl}_2$$

6. Consider the following reaction:



What mass of P₄ will completely react with 2.50 L of hydrogen gas, at 0°C and 1.50 atm pressure?

$$PV = nRT$$

$$\frac{1.50 \text{ atm}}{101.1 \text{ kPa}} = \frac{1.50 \text{ atm}}{101.1 \text{ kPa}} = 151.65 \text{ kPa}$$

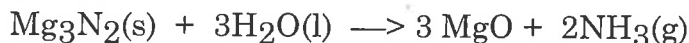
$$(151.65 \text{ kPa})(2.50 \text{ L}) = n \left(8.31 \frac{\text{KPa} \cdot \text{L}}{\text{mol} \cdot \text{K}} \right) (273 \text{ K})$$

$$n = 0.167 \text{ mol H}_2$$

$$\frac{0.167 \text{ mol}}{6 \text{ mol}} = 0.028 \text{ mol P}_4$$

$$\boxed{0.28 \text{ mol P}_4}$$

7. If water is added to magnesium nitride, ammonia gas is produced when the mixture is heated.



If 10.3 g of magnesium nitride is treated with water, what volume of ammonia gas would be collected at 20°C and 0.989 atm?

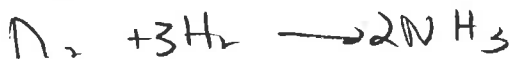
$$10.3 \text{ g Mg}_3\text{N}_2 \times \frac{1 \text{ mol}}{100.9 \text{ g}} \times \frac{2 \text{ mol NH}_3}{1 \text{ mol Mg}_3\text{N}_2} = 0.20 \text{ mol NH}_3$$

$$\frac{1.0 \text{ atm}}{101.1 \text{ kPa}} = \frac{0.989 \text{ atm}}{101.1 \text{ kPa}} = 100 \text{ kPa}$$

$$(100 \text{ kPa})(V) = (0.20 \text{ mol}) \left(8.31 \frac{\text{KPa} \cdot \text{L}}{\text{mol} \cdot \text{K}} \right) (293 \text{ K})$$

$$V = 0.21 \text{ L}$$

8. Nitrogen gas and hydrogen gas combine to produce ammonia gas (NH₃). What volume of hydrogen gas at 25°C and 735 mm is required for the complete reaction of 10.0g of nitrogen?



$$10.0 \text{ g N}_2 \times \frac{1 \text{ mol}}{28 \text{ g}} \times \frac{3 \text{ mol H}_2}{1 \text{ mol N}_2} = 1.07 \text{ mol H}_2$$

$$\frac{101.1 \text{ kPa}}{760 \text{ mm}} = \frac{X}{735} = 97.8 \text{ kPa}$$

$$(97.8 \text{ kPa})(V) = (1.07 \text{ mol}) \left(8.31 \frac{\text{KPa} \cdot \text{L}}{\text{mol} \cdot \text{K}} \right) (298 \text{ K})$$

$$\boxed{25.6 \text{ L}}$$