

# STOICHIOMETRY: MIXED PROBLEMS

Name \_\_\_\_\_

1.  $N_2 + 3H_2 \rightarrow 2NH_3$        $25.0 \text{ g } N_2 = ? \text{ L } NH_3$   
 What volume of  $NH_3$  at STP is produced if 25.0 g of  $N_2$  is reacted with an excess of  $H_2$ ?

$$\frac{25.0 \text{ g } N_2}{28.02 \text{ g}} \times \frac{1 \text{ mol}}{1 \text{ mol } N_2} \times \frac{2 \text{ mols } NH_3}{1 \text{ mol } N_2} \times \frac{22.4 \text{ L}}{1 \text{ mol } NH_3} = 40.0 \text{ L}$$

2.  $2KClO_3 \rightarrow 2KCl + 3O_2$        $5.0 \text{ g } KClO_3 \rightarrow ? \text{ L } O_2$   
 If 5.0 g of  $KClO_3$  is decomposed, what volume of  $O_2$  is produced at STP?

$$\frac{5.0 \text{ g } KClO_3}{122.55} \times \frac{1 \text{ mol}}{2 \text{ mols } KClO_3} \times \frac{3 \text{ mols } O_2}{1 \text{ mol}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = 1.4 \text{ L}$$

3. How many grams of  $KCl$  are produced in Problem 2?

$$\frac{5.0 \text{ g } KClO_3}{122.55} \times \frac{1 \text{ mol}}{2 \text{ mols } KClO_3} \times \frac{2 \text{ mols } KCl}{1 \text{ mol}} \times 74.55 \text{ g} = 3.0 \text{ g}$$

4.  $Zn + 2HCl \rightarrow ZnCl_2 + H_2$        $2.5 \text{ g } Zn = ? \text{ L } H_2$   
 What volume of hydrogen at STP is produced when 2.5 g of zinc react with an excess of hydrochloric acid?

$$\frac{2.5 \text{ g } Zn}{65.39 \text{ g}} \times \frac{1 \text{ mol}}{1 \text{ mol } Zn} \times \frac{1 \text{ mol } H_2}{1 \text{ mol}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = 0.86 \text{ L}$$

5.  $H_2SO_4 + 2NaOH \rightarrow 2H_2O + Na_2SO_4$        $2.0 \text{ g } Na_2SO_4 = ? \text{ molec of } H_2O$   
 How many molecules of water are produced if 2.0 g of sodium sulfate are produced in the above reaction?

$$\frac{2.0 \text{ g } Na_2SO_4}{142.05 \text{ g}} \times \frac{1 \text{ mol}}{1 \text{ mol } Na_2SO_4} \times \frac{2 \text{ mols } H_2O}{1 \text{ mol}} \times 6.02 \times 10^{23} \text{ molec.} = 2.4 \times 10^{24} \text{ molec.}$$

6.  $2AlCl_3 \rightarrow 2Al + 3Cl_2$        $10.0 \text{ g } AlCl_3 = ? \text{ molec } Cl_2$   
 If 10.0 g of aluminum chloride are decomposed, how many molecules of  $Cl_2$  are produced?

$$\frac{10.0 \text{ g } AlCl_3}{133.33 \text{ g}} \times \frac{1 \text{ mol}}{2 \text{ mols } AlCl_3} \times \frac{3 \text{ mols } Cl_2}{1 \text{ mol}} \times 6.02 \times 10^{23} \text{ molec.} = 6.77 \times 10^{22} \text{ molecules}$$

# STOICHIOMETRY: VOLUME-VOLUME PROBLEMS

Name \_\_\_\_\_

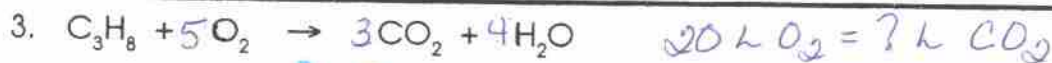


What volume of hydrogen is necessary to react with five liters of nitrogen to produce ammonia? (Assume constant temperature and pressure.)

$$\frac{5L N_2}{22.4L} \times \frac{3 \text{ mols } H_2}{1 \text{ mol } N_2} \times \frac{22.4L}{1 \text{ mol } H_2} = \underline{15L}$$

2. What volume of ammonia is produced in the reaction in Problem 1?

$$5L = ? L NH_3 \quad \frac{5L N_2}{11 N_2} \times \frac{2 NH_3}{1 N_2} = \underline{10L}$$



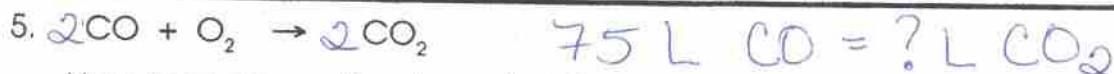
If 20 liters of oxygen are consumed in the above reaction, how many liters of carbon dioxide are produced?

$$\frac{20L O_2}{5 O_2} \times \frac{3 CO_2}{1 O_2} = \underline{12L}$$



If 30 mL of hydrogen are produced in the above reaction, how many milliliters of oxygen are produced?

$$\frac{30 \text{ mL } H_2}{2 H_2} \times \frac{1 O_2}{2 H_2} = \underline{15 \text{ mL}}$$



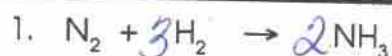
How many liters of carbon dioxide are produced if 75 liters of carbon monoxide are burned in oxygen? How many liters of oxygen are necessary?

$$\frac{75L CO}{2 CO} \times \frac{2 CO_2}{2 CO} = \underline{75L}$$

$$\frac{75L CO_2}{2 CO_2} \times \frac{1 O_2}{2 CO_2} = \underline{37.5L}$$

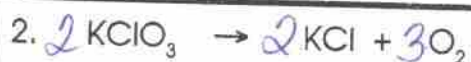
# STOICHIOMETRY: MOLE-MOLE PROBLEMS

Name Key



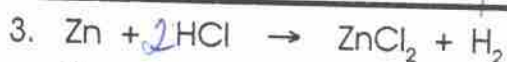
How many moles of hydrogen are needed to completely react with two moles of nitrogen?

$$\frac{2 \text{ mols } N_2}{1 \text{ mol}} \left| \frac{3 \text{ mols } H_2}{1 \text{ mol}} \right. = \underline{6 \text{ mols}}$$



How many moles of oxygen are produced by the decomposition of six moles of potassium chlorate?

$$\frac{6 \text{ mols } KClO_3}{2 \text{ mols } KClO_3} \left| \frac{3 \text{ mols } O_2}{1 \text{ mol}} \right. = \underline{9 \text{ mols}}$$



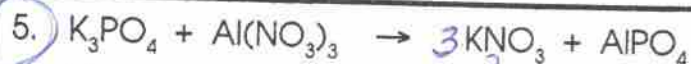
How many moles of hydrogen are produced from the reaction of three moles of zinc with an excess of hydrochloric acid?

$$\frac{3 \text{ mols } Zn}{1 \text{ mol } Zn} \left| \frac{1 \text{ mol } H_2}{1 \text{ mol}} \right. = \underline{3 \text{ mols}}$$



How many moles of oxygen are necessary to react completely with four moles of propane ( $C_3H_8$ )?

$$\frac{4 \text{ mols } C_3H_8}{1 \text{ mol } C_3H_8} \left| \frac{5 \text{ mols } O_2}{1 \text{ mol}} \right. = \underline{20 \text{ mols}}$$



How many moles of potassium nitrate are produced when two moles of potassium phosphate react with two moles of aluminum nitrate?

$$\frac{2 \text{ mols } K_3PO_4}{1 \text{ mol } K_3PO_4} \left| \frac{3 \text{ mols } KNO_3}{1 \text{ mol}} \right. = 6 \text{ mols } KNO_3$$

$$\frac{2 \text{ mols } Al(NO_3)_3}{1 \text{ mol } Al(NO_3)_3} \left| \frac{3 \text{ mols } KNO_3}{1 \text{ mol}} \right. = 6 \text{ mol } KNO_3 \quad \underline{6 \text{ mols } KNO_3}$$

# STOICHIOMETRY: MASS-MASS PROBLEMS

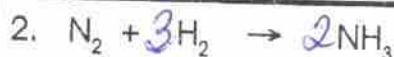
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How many grams of potassium chloride are produced if 25 g of potassium chlorate decompose?

$$\frac{25\text{g KClO}_3}{122.55} \times \frac{1\text{mol}}{2\text{mols KClO}_3} \times \frac{2\text{mols KCl}}{1\text{mol KCl}} \times 74.55 = 15.2$$

15g KCl



How many grams of hydrogen are necessary to react completely with 50.0 g of nitrogen in the above reaction?

$$\frac{50.0\text{g N}_2}{28.02\text{g}} \times \frac{1\text{mol N}_2}{3\text{mols H}_2} \times \frac{2\text{mols H}_2}{1\text{mol H}_2} \times 2.02\text{g} = 10.8\text{g}$$

10.8g H<sub>2</sub>

3. How many grams of ammonia are produced in the reaction in Problem 2?

$$\frac{50.0\text{g N}_2}{28.02\text{g}} \times \frac{1\text{mol}}{1\text{mol N}_2} \times \frac{2\text{mols NH}_3}{1\text{mol}} \times 17.04\text{g} = 60.8\text{g}$$

60.8g NH<sub>3</sub>



5.0g AgNO<sub>3</sub> = g? AgCl

How many grams of silver chloride are produced from 5.0 g of silver nitrate reacting with an excess of barium chloride?

$$\frac{5.0\text{g AgNO}_3}{169.88\text{g}} \times \frac{1\text{mol}}{2\text{mols}} \times \frac{2\text{mols}}{1\text{mol}} \times 143.32\text{g} = 4.2$$

4.2g AgCl

5. How much barium chloride is necessary to react with the silver nitrate in Problem 4?

$$\frac{5.0\text{g AgNO}_3}{169.88\text{g}} \times \frac{1\text{mol}}{2\text{mols AgNO}_3} \times \frac{1\text{mol BaCl}_2}{1\text{mol BaCl}_2} \times 208.23\text{g} = 3.1\text{g}$$

3.1g