Stoichiometry Test Practice

#1, 4, 5, 7, 9

You must do these problems!

Practice Test 1

1. $\underline{2}\,C_6H_{10} + \underline{17}\,O_2 \rightarrow \underline{12}\,CO_2 + \underline{10}\,H_2O$

   a) If I do this reaction with 35 grams of C_6H_{10} and 45 grams of oxygen, how many grams of carbon dioxide will be formed? $35g\ C_6H_{10} \times \frac{1mol\ C_6H_{10}}{82.16g\ C_6H_{10}} \times \frac{12 mols\ CO_2}{2 mols\ C_6H_{10}} \times \frac{44.01g\ CO_2}{1mol\ CO_2} = 112.48g\ CO_2$

   $45g\ O_2 \times \frac{1mol\ O_2}{32g\ O_2} \times \frac{12mols\ CO_2}{17mols\ O_2} \times \frac{44.01g\ CO_2}{1mol\ CO_2} = 43.67g\ CO_2$

   b) What is the limiting reagent for part (a)? ____________

   Oxygen is the limiting reagent because it can only produce 43.67g CO_2. Theoretically, this reaction will yield 43.67g CO_2.

   c) If 35 grams of carbon dioxide are actually formed from the reaction in part (a), what is the percent yield of this reaction? $\left(\frac{\text{actual yield}}{\text{theoretical yield}}\right) \times 100\%$ $\left(\frac{35g\ CO_2}{43.67g\ CO_2}\right) \times 100\% = 80.15\%$

2. Ethylene (C_2H_4) burns in oxygen to form carbon dioxide and water vapor.

   a) Write the balanced chemical equation for this reaction below.

   $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

   b) How many liters of water can be formed if 1.25 liters of ethylene are consumed in this reaction?

   * 3-step conversion because I'm asked to go from liters of one compound to liters of a totally different compound.

   $1.25L\ C_2H_4 \times \frac{1mol\ C_2H_4}{22.4L\ C_2H_4} \times \frac{2 mols\ H_2O}{1mol\ C_2H_4} \times \frac{22.4\ L\ H_2O}{1\ mol\ H_2O} = 2.5L \text{ of } H_2O$

3. a) Balance the following equation:

   ___ $Pb(SO_4)_2$ + $\underline{4}$ $LiNO_3 \rightarrow$ ___ $Pb(NO_3)_4$ + $\underline{2}$ Li_2SO_4

   b) How many moles of lithium nitrate will be needed to make 40 moles of lithium sulfate, assuming that you have an adequate amount of lead (IV) sulfate to do the reaction?

   $40 \text{ moles } Li_2SO_4 \times \frac{4 \text{ moles } LiNO_3}{2 \text{ moles } Li_2SO_4} = 80 \text{ moles } LiNO_3$

   c) How many moles of lead(IV) nitrate are produced if 25 moles of lithium sulfate are produced?

   $25 \text{ moles } Li_2SO_4 \times \frac{1 \text{ mole } Pb(NO_3)_4}{2 \text{ moles } Li_2SO_4} = 12.5 \text{ moles } Pb(NO_3)_4$

   d) How many moles of lithium nitrate are needed to react completely with 5.9 moles of lead(IV) sulfate?

   $5.9 \text{ moles } Pb(SO_4)_2 \times \frac{4 \text{ moles } LiNO_3}{1 \text{ mole } Pb(SO_4)_2} = 23.6 \text{ moles } LiNO_3$

4. a) Write the balanced equation for the reaction of acetic acid with aluminum hydroxide to form water and aluminum acetate: $3\,C_2H_3O_2H + Al(OH)_3 \longrightarrow Al(C_2H_3O_2)_3 + 3\,H_2O$

   b) Using the equation from part (a), determine the mass of aluminum acetate that can be made if I do this reaction with 125 grams of acetic acid and 275 grams of aluminum hydroxide.

$$125\text{ g } C_2H_3O_2H \times \frac{1\text{ mol } C_2H_3O_2H}{60.6\text{ g } C_2H_3O_2H} \times \frac{1\text{ mol } Al(C_2H_3O_2)_3}{3\text{ mols } C_2H_3O_2H} \times \frac{204.13\text{ g } Al(C_2H_3O_2)_3}{1\text{ mol } Al(C_2H_3O_2)_3} = 140.35\text{ g } Al(C_2H_3O_2)_3$$

$$275\text{ g } Al(OH)_3 \times \frac{1\text{ mol } Al(OH)_3}{78.01\text{ g } Al(OH)_3} \times \frac{1\text{ mol } Al(C_2H_3O_2)_3}{1\text{ mol } Al(OH)_3} \times \frac{204.13\text{ g } Al(C_2H_3O_2)_3}{1\text{ mol } Al(C_2H_3O_2)_3} = 719.60\text{ g } Al(C_2H_3O_2)_3$$

   c) What is the limiting reagent in problem #5?

Acetic acid ($C_2H_3O_2H$) is the limiting reagent.
Theoretically, this reaction will yield 140.35 g of aluminum acetate

5. a) Balance this equation and state which of the six types of reaction is taking place:

$\underline{1}$ Mg + $\underline{2}$ HNO_3 → $\underline{1}$ $Mg(NO_3)_2$ + $\underline{1}$ H_2

Type of reaction: Single displacement

   b) If I start this reaction with 40 grams of magnesium and an excess of nitric acid, how many grams of hydrogen gas will I produce?

$$40\text{ g Mg} \times \frac{1\text{ mol Mg}}{24.31\text{ g Mg}} \times \frac{1\text{ mol } H_2}{1\text{ mol Mg}} \times \frac{2.02\text{ g } H_2}{1\text{ mol } H_2} = 3.32\text{ g } H_2$$

   c) If 1.7 grams of hydrogen is actually produced, what was my percent yield of hydrogen?

$$\left(\frac{1.7}{3.32}\right) \times 100 = 51.2\%$$

Practice Test 2

6. a) Balance this equation and state what type of reaction is taking place:

$\underline{1}$ $NaHCO_3$ → $\underline{1}$ NaOH + $\underline{1}$ CO_2

Type of reaction: Decomposition

   b) If 25 grams of carbon dioxide gas is produced in this reaction, how many grams of sodium hydroxide should be produced?

$$25\text{ g } CO_2 \times \frac{1\text{ mole } CO_2}{44.01\text{ g } CO_2} \times \frac{1\text{ mole NaOH}}{1\text{ mole } CO_2} \times \frac{40\text{ g NaOH}}{1\text{ mole NaOH}} = 22.72\text{ g NaOH}$$

   c) If 50 grams of sodium hydroxide are actually produced, what was my percent yield?

$$\left(\frac{50}{22.72}\right) \times 100 = 220\%$$

This is the correct answer. If you ever calculated this during a lab, you would immediately know you goofed up!

7. Calcium carbonate decomposes at high temperatures to form carbon dioxide and calcium oxide:

   a) Write the balanced chemical equation for this reaction below.

$$CaCO_3 \longrightarrow CO_2 + CaO$$

   b) How many grams of calcium carbonate will I need to form 3.45 liters of carbon dioxide?

$$3.45\text{ L } CO_2 \times \frac{1\text{ mole } CO_2}{22.4\text{ L } CO_2} \times \frac{1\text{ mole } CaCO_3}{1\text{ mole } CO_2} \times \frac{100.09\text{ g } CaCO_3}{1\text{ mole } CaCO_3} = 15.42\text{ g } CaCO_3$$

8. Using the following equation:

$$2\ NaOH + H_2SO_4 \rightarrow 2\ H_2O + \boxed{Na_2SO_4}$$

How many grams of sodium sulfate will be formed if you start with 200 grams of sodium hydroxide and you have an excess of sulfuric acid?

$$200g\ NaOH \times \frac{1\ mole\ NaOH}{40g\ NaOH} \times \frac{1\ mole\ Na_2SO_4}{2\ moles\ NaOH} \times \frac{142.05\ g\ Na_2SO_4}{1 mole\ Na_2SO_4} = 355.13\ g\ Na_2SO_4$$

9. Chlorine is used by textile manufacturers to bleach cloth. Excess chlorine is destroyed by its reaction with sodium thiosulfate, $Na_2S_2O_3$:

$$Na_2S_2O_{3(aq)} + 4Cl_{2(g)} + 5H_2O_{(aq)} \rightarrow 2NaHSO_{4(aq)} + 8HCl_{(aq)}$$

a. How many moles of $Na_2S_2O_3$ are needed to react with 0.12mol of Cl_2?

$$0.12 mols\ Cl_2 \times \frac{1\ mol\ Na_2S_2O_3}{4 mols\ Cl_2} = 0.03\ mols\ Na_2S_2O_3$$

b. How many moles of HCl can form from 0.12mol of Cl_2?

$$0.12\ mols\ Cl_2 \times \frac{8\ mols\ HCl}{4\ mols\ Cl_2} = 0.24\ mols\ HCl$$

c. How many moles of H_2O are required for the reaction of 0.12mol of Cl_2?

$$0.12 mols\ Cl_2 \times \frac{5\ mols\ H_2O}{4\ mols\ Cl_2} = 0.15\ mols\ H_2O$$

d. How many moles of H_2O react if 0.24mol HCl is formed?

$$0.24\ mols\ HCl \times \frac{5\ mols\ H_2O}{8\ mols\ HCl} = 0.15\ mols\ H_2O$$

10. The incandescent white of a fireworks display is caused by the reaction of phosphorous with O_2 to give P_4O_{10}.

a. Write the balanced chemical equation for the reaction.

$$4P + 5O_2 \rightarrow P_4O_{10}$$

b. How many grams of O_2 are needed to combine with 6.85g of P?

$$6.85g\ P \times \frac{1 mole\ P}{30.97\ g\ P} \times \frac{5\ moles\ O_2}{4\ moles\ P} \times \frac{32\ g\ O_2}{1 mole\ O_2} = 8.85\ g\ O_2$$

c. How many grams of P_4O_{10} can be made from 8.00g of O_2?

$$8.00g\ O_2 \times \frac{1\ mole\ O_2}{32\ g\ O_2} \times \frac{1\ mole\ P_4O_{10}}{5\ moles\ O_2} \times \frac{283.88\ g\ P_4O_{10}}{1\ mole\ P_4O_{10}} = 14.19\ g\ P_4O_{10}$$

d. How many grams of P are needed to make 7.46g P_4O_{10}?

$$7.46\ g\ P_4O_{10} \times \frac{1\ mole\ P_4O_{10}}{283.88\ g\ P_4O_{10}} \times \frac{4\ moles\ P}{1\ mole\ P_4O_{10}} \times \frac{30.97\ g\ P}{1\ mole\ P} = 3.26\ g\ P$$