

## Practice Problems:

1. Carbon monoxide reacts with iron (III) oxide to produce solid iron and carbon dioxide.



a. Write and balance the chemical equation describing the reaction.



b. How many grams of iron will be produced from 343.1 g of iron (III) oxide?

$$343.1 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{160 \text{ g Fe}_2\text{O}_3} \times \frac{2 \text{ mol Fe}}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{56 \text{ g Fe}}{1 \text{ mol Fe}} = 240.2 \text{ g Fe}$$

c. How many liters of carbon dioxide will be formed (at STP) when 286.9 g of iron (III) oxide reacts with an excess amount of carbon monoxide?

$$286.9 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{160 \text{ g Fe}_2\text{O}_3} \times \frac{3 \text{ mol CO}_2}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{22.4 \text{ L CO}_2}{1 \text{ mol CO}_2} = 120.5 \text{ L}$$

d. If only 115 L of  $\text{CO}_2$  are collected from the reaction above (c), what is the percent yield?

$$\frac{115 \text{ L}}{120.7 \text{ L}} \times 100 = 95.28\%$$

e. How much iron will be produced from the reaction of 15.0 g of iron (III) oxide and 10.0 L of carbon monoxide (at STP)?

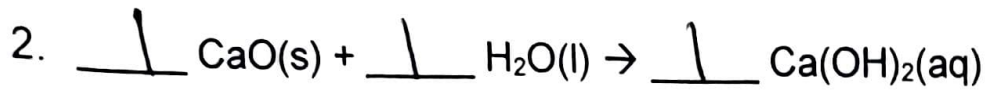
$$15.0 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mol Fe}_2\text{O}_3}{159.7 \text{ g}} \times \frac{2 \text{ mol Fe}}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{55 \text{ g Fe}}{1 \text{ mol Fe}} = 10.3 \text{ g Fe}$$

$$10.0 \text{ L CO} \times \frac{1 \text{ mol CO}}{22.4 \text{ L}} \times \frac{2 \text{ mol Fe}}{3 \text{ mol CO}} \times \frac{55 \text{ g Fe}}{1 \text{ mol Fe}} = 16.4 \text{ g Fe}$$

f. Based on (e) above, what is the limiting reactant? What reactant is present in excess?

$\text{Fe}_2\text{O}_3$  LR

CO - EXCESS



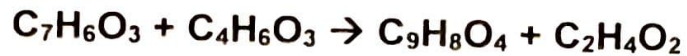
How many grams of calcium hydroxide will be formed in this reaction when 4.44 g of calcium oxide and 7.77 g of water are available to react? Also identify the limiting and excess reactants.

$$4.44 \text{ g CaO} \times \frac{1 \text{ mol CaO}}{56.08 \text{ g CaO}} \times \frac{1 \text{ mol Ca(OH)}_2}{1 \text{ mol CaO}} \times \frac{74.08 \text{ g Ca(OH)}_2}{1 \text{ mol Ca(OH)}_2} = \boxed{5.87 \text{ g Ca(OH)}_2}$$

$$7.77 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol Ca(OH)}_2}{1 \text{ mol H}_2\text{O}} \times \frac{74.08 \text{ g Ca(OH)}_2}{1 \text{ mol Ca(OH)}_2} = 31.9 \text{ g Ca(OH)}_2$$

LR = CaO    EXC = H<sub>2</sub>O

7. Aspirin (acetylsalicylic acid) and acetic acid byproduct ( $C_2H_4O_2$ ) are prepared by heating salicylic acid,  $C_7H_6O_3$ , with acetic anhydride,  $C_4H_6O_3$ .



a) What is the limiting reagent when 2.00 g of salicylic acid is heated with 4.00 g of acetic anhydride?

$$2.00 \text{ g } C_7H_6O_3 \times \frac{1 \text{ mol } C_7H_6O_3}{138.07 \text{ g } C_7H_6O_3} \times \frac{1 \text{ mol } C_9H_8O_4}{1 \text{ mol } C_7H_6O_3} \times \frac{180.09 \text{ g}}{1 \text{ mol } C_9H_8O_4} = 2.60 \text{ g } C_9H_8O_4$$

$$4.00 \text{ g } C_4H_6O_3 \times \frac{1 \text{ mol } C_4H_6O_3}{102.04 \text{ g } C_4H_6O_3} \times \frac{1 \text{ mol } C_9H_8O_4}{1 \text{ mol } C_4H_6O_3} \times \frac{180.09 \text{ g}}{1 \text{ mol } C_9H_8O_4} = 7.06 \text{ g } C_9H_8O_4$$

$$\boxed{LR = C_7H_6O_3}$$

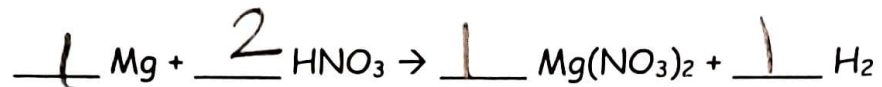
b) What is the theoretical yield (in grams) of aspirin,  $C_9H_8O_4$ ?

$$\boxed{2.60 \text{ g } C_9H_8O_4}$$

c) If the actual yield of aspirin is 2.10 g, what is the percentage yield?

$$\frac{2.10 \text{ g}}{2.60 \text{ g}} \times 100 = \boxed{80.8\%}$$

- 4) Balance this equation and state which type of reaction is taking place:



Type of reaction: SR

- 5) 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?

$$40 \text{ g Mg} \times \frac{1 \text{ mol Mg}}{24.3 \text{ g}} \times \frac{1 \text{ mol H}_2}{1 \text{ mol Mg}} \times \frac{2 \text{ g H}_2}{1 \text{ mol H}_2} = 3.3 \rightarrow \boxed{3 \text{ g H}_2}$$

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

$$\frac{1.7}{3.3} \times 100 = \boxed{51.25\%}$$