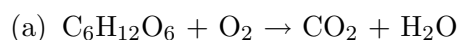


# S'more Chemical Equation Stoichiometry and Limiting Reactants Worksheet

1. Balance the following chemical equations:



2. Calculate the moles of  $\text{CO}_2$  produced when 10 moles of  $\text{C}_6\text{H}_{12}\text{O}_6$  react completely with excess  $\text{O}_2$ .

3. If 8.5 grams of  $\text{H}_2$  react with excess  $\text{O}_2$ , how many grams of  $\text{H}_2\text{O}$  will be formed? (Molar mass:  $\text{H}_2 = 2 \text{ g/mol}$ ,  $\text{H}_2\text{O} = 18 \text{ g/mol}$ )

4. Identify the limiting reactant when 5 moles of  $\text{Fe}_2\text{O}_3$  react with 15 moles of  $\text{H}_2$ . Write the balanced equation first.

5. Theoretical and Percent Yield:

(a) If the theoretical yield of a reaction is 25 grams of product and the actual yield is 20 grams, calculate the percent yield.

(b) Explain what factors might cause a reaction to have a percent yield less than 100

6. S'more Chemistry Context:

(a) Using the analogy of making s'mores (2 crackers + 1 chocolate +

1 marshmallow = 1 s'more), calculate how many s'mores can be made from 10 crackers, 5 chocolates, and 8 marshmallows. Identify the limiting reactant.

(b) If you have 3 s'mores leftover from a camping trip, calculate the percent yield if you expected to make 12 s'mores initially.

7. Challenge Problem:

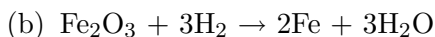
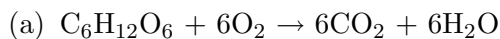
(a) A reaction requires 3 moles of A for every 2 moles of B. If you start with 12 moles of A and 10 moles of B, determine the limiting reactant and calculate the amount of product formed assuming a 1:1 molar ratio of product to B.

8. Real-Life Application:

(a) Ammonia ( $\text{NH}_3$ ) is produced using nitrogen gas ( $\text{N}_2$ ) and hydrogen gas ( $\text{H}_2$ ) in the Haber process:  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ . If you have 28 grams of  $\text{N}_2$  and 12 grams of  $\text{H}_2$ , determine the limiting reactant and calculate the mass of  $\text{NH}_3$  produced. (Molar masses:  $\text{N}_2 = 28 \text{ g/mol}$ ,  $\text{H}_2 = 2 \text{ g/mol}$ ,  $\text{NH}_3 = 17 \text{ g/mol}$ )

## Solutions

### 1. Balancing Chemical Equations:



### 2. Moles of CO<sub>2</sub> Produced:

- (a) From the equation, 1 mole of  $C_6H_{12}O_6$  produces 6 moles of  $CO_2$ . Therefore, 10 moles of  $C_6H_{12}O_6$  produce 60 moles of  $CO_2$ .

### 3. Mass of H<sub>2</sub>O Produced:

- (a) Moles of  $H_2 = \frac{8.5}{2} = 4.25$  moles.  
From the equation, 1 mole of  $H_2$  forms 1 mole of  $H_2O$ . Therefore, 4.25 moles of  $H_2O$  are formed.  
Mass of  $H_2O = 4.25 \times 18 = 76.5$  grams.

### 4. Limiting Reactant:

- (a)  $Fe_2O_3 + 3H_2 \rightarrow 2Fe + 3H_2O$ . From the stoichiometry, 5 moles of  $Fe_2O_3$  require 15 moles of  $H_2$ . Both are used completely; no limiting reactant.

### 5. Theoretical and Percent Yield:

- (a) Percent Yield =  $\frac{ActualYield}{TheoreticalYield} \times 100 = \frac{20}{25} \times 100 = 80\%$ .

- (b) Factors include incomplete reactions, side reactions, or loss of product during handling.

### 6. S'more Chemistry Context:

- (a) For 10 crackers, 5 chocolates, and 8 marshmallows: 10 crackers need 5 chocolates and 5 marshmallows. Since only 5 chocolates are available, chocolate is the limiting reactant. Maximum s'mores = 5.
- (b) Percent Yield =  $\frac{ActualYield}{ExpectedYield} \times 100 = \frac{3}{12} \times 100 = 25\%$ .

### 7. Challenge Problem:

- (a) For  $3A + 2B \rightarrow Product$ : Starting with 12 moles of A and 10 moles of B:  $\frac{12}{3} = 4$  reactions for A, and  $\frac{10}{2} = 5$  reactions for B. A is the limiting reactant. Product = 4 moles.

### 8. Real-Life Application:

- (a)  $N_2 + 3H_2 \rightarrow 2NH_3$ : Moles of  $N_2 = \frac{28}{28} = 1$  mole, Moles of  $H_2 = \frac{12}{2} = 6$  moles. From the stoichiometry, 1 mole of  $N_2$  reacts with 3 moles of  $H_2$ .  $N_2$  is the limiting reactant.  $NH_3$  formed =  $2 \times 1 = 2$  moles. Mass =  $2 \times 17 = 34$  grams.