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12.3 LIMITING REAGENT AND PERCENT YIELD

Section Review

Objectives

- Identify and use the limiting reagent in a reaction to calculate the maximum amount of product(s) produced and the amount of excess reagent
- Calculate theoretical yield, actual yield, or percent yield given the appropriate information

Vocabulary

- limiting reagent
- excess reagent
- theoretical yield
- actual yield
- percent yield

Key Equations

- percent yield = $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

Whenever quantities of two or more reactants are given in a stoichiometric problem, you must identify the ___1___. This is the reagent that is completely ___2___ in the reaction. The amount of limiting reagent determines the amount of ___3___ that is formed.

When an equation is used to calculate the amount of product that will form during a reaction, the value obtained is the ___4___. This is the ___5___ amount of product that could be formed from a given amount of reactant. The amount of product that forms when the reaction is carried out in the laboratory is called the ___6___.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

_____ **7.** Normally, the actual yield in a chemical reaction will be equal to or less than the theoretical yield.

_____ **8.** The actual yield of a chemical reaction can be calculated using mole ratios.

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_____ **9.** The amount of product can be determined from the amount of excess reagent.

_____ **10.** The percent yield of a product is 100 percent.

_____ **11.** If you had 100 steering wheels, 360 tires, and enough of every other part needed to assemble a car, the limiting reagent would be tires.

_____ **12.** The theoretical yield is the maximum amount of product that could be formed in a chemical reaction.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A	Column B
_____ **13.** actual yield	**a.** the ratio of the actual yield to the theoretical yield × 100
_____ **14.** limiting reagent	**b.** the amount of product actually formed when a reaction is carried out in the laboratory
_____ **15.** theoretical yield	**c.** the reactant that determines the amount of product that can be formed in a reaction
_____ **16.** percent yield	**d.** the reactant that is not completely used up in a chemical reaction
_____ **17.** excess reagent	**e.** the maximum amount of product that can be formed during a reaction

Part D Questions and Problems

Answer the following in the space provided.

18. a. What is the limiting reagent when 3.1 mol of SO_2 react with 2.7 mol of O_2 according to the equation:

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$

b. Calculate the maximum amount of product that can be formed and the amount of unreacted excess reagent.