

Limiting Reactants

Chem Worksheet 12-3

Name _____

When an automobile production plant runs out of tires no more cars can be produced even if there are still plenty of engines, bodies, seats, and other parts. When one of the reactants in a chemical reaction runs out the reaction stops as well. The substance that limits production in a chemical reaction is known as the **limiting reactant**. The reactant that is left over when the reaction stops is called the **excess reactant**.



Consider the chemical reaction between calcium and iodine. When 160 g (4 moles) of calcium reacts with 254 g (1 mole) of iodine the reaction makes 294 g (1 mole) of calcium iodide. Although there is enough calcium to make more calcium iodide, the iodine runs out first. Since all of the iodine gets used up it is called the limiting reactant. According to the balanced equation, if one mole of iodine reacts, one mole of calcium will react. This means that there are still 3 moles of calcium left. Because calcium is left over it is called the excess reactant.



Example

What mass of iron (II) sulfide will be produced if 9.68 g of iron reacts with 6.28 g of sulfur?



- balance the equation



- perform a calculation for each reactant:

$$\text{Fe} : \frac{9.68 \text{ g Fe}}{1} \times \frac{1 \text{ mol Fe}}{55.85 \text{ g Fe}} \times \frac{1 \text{ mol FeS}}{1 \text{ mol Fe}} \times \frac{87.91 \text{ g FeS}}{1 \text{ mol FeS}} = 15.24 \text{ g FeS}$$

$$\text{S} : \frac{6.28 \text{ g S}}{1} \times \frac{1 \text{ mol S}}{32.06 \text{ g S}} \times \frac{1 \text{ mol FeS}}{1 \text{ mol S}} \times \frac{87.91 \text{ g FeS}}{1 \text{ mol FeS}} = 17.22 \text{ g FeS}$$

- whichever reactant makes less product is the limiting reactant:

Iron is the limiting reactant. There is enough sulfur to make 17.22 g FeS, but only enough iron to make 15.24 g of FeS.

Find the amount of product formed in each of the following reactions.

- What mass of H_2O will be produced if 9.5 g of H_2 reacts with 1.2 g of O_2 ?

$$\underline{\hspace{1cm}} \text{H}_2 + \underline{\hspace{1cm}} \text{O}_2 \rightarrow \underline{\hspace{1cm}} \text{H}_2\text{O}$$
- If 1.85 g of $\text{Mg}(\text{OH})_2$ reacts with 3.71 g of HCl , how much MgCl_2 is produced? What is the limiting reactant?

$$\underline{\hspace{1cm}} \text{Mg}(\text{OH})_2 + \underline{\hspace{1cm}} \text{HCl} \rightarrow \underline{\hspace{1cm}} \text{MgCl}_2 + \underline{\hspace{1cm}} \text{H}_2\text{O}$$
- What mass of AgCl is produced when 53.42 g of AgNO_3 reacts with 14.19 g of NaCl ?

$$\underline{\hspace{1cm}} \text{AgNO}_3 + \underline{\hspace{1cm}} \text{NaCl} \rightarrow \underline{\hspace{1cm}} \text{AgCl} + \underline{\hspace{1cm}} \text{NaNO}_3$$
- If 14.7 g of calcium is placed in 11.5 g of water, what mass of hydrogen gas is produced?

$$\underline{\hspace{1cm}} \text{Ca} + \underline{\hspace{1cm}} \text{H}_2\text{O} \rightarrow \underline{\hspace{1cm}} \text{Ca}(\text{OH})_2 + \underline{\hspace{1cm}} \text{H}_2$$
- What mass of potassium hydroxide is formed when 8.2 g of potassium oxide is added to 1.3 g of water?

$$\underline{\hspace{1cm}} \text{K}_2\text{O} + \underline{\hspace{1cm}} \text{H}_2\text{O} \rightarrow \underline{\hspace{1cm}} \text{KOH}$$
- What mass of aluminum chloride could be made from 8.1 g of aluminum and 4.2 L of chlorine at STP?

$$\underline{\hspace{1cm}} \text{Al} + \underline{\hspace{1cm}} \text{Cl}_2 \rightarrow \underline{\hspace{1cm}} \text{AlCl}_3$$
- If 5.26 L of nitrogen monoxide and 7.64 L of oxygen are combined, what mass of nitrogen dioxide is formed? Assume conditions are STP.

$$\underline{\hspace{1cm}} \text{NO} + \underline{\hspace{1cm}} \text{O}_2 \rightarrow \underline{\hspace{1cm}} \text{NO}_2$$
- If 18.1 g of silicon tetrachloride reacts with 8.4 L of hydrogen at STP, what mass of silicon is formed?

$$\underline{\hspace{1cm}} \text{SiCl}_4 + \underline{\hspace{1cm}} \text{H}_2 \rightarrow \underline{\hspace{1cm}} \text{Si} + \underline{\hspace{1cm}} \text{HCl}$$
- What mass of $\text{Cu}(\text{OH})_2$ is produced in the reaction of 7.6 g $\text{Cu}(\text{NO}_3)_2$ with 6.2 g of KOH ?

$$\underline{\hspace{1cm}} \text{Cu}(\text{NO}_3)_2 + \underline{\hspace{1cm}} \text{KOH} \rightarrow \underline{\hspace{1cm}} \text{Cu}(\text{OH})_2 + \underline{\hspace{1cm}} \text{KNO}_3$$
- What mass of carbon dioxide is formed when 64 kg of ethylene is burned in 142 kg of oxygen?

$$\underline{\hspace{1cm}} \text{C}_2\text{H}_4 + \underline{\hspace{1cm}} \text{O}_2 \rightarrow \underline{\hspace{1cm}} \text{CO}_2 + \underline{\hspace{1cm}} \text{H}_2\text{O}$$

Limiting Reactions Chem Worksheet 12 3 Answers

Michal Rosen-Zvi



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Table of Contents Limiting Reactions Chem Worksheet 12 3 Answers

1. Understanding the eBook Limiting Reactions Chem Worksheet 12 3 Answers
 - The Rise of Digital Reading Limiting Reactions Chem Worksheet 12 3 Answers
 - Advantages of eBooks Over Traditional Books
2. Identifying Limiting Reactions Chem Worksheet 12 3 Answers
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Limiting Reactions Chem Worksheet 12 3 Answers
 - User-Friendly Interface
4. Exploring eBook Recommendations from Limiting Reactions Chem Worksheet 12 3 Answers
 - Personalized Recommendations
 - Limiting Reactions Chem Worksheet 12 3 Answers User Reviews and Ratings
 - Limiting Reactions Chem Worksheet 12 3 Answers and Bestseller Lists
5. Accessing Limiting Reactions Chem Worksheet 12 3 Answers Free and Paid eBooks
 - Limiting Reactions Chem Worksheet 12 3 Answers Public Domain eBooks
 - Limiting Reactions Chem Worksheet 12 3 Answers eBook Subscription Services
 - Limiting Reactions Chem Worksheet 12 3 Answers Budget-Friendly Options
6. Navigating Limiting Reactions Chem Worksheet 12 3 Answers eBook Formats

- ePub, PDF, MOBI, and More
 - Limiting Reactions Chem Worksheet 12 3 Answers Compatibility with Devices
 - Limiting Reactions Chem Worksheet 12 3 Answers Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Limiting Reactions Chem Worksheet 12 3 Answers
 - Highlighting and Note-Taking Limiting Reactions Chem Worksheet 12 3 Answers
 - Interactive Elements Limiting Reactions Chem Worksheet 12 3 Answers
 8. Staying Engaged with Limiting Reactions Chem Worksheet 12 3 Answers
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Limiting Reactions Chem Worksheet 12 3 Answers
 9. Balancing eBooks and Physical Books Limiting Reactions Chem Worksheet 12 3 Answers
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Limiting Reactions Chem Worksheet 12 3 Answers
 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
 11. Cultivating a Reading Routine Limiting Reactions Chem Worksheet 12 3 Answers
 - Setting Reading Goals Limiting Reactions Chem Worksheet 12 3 Answers
 - Carving Out Dedicated Reading Time
 12. Sourcing Reliable Information of Limiting Reactions Chem Worksheet 12 3 Answers
 - Fact-Checking eBook Content of Limiting Reactions Chem Worksheet 12 3 Answers
 - Distinguishing Credible Sources
 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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