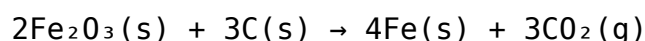


Calculate The Number Of Grams Of Fe₂O₃ Needed To React With 19.0g C

2Fe₂O₃(s)+3C(s) - 4Fe(s) + 3CO₂g

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When working with chemical reactions, one common task is to determine the amount of a reactant needed to produce a desired amount of product or to react completely with a given substance. In this article, we will explore how to calculate the number of grams of Fe₂O₃ (iron(III) oxide) required to react with 19.0 grams of carbon (C) based on the balanced chemical equation:

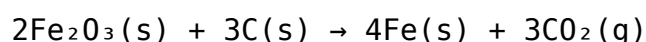


Understanding this process involves several steps, including stoichiometry, molar mass calculations, and the application of mole ratios. Let's walk through the process in detail to help you master how to perform such calculations.

Understanding the Chemical Equation

Balanced Chemical Equation

The reaction provided is:



This balanced equation indicates the molar ratios of reactants and products:

- 2 moles of Fe₂O₃ react with 3 moles of C to produce 4 moles of Fe and 3 moles of CO₂.

What This Means for Calculations

- For every 3 moles of carbon, 2 moles of Fe₂O₃ are needed.
- The molar ratio of Fe₂O₃ to C is 2:3.

Our goal is to find out how many grams of Fe₂O₃ are needed to react with 19.0 grams of carbon.

Step 1: Convert Grams of Carbon to Moles

The first step in any stoichiometric calculation is to convert the given mass of a substance to moles, as mole ratios are used to relate quantities in balanced equations.

Calculate the molar mass of Carbon (C)

- Atomic mass of carbon (C): approximately 12.01 g/mol

Convert 19.0 grams of carbon to moles

$$\begin{aligned} \text{Moles of C} &= \frac{\text{Mass of C}}{\text{Molar mass of C}} = \\ &= \frac{19.0 \text{ g}}{12.01 \text{ g/mol}} \approx 1.58 \text{ mol} \end{aligned}$$

Result: Approximately 1.58 mol of carbon.

Step 2: Use Mole Ratios to Find Moles of Fe₂O₃ Needed

From the balanced equation, the mole ratio of Fe₂O₃ to C is:

$$\frac{2 \text{ mol Fe}_2\text{O}_3}{3 \text{ mol C}}$$

To find the moles of Fe₂O₃ that react with 1.58 mol of C:

$$\begin{aligned} \text{Moles of Fe}_2\text{O}_3 &= \frac{2}{3} \times \text{Moles of C} = \\ &= \frac{2}{3} \times 1.58 \approx 1.05 \text{ mol} \end{aligned}$$

Result: About 1.05 mol of Fe₂O₃ are needed.

Step 3: Convert Moles of Fe₂O₃ to Grams

Next, convert moles of Fe₂O₃ to grams.

Calculate the molar mass of Fe₂O₃

- Iron (Fe): approximately 55.85 g/mol
- Oxygen (O): approximately 16.00 g/mol

```
\[
\text{Molar mass of Fe}_2\text{O}_3 = (2 \times 55.85) + (3 \times 16.00) =
111.70 + 48.00 = 159.70\text{ g/mol}
\]
```

Calculate grams of Fe₂O₃ needed

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\[
\text{Mass of Fe}_2\text{O}_3 = \text{Moles} \times \text{Molar mass} =
1.05\text{ mol} \times 159.70\text{ g/mol} \approx 167.7\text{ g}
\]
```

Result: Approximately 167.7 grams of Fe₂O₃ are required.

Summary of the Calculation

To summarize, here are the key steps:

- Convert the given grams of carbon to moles: 19.0 g C $\approx$ 1.58 mol C
- Use the mole ratio from the balanced equation to find moles of Fe₂O₃:
1.05 mol Fe₂O₃
- Convert moles of Fe₂O₃ to grams: $\approx$ 167.7 g Fe₂O₃

Therefore, approximately 167.7 grams of Fe₂O₃ are needed to completely react with 19.0 grams of carbon.

Additional Tips for Stoichiometry Calculations

Always Check the Mole Ratios

The key to accurate stoichiometry is understanding and applying the correct mole ratios from the balanced chemical equation. Always verify the coefficients before performing calculations.

Use Precise Atomic Masses

Using more precise atomic masses (e.g., 12.01 for C, 55.85 for Fe, 16.00 for O) improves the accuracy of your calculations.

Round Appropriately

Round your final answers to a suitable number of significant figures based on the data provided. For example, since the initial mass of carbon was given to three significant figures, round your final answer accordingly.

Why Is This Calculation Important?

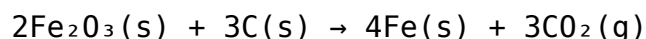
Understanding how to calculate the required amount of a reactant is fundamental in chemistry, especially in industrial processes, laboratory experiments, and environmental studies. It allows chemists to:

- Optimize reactant usage
- Minimize waste
- Design efficient chemical processes
- Calculate yields and theoretical product amounts

Conclusion

Calculating the grams of Fe_2O_3 needed to react with a specific amount of carbon involves converting grams to moles, applying mole ratios from the balanced equation, and converting moles back to grams. In this case, approximately 167.7 grams of Fe_2O_3 are required to react completely with 19.0

grams of carbon according to the reaction:



Mastering these steps enhances your ability to perform stoichiometric calculations confidently and accurately, a vital skill in both academic and professional chemistry settings.

Frequently Asked Questions

How do I determine the number of grams of Fe₂O₃ needed to react with 19.0 g of C in the given reaction?

First, calculate the moles of C using its molar mass, then use the stoichiometry of the balanced equation to find the moles of Fe₂O₃ required, and finally convert that to grams.

What is the molar mass of Fe₂O₃ used in calculations?

The molar mass of Fe₂O₃ is approximately 159.69 g/mol, calculated as (2 × 55.85) + (3 × 16.00).

How many moles of carbon are present in 19.0 grams of C?

Number of moles of C = 19.0 g / 12.01 g/mol ≈ 1.58 mol.

What is the molar ratio between Fe₂O₃ and C in the reaction?

From the balanced equation, 2 mol Fe₂O₃ reacts with 3 mol C, so the ratio is 2:3.

How do I calculate the grams of Fe₂O₃ needed for 1.58 mol of C?

Use the molar ratio: (2 mol Fe₂O₃ / 3 mol C) × 1.58 mol C = 1.05 mol Fe₂O₃. Then, multiply by the molar mass: 1.05 mol × 159.69 g/mol ≈ 167.7 g of Fe₂O₃.

What is the final answer for the grams of Fe₂O₃

needed in this reaction?

Approximately 167.7 grams of Fe₂O₃ are required to react with 19.0 g of C.

Why is it important to use the balanced chemical equation in this calculation?

Because the balanced equation provides the correct molar ratios of reactants and products, ensuring accurate stoichiometric conversions.

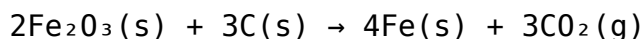
Additional Resources

Calculate The Number Of Grams Of Fe₂O₃ Needed To React With 19.0 g C

Introduction

Understanding chemical reactions at the molecular level is foundational to both academic chemistry and industrial applications. A core skill in this domain is accurately calculating the quantities of reactants required or produced in a chemical process. In this context, the problem of determining how many grams of iron(III) oxide (Fe₂O₃) are needed to react with a specified amount of carbon (C) is a classic example of stoichiometric analysis. This type of calculation is vital in fields such as materials science, metallurgy, environmental chemistry, and chemical engineering, where precise reactant proportions influence efficiency, cost, and safety.

This article explores the step-by-step process of calculating the mass of Fe₂O₃ required to completely react with 19.0 grams of carbon, based on the balanced chemical equation:



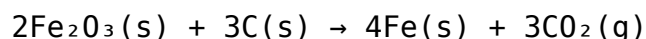
The investigation proceeds through a detailed review of stoichiometric principles, molar conversions, and contextual understanding of the reaction, culminating in a comprehensive calculation that demonstrates the application of theoretical chemistry to practical problems.

Understanding the Chemical Equation

Before engaging in calculations, it is essential to interpret the reaction correctly, including the role of each component and the significance of the coefficients in the balanced equation.

The Balanced Equation

The given reaction is:



This indicates:

- Reactants: 2 moles of iron(III) oxide (Fe_2O_3) react with 3 moles of carbon (C).
- Products: The reaction yields 4 moles of elemental iron (Fe) and 3 moles of carbon dioxide (CO_2).

The coefficients 2, 3, 4, and 3 define molar ratios critical for stoichiometric calculations.

Stoichiometric Ratios and Their Significance

From the balanced equation:

- 2 mol Fe_2O_3 reacts with 3 mol C.
- To find the amount of Fe_2O_3 needed to react with a given mass of C, we need to convert grams of C into moles, then use molar ratios to find moles of Fe_2O_3 , and finally convert back into grams.

Step-by-Step Calculation Methodology

The comprehensive process involves:

1. Calculating the moles of carbon reacting.
2. Using molar ratios to determine the moles of Fe_2O_3 required.
3. Converting the moles of Fe_2O_3 into grams.

This systematic approach ensures accuracy and clarity.

Step 1: Convert grams of C to moles

The molar mass of carbon (C):

- Atomic mass of C ≈ 12.01 g/mol

Given:

- Mass of C = 19.0 g

Calculate:

$$\begin{aligned} \text{moles of C} &= \frac{\text{mass}}{\text{molar mass}} = \frac{19.0 \text{ g}}{12.01 \text{ g/mol}} \approx 1.58 \text{ mol} \end{aligned}$$

Step 2: Use molar ratios to determine moles of Fe₂O₃

From the balanced equation:

- 3 mol C react with 2 mol Fe₂O₃

Set up a proportion:

$$\frac{2 \text{ mol Fe}_2\text{O}_3}{3 \text{ mol C}} = \frac{x \text{ mol Fe}_2\text{O}_3}{1.58 \text{ mol C}}$$

Solve for (x):

$$x = \frac{2}{3} \times 1.58 \approx 1.053 \text{ mol}$$

Thus, approximately 1.053 mol of Fe₂O₃ are needed to react with 1.58 mol of carbon.

Calculating the Mass of Fe₂O₃ Required

Step 3: Convert moles of Fe₂O₃ to grams

The molar mass of Fe₂O₃:

- Iron (Fe): approximately 55.85 g/mol
- Oxygen (O): approximately 16.00 g/mol

Calculate:

\[

$\text{Molar mass of Fe}_2\text{O}_3 = (2 \times 55.85) + (3 \times 16.00) = 111.70 + 48.00 = 159.70 \text{ g/mol}$

Determine the mass:

$\text{Mass of Fe}_2\text{O}_3 = 1.053 \text{ mol} \times 159.70 \text{ g/mol} \approx 168.3 \text{ g}$

Final Result and Implications

Based on the calculations, approximately 168.3 grams of Fe_2O_3 are required to fully react with 19.0 grams of carbon according to the given chemical reaction.

This quantitative insight has multiple practical implications:

- Industrial applications: In steel-making or reduction processes, precise quantities of raw materials are vital for efficiency and cost-effectiveness.
- Environmental considerations: Understanding reactant proportions helps in optimizing processes to minimize waste and emissions.
- Educational value: Demonstrates the practical application of stoichiometry, reinforcing theoretical principles with real-world relevance.

Additional Considerations and Potential Variations

While the above calculation assumes pure reactants and complete reaction, real-world scenarios may involve considerations such as:

- Purity of reactants: Impurities may alter the required quantities.
- Reaction conditions: Temperature and pressure can influence reaction completeness.
- Excess reactant: Practical processes often use excess Fe_2O_3 to ensure complete reduction of carbon.

Moreover, similar calculations can be extended to other related reactions, such as the reduction of Fe_2O_3 with different reducing agents or in different phases.

Conclusion

Calculating the amount of Fe_2O_3 needed to react with a given mass of carbon exemplifies the core principles of chemical stoichiometry. This process involves converting mass to moles, applying molar ratios from the balanced equation, and converting back to grams, providing a clear pathway from theoretical chemistry to practical application. Mastery of these calculations supports advancements in industrial chemistry, environmental management, and educational endeavors, illustrating the enduring importance of precise quantitative analysis in chemical sciences.

In summary:

- 19.0 g of carbon corresponds to approximately 1.58 mol C.
- Using molar ratios, about 1.053 mol Fe_2O_3 is needed.
- This equates to roughly 168.3 grams of Fe_2O_3 required for complete reaction.

This detailed analysis underscores the importance of stoichiometry as a bridge between chemical equations and real-world quantities, enabling scientists and engineers to design efficient, safe, and sustainable chemical processes.

References

- Zumdahl, S. S., & Zumdahl, S. A. (2014). Chemistry: An Atoms First Approach. Cengage Learning.
- House, J. E. (2007). Principles of Chemical Nomenclature and Stoichiometry. Academic Press.
- Lide, D. R. (Ed.). (2004). CRC Handbook of Chemistry and Physics (85th ed.). CRC Press.

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