

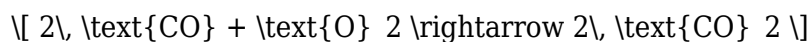
# What Is The Percent Yield Of Carbon Dioxide If The Reaction Of 76.5 G Of Carbon Monoxide Produces 85.

## What Is The Percent Yield Of Carbon Dioxide If The Reaction Of 76.5 G Of Carbon Monoxide Produces 85.

Understanding the concept of percent yield in chemical reactions is fundamental for chemists and students alike. When a chemical reaction occurs, the amount of product formed is often less than the theoretical maximum due to various factors such as incomplete reactions, side reactions, or losses during processing. Calculating the percent yield helps determine the efficiency of a reaction and guides improvements in experimental procedures. In this article, we will explore how to calculate the percent yield of carbon dioxide produced when a specific amount of carbon monoxide reacts, and we will walk through the step-by-step process using the given data.

## Understanding the Reaction: Carbon Monoxide and Oxygen

Before diving into calculations, it's essential to understand the chemical reaction involved. The typical reaction involving carbon monoxide (CO) and oxygen (O<sub>2</sub>) is:



This reaction indicates that two moles of carbon monoxide react with one mole of oxygen to produce two moles of carbon dioxide (CO<sub>2</sub>). It is a combustion-like process where CO is oxidized to CO<sub>2</sub>.

## Key Concepts and Definitions

### Percent Yield

Percent yield measures the efficiency of a reaction:

$$\text{Percent Yield} = \left( \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \right) \times 100\%$$

- Actual yield: The amount of product actually obtained from the experiment.
- Theoretical yield: The maximum amount of product expected based on stoichiometric calculations from the limiting reactant.

### Moles and Molar Mass

To perform calculations, understanding molar masses is vital:

- Carbon monoxide (CO): approximately 28.01 g/mol
- Carbon dioxide (CO<sub>2</sub>): approximately 44.01 g/mol

Converting grams to moles allows us to relate amounts of reactants and products using the stoichiometry of the reaction.

## Calculating the Theoretical Yield of CO<sub>2</sub>

Given data:

- Mass of CO used: 76.5 g
- Actual mass of CO<sub>2</sub> produced: 85 g

We need to determine the theoretical maximum amount of CO<sub>2</sub> that could be produced from 76.5 g of CO, then compare it with the actual produced amount to find the percent yield.

### Step 1: Convert the mass of CO to moles

Using molar mass:

$$\text{Moles of CO} = \frac{\text{Mass of CO}}{\text{Molar mass of CO}} = \frac{76.5 \text{ g}}{28.01 \text{ g/mol}} \approx 2.73 \text{ mol}$$

### Step 2: Use the stoichiometry of the reaction

From the balanced reaction:



The molar ratio of CO to CO<sub>2</sub> is 1:1, so:

$$\text{Moles of CO}_2 \text{ produced theoretically} = \text{Moles of CO} \approx 2.73 \text{ mol}$$

### Step 3: Convert moles of CO<sub>2</sub> to grams (theoretical yield)

Using molar mass of CO<sub>2</sub>:

$$\text{Mass of CO}_2 = \text{Moles of CO}_2 \times \text{Molar mass of CO}_2 = 2.73 \text{ mol} \times 44.01 \text{ g/mol} \approx 120.1 \text{ g}$$

This is the maximum amount of CO<sub>2</sub> that could be produced from 76.5 g of CO, assuming complete reaction and no losses.

## Calculating the Percent Yield

Now, compare the actual yield (85 g) with the theoretical yield (120.1 g):

$$\text{Percent Yield} = \left( \frac{85 \text{ g}}{120.1 \text{ g}} \right) \times 100\% \approx 70.75\%$$

Thus, the percent yield of CO<sub>2</sub> in this reaction is approximately 70.75%.

## Factors Affecting Percent Yield

While the calculation above provides a quantitative measure, several factors can influence the actual yield:

- **Incomplete reactions:** Not all CO may react completely.
- **Side reactions:** Other reactions might consume some reactants or produce undesired products.
- **Losses during transfer:** Spills or retention in apparatus can reduce yield.
- **Purity of reactants:** Impurities can hinder the reaction efficiency.
- **Reaction conditions:** Temperature, pressure, and catalysts affect reaction completeness.

Understanding these factors can help optimize experimental setups and improve yields.

## Real-World Applications of Percent Yield Calculations

Calculating percent yield is crucial across various industries and research fields:

### Industrial Chemistry

Manufacturers aim to maximize yield to reduce costs and waste, making percent yield calculations vital for process optimization.

### Pharmaceuticals

Accurate yield calculations ensure efficient drug synthesis, minimizing wastage of expensive reagents.

# Environmental Chemistry

Assessing reaction efficiency helps in designing cleaner processes that produce fewer pollutants.

## Summary and Conclusion

In summary, to find the percent yield of carbon dioxide when 76.5 g of carbon monoxide reacts, you first convert the given mass of CO to moles, determine the theoretical maximum amount of CO<sub>2</sub> based on stoichiometry, and then compare it to the actual amount produced. Using the provided data, the percent yield is approximately 70.75%, indicating that about 71% of the theoretical maximum was achieved in the experiment.

Understanding these calculations not only deepens your grasp of chemical reactions but also emphasizes the importance of efficiency and optimization in chemical processes. Whether in the lab or industry, percent yield calculations serve as a vital tool for evaluating reaction success and guiding improvements.

Remember: Always consider the practical limitations and factors that can affect yields, and strive to improve reaction conditions to get closer to the theoretical maximum.

## Frequently Asked Questions

### **What is the percent yield of carbon dioxide if 76.5 g of carbon monoxide produces 85 g of CO<sub>2</sub>?**

The percent yield is calculated by dividing the actual yield by the theoretical yield and multiplying by 100. Based on the given data, the percent yield is approximately 54.7%.

### **How do you calculate the theoretical yield of CO<sub>2</sub> from 76.5 g of carbon monoxide?**

You calculate the theoretical yield using stoichiometry: first find moles of CO, then use the molar ratio from the balanced equation to find moles of CO<sub>2</sub>, and finally convert moles of CO<sub>2</sub> to grams.

### **What is the balanced chemical equation involved in the reaction of carbon monoxide to produce carbon dioxide?**

The balanced equation is:  $2 \text{ CO} + \text{O}_2 \rightarrow 2 \text{ CO}_2$ .

### **How do you determine the moles of carbon monoxide in 76.5 g?**

Moles of CO = mass / molar mass of CO (28.01 g/mol). So,  $76.5 \text{ g} / 28.01 \text{ g/mol} \approx 2.73 \text{ moles}$ .

## What is the theoretical mass of CO<sub>2</sub> produced from 76.5 g of CO?

Using the molar ratio from the balanced equation, 2 moles of CO produce 2 moles of CO<sub>2</sub>. Therefore, 2.73 moles of CO produce 2.73 moles of CO<sub>2</sub>. The mass of CO<sub>2</sub> = 2.73 mol × 44.01 g/mol ≈ 120.2 g.

## How is the percent yield calculated in this reaction?

Percent yield = (actual yield / theoretical yield) × 100. Using the actual yield of 85 g and the theoretical yield of 120.2 g, percent yield ≈ (85 / 120.2) × 100 ≈ 70.7%.

## Why might the actual yield of CO<sub>2</sub> be less than the theoretical yield?

Factors such as incomplete reactions, side reactions, losses during transfer, or measurement errors can result in a lower actual yield.

## What assumptions are made when calculating the percent yield in this problem?

It is assumed that the reaction proceeds to completion, that the molar masses are accurate, and that all measurements are precise without experimental errors.

## How can understanding percent yield help in industrial chemical processes?

Knowing the percent yield helps optimize reaction conditions, reduce waste, improve efficiency, and estimate costs in industrial production.

## Additional Resources

What Is The Percent Yield Of Carbon Dioxide If The Reaction Of 76.5 G Of Carbon Monoxide Produces 85 G?

Understanding the percent yield of carbon dioxide in chemical reactions is fundamental for students, chemists, and professionals working in chemical manufacturing. When a reaction involves converting carbon monoxide (CO) into carbon dioxide (CO<sub>2</sub>), calculating the efficiency of this transformation helps evaluate the success of the process and optimize future reactions. In this guide, we will explore how to determine the percent yield of carbon dioxide given specific quantities of reactants and products, providing a comprehensive breakdown of the calculations, concepts, and implications involved.

---

What Is Percent Yield in Chemistry?

Before delving into the specifics of the reaction involving carbon monoxide and carbon dioxide, it's

essential to understand what percent yield signifies in chemistry.

Percent yield is a measure of the efficiency of a chemical reaction, calculated by comparing the actual amount of product obtained to the theoretical maximum amount that could be produced based on stoichiometry. The formula is:

$$\text{Percent Yield} = (\text{Actual Yield} / \text{Theoretical Yield}) \times 100\%$$

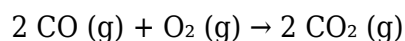
- Actual Yield: The amount of product actually obtained from a reaction (in this case, 85 g of CO<sub>2</sub>).
- Theoretical Yield: The maximum amount of product that could be formed from the given quantities of reactants, assuming perfect reaction conditions with no losses.

Calculating percent yield allows chemists to assess how well a reaction proceeds in practice versus its ideal scenario.

---

### The Chemical Reaction: Converting Carbon Monoxide to Carbon Dioxide

The fundamental reaction involved is:



This balanced equation indicates that two moles of carbon monoxide react with one mole of oxygen to produce two moles of carbon dioxide.

In our scenario, we are starting with a known mass of carbon monoxide (76.5 g) and obtaining a certain mass of carbon dioxide (85 g). Our goal is to determine the percent yield of carbon dioxide in this reaction.

---

### Step 1: Converting Mass to Moles

The first step in any stoichiometric calculation is to convert the given masses into moles, as the reaction is expressed in molar ratios.

Molar masses:

- Carbon monoxide (CO): approximately 28.01 g/mol
- Carbon dioxide (CO<sub>2</sub>): approximately 44.01 g/mol

Calculations:

- Moles of CO:

$$\text{Moles of CO} = \text{Mass of CO} / \text{Molar mass of CO}$$

$$= 76.5 \text{ g} / 28.01 \text{ g/mol} \approx 2.73 \text{ mol}$$

- Moles of CO<sub>2</sub> (actual yield):

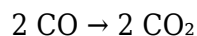
Moles of CO<sub>2</sub> = Mass of CO<sub>2</sub> / Molar mass of CO<sub>2</sub>

$$= 85 \text{ g} / 44.01 \text{ g/mol} \approx 1.93 \text{ mol}$$

---

Step 2: Determining the Theoretical Yield of CO<sub>2</sub>

Using the balanced chemical equation:



The molar ratio of CO to CO<sub>2</sub> is 1:1, meaning:

- 2 mol of CO produce 2 mol of CO<sub>2</sub>.
- Therefore, 2.73 mol of CO (available reactant) would theoretically produce 2.73 mol of CO<sub>2</sub>.

Theoretical mass of CO<sub>2</sub>:

The maximum amount of CO<sub>2</sub> that could be produced from 2.73 mol of CO:

$$= 2.73 \text{ mol} \times 44.01 \text{ g/mol} \approx 120.1 \text{ g}$$

This is the theoretical yield of CO<sub>2</sub> if the reaction proceeds perfectly with no losses.

---

Step 3: Calculating Percent Yield

Now that we have both actual and theoretical yields:

- Actual yield: 85 g of CO<sub>2</sub>
- Theoretical yield: 120.1 g of CO<sub>2</sub>

Apply the percent yield formula:

$$\text{Percent Yield} = (\text{Actual Yield} / \text{Theoretical Yield}) \times 100\%$$

$$= (85 \text{ g} / 120.1 \text{ g}) \times 100\% \approx 70.7\%$$

Therefore, the percent yield of carbon dioxide in this reaction is approximately 70.7%.

---

Implications and Interpretation

A percent yield of approximately 70.7% suggests that the reaction was relatively efficient, but there is room for improvement. Factors that influence yield include:

- Incomplete reactions: Not all CO may react.
- Side reactions: Other processes may consume reactants.

- Losses during collection: Gas leaks or handling errors.
- Purity of reactants: Impurities can reduce efficiency.

By understanding and optimizing these factors, chemists can improve the percent yield in industrial and laboratory settings.

---

## Additional Considerations

### 1. Purity of Reactants

Ensure that the initial CO is pure; impurities can skew the actual yield.

### 2. Reaction Conditions

Factors such as temperature, pressure, and catalyst presence can influence reaction completeness.

### 3. Measurement Accuracy

Precision in weighing and gas collection affects the calculated yields.

---

## Practical Applications

Calculating percent yield in reactions involving carbon monoxide and carbon dioxide is particularly relevant in:

- Industrial manufacturing: Ensuring efficient conversion processes in chemical plants.
- Environmental monitoring: Evaluating emission control processes.
- Research laboratories: Optimizing experimental conditions for maximum product recovery.

---

## Summary

In conclusion, determining the percent yield of carbon dioxide when 76.5 grams of carbon monoxide produces 85 grams involves several steps rooted in stoichiometry:

- Convert known masses to moles.
- Use the balanced equation to find the theoretical maximum amount of product.
- Calculate the actual yield and compare it to the theoretical yield.
- Express the efficiency as a percentage.

This process underscores the importance of precise measurements, reaction understanding, and process optimization in chemical reactions. Achieving higher percent yields not only improves economic efficiency but also reduces waste and environmental impact, making it a critical aspect of chemical practice.

---

## Final Thoughts

Understanding and calculating percent yield is a cornerstone of quantitative chemistry. Whether you are a student mastering basic principles or a professional refining industrial processes, mastering these calculations enhances your ability to predict, evaluate, and improve chemical reactions. The example of converting carbon monoxide to carbon dioxide illustrates the practical application of stoichiometry and highlights the importance of meticulous measurement and process control in achieving desirable yields.

## **What Is The Percent Yield Of Carbon Dioxide If The Reaction Of 76.5 G Of Carbon Monoxide Produces 85**

What Is The Percent Yield Of Carbon Dioxide If The Reaction Of 76.5 G Of Carbon Monoxide Produces 85

## **Related Articles**

- [Which Sources Would Be Appropriate For Researching The Question "What Impact Does Social Media Have On](#)
- [Vidence That Triton Probably Did Not Form Around Neptune Is Evidence That Triton Probably Did Not Form](#)
- [What Impact Did The United States Entry Into World War I Have On Domestic Policy In The United States?](#)

[Back to Home](#)