

Percentage yield (Unit: _____)

❖ There are two types of yield:

- I. Theoretical yield: The quantity of product that is calculated to form.
- II. Actual yield : The amount of product actually obtained in a reaction.

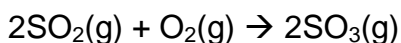
❖ The actual yield is always less than the theoretical yield.

❖ The percentage yield can be calculated from the following expression:

$$\text{Percentage yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$$

Example 1:

128g of sulphur dioxide, SO₂, was reacted with oxygen to produce sulphur trioxide, SO₃.
The equation for the reaction is:



140g of SO₃ was produced in the reaction. Calculate the percentage yield of the SO₃.

Solution

Step 1 : Balanced equation	
Step 2 : Mole ratio	
Step 2.5* : Calculate no. of moles (SO ₂)	
Step 3 : Find no. of moles (SO ₃)	
Step 4 : Find the mass	

Step 5 : Percentage yield	
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Therefore, the percentage yield of SO_3 is _____ %.

Example 2

50.0 cm^3 of 0.105 mol/dm^3 aqueous calcium chloride was treated with an excess of aqueous silver nitrate. White silver chloride was precipitated. The precipitate was dried and weighed. A mass of 1.45g was recorded. Calculate the percentage yield.

Solution

Step 1 : Balanced equation	
Step 2 : Mole ratio	
Step 2.5* : Calculate no. of moles (CaCl_2)	
Step 3 : Find no. of moles (AgCl)	
Step 4 : Find the mass (AgCl)	
Step 5 : Percentage yield	

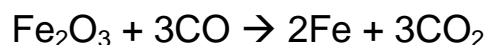
Exercise 1

1. When sodium is reacted with chlorine, sodium chloride is obtained.

a) What mass of sodium chloride is obtained if 5g of sodium was reacted.

b) If the experimental yield is 6g. What is the percentage yield?

2. Iron and carbon dioxide were produced when iron (III) oxide was reacted with carbon monoxide.



Experimentally, 20g of iron was produced when 40g of iron (III) oxide was reacted. What is the percentage of iron?

3. In an experiment, 32g of sulphur trioxide yield 24g sulphur trioxide.

Calculate the percentage yield of sulphur trioxide, SO_3 ?

Percentage purity (Unit: _____)

It gives an indication of the amount of impurity in a chemical substance.

The percentage purity of a sample of a substance can be calculated from the following formula:

$$\text{Percentage purity} = \frac{\text{mass of pure substance in sample}}{\text{Mass of sample}} \times 100\%$$

Example 1

An impure sample of calcium carbonate (CaCO_3) contains calcium sulphate as an impurity. When excess hydrochloric acid was added to 6g of the sample, 1200 cm^3 of gas was produced (measured at r.t.p.). Calculate the percentage purity of the calcium carbonate sample.

Solution

Step 1 : Balanced equation	
Step 2 : Mole ratio	
Step 2.5* : Calculate no. of moles (CO_2)	
Step 3 : Find no. of moles (CaCO_3)	
Step 4 : Find the mass (CaCO_3)	
Step 5 : Percentage purity	

Example 2:

A 3.21g sample of copper (II) carbonate was reacted with excess hydrochloric acid. It was found that 480cm³ of carbon dioxide gas measured at r.t.p. was given off. What is the percentage purity of the copper (II) carbonate in the given sample?

[1 mol gas occupies 24.0 dm³ at r.t.p]

Solution:

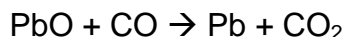
Step 1 : Balanced equation	
Step 2 : Mole ratio	
Step 2.5* : Calculate no. of moles (CO ₂)	
Step 3 : Find no. of moles (CuCO ₃)	
Step 4 : Find the mass (CaCO ₃)	
Step 5 : Percentage purity	

Exercise 2

1. When 6.5g of zinc containing impurities was reacted with excess hydrochloric acid, 13g of zinc chloride was obtained. Calculate the percentage purity of the zinc sample?



2. An impure sample of lead oxide was reduced to lead metal by an excess stream of carbon monoxide. If 400g of lead was produced from 446g of the sample, what is the percentage purity of the lead oxide?



3. When 47.8g of an impure lead sulphide was burnt in excess oxygen, 40g of lead oxide was obtained. How pure is the lead sulphide?



4. Manganese (IV) oxide reacts with hydrochloric acid according to the following equation:



A 8.7g sample of manganese (IV) oxide was added to 2.0 mol/dm³ hydrochloric acid. 48.0cm³ of the acid was needed to react with the manganese (IV) oxide in the given sample. Calculate the percentage purity of manganese (IV) oxide.