

Yield Atom Economy

GCSE Chemistry · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

A student expected to make 8.0 g of copper sulfate crystals but made 6.0 g. Calculate the percentage yield. (2 marks)

Step 1 · Formula

$$\% \text{ yield} = \text{mass made} \div \text{maximum mass} \times 100$$

Step 2 · Substitute

$$6.0 \div 8.0 \times 100 = 75\%$$

Answer: 75%

Check: Yield must be 100% or less ✓

2. Now try one with the steps

Calculate the atom economy for making calcium oxide: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$. (Ca = 40, C = 12, O = 16) (2 marks)

Step 1 · M_r of reactants

Step 2 · M_r of desired product

Step 3 · Atom economy

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. Write the equation used to calculate percentage yield. [1]

2. A reaction could make 8.0 g of product but 6.0 g is made. Calculate the percentage yield. [2]

3. A reaction could make 4.0 g of product but 3.2 g is made. Calculate the percentage yield. [2]

4. Give three reasons why the percentage yield of a reaction is less than 100%. [3]

5. Define the term atom economy. [1]

6. State the atom economy of a reaction with only one product. [1]

7. Calculate the atom economy, percentage, for making calcium oxide from calcium carbonate. [2]
 $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ (Ca = 40, C = 12, O = 16)

8. Calculate the atom economy, percentage to 3 significant figures, for making ethanol by fermentation. $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$ (C = 12, H = 1, O = 16) [3]

9. Calculate the atom economy, percentage to 3 significant figures, for $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$. [3]
(Fe = 56, C = 12, O = 16)

10. Explain why industry prefers reactions with a high atom economy. [2]

11. Calculate the maximum mass, in g, of calcium oxide that can be made from 10.0 g of calcium carbonate. $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ (Ca = 40, C = 12, O = 16) [3]

12. In question 11, 4.2 g of calcium oxide was actually made. Calculate the percentage yield. [1]

13. 12 g of magnesium is burned. $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$. The percentage yield is 80%. Calculate the mass, in g, of magnesium oxide made. (Mg = 24, O = 16) [3]

14. Suggest two reasons why a company might choose a reaction pathway with a lower atom economy. [2]

4. Before you hand it in

Confusing percentage yield with atom economy

Yield compares what you MADE with what you COULD make; atom economy compares useful product with ALL reactants, from the equation.

Leaving out balancing numbers in atom economy

Multiply each M_r by its balancing number.

Getting a yield over 100%

Dry the product fully and check: $\text{actual} \div \text{theoretical}$.