

GCSE Chemistry (9 – 1)

Percentage Yield

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/5
2	/12
3	/4
4	/7
5	/6
6	/7
7	/6
Total	/47
%	
Grade	

Information

- The maximum mark for this paper is 47 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Percentage yield measures a reaction's efficiency by comparing the actual yield to the theoretical yield.

The following questions involve percentage yield. Circle the letter of the correct answer of each.

- a) A reaction is expected to produce a maximum of 40.0 grams of a product. If the experiment only produces 32.0 grams, what is the percentage yield?

A	B	C	D
50%	75%	80%	100%

(1 mark)

- b) Before an experiment, a student uses the balanced chemical equation to calculate that they should produce a maximum of 4.0 g of copper sulfate. This 4.0 g value is known as the

A	B	C	D
Actual yield	Theoretical yield	Limiting reactant	Percentage yield

(1 mark)

- c) In many chemical reactions, the percentage yield is less than 100%. Which of the following is a valid reason for this?

- A** A catalyst was used to speed up the reaction.
- B** The reaction was reversible and did not go to completion.
- C** The reactants were heated too strongly.
- D** The student used an accurate mass balance to weigh the product.

(1 mark)

- d) In an experiment, the maximum theoretical yield of a salt was calculated to be 20 g. A student only managed to produce 15 g of the salt. What is the percentage yield?

A	B	C	D
50%	75%	80%	100%

(1 mark)

- e) Which statement best describes percentage yield?

- A** It measures how fast a reaction happens.
- B** It is the mass of the reactant that is completely used up first.
- C** It compares the amount of product actually made with the maximum amount that could have been made.
- D** It measures how much of the reactants' mass ends up in the useful product.

(1 mark)

(Total for Question 1 is 5 marks)

2. The following questions are about percentage yield.

a) A student has reacted some sodium metal with chlorine gas to produce sodium chloride.

The theoretical yield of sodium chloride from this reaction is 11.70 g.

In the experiment, the student produces an actual yield of 9.90 g.

Calculate the percentage yield of sodium chloride. Give your answer to **one** decimal place.

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(2 marks)

b) In an experiment, a sample of calcium carbonate is heated strongly.

The theoretical yield of calcium oxide is calculated to be 28.0 g.

The actual mass of calcium oxide produced is 25.5 g.

Calculate the percentage yield of calcium oxide. Give your answer to **three** significant figures.

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(2 marks)

c) An excess of iron is added to a solution of copper(II) sulfate.

The maximum mass of copper that could possibly be formed is 6.4 g.

After filtering and drying, the student collects 5.8 g of copper.

What is the percentage yield for this reaction? Give your answer to **three** significant figures.

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(2 marks)

- d) Ammonia is produced in the Haber process.

In a batch at an industrial plant, the theoretical yield of ammonia is 500 kg.

The actual yield of ammonia collected from this batch is 85 kg.

Calculate the percentage yield of ammonia. Give your answer to **three** significant figures.

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(2 marks)

- e) A chemist makes a sample of the insoluble salt, silver chloride, by mixing two solutions together.

Based on the amounts of reactants used, the theoretical yield of silver chloride is 14.35 g.

After filtering and drying the product, the chemist obtains an actual yield of 13.80 g of silver chloride.

Calculate the percentage yield of silver chloride. Give your answer to **three** significant figures.

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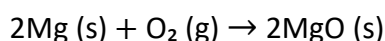
(2 marks)

- f) A student burns a piece of magnesium ribbon in a crucible to form magnesium oxide.

The theoretical yield of the white magnesium oxide powder is calculated to be 4.0 g.

After the experiment, the student finds that the actual yield of magnesium oxide is 3.5 g.

The balanced equation for this reaction is:



Calculate the percentage yield of magnesium oxide.

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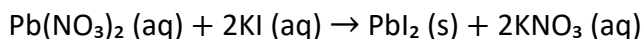
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(2 marks)

(Total for Question 2 is 12 marks)

3. A student prepares a sample of lead(II) iodide by mixing a solution of lead(II) nitrate with a solution of potassium iodide. Lead(II) iodide is an insoluble yellow solid.

The balanced chemical equation for the reaction is:



The student calculated that the theoretical yield of lead(II) iodide is 9.2 g.

The student filters the mixture and after drying the solid product, finds the actual yield is 8.5 g.

- a) Calculate the percentage yield of lead(II) iodide. Give your answer to one decimal place.

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(2 marks)

- b) The student's percentage yield was less than 100%.

Give **two** reasons why the actual yield in an experiment is often less than the theoretical yield.

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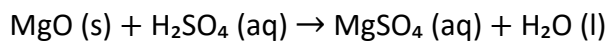
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(2 marks)

(Total for Question 3 is 4 marks)

4. A student prepared magnesium sulfate by reacting magnesium oxide with sulfuric acid.
The balanced equation for the reaction is:



The student started with 4.0 g of magnesium oxide.

They produced 8.5 g of pure, dry magnesium sulfate crystals.

- a) Calculate the relative formula mass (M_r) of magnesium oxide (MgO).

Relative formula mass of magnesium oxide = ...
(1 mark)

- b) Calculate the number of moles in 4.0 g of magnesium oxide.

Moles of magnesium oxide = ...
(1 mark)

- c) Using the balanced equation, determine the maximum theoretical mass of magnesium sulfate (MgSO_4) that could be produced.

Maximum theoretical mass of magnesium sulfate = ...
(3 marks)

- d) Calculate the percentage yield of magnesium sulfate.
Give your answer to 3 significant figures.

Percentage yield of magnesium sulfate = ...
(2 marks)

(Total for Question 4 is 7 marks)

5. Copper(II) carbonate is a green powder that thermally decomposes to produce black copper(II) oxide and carbon dioxide gas. The equation is:



A scientist heats 12.35 g of copper(II) carbonate. She produces 7.16 g of copper(II) oxide.

- a) Calculate the theoretical yield of copper(II) oxide (CuO) from 12.35 g of copper(II) carbonate (CuCO₃).

Theoretical yield of copper(II) oxide = ...

(3 marks)

- b) Calculate the percentage yield for this experiment.

Percentage yield of copper(II) oxide (CuO) = ...

(2 marks)

- c) Suggest **one** reason why the percentage yield was less than 100%.

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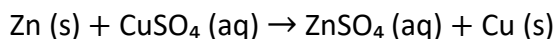
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(1 mark)

(Total for Question 5 is 6 marks)

6. Zinc powder is added to an excess of copper(II) sulfate solution. The zinc displaces the copper.
The equation for this reaction is:



A student reacts 3.25 g of zinc powder and collects the solid copper produced.
After filtering and drying, the mass of the copper was 2.80 g.

- a) Calculate the number of moles in 3.25 g of zinc.

Moles of zinc = ...
(1 mark)

- b) Use the mole ratio in the equation to determine the maximum mass of copper that can be produced.

maximum mass of copper = ...
(2 marks)

- c) Calculate the percentage yield of copper.

Percentage yield of copper = ...
(2 marks)

- d) Another student repeats the experiment but reports a percentage yield of 104%.

Explain why a yield greater than 100% is not possible and suggest a likely experimental error.

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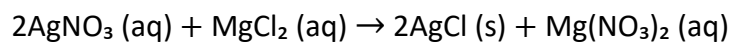
(2 mark)

(Total for Question 6 is 7 marks)

7. A student prepares a sample of silver chloride, a white precipitate, by reacting silver nitrate with magnesium chloride.

They dissolve 6.80 g of solid silver nitrate (AgNO_3) in water and react it with 30.0 cm^3 of a 0.50 mol/dm^3 magnesium chloride (MgCl_2) solution.

The balanced equation for the reaction is:



After filtering, washing, and drying the precipitate, the student obtains an actual yield of 3.95 g of silver chloride (AgCl).

Calculate the percentage yield of silver chloride for this experiment.
Show all working.

Percentage yield = ...
(6 marks)

(Total for Question 7 is 6 marks)