Making a pure, dry soluble salt

Answers, marking points and revision notes | AQA Combined Science 8464 and AQA GCSE Chemistry 8462

GCSE science required practicals

This practical online

Answers

1 Name the salt made when copper(II) oxide reacts with sulfuric acid. (1 mark)

Copper(II) sulfate.

Marking points

- Copper(II) sulfate (copper sulfate accepted)

2 Explain how a pupil can tell that the copper(II) oxide is in excess. (2 marks)

Black solid is left at the bottom of the beaker and does not disappear even after stirring. This means there is no acid left to react with it.

Marking points

- Black solid remains / does not dissolve when stirred
- Because all of the acid has been used up

3 Give two variables the groups kept the same so that their masses of crystals could be compared fairly. (2 marks)

The volume of sulfuric acid (25 cm^3) and the concentration of the acid.

Marking points

- Volume of acid
- Concentration of acid (or mass of copper(II) oxide added, or time left to crystallise)

4 During evaporation, one pupil heats the basin strongly until the solution boils hard. Give one hazard of doing this and one way to reduce the risk. (2 marks)

Hot solution can spit out of the basin and burn the skin or get in the eyes. Heat gently, for example over a water bath, wear goggles and stop heating once crystals start to appear.

Marking points

- Hot liquid spitting / splashing causing burns or eye damage
- Heat gently (water bath) and wear goggles / stop heating before dryness

5 Explain why the mixture is filtered before it is evaporated. (2 marks)

Filtering removes the excess copper(II) oxide, which is insoluble. If it was left in, the crystals would be contaminated with black powder, so the salt would not be pure.

Marking points

- Removes the excess / unreacted copper(II) oxide
- So the salt is pure / not contaminated with the insoluble solid

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6 Use the table to calculate the mass of copper(II) oxide that reacted for Group A. (2 marks)

0.98 g

Mass reacted = mass added - mass left over

Mass reacted = 1.50 - 0.52

Mass reacted = 0.98 g

Marking points

- 1.50 - 0.52 seen
- 0.98 g

7 Which group's mass of crystals is anomalous? Suggest one reason for this result, and say what the class should do with it. (3 marks)

Group D, because 1.37 g is much lower than the others, which are all about 2.5 g. They may have spilt some of the filtrate, or they may not have waited long enough for all the crystals to form. The class should leave it out when working out the mean.

Marking points

- Group D
- Sensible reason, e.g. filtrate spilt, crystals lost when moved, not left long enough to crystallise
- Leave it out of the mean (or repeat that group's preparation)

8 Calculate the mean mass of dry crystals made by the class. Do not include the anomalous result. Give your answer to 2 decimal places. Show your working. (3 marks)

2.58 g

Leave out Group D (1.37 g)

Total = 2.61 + 2.48 + 2.55 + 2.66 = 10.30 g

Mean = 10.30 / 4

Mean = 2.575 g

Mean = 2.58 g (2 decimal places)

Marking points

- Group D left out
- (2.61 + 2.48 + 2.55 + 2.66) / 4
- 2.58 g

9 Calculate the percentage of the copper(II) oxide added by Group A that reacted with the acid. Use your answer to question 6. Give your answer to 2 significant figures. Show your working. (3 marks)

65%

Percentage reacted = (mass reacted / mass added) x 100

Percentage reacted = (0.98 / 1.50) x 100

Percentage reacted = 65.3...

Percentage reacted = 65% (2 significant figures)

Marking points

- 0.98 / 1.50
- x 100
- 65%

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10 The masses of unreacted copper(II) oxide are all close to 0.5 g. Explain what this tells you about the amount of acid each group used, and why Group D's low mass of crystals was not caused by using less acid.

(3 marks)

Each group had about the same amount of copper(II) oxide react, about 1.0 g. This suggests that every group used the same amount of acid, because the acid is what runs out first. Group D's unreacted mass (0.51 g) is normal, so the same amount of salt was made in their solution and the crystals must have been lost later, during filtering, evaporating or drying.

Marking points

- Similar mass reacted in every group
- So the same amount of acid was used / acid ran out first in each case
- Group D's unreacted mass is normal, so the loss happened after the reaction

11 Write a balanced symbol equation, with state symbols, for the reaction between copper(II) oxide and sulfuric acid.

(2 marks)

$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$

Marking points

- Correct formulae, balanced
- Correct state symbols

12 **Higher tier**

Kwame says the crystals would be larger if he evaporated all the water quickly on a hot gauze. Explain why he is wrong.

(2 marks)

Fast evaporation makes lots of tiny crystals form at once, or just a powder. Slow evaporation at room temperature gives the particles time to join on to a few growing crystals, so the crystals end up larger.

Marking points

- Rapid evaporation gives small crystals / powder
- Slow crystallisation lets fewer, larger crystals grow

13 Group B's crystals still looked wet when they weighed them. Explain what effect this has on their mass, and suggest how they could improve their method.

(2 marks)

The water adds to the mass, so their result is higher than the true mass of crystals. They should pat the crystals dry between filter paper and leave them in a warm place until two weighings give the same mass.

Marking points

- Mass is too high because of water
- Dry between filter paper / in a warm oven and reweigh until mass stays constant

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14 Describe how you would make pure, dry crystals of zinc chloride from zinc carbonate powder and dilute hydrochloric acid.

(6 marks)

Measure about 25 cm^3 of dilute hydrochloric acid into a beaker with a measuring cylinder and wear goggles. Add zinc carbonate a spatula at a time and stir. It will fizz because carbon dioxide is made. Keep adding until the fizzing stops and some white powder stays undissolved at the bottom, which shows the zinc carbonate is in excess and all the acid has reacted. Filter the mixture through filter paper into a conical flask to remove the excess zinc carbonate. Pour the clear filtrate into an evaporating basin and heat it gently until about half the water has gone and crystals start to appear. Do not heat it to dryness. Leave the basin somewhere warm for a few days so the rest of the water evaporates slowly. Finally, pat the crystals dry with filter paper.

Marking points (any 6, with the method in a logical order)

- Measure a volume of dilute hydrochloric acid into a beaker
- Add zinc carbonate a little at a time, stirring
- Fizzing shows carbon dioxide being given off
- Add until fizzing stops and solid remains (excess)
- Filter to remove the excess zinc carbonate
- Heat the filtrate gently to evaporate some of the water
- Do not heat to dryness; leave to crystallise slowly
- Dry the crystals with filter paper or in a warm place
- Safety: goggles worn

How it is marked

- 5-6 marks: a clear, logical method in the right order that could be followed to get pure dry crystals, including adding to excess, filtering, gentle evaporation and slow crystallisation.
- 3-4 marks: most of the main stages are there, but one is missing or out of order, or there is little detail about how to tell when the carbonate is in excess.
- 1-2 marks: one or two relevant steps, such as reacting the substances or filtering, with no clear sequence.

Revision notes: the method

Aim: To make pure, dry crystals of a soluble salt (copper(II) sulfate) by reacting an insoluble metal oxide with a dilute acid.

Equipment

- 25 cm^3 measuring cylinder
- 100 cm^3 beaker
- dilute sulfuric acid
- copper(II) oxide powder
- spatula and glass rod
- Bunsen burner, tripod, gauze and heatproof mat
- filter funnel and filter paper
- conical flask
- evaporating basin and water bath
- balance
- safety goggles

Method

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1. Measure 25 cm^3 of dilute sulfuric acid with a measuring cylinder and pour it into a beaker.
2. Warm the acid gently over a Bunsen burner, but do not let it boil.
3. Add copper(II) oxide one spatula at a time, stirring with a glass rod after each addition.
4. Keep adding until some black powder stays at the bottom however much you stir. This shows the copper(II) oxide is in excess and all the acid has reacted.
5. Let the mixture cool, then filter it through a filter paper in a funnel into a conical flask to remove the excess copper(II) oxide.
6. Pour the blue filtrate into an evaporating basin.
7. Heat the basin gently over a water bath or on a gauze until about half of the water has evaporated and crystals start to form at the edge.
8. Leave the basin in a warm place for a day or two so the rest of the water evaporates slowly and larger crystals grow.
9. Pat the crystals dry between two pieces of filter paper.

Variables

- **Independent:** None in the usual sense: this is a preparation, not an investigation. In a class comparison the independent variable could be the volume of acid used.
- **Dependent:** The mass of dry crystals made (measured on a balance), and their appearance.
- **Control:** Volume and concentration of the sulfuric acid; Temperature the acid is warmed to; Time left to crystallise; The copper(II) oxide added until it is in excess

Hazards

Hazard	What could happen	How to reduce the risk
Dilute sulfuric acid	Can irritate the eyes and skin	Wear safety goggles and wash any splashes off skin straight away
Copper(II) sulfate solution and crystals	Harmful if swallowed and irritates the eyes	Wear goggles, do not taste, wash hands after the lesson
Hot basin and boiling solution	Burns, or hot solution spitting out of the basin	Heat gently, stop before the solution is dry, and use tongs to move the basin

Key points

- The solid is added in excess so that all of the acid is used up and none is left in the salt.
- Filtering removes the excess insoluble solid; the salt you want is in the filtrate, not on the paper.
- Do not boil the solution to dryness: you get a powder instead of crystals and the salt can decompose.
- Warming the acid speeds up the reaction, but it must not boil.
- The salt's name comes from the acid: sulfuric acid gives sulfates, hydrochloric acid gives chlorides, nitric acid gives nitrates.
- Metal carbonates work too: they fizz, and when the fizzing stops the acid is used up.

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