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0620/61

May/June 2019

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

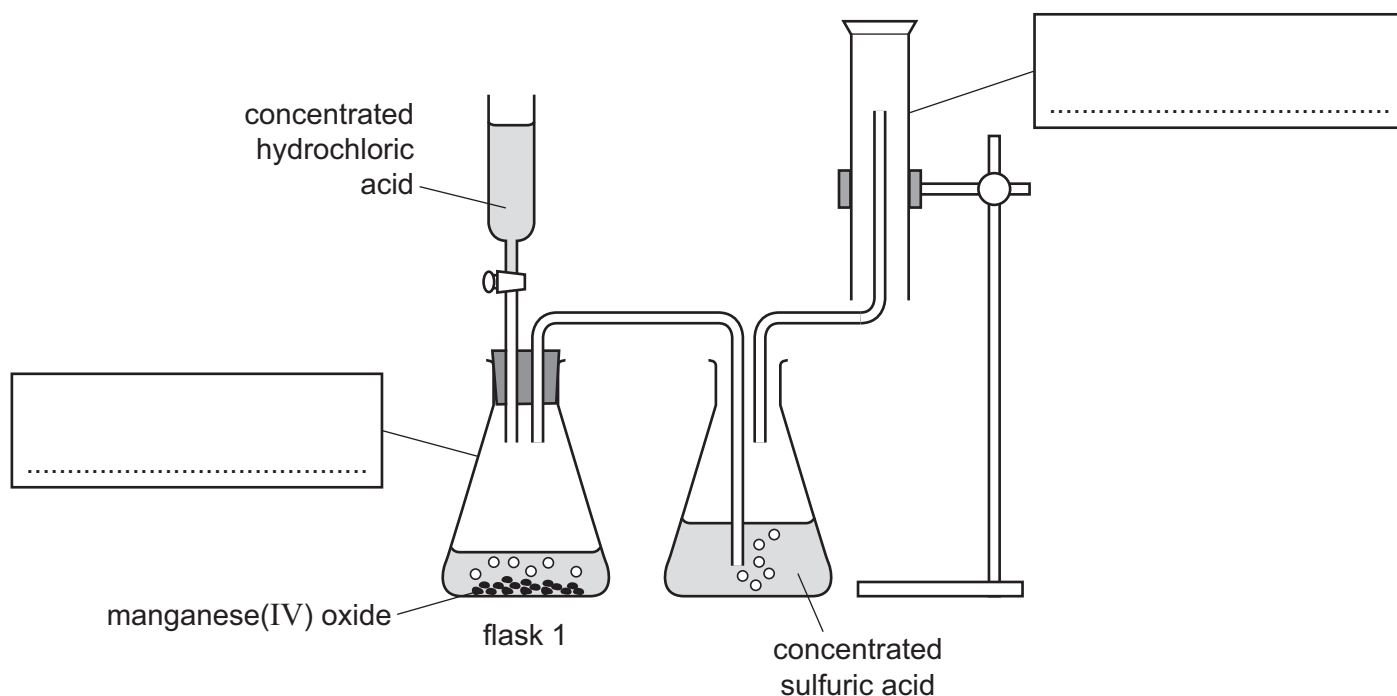
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- 1 The diagram shows the apparatus a student used to prepare a dry sample of chlorine gas. Chlorine is more dense than air.



- (a) Complete the boxes to name the apparatus. [2]

- (b) Use the diagram to identify **two** mistakes the student made.

1

.....

2

.....

[2]

- (c) Suggest **one** reason why the gas produced in flask 1 is passed through concentrated sulfuric acid.

..... [1]

- (d) Describe a test for chlorine.

test

observations

[2]

- (e) Suggest why this experiment is done in a fume cupboard.

..... [1]

[Total: 8]

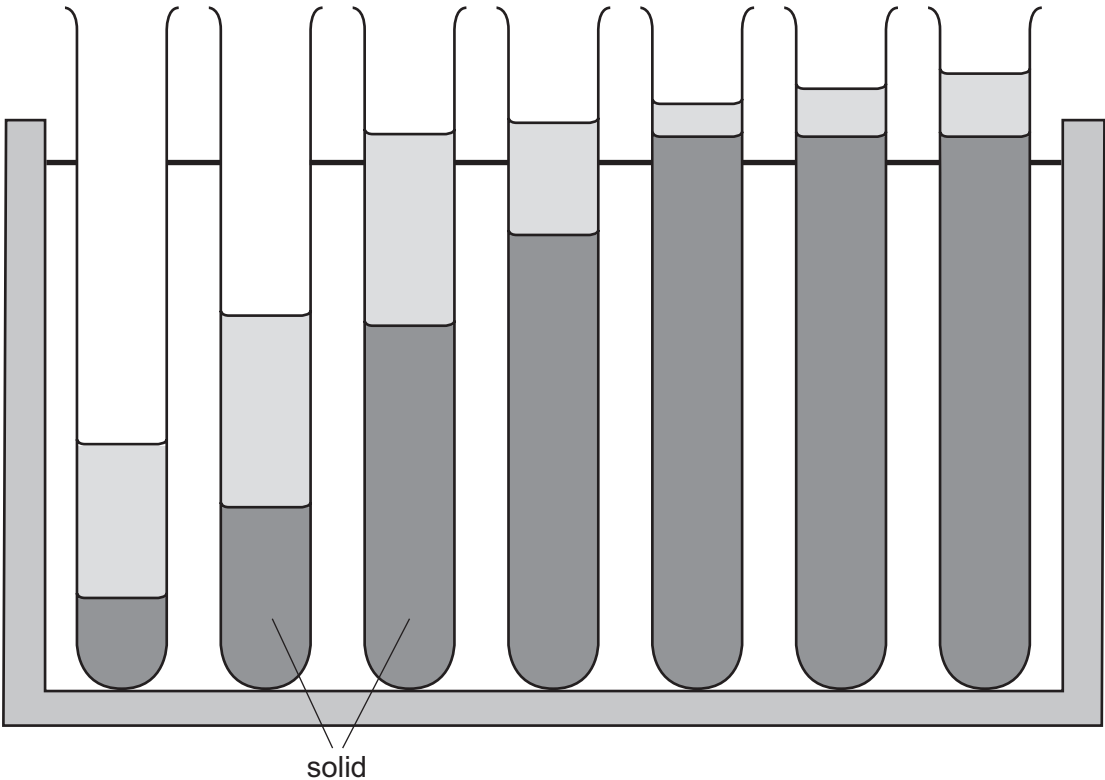
2 A student investigated the reaction between aqueous sodium carbonate and aqueous barium nitrate.

- A burette was filled with aqueous sodium carbonate.
- Seven test-tubes were labelled 1, 2, 3, 4, 5, 6 and 7.
- A measuring cylinder was used to pour 6 cm^3 of aqueous barium nitrate into each of the seven test-tubes in a test-tube rack.
- 1.0 cm^3 of aqueous sodium carbonate was added from the burette to test-tube 1.
- 2.0 cm^3 of aqueous sodium carbonate was added from the burette to test-tube 2.
- 4.0 cm^3 of aqueous sodium carbonate was added from the burette to test-tube 3.
- 5.0 cm^3 of aqueous sodium carbonate was added from the burette to test-tube 4.
- 6.0 cm^3 of aqueous sodium carbonate was added from the burette to test-tube 5.
- 7.0 cm^3 of aqueous sodium carbonate was added from the burette to test-tube 6.
- 8.0 cm^3 of aqueous sodium carbonate was added from the burette to test-tube 7.

A glass rod was used to stir the contents of each of the test-tubes. The contents of the test-tubes were left to stand until the solid formed had settled. A ruler was used to measure the height of the solid formed in each test-tube.

- (a) Use a ruler to measure the heights of the solid formed in each test-tube shown in the diagram. Record the heights of the solid formed in the table and complete the table.

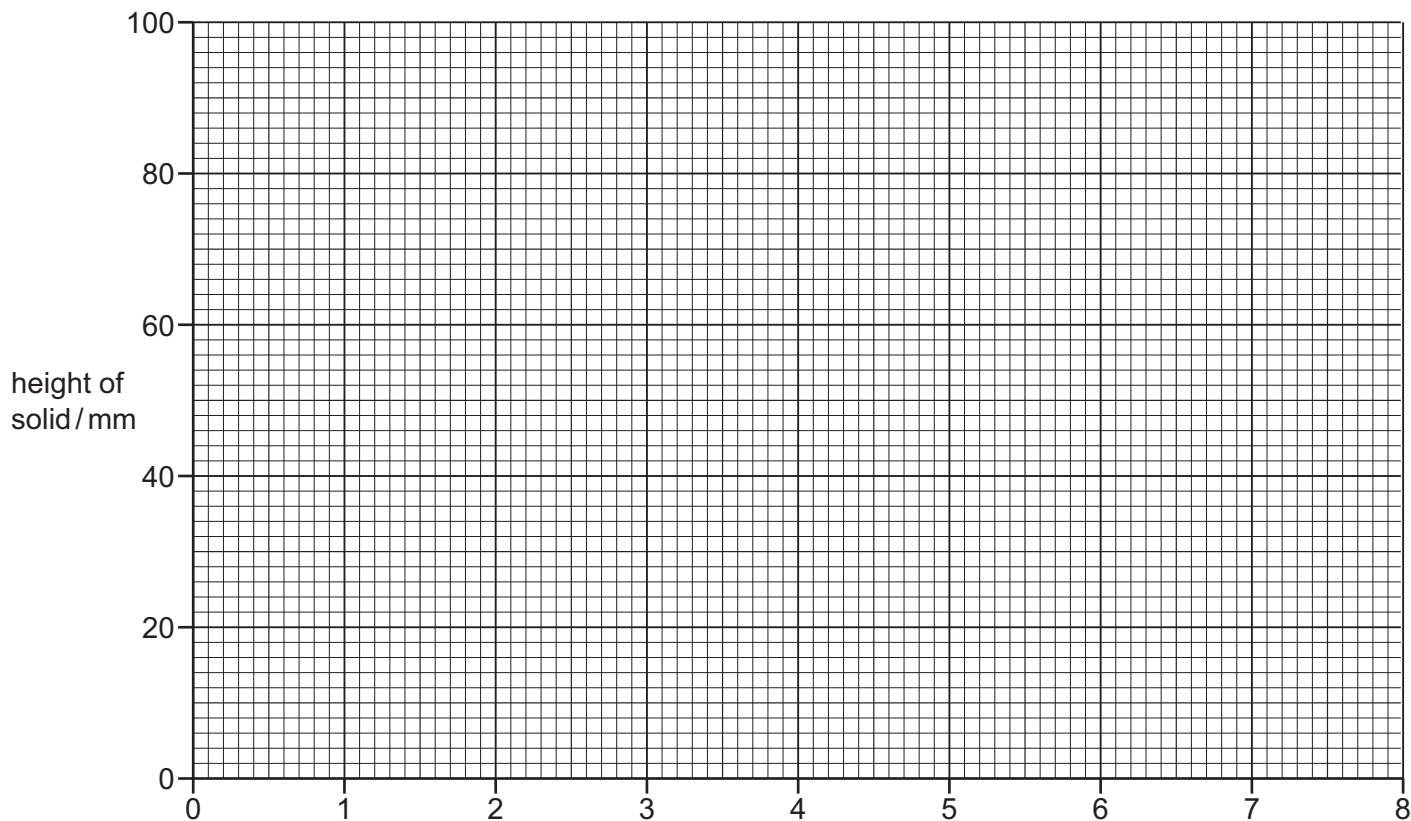
test-tube number	1	2	3	4	5	6	7
volume of aqueous sodium carbonate / cm^3							



height of solid / mm							
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[3]

(b) Plot the results on the grid. Draw **two** intersecting lines of best fit. Label the x-axis.



[4]

(c) **From your graph**, deduce the height of the solid formed when 3.0 cm^3 of aqueous sodium carbonate is added to 6 cm^3 of aqueous barium nitrate.

Show clearly **on the grid** how you worked out your answer.

..... mm [2]

(d) Describe the trend in the heights of the solids formed in test-tubes 1–7.

.....

 [2]

- (e) Predict what would happen if the experiment were continued using three further test-tubes each containing 6 cm^3 of aqueous barium nitrate and separately adding 9.0 cm^3 , 10.0 cm^3 and 11.0 cm^3 of aqueous sodium carbonate to each one.
Explain your answer.

.....
.....
..... [2]

- (f) Suggest **one** change to the **apparatus** used which could be made to obtain more accurate results.

..... [1]

- (g) Suggest a **different** method to measure the amount of solid formed during the experiment.

.....
.....
.....
..... [3]

- (h) Suggest how the reliability of the results could be checked.

.....
..... [1]

[Total: 18]

- 3 Two substances, solution **F** and solid **G**, were analysed. Solution **F** was dilute hydrochloric acid. Tests were done on solution **F** and solid **G**.

tests on solution F

Complete the expected observations.

Solution **F** was divided into four equal portions in four test-tubes.

- (a) The pH of the first portion of solution **F** was tested.

pH = ... [1]

- (b) Magnesium ribbon was added to the second portion of solution **F**. The gas produced was tested.

observations
.....
..... [3]

- (c) Dilute nitric acid and aqueous silver nitrate were added to the third portion of solution **F**.

observations [1]

- (d) Dilute nitric acid and aqueous barium nitrate were added to the fourth portion of solution **F**.

observations [1]

tests on solid G

Some of the tests and observations are shown.

tests on solid G	observations
The appearance of solid G was studied.	white solid
test 1 Dilute hydrochloric acid was added to solid G . The gas produced was tested. The solution formed was divided into two portions for test 2 .	rapid effervescence limewater turned milky
test 2 An excess of aqueous sodium hydroxide was added to the first portion of the solution from test 1 . An excess of aqueous ammonia was added to the second portion of the solution from test 1 .	white precipitate formed which was insoluble in excess no precipitate formed

(e) Identify solid **G**.

..... [2]

[Total: 8]

4 Steel nails rust in the presence of air and water. Plan an investigation to:

- show that coating steel nails with paint helps to protect the nails from rusting
- show that coating steel nails with zinc helps to protect the nails from rusting
- determine which coating is more effective at protecting steel nails from rusting.

You are provided with:

- uncoated steel nails
- steel nails coated with paint
- steel nails coated with zinc
- common laboratory apparatus.

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..... [6]

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0620/62

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1 hour

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1 A student did the following steps to make zinc chloride crystals from solid zinc oxide.

- step 1** Pour 40 cm³ of dilute hydrochloric acid into a beaker. Add a small amount of zinc oxide. Warm the mixture and stir it.
- step 2** Continue to add zinc oxide to the beaker until all of the dilute hydrochloric acid has reacted.
- step 3** Remove the excess zinc oxide.
- step 4** Obtain crystals of zinc chloride from the solution.

(a) Name the apparatus used in **step 1** to:

(i) add the zinc oxide

..... [1]

(ii) warm the mixture.

..... [1]

(b) How did the student know that all of the dilute hydrochloric acid had reacted in **step 2**?

.....
..... [1]

(c) (i) What is meant by the term *excess* in **step 3**?

..... [1]

(ii) How is the excess zinc oxide removed in **step 3**?

..... [1]

(d) Describe how the crystals are obtained in **step 4**.

.....
.....
..... [3]

(e) Suggest how the method would differ if zinc carbonate were used instead of zinc oxide.

..... [1]

[Total: 9]

- 2 A student investigated the rate of reaction between magnesium ribbon and solutions of dilute hydrochloric acid of different concentrations, solutions **H**, **I**, **J** and **K**. The dilute hydrochloric acid was in excess in all experiments.

Five experiments were done.

Experiment 1

- A measuring cylinder was used to pour 30 cm³ of solution **H** into a beaker.
- A 5.0 cm length of magnesium ribbon was then added to the beaker.
- A timer was started immediately.
- The time taken for all of the magnesium ribbon to react and to disappear completely was measured.

Experiment 2

- Experiment 1 was repeated but using solution **I** instead of solution **H**.

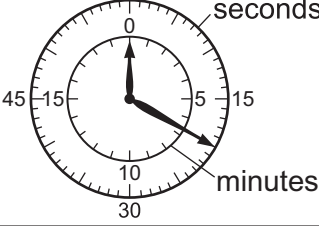
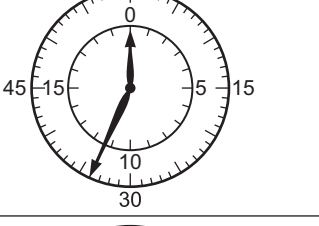
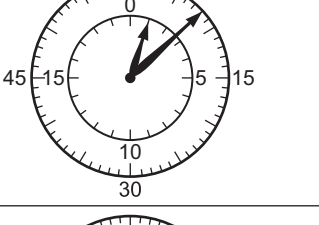
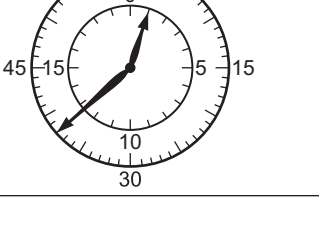
Experiment 3

- Experiment 1 was repeated but using solution **J** instead of solution **H**.

Experiment 4

- Experiment 1 was repeated but using solution **K** instead of solution **H**.

(a) Use the stop-clock diagrams to record the time taken for each experiment in the table.

experiment	solution	concentration of hydrochloric acid in mol/dm ³	stop-clock diagram	time taken for the magnesium ribbon to disappear completely/s
1	H	2.0		
2	I	1.5		
3	J	1.0		
4	K	0.8		

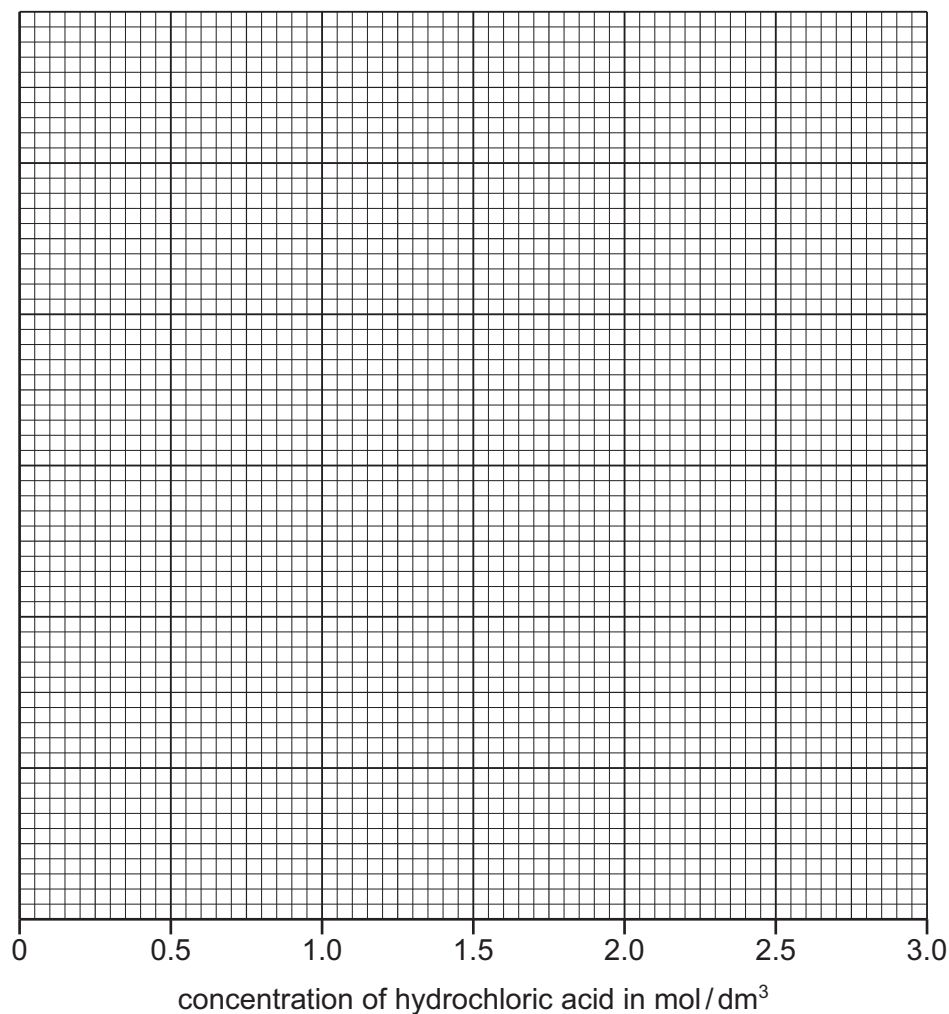
Experiment 5

Solution **J** was added to some magnesium ribbon in a test-tube. The gas produced was tested. The observations were recorded in the table.

observations	rapid effervescence and the test-tube felt hot lighted splint 'popped'
--------------	---

(b) Plot the results for Experiments 1–4 on the grid. Draw a smooth line graph.

time taken for the
magnesium ribbon to
disappear completely / s



[3]

(c) From your graph, deduce the time taken for the magnesium ribbon to disappear completely if a solution of hydrochloric acid of concentration 2.5 mol/dm^3 were used.

Show clearly **on the grid** how you worked out your answer.

..... [3]

(d) (i) Why was the same length of magnesium used in Experiments 1–4?

..... [1]

(ii) Suggest the effect on the results if Experiments 1–4 were repeated using 2.5 cm lengths of magnesium ribbon instead of 5.0 cm lengths of magnesium ribbon. Explain your answer.

.....

..... [1]

(e) Suggest a **different** method which a student could use to investigate the rate of reaction between magnesium ribbon and dilute hydrochloric acid. State the apparatus the student would use and the measurements the student would take.

apparatus

.....

measurements

.....

.....

[3]

(f) Use the observations from Experiment 5 to answer these questions.

(i) What type of chemical reaction occurs when magnesium ribbon reacts with dilute hydrochloric acid?

..... [1]

(ii) Identify the gas produced.

..... [1]

[Total: 16]

- 3 Two substances, solid **L** and solid **M**, were analysed. Solid **L** was hydrated ammonium sulfate. Tests were done on solid **L** and solid **M**.

tests on solid L

Complete the expected observations.

- (a) Describe the appearance of solid **L**.

..... [1]

Solid **L** was divided into two portions.

- (b) The first portion of solid **L** was heated in a hard-glass test-tube. Any gas produced was tested with cobalt(II) chloride paper.

observations

..... [3]

The second portion of solid **L** was added to distilled water. The mixture was shaken to dissolve solid **L** and form solution **L**. The solution of **L** was divided into two equal portions in two test-tubes.

- (c) An excess of aqueous sodium hydroxide was added to the first portion of solution **L**. The mixture was heated and the gas produced was tested.

observations

..... [2]

- (d) Dilute nitric acid and aqueous barium nitrate were added to the second portion of solution **L**.

observation [1]

tests on solid M

Some of the tests and observations are shown.

tests on solid M	observations
Solid M was dissolved in water. The solution was divided into three portions. test 1 An excess of aqueous sodium hydroxide was added to the first portion of the solution.	red-brown precipitate formed
test 2 An excess of aqueous ammonia was added to the second portion of the solution.	red-brown precipitate formed
test 3 Dilute nitric acid and aqueous silver nitrate were added to the third portion of the solution.	white precipitate formed

(e) Identify solid **M**.

..... [2]

[Total: 9]

- 4 Azurite is an ore of copper which contains copper(II) carbonate. Azurite contains no other metal ions.

Plan an experiment to show how a sample of copper could be obtained from large lumps of azurite.

Your answer should include:

- descriptions of the reactions involved
- the expected observations.

You are provided with a large lump of azurite and common laboratory chemicals and apparatus.

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..... [6]

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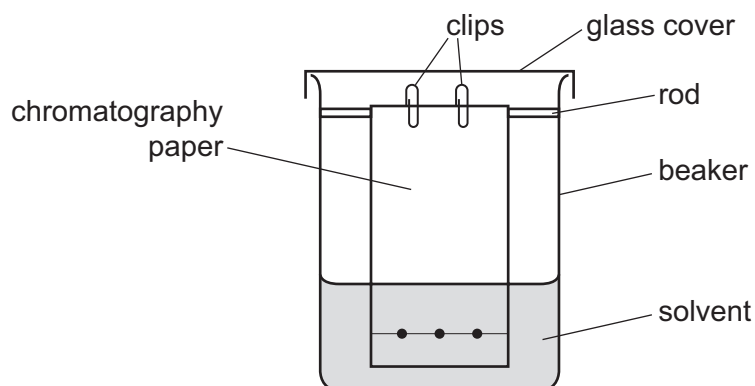
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- 1 A student investigated the colours present in three hair dyes, **P**, **Q** and **R**, using chromatography. **P**, **Q** and **R** are insoluble in water. The student suggested setting up the apparatus for the experiment as shown.



- (a) Why is a lid necessary on top of the beaker?

..... [1]

- (b) (i) Identify **one** mistake in the student's diagram.

..... [1]

- (ii) Suggest why this mistake would stop the experiment working.

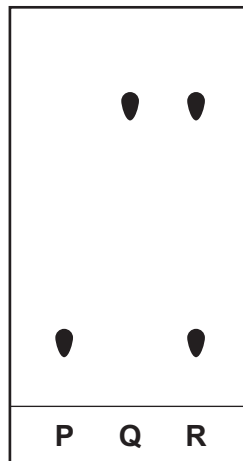
.....

..... [1]

- (c) Name a suitable solvent that could be used in this experiment.

..... [1]

- (d) A separate chromatography experiment was done using the hair dyes **P**, **Q** and **R**. The chromatogram obtained is shown.



State **three** conclusions about the hair dyes **P**, **Q** and **R** which can be deduced from the chromatogram.

1

2

3

[3]

[Total: 7]

- 2 A student investigated the temperature changes when two different metals, zinc and magnesium, reacted with aqueous copper(II) sulfate.

Three experiments were done.

Experiment 1

- A measuring cylinder was used to pour 25 cm^3 aqueous copper(II) sulfate into a polystyrene cup.
- The initial temperature of the solution was measured and the timer was started.
- The temperature of the solution was measured at 30 seconds and at 60 seconds.
- At 60 seconds, 5g of zinc powder was added to the aqueous copper(II) sulfate. The mixture was stirred with a thermometer.
- The temperature of the mixture was measured every 30 seconds for 210 seconds. The mixture was stirred continuously.

(a) Use the thermometer diagrams to record the temperatures in the table.

time / s	0	30	60	90	120	150	180	210
thermometer diagram								
temperature of mixture / °C								

[2]

Experiment 2

- Experiment 1 was repeated using 5g of magnesium powder instead of zinc powder.

(b) Use the thermometer diagrams to record the temperatures in the table.

time / s	0	30	60	90	120	150	180	210
thermometer diagram								
temperature of mixture / °C								

[1]

Experiment 3

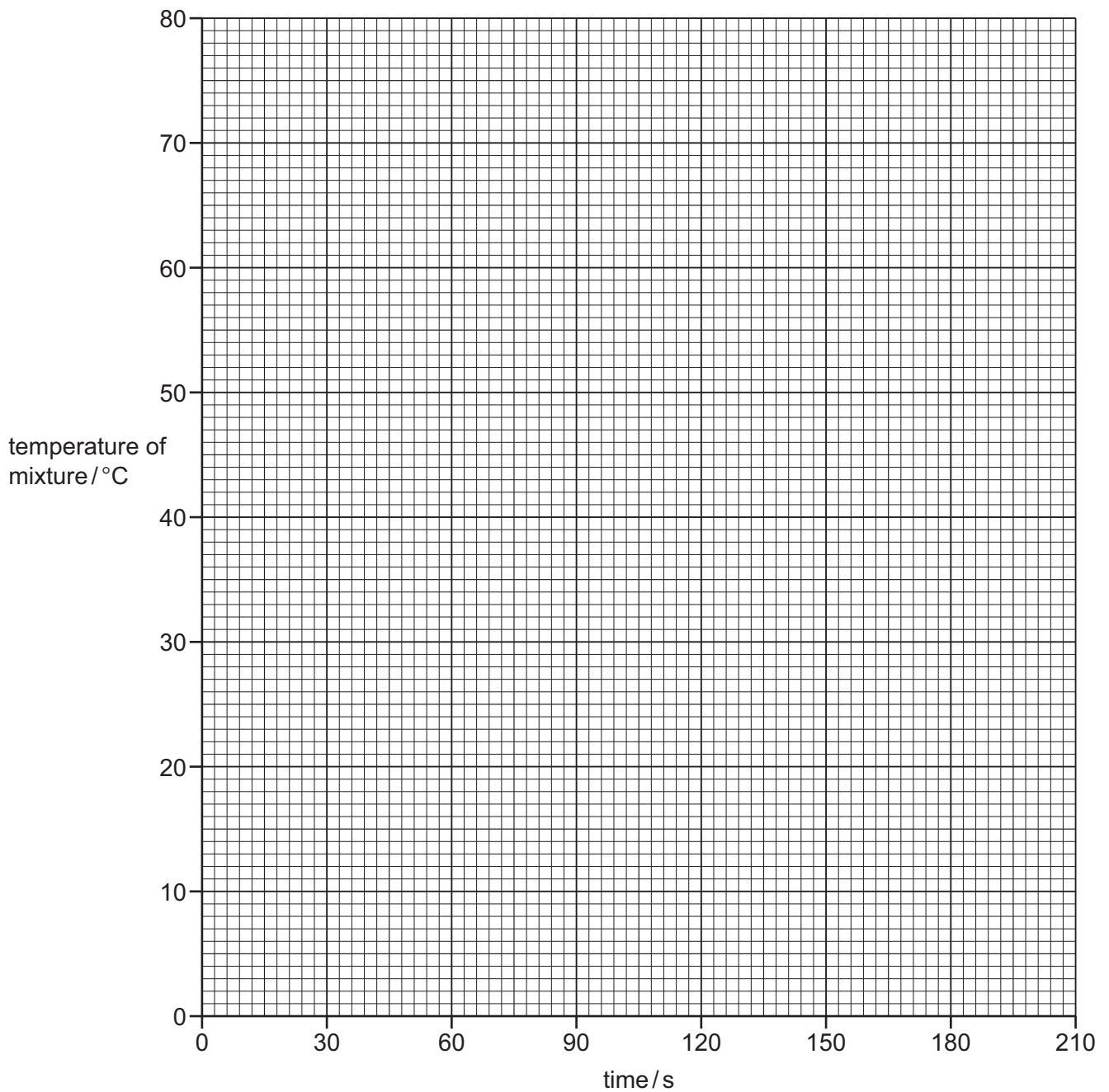
- Experiment 1 was repeated using 5g of zinc granules instead of zinc powder.

(c) Use the thermometer diagrams to record the temperatures in the table.

time / s	0	30	60	90	120	150	180	210
thermometer diagram								
temperature of mixture / °C								

[1]

- (d) Plot the results for Experiments 1–3 on the grid and draw **three** smooth line graphs. Clearly label your lines.



[3]

- (e) **From your graph**, deduce the temperature of the mixture in Experiment 2 after 75 seconds.

Show clearly **on the grid** how you worked out your answer.

..... °C [2]

- (f) (i) From the results, which Experiment was the most exothermic? Explain your answer.

.....
..... [2]

- (ii) Compare the rates of reaction in Experiments 1 and 3. Explain why the rates of reaction are different.

.....
.....
..... [2]

- (g) Predict the temperature of the mixture in Experiment 2 after 2 hours. Explain your answer.

.....
..... [2]

- (h) When doing the experiments, what would be the advantage of taking the temperature readings every 15 seconds?

.....
..... [2]

- (i) Explain why a copper can should **not** be used in place of the polystyrene cup in these experiments.

.....
.....
..... [2]

[Total: 19]

- 3 Two substances, solid **N** and solid **O** were analysed. Solid **N** was hydrated aluminium sulfate. Tests were done on solid **N** and solid **O**.

tests on solid N

Complete the expected observations.

- (a) Describe the appearance of solid **N**.

observation [1]

Solid **N** was divided into two portions.

- (b) The first portion of solid **N** was heated in a hard-glass test-tube. Any gas produced was tested with cobalt(II) chloride paper.

observations

..... [2]

The second portion of solid **N** was added to distilled water. The mixture was shaken to dissolve solid **N** and form solution **N**. Solution **N** was divided into two equal portions in two test-tubes.

- (c) (i) Drops of aqueous sodium hydroxide were added to the first portion of solution **N** until a change was seen.

observations [1]

- (ii) An excess of aqueous sodium hydroxide was then added to the mixture from (c)(i).

observations [1]

- (d) Dilute nitric acid and aqueous barium nitrate were added to the second portion of solution **N**.

observations [1]

tests on solid O

Some of the tests and observations are shown.

tests on solid O	observations
test 1 A flame test was done on solid O.	lilac flame
Solid O was dissolved in water. The solution was divided into two portions. test 2 An excess of aqueous sodium hydroxide was added to the first portion of the solution.	no change
test 3 Dilute nitric acid and aqueous silver nitrate were added to the second portion of the solution.	white precipitate formed

(e) Identify solid O.

..... [2]

[Total: 8]

- 4 Calcium carbonate, calcium hydroxide and calcium oxide can be used to neutralise the acid in soil.

Plan an investigation to find out which of these calcium compounds neutralises acid most effectively.

You are provided with the three calcium compounds, dilute hydrochloric acid and common laboratory apparatus and chemicals.

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..... [6]

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