Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8180759168

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **May/June 2017**

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.

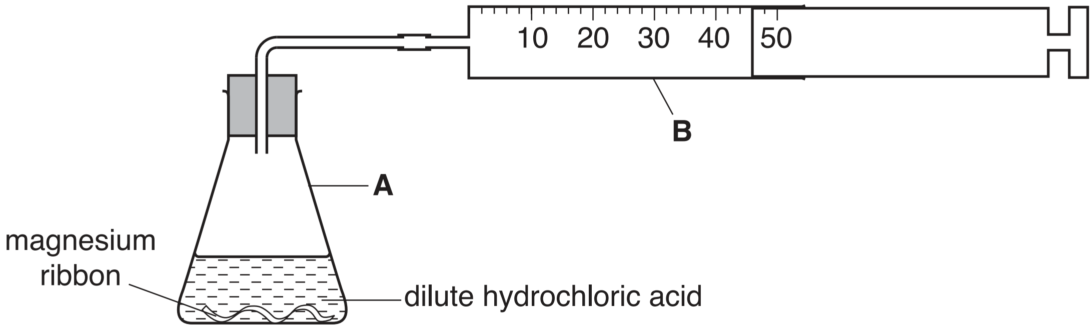
Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
Electronic calculators may be used.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **14** printed pages and **2** blank pages.

CAMBRIDGE
International Examinations

1 A student adds a known mass of magnesium ribbon to 100 cm^3 of dilute hydrochloric acid (an excess) in the apparatus shown. Hydrogen gas is evolved.



(a) (i) Give a test and observation to identify hydrogen gas.

....[1]

(ii) Name apparatus **A** and **B**.

A ....

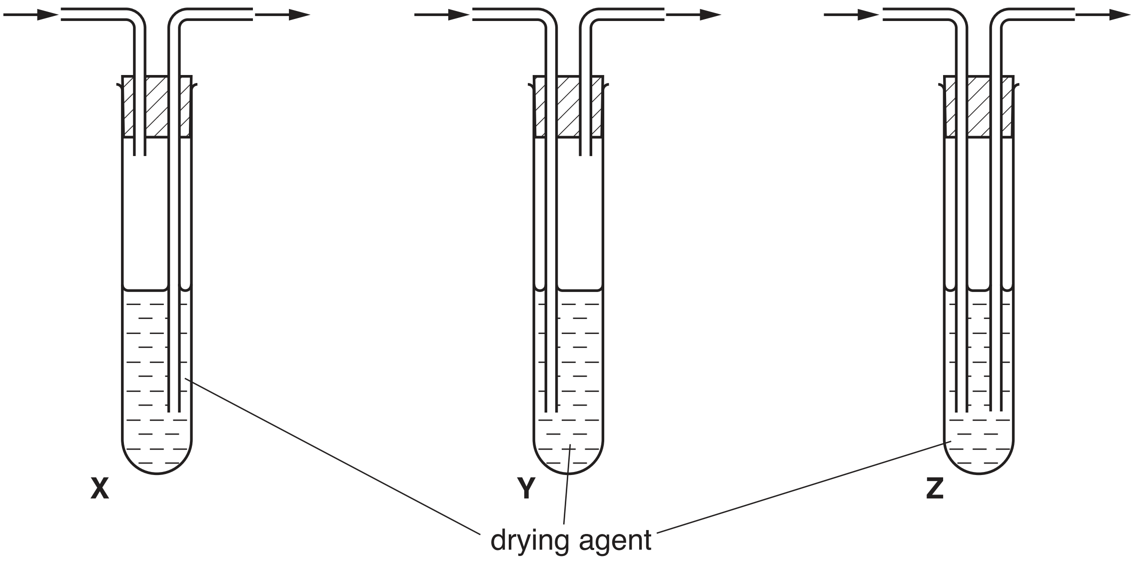
B .... [2]

(iii) What volume of hydrogen is collected in **B**?

.... cm^3 [1]

(b) (i) A student is asked to produce a dry sample of hydrogen by passing it through a drying agent.

The direction of flow of the gas through the apparatus is shown by the arrows.



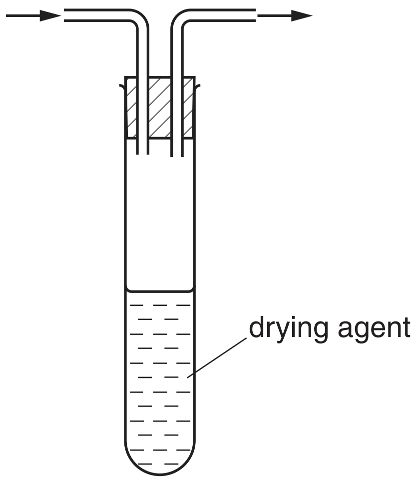
Which apparatus, **X**, **Y**, or **Z**, should be used?

....

Explain your answer.

.... [2]

(ii) Explain why the student would **not** be able to produce a dry sample of the gas using the apparatus below.

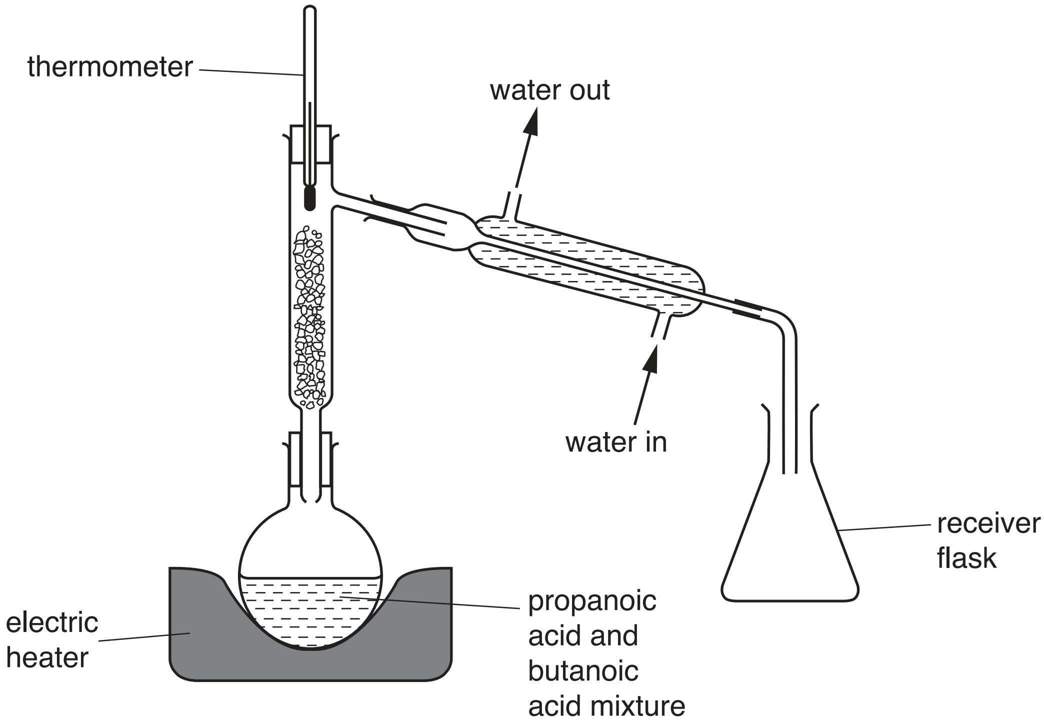


....

....[1]

[Total: 7]

2 A student separates propanoic acid (b.p. 141 °C) and butanoic acid (b.p. 164 °C) using the apparatus shown.



(a) Explain why the receiver flask must be left open.

....

....[1]

(b) **(i)** What is the reading on the thermometer when the first drops of liquid appear in the receiver flask?

.... °C [1]

(ii) Name this liquid.

....[1]

(iii) How does the student know when all of this liquid has distilled over?

....[1]

(c) Suggest a safety item that the student should use when doing this experiment.

....[1]

[Total: 5]

3 Copper(II) sulfate crystals contain water of crystallisation which may be removed by heating.

(a) You are to plan an experiment to find the percentage, by mass, of water in copper(II) sulfate crystals.

You should
- describe or draw a diagram of the apparatus that may be used to remove the water,
- suggest all the weighings that should be done,
- show how they may be used to calculate the percentage, by mass, of water.

....

....

....

....

....

.... [5]

(b) The formula for copper(II) sulfate crystals is $CuSO_4.\mathbf{y}H_2O$ where **y** is the number of moles of water of crystallisation in one mole of crystals.

A student does an experiment and finds that **y** = 4. The correct value of **y** for her sample is 5.

Suggest an error in her experiment that would result in this difference. Explain how this error would lead to the lower value of **y** and suggest how the experiment could be improved to result in a correct value for **y**.

You can assume that all her weighings were read and recorded correctly and that her calculation was correct.

....

....

....

....

....

....

.... [3]

[Total: 8]

4 A student is asked to determine the percentage purity of a sample of impure magnesium carbonate.

(a) The sample is added to a previously weighed container, which is then reweighed.

mass of container + impure magnesium carbonate = 8.20 g
mass of container = 6.98 g

Calculate the mass of impure magnesium carbonate used in the experiment.

.... g [1]

(b) The sample is placed in a beaker and 50.0 cm^3 of 1.00 mol / dm^3 hydrochloric acid, an excess, is added.

The mixture is allowed to react. Carbon dioxide is produced.

What is observed in the flask as the reaction takes place?

....[1]

(c) When the reaction has finished the solution is made up to 250 cm^3 with distilled water.

This is solution **V**.

(i) In which apparatus should **V** be prepared?

.... [1]

(ii) Using a pipette, 25.0 cm^3 of **V** is transferred into a conical flask.

Name a safety item that the student should attach to the pipette and suggest why it is used.

safety item ....

why it is used ....

....
[2]

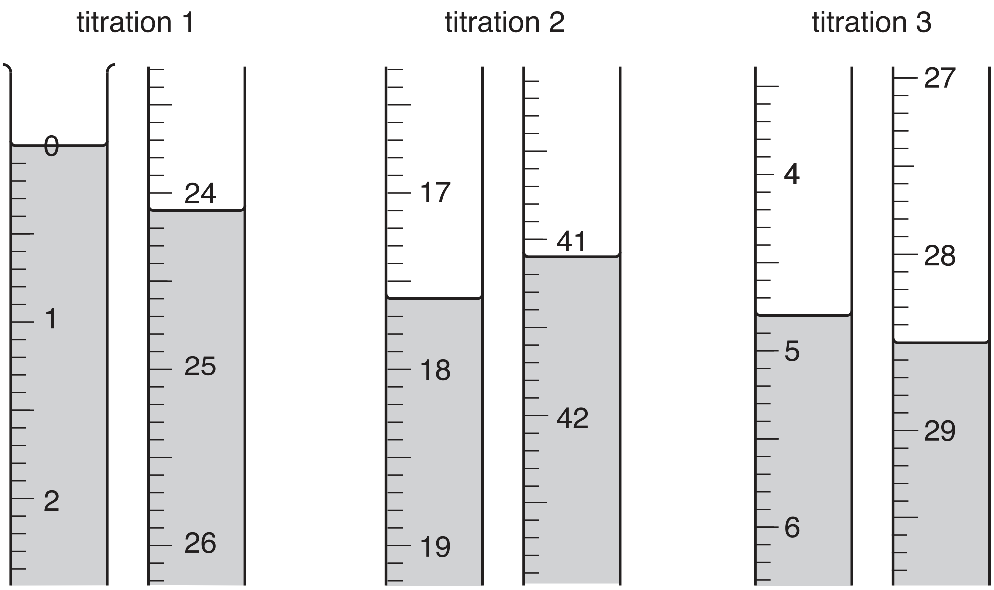
(d) A few drops of methyl orange indicator are added to the conical flask.

0.100 mol / dm^3 sodium hydroxide is added to the solution from a burette until an end-point is reached.

What is the colour change of the methyl orange at the end-point?

The colour changes from .... to .... [1]

(e) The student does three titrations. The diagrams show parts of the burette with the liquid levels at the beginning and end of each titration.



Use the diagrams to complete the results table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of 0.100 mol / dm^3 sodium hydroxide / cm^3			
best titration results (✓)			

Summary
Tick (✓) the best titration results.

Using these results, the average volume of 0.100 mol / dm^3 sodium hydroxide required is

.... cm^3. [4]

(f) Calculate the number of moles of sodium hydroxide in the average volume of 0.100 mol / dm^3 sodium hydroxide.

.... moles [1]

(g) Using the equation and your answer to **(f)**, deduce the number of moles of hydrochloric acid in 25.0 cm^3 of **V**.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

.... moles [1]

(h) Calculate the number of moles of hydrochloric acid in 250 cm^3 of **V**.

.... moles [1]

(i) 50.0 cm^3 of 1.00 mol / dm^3 hydrochloric acid contains 0.0500 moles of hydrochloric acid.

Subtract your answer to **(h)** from 0.0500 to determine the number of moles of hydrochloric acid that react with the sample of magnesium carbonate.

.... moles [1]

(j) The equation for the reaction between magnesium carbonate and hydrochloric acid is shown.

$$MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$$

Using the equation and your answer to **(i)**, deduce the number of moles of magnesium carbonate in the sample.

.... moles [1]

(k) **(i)** Calculate the mass of magnesium carbonate in the sample.

[The relative formula mass of magnesium carbonate is 84.]

.... g [1]

(ii) Using your answers to **(a)** and **(k)(i)**, calculate the percentage purity of the magnesium carbonate.

.... % [1]

[Total: 17]

5 You are provided with aqueous solutions of four different metal sulfates.

- chromium(III) sulfate
- copper(II) sulfate
- iron(II) sulfate
- iron(III) sulfate

(a) Using reagents that are available in a laboratory, suggest a test that can be done to confirm the presence of the sulfate ion in each of the four solutions.

test ....

....

observation ....

.... [3]

(b) **(i)** In order to identify the cation present in each solution a small volume of aqueous sodium hydroxide is added to 1 cm^3 of each solution in a test-tube, followed by an excess of the reagent.

The observations for each test are recorded in the table.

Complete the table by deducing the cation present in each solution.

addition of a small volume of aqueous sodium hydroxide	addition of excess aqueous sodium hydroxide	cation present
red-brown ppt	insoluble in excess	
light blue ppt	insoluble in excess	
green ppt	insoluble in excess	
green ppt	soluble in excess	

[4]

(ii) A small volume of aqueous ammonia is added to 1 cm^3 of each solution in a test-tube, followed by an excess of this reagent.

Record in the table the observations which correspond to the presence of each cation.

addition of a small volume of aqueous ammonia	addition of an excess of aqueous ammonia	cation present
		Cr^{3+}
		Fe^{2+}
		Cu^{2+}
		Fe^{3+}

[4]

[Total: 11]

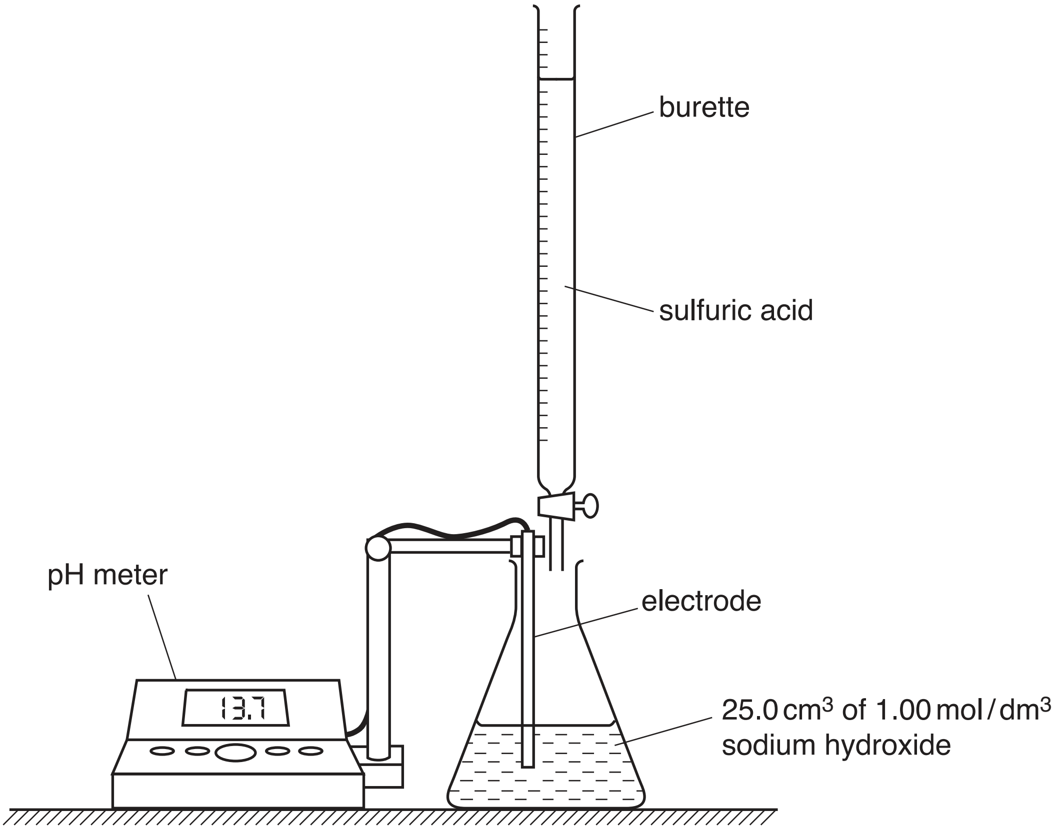
PLEASE TURN OVER.

6 A student prepares a sample of sodium sulfate crystals using a titration method.

The student transfers 25.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide to a conical flask and adds dilute sulfuric acid from a burette.

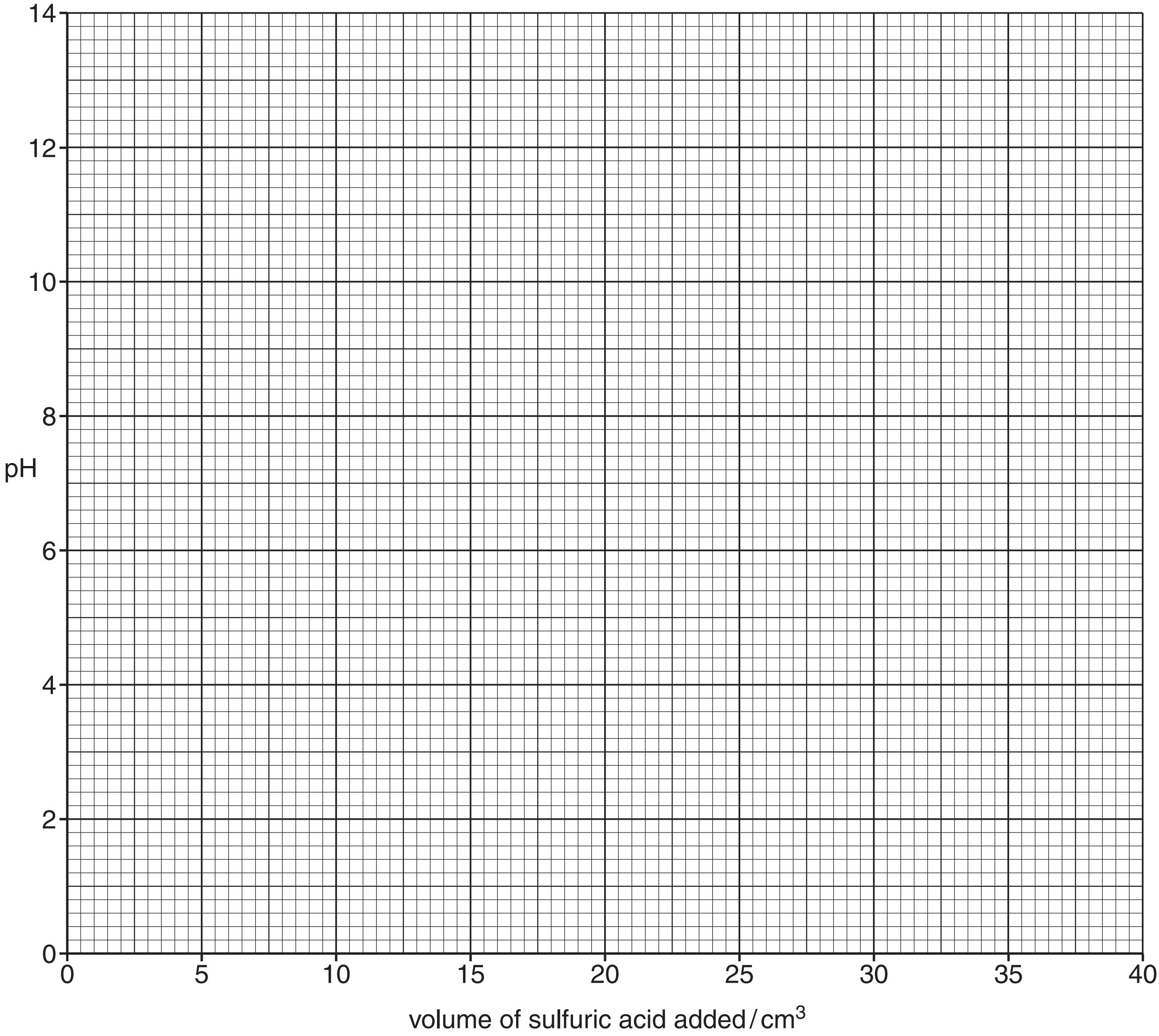
After each addition of sulfuric acid, the student records the pH of the solution, measured by a pH meter.

The apparatus and table of results are shown.



volume of sulfuric acid added / cm^3	pH value
5.0	13.7
10.0	13.5
20.0	12.2
22.0	11.8
24.0	11.2
26.0	10.0
28.0	4.2
30.0	3.0
40.0	1.2

(a) Plot the points on the grid. Draw a smooth curve through all of the points. Extend your line to cross the *y*-axis.



[3]

(b) Use the graph to answer the following questions.

(i) What is the pH of 25.0 cm^3 of 1.00 mol / dm^3 sodium hydroxide?

....[1]

(ii) What is the pH of the solution when 15.0 cm^3 of acid is added?

....[1]

(c) **(i)** At the end-point of the titration, the pH changes rapidly when only a small volume of acid is added.

Use your graph to suggest the pH of the solution at the end-point.

....[1]

(ii) Using your answer to **(i)** and your graph, what volume of acid is required to neutralise $25.0\,cm^3$ of $1.00\,mol/dm^3$ sodium hydroxide?

.... cm^3 [1]

(d) Sulfuric acid reacts with sodium hydroxide.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Using the equation and your answer to **(c)(ii)**, calculate the concentration of sulfuric acid used in the experiment.

....mol/dm^3 [2]

(e) Describe how a student makes pure, dry crystals from aqueous sodium sulfate.

....

....

....

....

....

....[3]

[Total: 12]

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