UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3468340117

CHEMISTRY **5070/04**

Paper 4 Alternative to Practical **May/June 2008**

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 a soft pencil for any diagrams, graphs or rough working.
Do **not** use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
The number of marks is given in brackets [ ] at the end of each question or part question.
At the end of the examination, fasten all your work securely together.

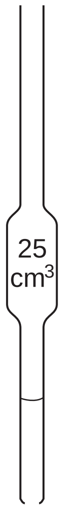
For Examiner's Use

This document consists of **18** printed pages and **2** blank pages.

(DR/DR) T46257/2

UNIVERSITY of CAMBRIDGE International Examinations

1 The diagram below shows a pipette.
What error has been made in its manufacture?



....

[Total: 1]

2 A student was given some hydrated sodium carbonate crystals, $Na_2CO_3.xH_2O$, wher[illegible] whole number. They were placed in a previously weighed container, which was reweigh[illegible]

mass of container + sodium carbonate crystals = 9.87 g
mass of container = 5.83 g

(a) Calculate the mass of sodium carbonate crystals used in the experiment.

....g [1]

The container and crystals were heated to remove the water of crystallisation and then reweighed. This process was repeated until there was no further change in mass.

(b) Describe the appearance of the sodium carbonate crystals after heating.

....

....[2]

mass of container + sodium carbonate after heating = 7.35 g

(c) **(i)** Calculate the mass of sodium carbonate which remained after heating.

....g [1]

(ii) Calculate the mass of water which was lost from the crystals.

....g [1]

(d) **(i)** Calculate the relative formula mass of sodium carbonate, Na_2CO_3, and the formula mass of water.
[A_r: Na, 23; C, 12; O, 16; H, 1]

relative formula mass of sodium carbonate ....

relative formula mass of water ....
[1]

(e) Using your answers to **(c)** and **(d)**, calculate

(i) the number of moles of sodium carbonate which remained after heating,

.... [1]

(ii) the number of moles of water which were lost on heating.

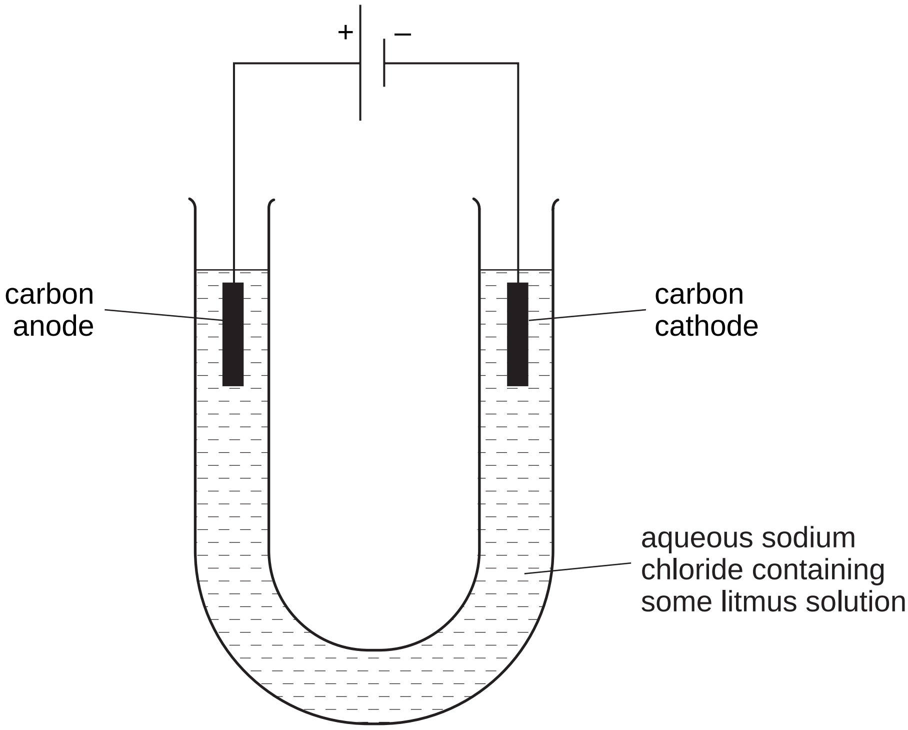
.... [1]

(f) Using your answers to **(e)** calculate the value of x in the formula $Na_2CO_3.xH_2O$.

x =....................................... [2]

[Total: 10]

3 A student electrolysed concentrated aqueous sodium chloride using the apparatus
The solution also contained litmus solution.



(a) **(i)** Name the gas produced at the anode (positive electrode).

.... [1]

(ii) Suggest what happened to the colour of the solution around the anode as the electrolysis proceeded.

.... [1]

(iii) Why did this change take place?

.... [1]

(b) **(i)** Name the gas produced at the cathode (negative electrode).

.... [1]

(ii) Give a test for this gas.

.... [1]

(iii) What happened to the colour of the solution around the cathode as the electrolysis proceeded?

.... [1]

(iv) Why did this change take place?

.... [1]

(c) The solution was replaced by a dilute solution of an acid. Suggest which aci produce the same gases as those produced with concentrated aqueous so chloride.

.... [1]

(d) Under what conditions does the electrolysis of sodium chloride produce sodium at one of the electrodes?

.... [1]

[Total: 9]

In questions **4** to **8** inclusive, place a tick (✓) in the box against the best answer.

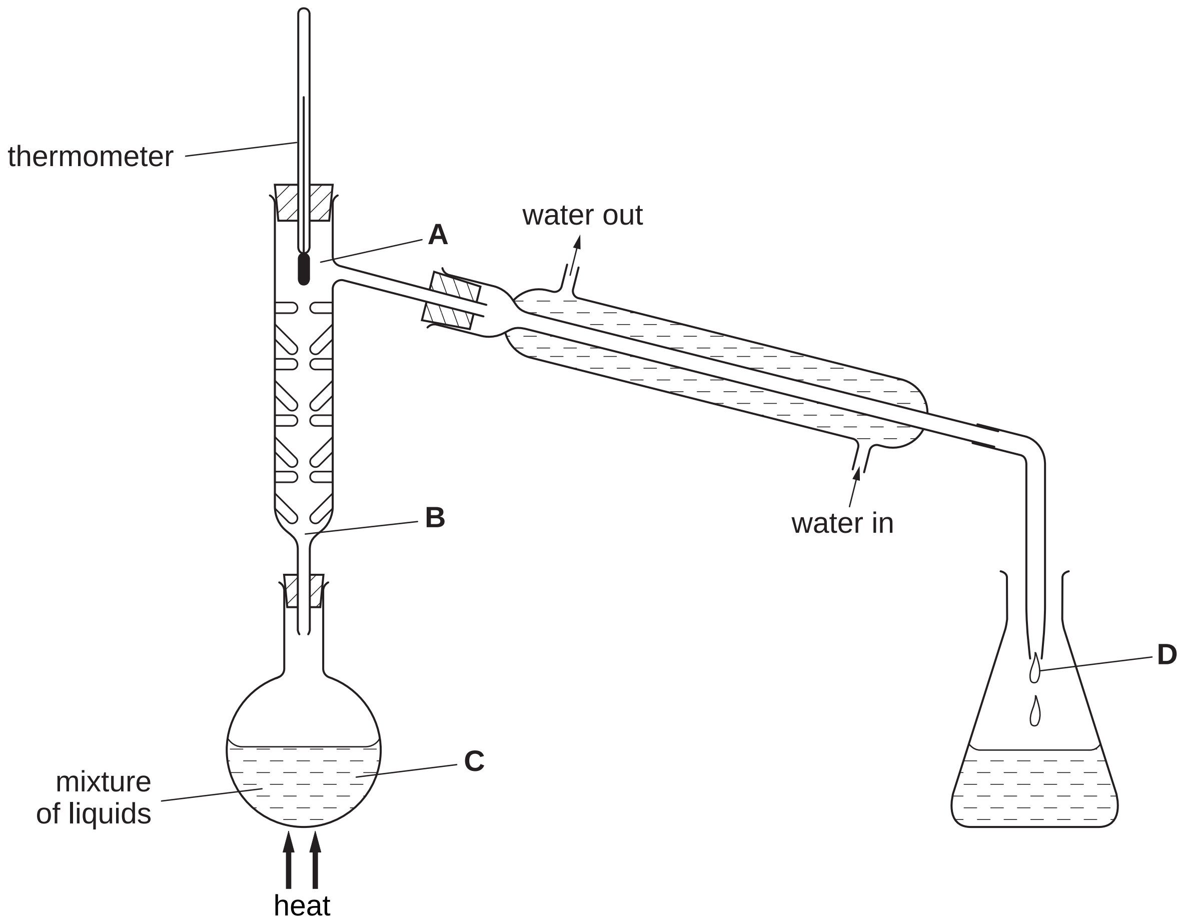
4 In each of four experiments, the same mass of magnesium was added to the same volume of an excess of sulphuric acid.

Which set of conditions will result in the magnesium being used up the fastest?

	form of magnesium	concentration of acid	temperature	
(a)	ribbon	1 mol/dm^3	20 °C	☐
(b)	powder	0.5 mol/dm^3	20 °C	☐
(c)	ribbon	0.5 mol/dm^3	80 °C	☐
(d)	powder	1 mol/dm^3	80 °C	☐

[Total: 1]

5 Equal volumes of two liquids that mix completely but do not react together are placed in the apparatus below. The mixture is heated.



When the thermometer first shows a steady reading, at which point **A**, **B**, **C**, or **D** will there be the highest proportion of the liquid with the higher boiling point?

(a) **A** ☐

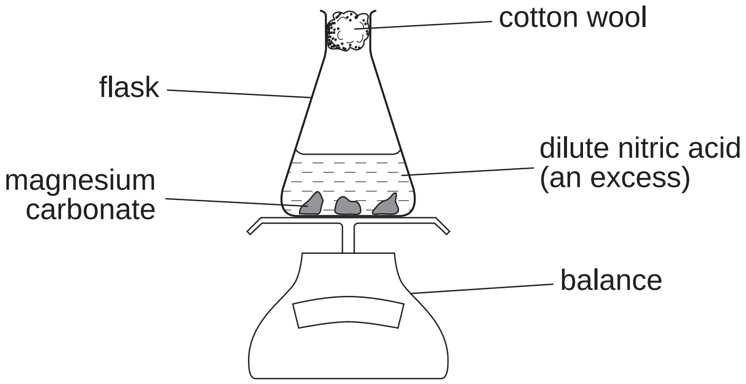
(b) **B** ☐

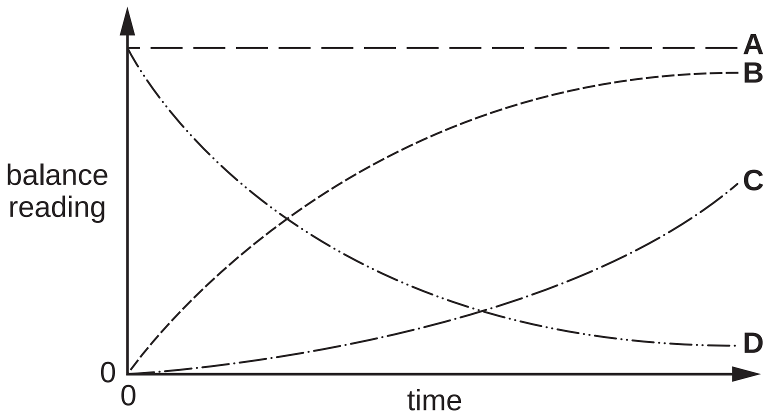
(c) **C** ☐

(d) **D** ☐

[Total: 1]

6 The experiment shown below was set up and the balance was read at intervals.





A graph of the balance reading against time was plotted.
Which curve was obtained?

(a) **A** ☐

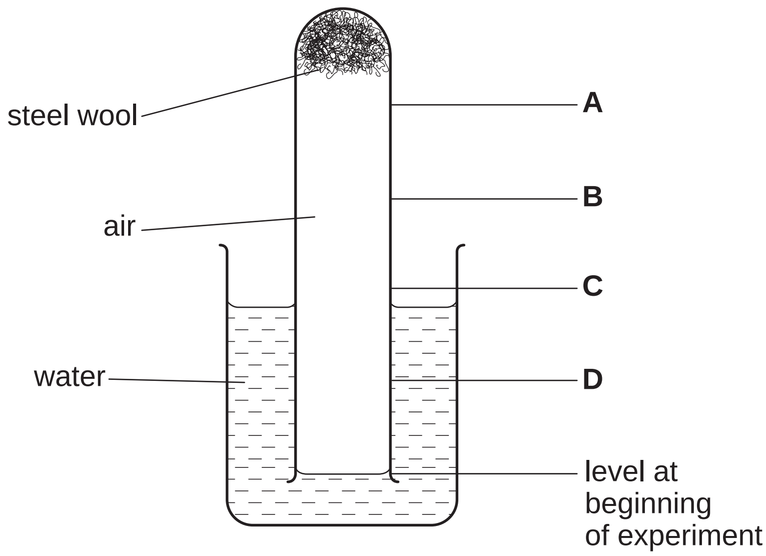
(b) **B** ☐

(c) **C** ☐

(d) **D** ☐

[Total: 1]

7 The diagram below shows a ball of steel wool placed inside the end of a test-tube. Th[e] tube is inverted in a beaker of water, trapping the air inside.



What was the level of the water after several days?

(a) **A** ☐

(b) **B** ☐

(c) **C** ☐

(d) **D** ☐ [Total: 1]

8 Calcium carbonate reacts with hydrochloric acid as shown below.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

What volume of 1.0 mol/dm^3 hydrochloric acid is needed to completely react with 2.0 g of calcium carbonate?
[M_r: $CaCO_3$, 100]

(a) 20 cm^3 ☐

(b) 40 cm^3 ☐

(c) 200 cm^3 ☐

(d) 400 cm^3 ☐ [Total: 1]

9 An experiment was done to find the concentration of an aqueous solution of amm[onium] chloride labelled **P**.

Q was 0.0800 mol/dm^3 hydrochloric acid.

A 25.0 cm^3 sample of **P** was measured into a flask followed by 25.0 cm^3 of 2.00 mol/dm^3 sodium hydroxide (an excess). Some of the sodium hydroxide reacted with the ammonium chloride to produce ammonia. The equation is given below.

$$NaOH + NH_4Cl \longrightarrow NaCl + NH_3 + H_2O$$

(a) What apparatus should be used to measure out 25.0 cm^3 of a solution?

.... [1]

The flask was heated until no more ammonia was detected in the steam.

(b) Suggest a test to detect ammonia in the steam leaving the flask.

.... [1]

After cooling, the mixture was transferred to a volumetric flask and made up to 250 cm^3 with distilled water.
This was solution **R**.

25.0 cm^3 of **R** was transferred to a conical flask and a few drops of methyl orange indicator added.

(c) What colour was the methyl orange in the flask?

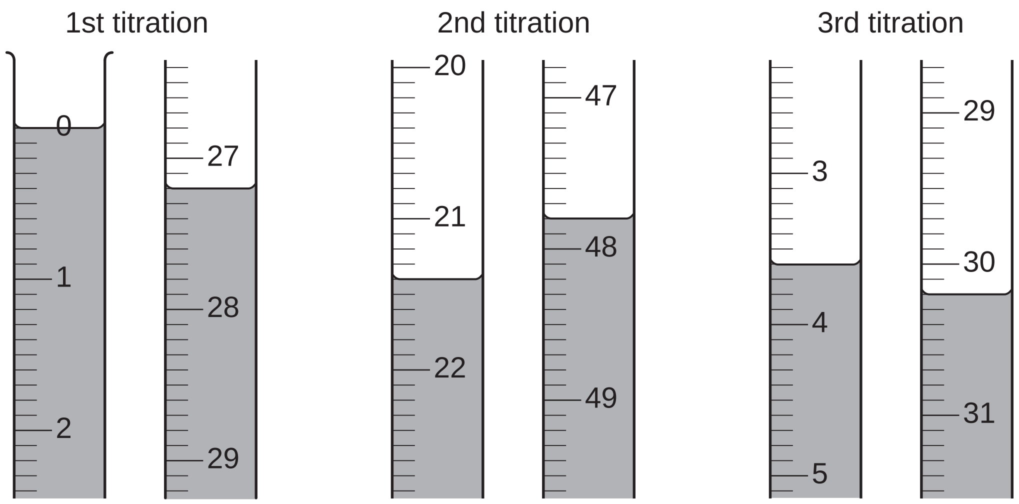
....

A burette was filled with **Q**.
Q was run into the conical flask until an end-point was reached.

What was the colour of the methyl orange when the end-point was reached?

....
[1]

Three titrations were done. The diagrams below show parts of the burette with the levels at the beginning and end of each titration.



(d) Use the diagrams to complete the following table.

titration number	1	2	3
final burette reading /cm^3			
initial burette reading /cm^3			
volume of **Q** used /cm^3			
best titration results (✓)			

Summary:

Tick (✓) the best titration results.

Using these results the average volume of **Q** was ....cm^3. [4]

(e) **Q** was 0.0800 mol/dm^3 hydrochloric acid. Calculate the number of moles of hydrochloric acid in the average volume of **Q** calculated in **(d)**.

.... [1]

(f) Using the equation

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

and your answer to **(e)**, deduce the number of moles of sodium hydroxide in 25.0 cm^3 of **R**.

.... [1]

(g) Using your answer to **(f)** calculate the number of moles of sodium hydroxide in 250 cm^3 of **R**.

.... [1]

(h) Calculate the number of moles of sodium hydroxide present in 25.0 cm^3 of 2.00 mol/dm^3 aqueous sodium hydroxide which was added originally to 25.0 cm^3 of **P**.

.... [1]

(i) Using your answers to **(g)** and **(h)**, calculate the number of moles of sodium hydroxide that reacted with 25.0 cm^3 of **P**.

.... [1]

(j) Using the equation

$$NaOH + NH_4Cl \longrightarrow NH_3 + NaCl + H_2O$$

and your answer to **(i)**,

(i) deduce the number of moles of ammonium chloride in 25.0 cm^3 of **P**,

.... [1]

(ii) calculate the concentration, in mol/dm^3, of **P**.

.... [1]

[Total: 14]

10 The following table shows the tests a student did on compound **T**.
Complete the table by describing the observation in test **(a)** and the test and observations which lead to the conclusion in test **(d)**.
For tests **(b)** and **(c)** suggest which ion(s) may be present in **T** as indicated by the observations for **each** test.

test	observation	conclusion
(a) **T** was dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.		**T** does not contain a transition metal.
(b) **(i)** To the first part aqueous sodium hydroxide was added until a change was seen. **(ii)** An excess of aqueous sodium hydroxide was added to the mixture from **(i)**.	A white precipitate was produced. The white precipitate dissolved.	**T** may contain ....ion(s).
(c) **(i)** To the second part aqueous ammonia was added until a change was seen. **(ii)** An excess of aqueous ammonia was added to the mixture from **(i)**.	A white precipitate was produced. The white precipitate remained in the solution.	**T** contains the ....ion.
(d)		**T** contains NO_3^- ions.

Conclusion: the formula of compound **T** is [Total: 9]

11 The reaction between lead(II) nitrate, $Pb(NO_3)_2$, and potassium iodide, KI, prod precipitate of lead(II) iodide.

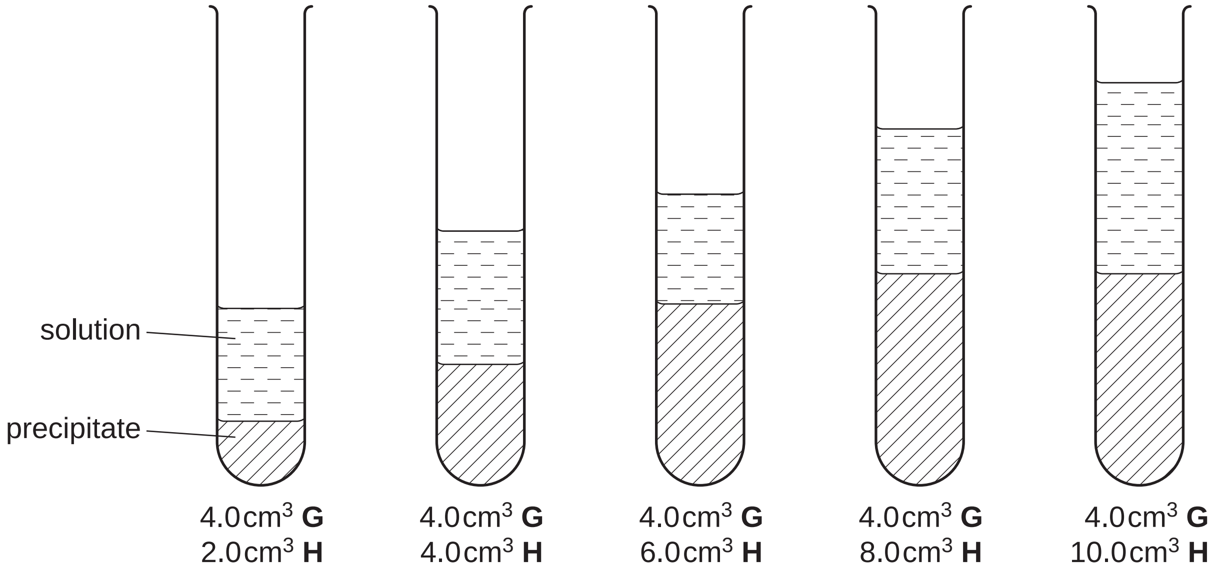
(a) Write the equation for the reaction between lead(II) nitrate and potassium iodide.

....[2]

Solution **G** is a solution of potassium iodide.
Solution **H** is 1.0 mol/dm^3 lead(II) nitrate.

4.0 cm^3 of **G** was placed in each of five test-tubes.

The diagrams below show the results of adding different volumes of **H** to each of the tubes. Each test-tube was left for a while to allow the precipitate to settle.

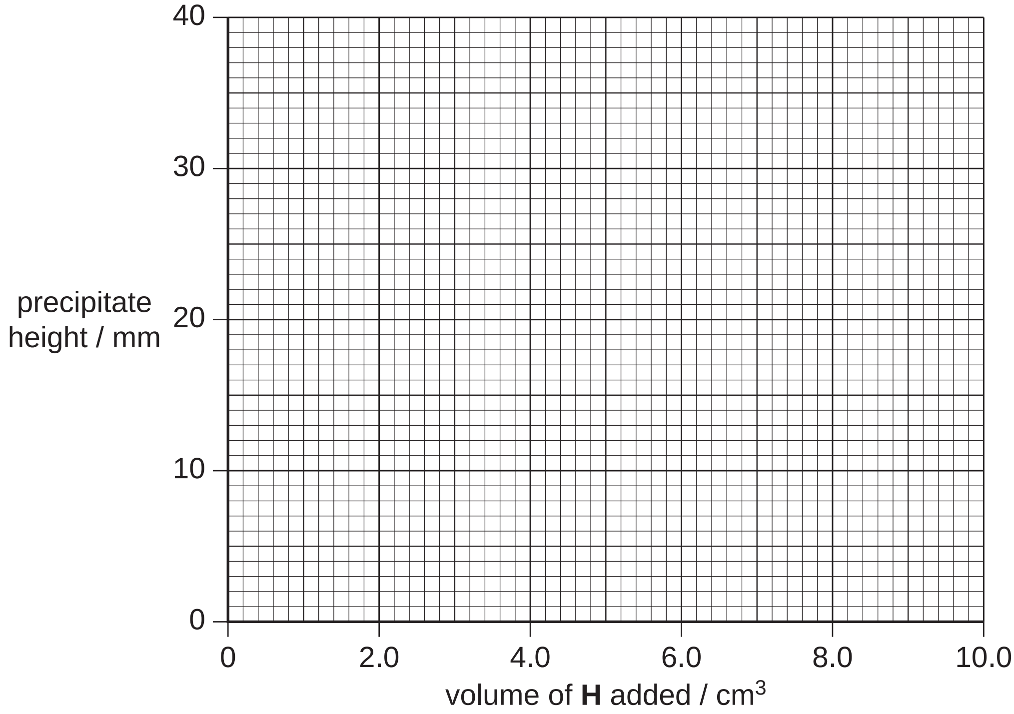


(b) Measure the height of each precipitate in millimetres. Record the results in the table below.

test-tube	1	2	3	4	5
volume of **H** added / cm^3	2.0	4.0	6.0	8.0	10.0
precipitate height / mm					

[2]

(c) Plot these results on the grid below and join the points with two intersecting lines.



[3]

(d) **(i)** What was the minimum volume of **H** required to completely react with 4.0 cm^3 **G**?

....cm^3 [1]

(ii) Using your answers to **(a)** and **(d)(i)**, calculate the concentration of potassium iodide in **G**.

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

(e) The experiment was repeated using 2.0 mol/dm^3 lead(II) nitrate and solution **G**.

(i) Calculate the minimum volume of 2.0 mol/dm^3 lead(II) nitrate which was required to completely react with 4.0 cm^3 of **G**.

....cm^3 [1]

(ii) What was the height of the precipitate in the test-tube when this reaction occurred?

.... [1]

[Total: 12]

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