Cambridge Assessment International Education
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **October/November 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.
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.

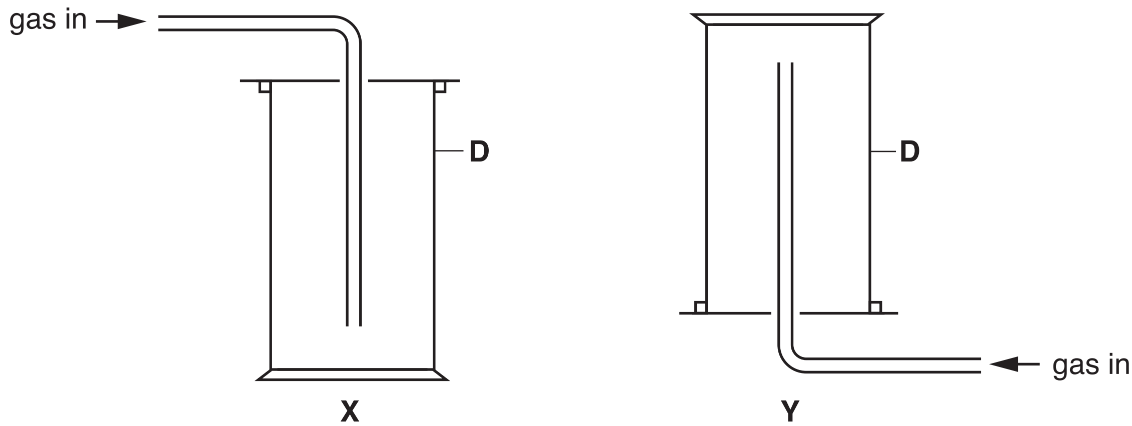
DC (ST/CT) 165354/2

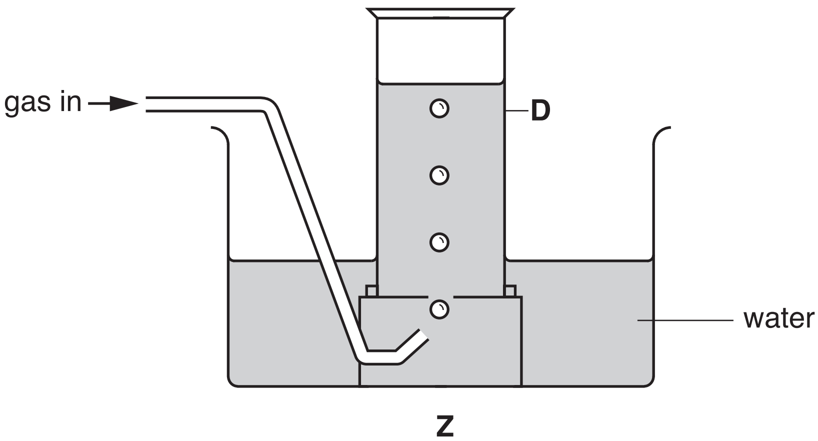
Cambridge Assessment International Education

1 Three gases, **A**, **B** and **C**, have the properties shown.

gas	density	solubility in water	appearance
A	less dense than air	insoluble	colourless
B	more dense than air	insoluble	colourless
C	more dense than air	soluble	green

Some sets of apparatus, **X**, **Y** and **Z**, used to collect gases are shown.





(a) Apparatus **D** is used to collect the gases.

Name apparatus **D**.

.... [1]

(b) Which **two** sets of apparatus, from **X**, **Y** and **Z**, can be used to collect gas **A**?

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

(c) Which set of apparatus, **X**, **Y** or **Z**, can be used to collect gas **C**?

.... [1]

(d) **(i)** State why apparatus **Y** is less suitable than apparatus **X** to collect gas **B**.

.... [1]

(ii) State why apparatus **X** is less suitable than apparatus **Z** to collect gas **B**.

....

.... [1]

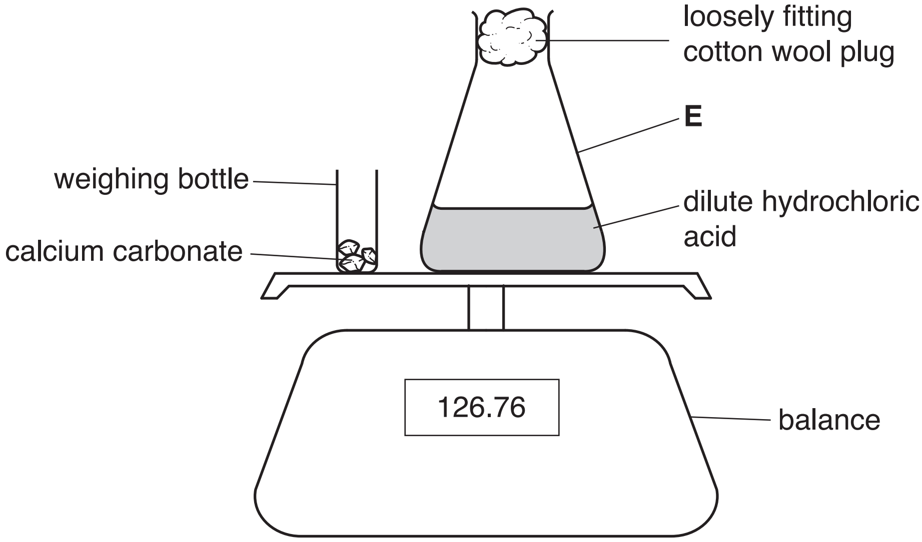
[Total: 5]

2 Calcium carbonate reacts with dilute hydrochloric acid.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

Vigorous bubbling is seen.

A student investigates the rate of this reaction using three samples of calcium carbonate. Each sample has a different particle size.



In each experiment the student adds all of the calcium carbonate, an excess, to dilute hydrochloric acid in apparatus **E**. The weighing bottle is replaced on the balance. The student records the mass every 30 seconds.

In experiment **1** the student uses large lumps of calcium carbonate.

(a) Name apparatus **E**.

.... [1]

(b) Which variable, other than mass, is measured in the experiment? Name the piece of apparatus used to measure this variable.

variable ....

apparatus ....
[1]

(c) Why does the mass decrease?

.... [1]

(d) The student does two more experiments. In each experiment the student uses calcium carbonate of different particle sizes.

In experiment **2** the student uses small lumps of calcium carbonate instead of large lumps.

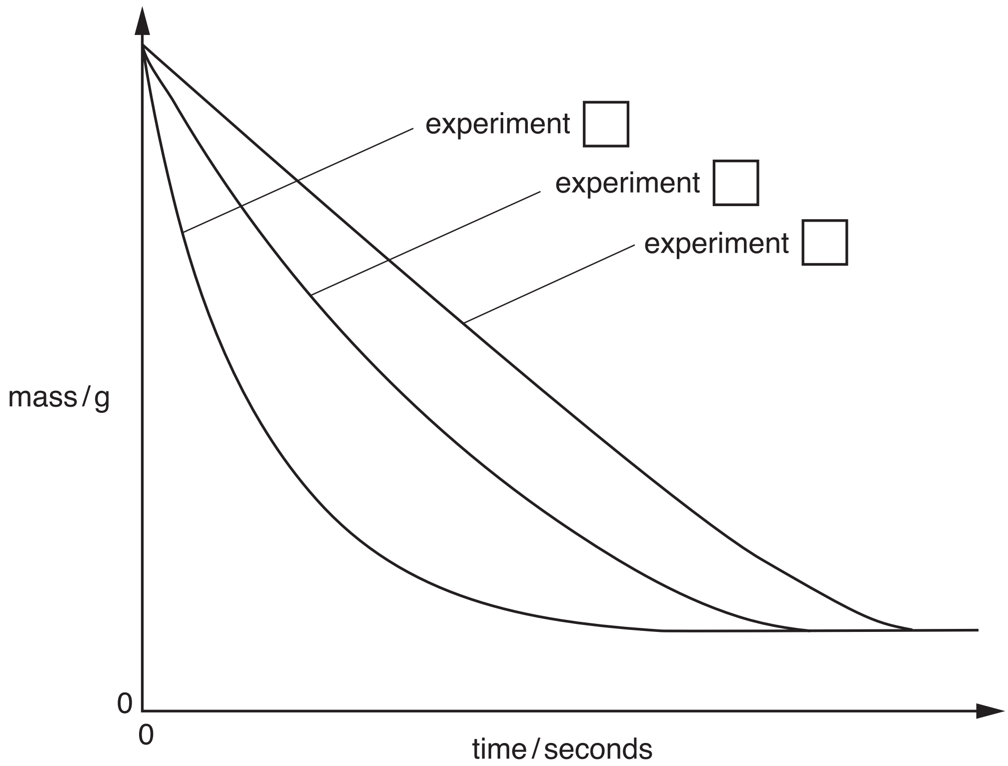
In experiment **3** the student uses powdered calcium carbonate instead of large lumps.

Suggest two variables that the student keeps constant so that the particle size of the calcium carbonate is the only variable that affects the rate of reaction.

1 ....

2 ....
[2]

(e) The student plots a graph of the results.



(i) Describe how the graphs are used to decide which experiment has the fastest rate.

....

.... [1]

(ii) Write a number in each box on the graph to identify experiments **1**, **2** and **3**. [1]

(iii) State how the graph shows that the reactions stop.

.... [1]

(iv) Why do the reactions stop?

.... [1]

[Total: 9]

3 An unlabelled bottle contains solid sodium carbonate, Na_2CO_3. Another unlabelled bottle contains solid sodium hydrogencarbonate, $NaHCO_3$.

The reaction between sodium carbonate and dilute hydrochloric acid is exothermic.

The reaction between sodium hydrogencarbonate and dilute hydrochloric acid is endothermic.

Plan experiments using the reaction of each solid with dilute hydrochloric acid:

- to identify each solid
- to determine which reaction produces the larger energy change per gram of solid.

You may use any of the apparatus normally found in a chemistry laboratory but no other chemicals.

You should state all the measurements you would make.

Chemical equations are not required.

....

....

....

....

....

....

....

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....

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....

....

....

....

[7]

4 A student is provided with solutions of:

- aqueous chromium(III) nitrate
- aqueous iron(II) chloride
- aqueous iron(III) chloride.

The student tests the three aqueous solutions by adding each reagent shown in the table.

Record the observations in the table.

Write 'no reaction' where appropriate.

	reagents			
solutions	aqueous sodium hydroxide	aqueous sodium hydroxide in excess	aqueous silver nitrate and dilute nitric acid	aluminium and aqueous sodium hydroxide + heat
aqueous chromium(III) nitrate				name of gas .... test for gas .... result of test ....
aqueous iron(II) chloride				
aqueous iron(III) chloride				

[10]

5 A student does an experiment to determine the percentage by mass of potassium iodate(V), KIO_3, in a sample of impure potassium iodate(V). The sample of impure potassium iodate(V) is placed in a previously weighed container which is then reweighed.

mass of container + impure potassium iodate(V) = 8.20 g

mass of empty container = 5.28 g

(a) Calculate the mass of impure potassium iodate(V) used in the experiment.

.... g [1]

(b) The student transfers the sample of impure potassium iodate(V) to a beaker, adds water and stirs with a glass rod until all the solid has dissolved. The solution is then transferred to a suitable container.

The beaker is washed out twice with water and the washings are transferred to the same container as the solution.

Why is the beaker washed out and the washings transferred to the same container as the solution?

.... [1]

(c) The solution of impure potassium iodate(V) is made up to 500.0 cm^3 with water. This is solution **G**.

Name the container in which solution **G** is made.

.... [1]

(d) The student transfers 25.0 cm^3 of **G** to a conical flask using a pipette.

Which liquid should be used to wash out the pipette, immediately before using it, to measure 25.0 cm^3 of **G**?

.... [1]

The student adds an excess of aqueous potassium iodide and an excess of dilute sulfuric acid to the conical flask. A reaction occurs to form iodine. This is solution **H**.

The amount of iodine produced can be determined by titration with aqueous sodium thiosulfate, $Na_2S_2O_3$, with a suitable indicator.

Solution **L** is 0.100 mol / dm^3 $Na_2S_2O_3$.

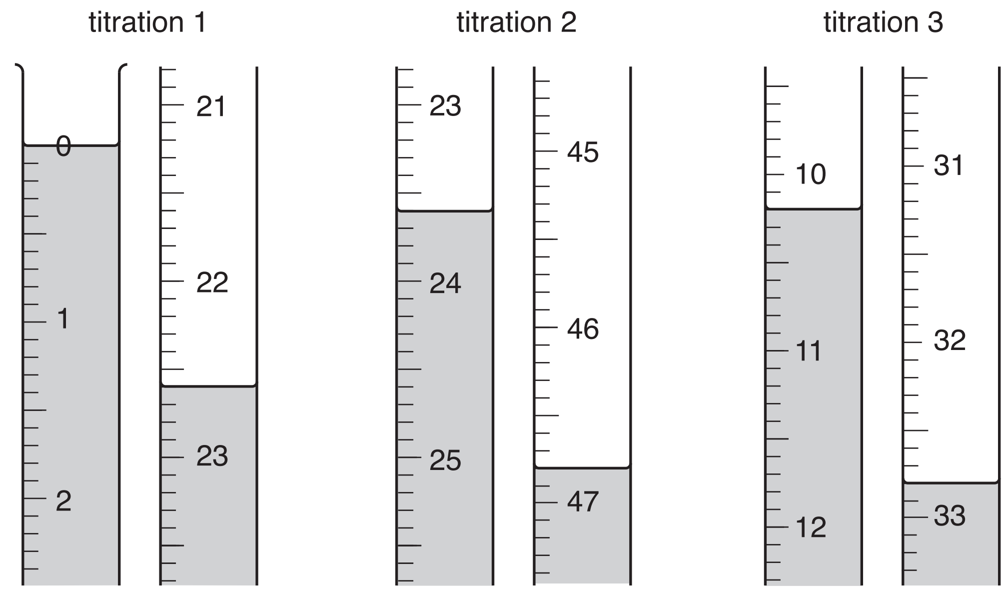
L is put into a burette and run into the conical flask until the end-point is reached.

(e) Why is it unnecessary to measure exactly the same amounts of aqueous potassium iodide and dilute sulfuric acid for each of the titrations?

....

.... [1]

(f) Three titrations are done. 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 table.

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

Summary

Tick (✓) the best titration results in the table.

Use these best results to calculate the average volume of **L**.

.... cm^3 [4]

(g) Calculate the number of moles of $Na_2S_2O_3$ in the average volume of **L**, 0.100 mol/dm^3 $Na_2S_2O_3$, used in the titration.

.... moles [1]

(h) Use the equation to calculate the number of moles of I_2 in **H** in the conical flask.

$$2Na_2S_2O_3 + I_2 \rightarrow 2NaI + Na_2S_4O_6$$

.... moles [1]

(i) Use the equation to calculate the number of moles of KIO_3 that produces the number of moles of I_2 calculated in **(h)**. This is the number of moles of KIO_3 in 25.0 cm^3 of **G**.

$$KIO_3 + 5KI + 3H_2SO_4 \rightarrow 3I_2 + 3K_2SO_4 + 3H_2O$$

.... moles [1]

(j) Calculate the number of moles of KIO_3 in 500.0 cm^3 of **G**.

.... moles [1]

(k) Calculate the M_r of KIO_3.

[A_r: K, 39; I, 127; O, 16]

.... [1]

(l) Use your answers to **(j)** and **(k)** to calculate the mass of potassium iodate(V), KIO_3, in the sample of impure potassium iodate(V).

....g [1]

(m) Use your answers to **(a)** and **(l)** to calculate the percentage by mass of KIO_3 in the sample of impure potassium iodate(V).

.... % [1]

[Total: 16]

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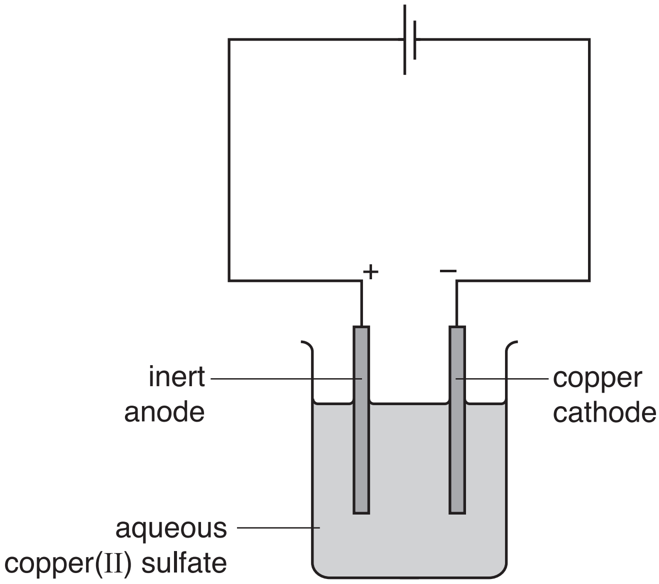
6 A student passes an electric current through an electrolyte of aqueous copper(II) sulfate using an inert anode and a copper cathode.



(a) Bubbles of gas are observed at the anode.

Name the gas given off at the anode. Give a test and observation to identify the gas.

name ....

test ....

observation ....
[2]

(b) A layer of copper is deposited at the copper cathode. A student wants to find the mass of copper deposited.

The student removes the cathode after 5 minutes.

(i) What should the student do to the cathode before weighing it?

.... [1]

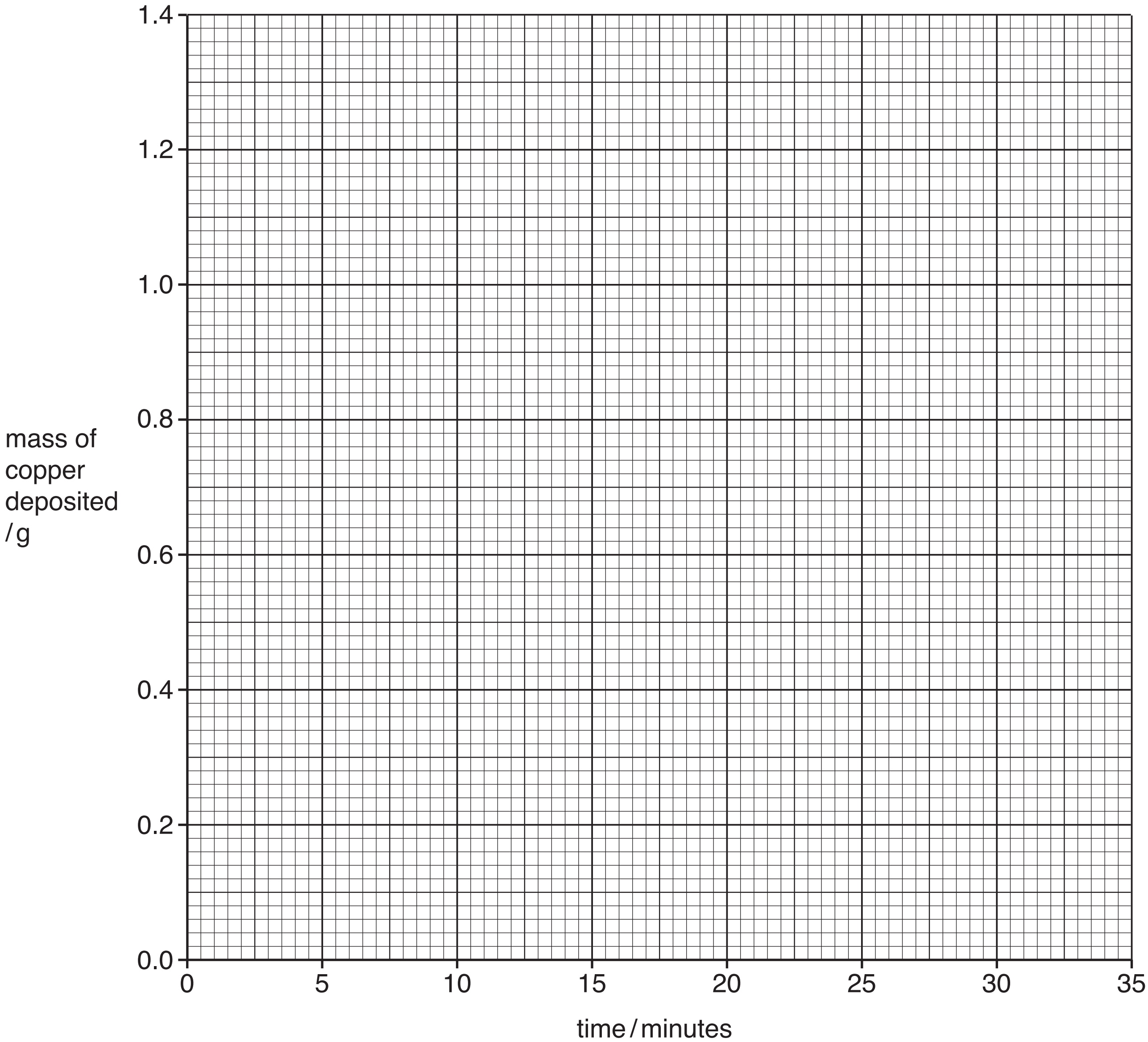
(ii) The student weighs the cathode. Which essential measurement is missing from the experimental method?

.... [1]

(c) After the student weighed the cathode she replaced it in the circuit and continued the experiment. She determined the mass of copper deposited at five-minute intervals.

time / minutes	mass of copper deposited / g
0	0.00
5	0.28
10	0.54
15	0.62
20	1.12
25	1.20
30	1.20
35	1.20

(i) Plot the results in the table on the grid. Use the points to draw two intersecting straight lines of best-fit.



[4]

(ii) Draw a circle around the anomalous point. [1]

(d) **(i)** Use your graph to determine how long it takes for 0.80 g of copper to be deposited.

.... minutes [1]

(ii) Use your graph to determine how long it takes for all the copper to be deposited.

.... minutes [1]

(e) What is the colour of the electrolyte:

- at the start of the experiment

  ....

- when **all** the copper has been deposited at the cathode?

  ....

[2]

[Total: 13]

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