Cambridge IGCSE

**Cambridge Assessment International Education**
Cambridge International General Certificate of Secondary Education

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| CANDIDATE NAME | | | | | | | | | | |
| CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | | |

*4373080598*

**PHYSICAL SCIENCE** **0652/51**

Paper 5 Practical Test **October/November 2019**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

**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.
Notes for Use in Qualitative Analysis for this paper are printed on pages 15–16.

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.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| Total | |

This document consists of **15** printed pages and **1** blank page.

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Cambridge Assessment International Education

1 You are going to investigate the thermal energy produced when a neutralisation reaction occurs.

(a)
- Use a measuring cylinder to measure 25 $cm^3$ aqueous hydrochloric acid and place it into a small beaker.
- Measure the temperature of the 25 $cm^3$ aqueous hydrochloric acid to the nearest 0.5 °C and record this value at time 0 seconds in Table 1.1.
- Rinse the measuring cylinder with distilled water and use it to measure 25 $cm^3$ aqueous sodium hydroxide.
- Add the 25 $cm^3$ aqueous sodium hydroxide to the hydrochloric acid in the beaker, start the stopclock and stir the mixture.
- Measure the temperature of the mixture in the beaker every 30 seconds for 5 minutes.

Record the temperatures to the nearest 0.5 °C in Table 1.1. [3]

**Table 1.1**

| time / s | temperature / °C |
|---|---|
| 0 | |
| 30 | |
| 60 | |
| 90 | |
| 120 | |
| 150 | |
| 180 | |
| 210 | |
| 240 | |
| 270 | |
| 300 | |

**(b)** **(i)** Plot a graph of temperature (vertical axis) against time on the grid provided.

[3]

**(ii)**
- Draw the best-fit straight line for the increasing temperatures.
- Draw the best-fit straight line for the decreasing temperatures.
- Extend both lines until they cross. This is the actual highest temperature reached in the reaction.

Record this highest temperature.

highest temperature reached = .................................................... °C [2]

**(c)** The temperature rise of the reaction is the highest temperature reached minus the temperature at time 0 seconds.

The thermal energy produced by this reaction can be calculated by the equation:

thermal energy produced = 50 × 4.2 × temperature rise

Calculate the thermal energy produced in this reaction.

thermal energy produced = ...................................................... J [1]

**(d)** The calculated amount of thermal energy produced in your experiment is much lower than the expected value.

Suggest **two** different reasons why your value for the thermal energy produced is lower than the expected value.

For each reason, suggest how the experiment can be changed to improve the accuracy. The changes must be possible using apparatus found in a school or college laboratory.

reason 1 ..........................................................................................................................

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improvement 1 ..................................................................................................................

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reason 2 ..........................................................................................................................

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improvement 2 ..................................................................................................................

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[2]

**(e)** In this experiment, the amount of sodium hydroxide exactly neutralises the amount of hydrochloric acid. Neither of the reagents is in excess.

The equation for the reaction is:

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

A student repeats the experiment but replaces the hydrochloric acid with $25\,cm^3$ of sulfuric acid, which has the same concentration as the hydrochloric acid.

The equation for this reaction is:

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

Suggest a value for the amount of thermal energy produced in this reaction, based on your result in **(c)**.

Explain your suggestion.

thermal energy produced = .................................. J

explanation ......................................................................................................................

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

[Total: 13]

**Question 2 begins over the page**

**2** You are given two substances, solid compound **A** and solution **B**.

You are going to perform a series of tests to identify **A** and **B**.

**(a)** Record the appearance of solid **A**.

- Add 20 $cm^3$ distilled water and stir well.

Record the appearance of the solution of **A**.

appearance of solid **A** ..............................................................................................................

appearance of the solution of **A** ..........................................................................................
[1]

**(b)**
- Put 2 cm depth of the solution of **A** into each of 4 test-tubes.
- To the first test-tube, add a few drops of nitric acid followed by a few drops of aqueous silver nitrate.
- To the second test-tube, add a few drops of nitric acid followed by a few drops of aqueous barium nitrate.
- To the third test-tube, add aqueous sodium hydroxide until it is in excess.
- To the fourth test-tube, add a wooden splint and leave to soak for use in **(b)(ii)**.

**(i)** Record the observations for the first three tests in Table 2.1.

**Table 2.1**

| test | observation |
|---|---|
| nitric acid and aqueous silver nitrate | |
| nitric acid and aqueous barium nitrate | |
| aqueous sodium hydroxide | |

[2]

**(ii)** • Place the wooden splint from the fourth test-tube into a blue flame.

Record the immediate flame colour.

flame colour .................................................................................................... [1]

**(iii)** Suggest the name of compound **A**. ........................................................................ [1]

**(c)** • Put 2 cm depth of solution **B** into a test-tube.

• Add the solution of **A** until it is in excess.

Record your observations and identify solution **B**.

observations ..........................................................................................................

..............................................................................................................................

..............................................................................................................................

identity of solution **B** ............................................................................................
[2]

[Total: 7]

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**3** You are going to calculate the density of soft modelling clay. You will use two different methods to find its volume.

**(a) Finding the mass**

- Flatten the soft modelling clay to make a disc shape which is approximately 5 cm in diameter.
- Set up the metre rule and pivot as shown in Fig. 3.1.
- Place the pivot under the 50.0 cm mark on the rule.
- Place the soft modelling clay on the rule so that its centre is at the 10.0 cm mark on the rule.
- Place the 50.0 g mass on the metre rule and adjust its position so that the rule is as close to being balanced as possible.

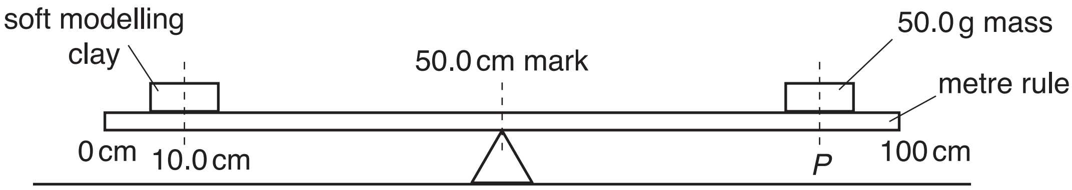


**Fig. 3.1**

**(i)** Determine and record the position $P$ of the centre of the 50.0 g mass on the ruler.

$P$ = .................................................. cm [1]

**(ii)** Calculate the mass $m$ of the soft modelling clay.

Use the equation:

$$m = 1.25(P - 50.0)$$

$m$ = ..................................................... g [1]

**(iii)** It is difficult to obtain an accurate value of the mass of the modelling clay using this method.

State one difficulty in this method.

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

**(b) Finding the volume – method 1**

- Roll the soft modelling clay into a ball.
- Use the wooden blocks to help you measure the diameter of the ball.
- Measure the diameter $d_1$ of the ball.

**(i)** Record $d_1$.

$d_1$ = .................................................. cm [1]

**(ii)** Draw a labelled diagram to show how you used the wooden blocks to help you measure the diameter of the soft modelling clay ball.

[1]

**(iii)** • Measure the diameter in two more places on the ball.

Record these measurements as $d_2$ and $d_3$.

Use your value of $d_1$ from part **(b)(i)** and the values of $d_2$ and $d_3$ to calculate $d_{av}$, the average of the three diameter measurements $d_1$, $d_2$ and $d_3$.

$d_2$ = ........................................................ cm

$d_3$ = ........................................................ cm

$d_{av}$ = ........................................................ cm [1]

**(iv)** Calculate the volume $V_1$ of the soft modelling clay.

Use the equation:

$$V_1 = 0.52 d_{av}^{\ 3}$$

Give your answer to a suitable number of significant figures.

$V_1$ = ................................................. $cm^3$ [2]

**(v)** Use your values from **(a)(ii)** and **(b)(iv)** to calculate the density $\rho_1$ of the modelling clay.

Use the equation:

$$\rho_1 = \frac{m}{V_1}$$

$\rho_1$ = ............................................ g/cm$^3$ [1]

**(c) Finding the volume – method 2**

- Check that the measuring cylinder provided contains 50.0 cm$^3$ of water.
- Gently submerge the soft modelling clay into the water inside the measuring cylinder.

**(i)** Record the new volume $V_2$ shown by the measuring cylinder.

$V_2$ = ................................................ cm$^3$ [1]

**(ii)** Calculate volume $V_3$ of the soft modelling clay.

Use the equation:

$$V_3 = V_2 - 50$$

$V_3$ = ................................................ cm$^3$ [1]

**(iii)** Use your answers from **(a)(ii)** and **(c)(ii)** to calculate another density value $\rho_2$ of the soft modelling clay.

Use the equation:

$$\rho_2 = \frac{m}{V_3}$$

$\rho_2$ = ............................................ g/cm$^3$ [1]

**(d)** Suggest which method of measuring the volume of the soft modelling clay is more accurate.

Explain your answer.

method ..........................................................................................................................

explanation ....................................................................................................................

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[1]

[Total: 13]

**4** A student investigates how the length of a pendulum affects its period. The period of a pendulum is the time it takes for one complete (to and fro) oscillation as shown in Fig. 4.1.

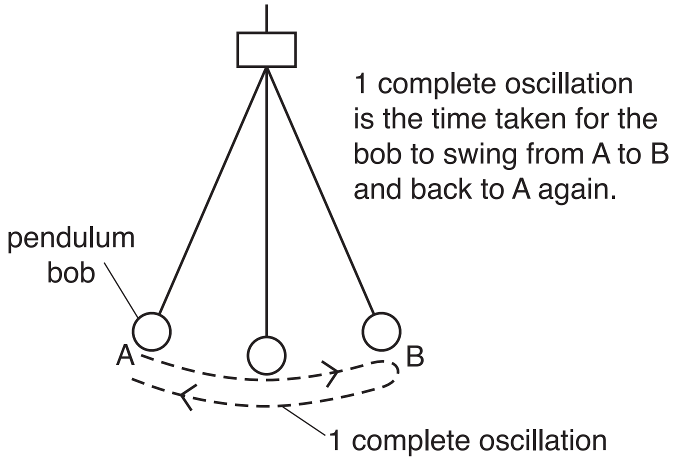


**Fig. 4.1**

Plan an experiment to investigate the relationship between the length $l$ of a pendulum and its period $T$ as shown in Fig. 4.2.

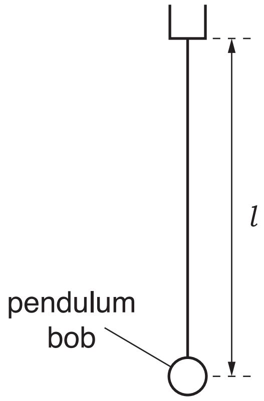


**Fig. 4.2**

You can assume you have access to school or college laboratory equipment.

Your plan should include:

- any additional apparatus needed
- a brief description of the method, including number and range of pendulum lengths to use
- the measurements you will make
- the variables to control
- the precautions you will take to ensure that the results are as accurate as possible
- the table you will draw to record your results, with column headings (you are **not** required to enter any readings into the table).

A diagram is not required but you may draw one if it helps to explain your plan.

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[7]

 

## NOTES FOR USE IN QUALITATIVE ANALYSIS

### Tests for anions

| *anion* | *test* | *test result* |
|---|---|---|
| carbonate ($CO_3^{2-}$) | add dilute acid | effervescence, carbon dioxide produced |
| chloride ($Cl^-$) [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | white ppt. |
| bromide ($Br^-$) [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | cream ppt. |
| nitrate ($NO_3^-$) [in solution] | add aqueous sodium hydroxide, then aluminium foil; warm carefully | ammonia produced |
| sulfate ($SO_4^{2-}$) [in solution] | acidify, then add aqueous barium nitrate | white ppt. |

### Tests for aqueous cations

| *cation* | *effect of aqueous sodium hydroxide* | *effect of aqueous ammonia* |
|---|---|---|
| ammonium ($NH_4^+$) | ammonia produced on warming | – |
| calcium ($Ca^{2+}$) | white ppt., insoluble in excess | no ppt. or very slight white ppt. |
| copper ($Cu^{2+}$) | light blue ppt., insoluble in excess | light blue ppt., soluble in excess, giving a dark blue solution |
| iron(II) ($Fe^{2+}$) | green ppt., insoluble in excess | green ppt., insoluble in excess |
| iron(III) ($Fe^{3+}$) | red-brown ppt., insoluble in excess | red-brown ppt., insoluble in excess |
| zinc ($Zn^{2+}$) | white ppt., soluble in excess, giving a colourless solution | white ppt., soluble in excess, giving a colourless solution |

## Tests for gases

| *gas* | *test and test result* |
|---|---|
| ammonia ($NH_3$) | turns damp red litmus paper blue |
| carbon dioxide ($CO_2$) | turns limewater milky |
| chlorine ($Cl_2$) | bleaches damp litmus paper |
| hydrogen ($H_2$) | 'pops' with a lighted splint |
| oxygen ($O_2$) | relights a glowing splint |

## Flame tests for metal ions

| *metal ion* | *flame colour* |
|---|---|
| lithium ($Li^+$) | red |
| sodium ($Na^+$) | yellow |
| potassium ($K^+$) | lilac |
| copper(II) ($Cu^{2+}$) | blue-green |