Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0412119406

PHYSICAL SCIENCE **0652/61**

Paper 6 Alternative to Practical **October/November 2023**

1 hour

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION
- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

DC (PQ/CGW) 320924/3

1 A student investigates the amount of precipitate formed when aqueous sodium carbonate reacts with aqueous barium nitrate.

The word equation for the reaction is shown.

sodium carbonate(aq) + barium nitrate(aq) $\rightarrow$ barium carbonate(s) + sodium nitrate(aq)

(a) Procedure

The student:

- labels 8 test-tubes **1**, **2**, **3**, **5**, **6**, **7**, **8** and **9** (there is no test-tube **4**)
- uses a measuring cylinder to add $5\,cm^3$ of aqueous barium nitrate into each test-tube
- adds $1\,cm^3$ of aqueous sodium carbonate to test-tube labelled **1** and stirs with a glass rod
- adds the volumes of aqueous sodium carbonate shown in Table 1.1 to the other test-tubes, stirring each with a glass rod
- leaves the test-tubes to stand for 10 minutes to allow the precipitate to settle
- after 10 minutes measures the height of precipitate in each test-tube
- records these heights in Table 1.1.

Table 1.1

test-tube number	volume of aqueous sodium carbonate added / cm^3	height of precipitate / mm
1	1	5
2	2	10
3	3	....
5	5	20
6	6	....
7	7	29
8	8	29
9	9	29

(i) Suggest a piece of apparatus suitable for measuring the $5\,cm^3$ of aqueous barium nitrate more accurately than the measuring cylinder.

.... [1]

(ii) Fig. 1.1 shows the height of the precipitate in the test-tube for 3 cm^3 and 6 cm^3 of aqueous sodium carbonate added.

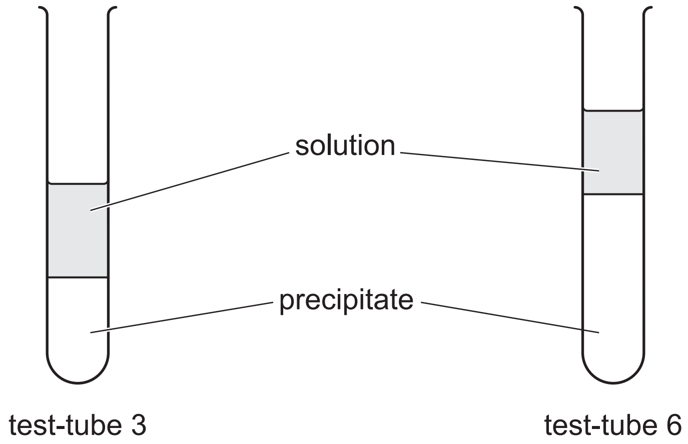


Fig. 1.1

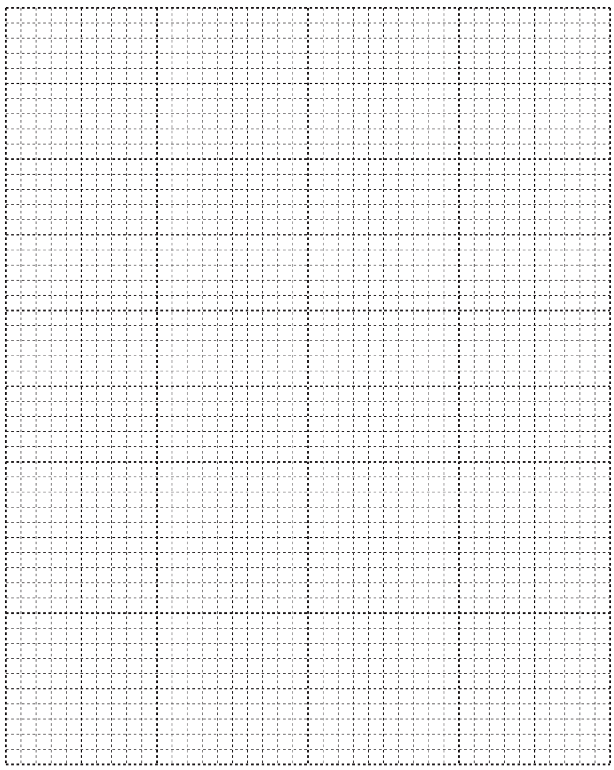
Record in Table 1.1 the height of the precipitate in each test-tube in millimetres to the nearest millimetre. [2]

(iii) Explain why it is difficult to get an accurate value for the height of the precipitate.

....

.... [1]

(b) (i) On the grid, plot a graph of the height of precipitate (vertical axis) against volume of aqueous sodium carbonate added.



[3]

(ii) Draw the best-fit line. [1]

(iii) Describe the relationship between the height of precipitate and the volume of aqueous sodium carbonate added.

....

.... [2]

(iv) Use your graph to estimate the height of the precipitate formed when $4.0\,cm^3$ of aqueous sodium carbonate is added to $5\,cm^3$ of aqueous barium nitrate.

Show clearly on your graph how you arrived at your answer.

.... mm [2]

(c) The height of the precipitate is the same for $7\,cm^3$, $8\,cm^3$ and $9\,cm^3$ of aqueous sodium carbonate added. These are not anomalous results.

Suggest why these heights are the same.

....

.... [1]

(d) Suggest how the procedure can be adapted to increase confidence in the results.

....

.... [1]

[Total: 14]

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2 The student investigates further the reaction in Question **1**.

(a) **(i)** In the experiment in Question **1**, when aqueous sodium carbonate reacts with aqueous barium nitrate, a white precipitate forms.

The precipitate is separated from the mixture by filtration.

Draw a labelled diagram of the assembled filtration apparatus.

[1]

(ii) Label the residue and the filtrate on your drawing in **(a)(i)**. [1]

(b) **Procedure**

The student:

- puts 1 cm depth of aqueous sodium carbonate into a clean test-tube
- adds 1 cm depth of aqueous barium nitrate to the test-tube and observes a white precipitate
- adds approximately 3 cm^3 of dilute nitric acid to the test-tube
- keeps the test-tube for **(c)**.

The student observes that when the dilute nitric acid is added a gas is given off and the white precipitate dissolves, giving a colourless solution.

(i) Describe what the student sees in the test-tube that shows a gas is given off in the reaction.

....

.... [1]

(ii) Describe the test which identifies the gas given off as carbon dioxide. Include the observation for a positive result.

test ....

observation ....
[1]

(c) The student adds more aqueous barium nitrate to the test-tube at the end of the procedure in **(b)**. No white precipitate forms.

Aqueous barium nitrate is used to identify sulfate ions.

When aqueous barium nitrate is added to a solution of sulfate ions, a white precipitate is formed.

Explain why nitric acid is also added in the test for sulfate ions.

....

.... [1]

(d) The barium ions can be identified by using a flame test.

Explain why a blue Bunsen burner flame is used for the flame test rather than a yellow flame.

....

.... [1]

[Total: 6]

3 A student investigates the refraction of light by a transparent block.

Fig. 3.1 shows the student's ray-trace sheet.

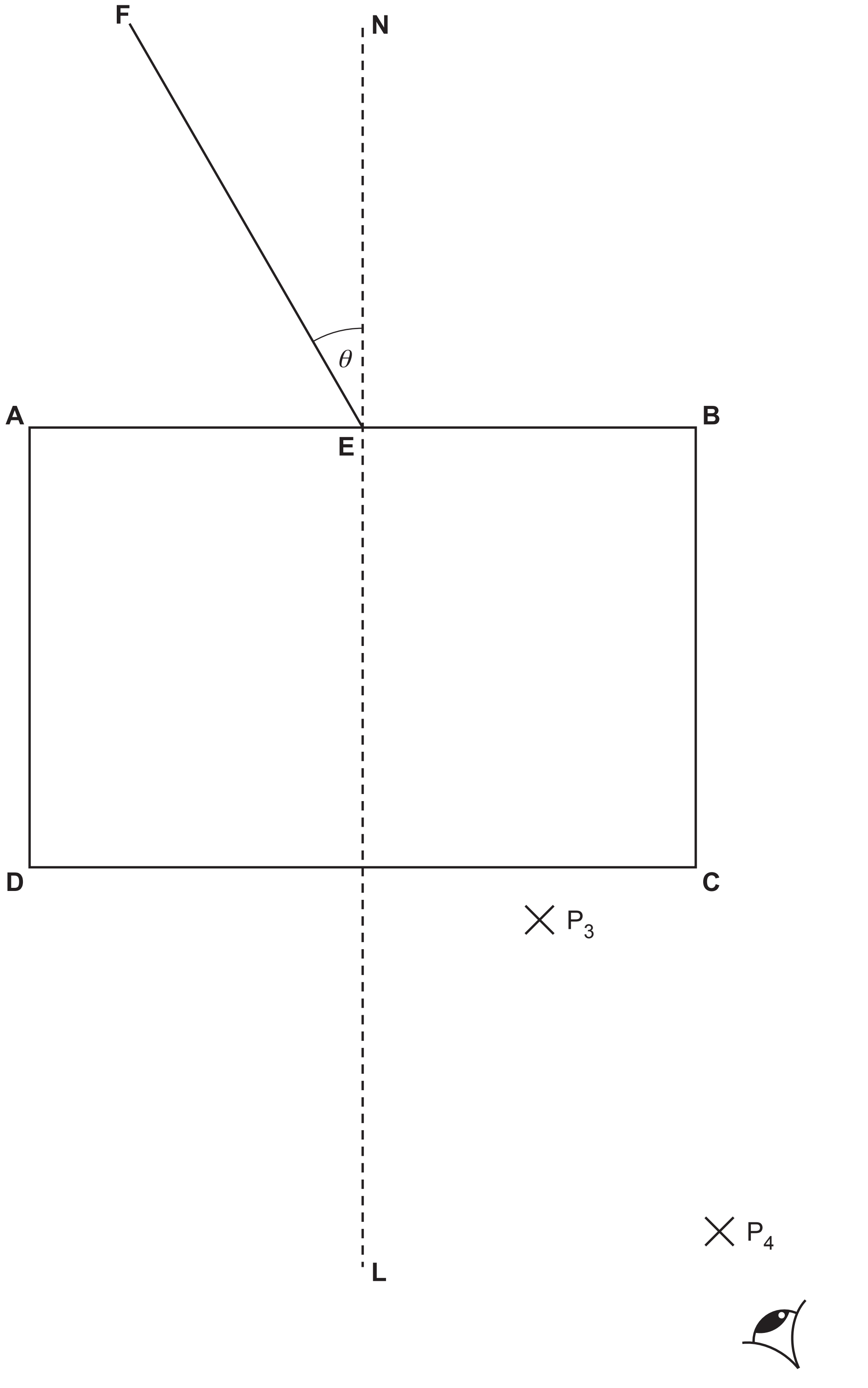

Fig. 3.1

(a) Procedure

The student:

- places a transparent block at the centre of the ray-trace sheet
- draws round the block and labels the corners **ABCD** as shown in Fig. 3.1
- removes the block
- draws the normal **NL** and line **FE** as shown in Fig. 3.1.

(i) Measure the angle of incidence θ that line **FE** makes with the normal **NL**.

θ = ... ° [1]

(ii) The student places two pins $\mathbf{P_1}$ and $\mathbf{P_2}$ on the line **FE** a distance apart that is suitable for ray-tracing.

Mark with crosses points $\mathbf{P_1}$ and $\mathbf{P_2}$ on line **FE** a distance apart that is suitable for ray-tracing. [1]

(b) The student then:

- replaces the block
- views the images of $\mathbf{P_1}$ and $\mathbf{P_2}$ through the block from the direction indicated by the eye on Fig. 3.1
- places two pins $\mathbf{P_3}$ and $\mathbf{P_4}$ so that pins $\mathbf{P_3}$ and $\mathbf{P_4}$ and the images of pins $\mathbf{P_1}$ and $\mathbf{P_2}$ all appear exactly one behind the other
- labels the positions of $\mathbf{P_3}$ and $\mathbf{P_4}$
- removes the block and pins from the ray-trace sheet.

(i) Draw a line joining the positions of $\mathbf{P_3}$ and $\mathbf{P_4}$.

Continue the line $\mathbf{P_3 P_4}$ until it meets the normal **NL**. Label this point **H**.

Label the point at which the line $\mathbf{P_3 P_4}$ meets **CD** with the letter **G**.

Join points **G** and **E** with a straight line.

[1]

(ii) Measure and record the length a of line **GE** and the length b of line **GH**.

a = ... cm

b = ... cm
[1]

(iii) Calculate a value n_1 for the refractive index. Use the equation:

$$n_1 = \frac{a}{b}$$

Record your value of n_1 to a suitable number of significant figures.

n_1 = ... [2]

(c) The student repeats the procedure with an angle of incidence $\theta = 50°$ to the normal **NL**.

The student measures the new lengths of lines a and b. The measurements are shown in Fig. 3.2.

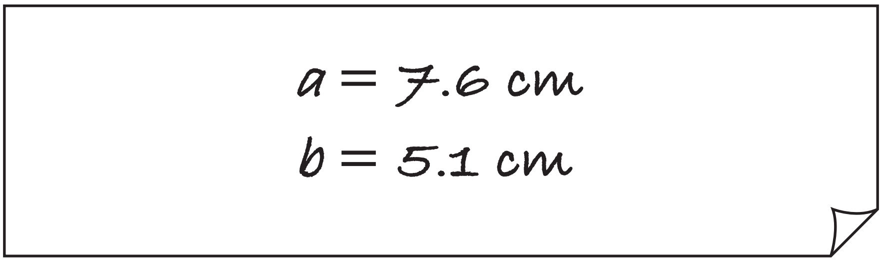

Fig. 3.2

(i) Calculate a value n_2 for the refractive index. Use the equation:

$$n_2 = \frac{a}{b}$$

Record your value of n_2 to a suitable number of significant figures.

n_2 = ... [2]

(ii) Two quantities are considered equal within the limits of experimental error if their values are within 10% of each other.

A student suggests that the values n_1 and n_2 should be considered equal.

State whether your results support this suggestion. Justify your answer by reference to your results.

....

.... [2]

(iii) Explain why the value n_2 is likely to be a more accurate value for the refractive index than n_1.

....

....

.... [1]

(d) Suggest a precaution that you should take with this experiment to increase confidence in the results.

....

....

.... [1]

(e) Suggest why different students, all doing this experiment carefully, may not obtain identical results.

....

....

.... [1]

[Total: 13]

4 Conducting putty is modelling clay that conducts electrical current.

Plan an experiment to investigate the relationship between the diameter *d* of the conducting putty and its resistance *R*.

Resistance is calculated using the equation

$$R = \frac{V}{I}$$

where *V* is the potential difference across the conductor and *I* is the current through the conductor.

The student has a battery pack, connecting leads and some conducting putty which can be moulded into a cylinder shape as shown in Fig. 4.1.

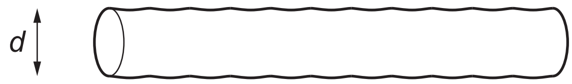

Fig. 4.1

Other apparatus normally available in a school laboratory may also be used.

Your plan should include:

- any additional apparatus needed
- a brief description of the method, including the measurements you make, a circuit diagram and the table you use to record your results (you are not required to enter any readings into the table)
- the variables to control
- the precautions you take to ensure the results are as accurate as possible
- an explanation of how you use your results to reach a conclusion.

[7]

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