Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

1917563832

PHYSICAL SCIENCE **0652/51**

Paper 5 Practical Test **October/November 2023**

1 hour 15 minutes

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

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 [ ].
- Notes for use in qualitative analysis are provided in the question paper.

For Examiner's Use	
1	
2	
3	
4	
Total	

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

1 You are going to investigate 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

- Label 6 test-tubes **1**, **2**, **3**, **5**, **6** and **7** (there is no test-tube **4**).
- Using a measuring cylinder, add 5 cm^3 of aqueous barium nitrate into each test-tube.
- Using a **clean** measuring cylinder, add 1 cm^3 of aqueous sodium carbonate to test-tube **1** and stir with a glass rod.
- Using the measuring cylinder used for adding aqueous sodium carbonate to test-tube **1**, add the volumes of aqueous sodium carbonate shown in Table 1.1 to the other test-tubes, stirring each with a glass rod.
- Leave the test-tubes to stand for at least 10 minutes to allow the precipitate to settle.

Complete Question **2** while you wait.

- After at least 10 minutes measure the height of precipitate in each test-tube.

Record, in Table 1.1, these heights in millimetres to the nearest millimetre.

Table 1.1

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

[3]

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

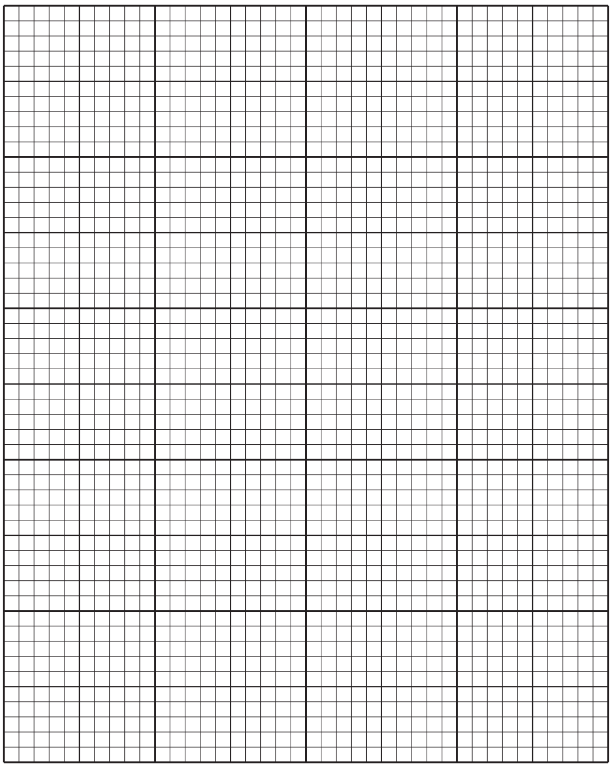
.... [1]

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

....

.... [1]

(c) **(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.

....

.... [1]

(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]

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

....

.... [1]

[Total: 13]

2 You are going to investigate 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**

Read the whole of **(b)** **before** doing the experiment.

- Put approximately 1 cm depth of aqueous sodium carbonate into a test-tube.
- Add approximately 1 cm depth of aqueous barium nitrate to the test-tube.
- Add approximately 3 cm^3 of dilute nitric acid to the test-tube.
- Identify the gas given off.

Keep the test-tube and contents for **(b)(iii)**.

(i) Describe what you see in the test-tube when the dilute nitric acid is added.

....

....

.... [2]

(ii) Describe the test which identifies the gas given off. Give the observation for the positive result.

test ....

observation .... [1]

(iii) Use the test-tube from the end of the procedure in **2(b)** for this test.

- add a few drops of aqueous barium nitrate to the test-tube.

Record your observations.

....

.... [1]

(c) 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]

Remember to go back and complete Question 1.

[Total: 7]

3 You are going to investigate the refraction of light by a transparent block.

You will use the diagram shown in Fig. 3.1.

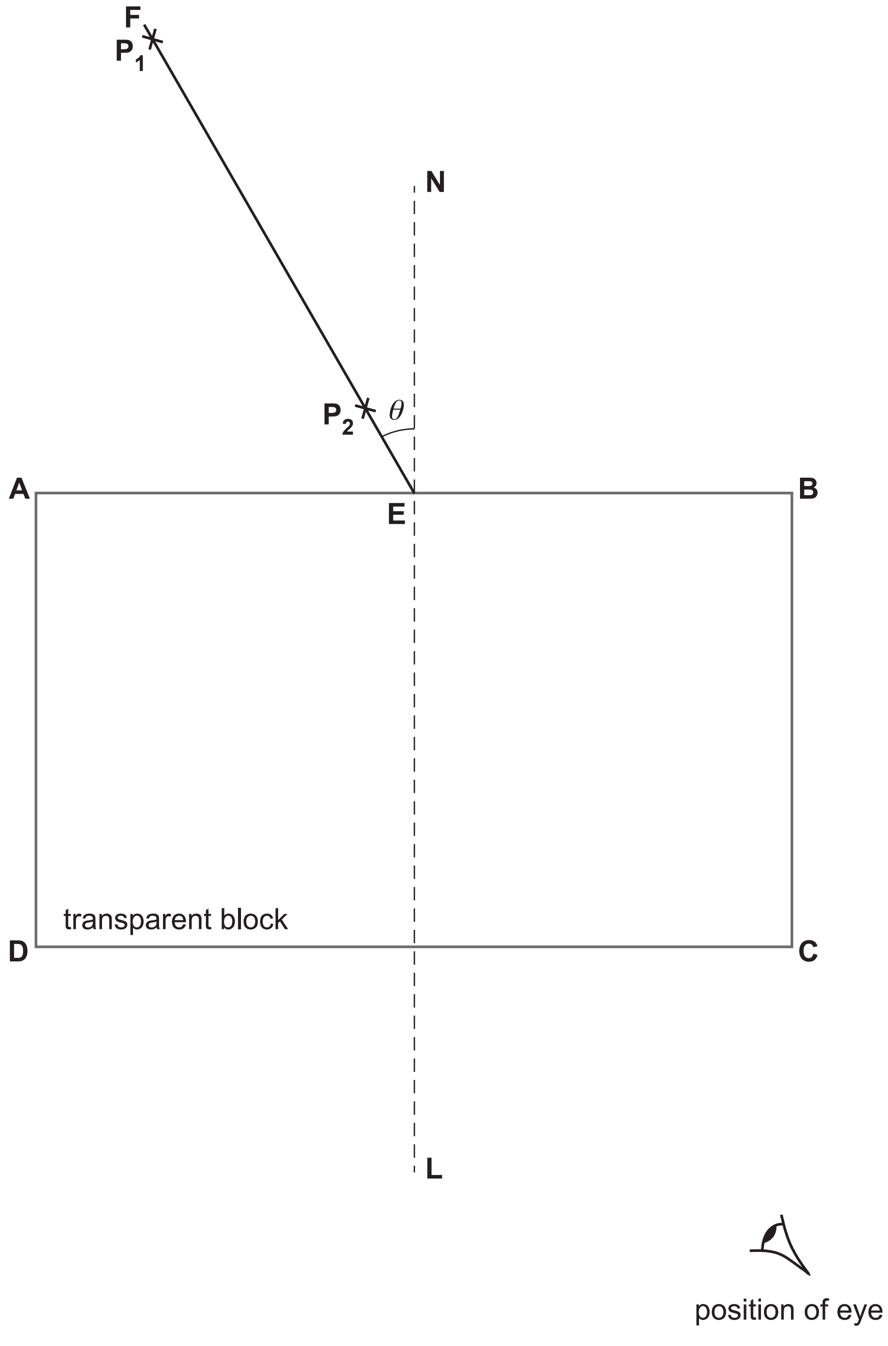


Fig. 3.1

(a) **(i)** Measure and record the angle θ that line **FE** makes with the normal **NL**.

θ = ... ° [1]

(ii) Procedure

- Arrange this paper so that page 6 lies over the pinboard provided.
- Place the block inside the labelled rectangle shown in Fig. 3.1.
- The longer side of the block must lie along **AB** with the normal **NL** crossing the longer side approximately in the centre.

The side of the block closest to the line **CD** is now referred to as side **CD**.

- Insert one pin at position $\mathbf{P_1}$ and another pin at position $\mathbf{P_2}$ on line **FE**.
- View the images of $\mathbf{P_1}$ and $\mathbf{P_2}$ through the side **CD** of the block from the position indicated by the eye. Move your head slightly so that the images of $\mathbf{P_1}$ and $\mathbf{P_2}$ appear one behind the other.
- Place a third pin between side **CD** and your eye, in line with the images of $\mathbf{P_1}$ and $\mathbf{P_2}$. This is pin $\mathbf{P_3}$.
- Place a fourth pin a suitable distance from pin $\mathbf{P_3}$, in line with pin $\mathbf{P_3}$ and the images of $\mathbf{P_1}$ and $\mathbf{P_2}$. This is pin $\mathbf{P_4}$.
- Label the positions of the pins $\mathbf{P_3}$ and $\mathbf{P_4}$.
- Remove the block and pins from the paper.
- Draw a line joining the positions of $\mathbf{P_3}$ and $\mathbf{P_4}$.
- Continue the line until it meets the normal **NL** and label this point **H**.
- Also label the point at which the line crosses **CD** with the letter **G**.
- Join points **G** and **E** with a straight line. [2]

(iii) Measure the length *a* of line **GE**.

a = ... cm

Measure the length *b* of line **GH**.

b = ... cm

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 = ...

[3]

(b) You are now going to repeat the process using a different angle of incidence.

You will use the diagram shown in Fig. 3.2.

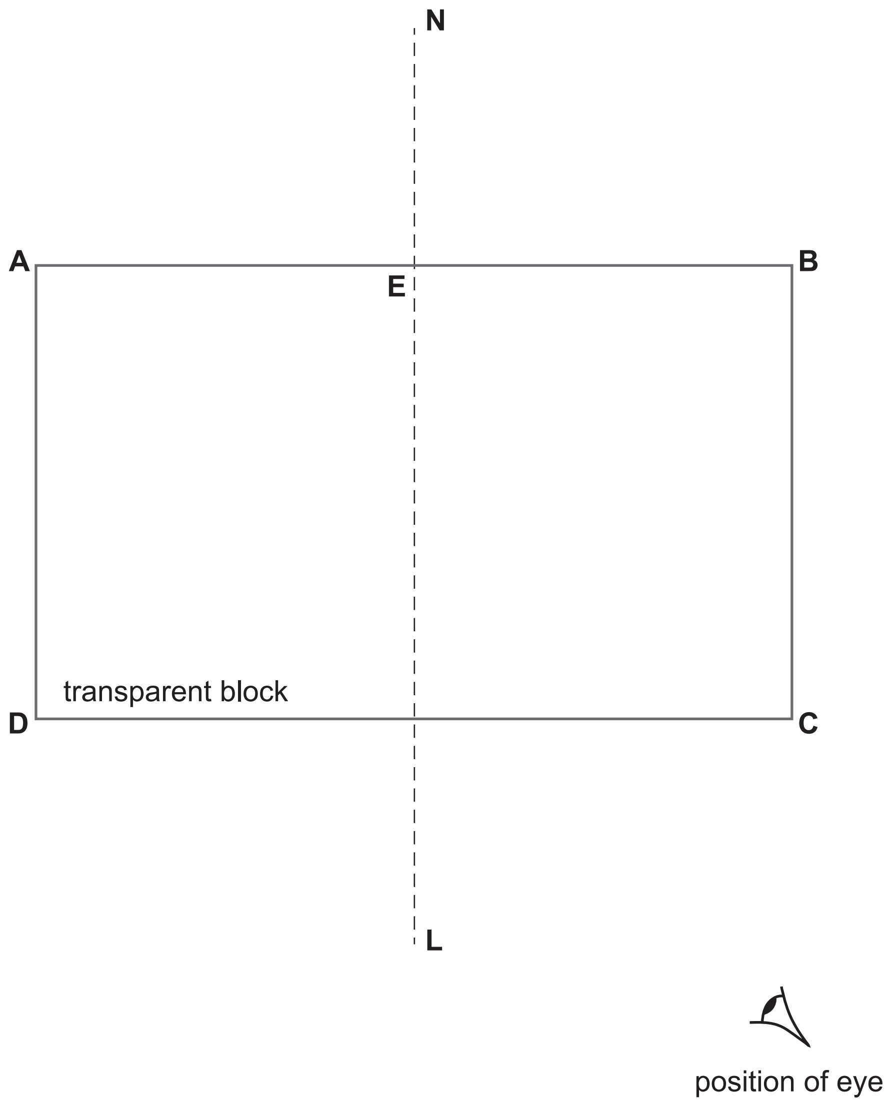


Fig. 3.2

(i) Procedure

- On Fig. 3.2, draw a line to the left of the normal **NL** at an angle of incidence $i = 50°$. Label the line **FE**.
- Arrange this paper so that page 8 lies over the pinboard provided.
- Place the block inside the labelled rectangle shown in Fig. 3.2 as in part **(a)(ii)**.
- Insert two pins a suitable distance apart on line **FE**. Label the positions of the pins $\mathbf{P_5}$ and $\mathbf{P_6}$.
- View the images of $\mathbf{P_5}$ and $\mathbf{P_6}$ through the side **CD** of the block from the position indicated by the eye. Move your head slightly so that the images of $\mathbf{P_5}$ and $\mathbf{P_6}$ appear one behind the other.
- Place a third pin between side **CD** and your eye, in line with the images of $\mathbf{P_5}$ and $\mathbf{P_6}$. This is pin $\mathbf{P_7}$.
- Place a fourth pin a suitable distance from pin $\mathbf{P_7}$, in line with pin $\mathbf{P_7}$ and the images of $\mathbf{P_5}$ and $\mathbf{P_6}$. This is pin $\mathbf{P_8}$.
- Label the positions of the pins $\mathbf{P_7}$ and $\mathbf{P_8}$.
- Remove the block and pins from the paper.
- Draw a line joining the positions of $\mathbf{P_7}$ and $\mathbf{P_8}$.
- Continue the line until it meets the normal **NL** and label this point **H**.
- Also label the point at which the line crosses **CD** with the letter **G**.
- Join points **G** and **E** with a straight line. [1]

(ii) Measure the length *c* of line **GE**.

c = ... cm

Measure the length *d* of line **GH**.

d = ... cm

Calculate a value n_2 for the refractive index.

Use the equation:

$$n_2 = \frac{c}{d}$$

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

n_2 = ...

[2]

(c) **(i)** 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]

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

....

....

.... [1]

(d) Suggest why different students, all doing this experiment carefully, may obtain slightly different results.

....

....

.... [1]

[Total: 13]

BLANK PAGE

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.

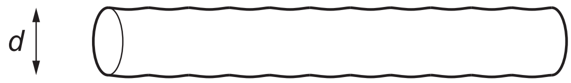


Fig. 4.1

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

You will **not** be doing this experiment.

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]

BLANK PAGE

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(II) (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