



CANDIDATE  
NAME

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CENTRE  
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**0652/62**

October/November 2023

**1 hour**

No additional materials are needed.

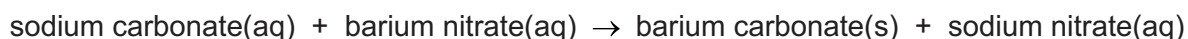
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction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

- 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.

- 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.



**(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  $5\text{ cm}^3$  of aqueous barium nitrate into each test-tube
- adds  $1\text{ cm}^3$  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.

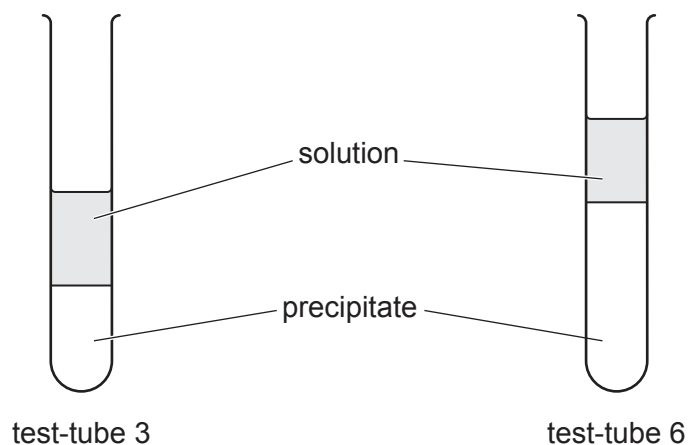
**Table 1.1**

test-tube number	volume of aqueous sodium carbonate added/ $\text{cm}^3$	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  $5\text{ cm}^3$  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<sup>3</sup> and 6 cm<sup>3</sup> of aqueous sodium carbonate added.



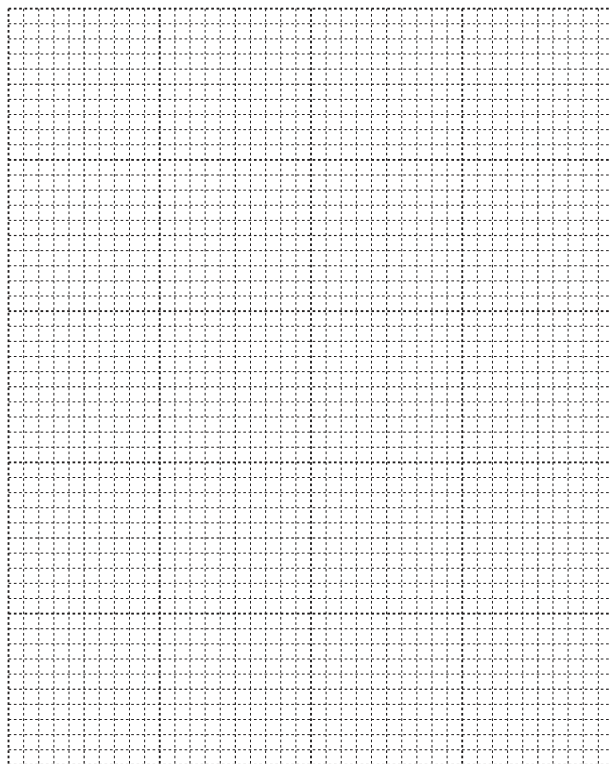
**Fig. 1.1**

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  $4.0\text{ cm}^3$  of aqueous sodium carbonate is added to  $5\text{ cm}^3$  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  $7\text{ cm}^3$ ,  $8\text{ cm}^3$  and  $9\text{ cm}^3$  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]



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<sup>3</sup> 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.

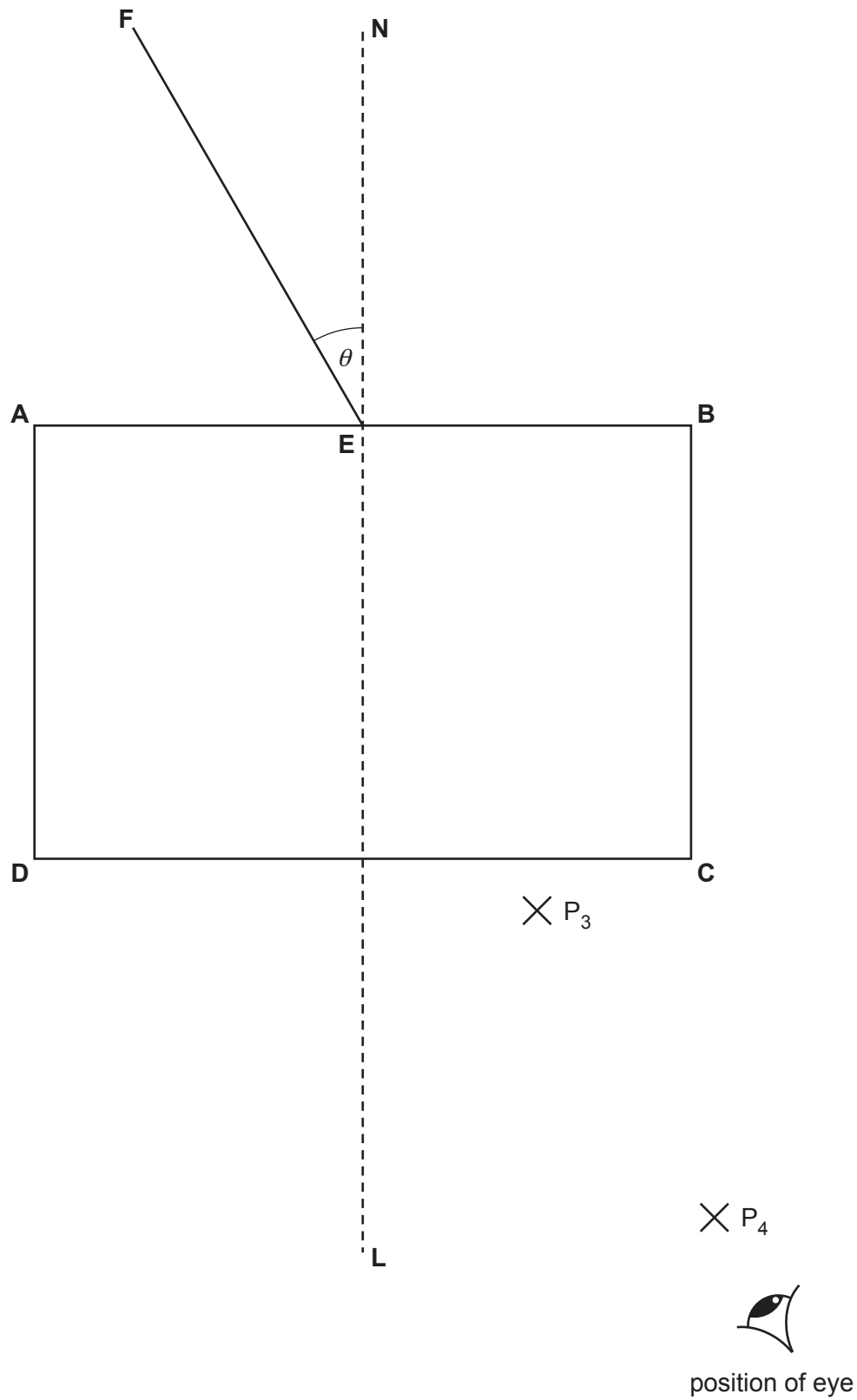


Fig. 3.1



**(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  $\theta$  that line **FE** makes with the normal **NL**.

$$\theta = \dots\dots\dots^\circ \quad [1]$$

- (ii) The student places two pins **P<sub>1</sub>** and **P<sub>2</sub>** on the line **FE** a distance apart that is suitable for ray-tracing.

Mark with crosses points **P<sub>1</sub>** and **P<sub>2</sub>** on line **FE** a distance apart that is suitable for ray-tracing. [1]

**(b) The student then:**

- replaces the block
- views the images of **P<sub>1</sub>** and **P<sub>2</sub>** through the block from the direction indicated by the eye on Fig. 3.1
- places two pins **P<sub>3</sub>** and **P<sub>4</sub>** so that pins **P<sub>3</sub>** and **P<sub>4</sub>** and the images of pins **P<sub>1</sub>** and **P<sub>2</sub>** all appear exactly one behind the other
- labels the positions of **P<sub>3</sub>** and **P<sub>4</sub>**
- removes the block and pins from the ray-trace sheet.

- (i) Draw a line joining the positions of **P<sub>3</sub>** and **P<sub>4</sub>**.

Continue the line **P<sub>3</sub>P<sub>4</sub>** until it meets the normal **NL**. Label this point **H**.

Label the point at which the line **P<sub>3</sub>P<sub>4</sub>** 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**.

$$a = \dots\dots\dots \text{ cm}$$

$$b = \dots\dots\dots \text{ cm}$$

[1]

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

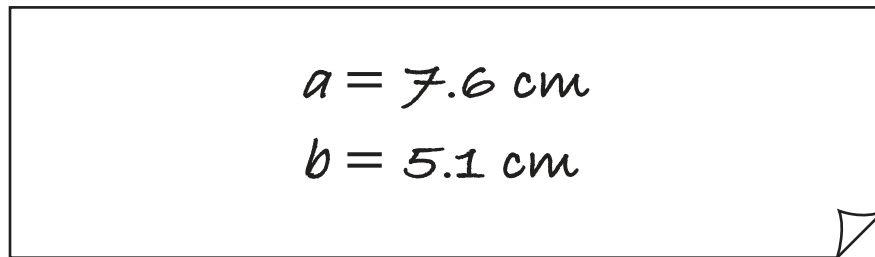
$$n_1 = \frac{a}{b}$$

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

$$n_1 = \dots\dots\dots [2]$$

- (c) The student repeats the procedure with an angle of incidence  $\theta = 50^\circ$  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.

$$n_2 = \dots\dots\dots [2]$$

- (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.







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