



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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5054/41

October/November 2022

1 hour

You must answer on the question paper.

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 30.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Any blank pages are indicated.

1 A student measures the refractive index of oil.

- Oil is poured into a semi-circular transparent plastic container as shown in Fig. 1.1.
- The container is placed on top of a 360° protractor as shown in Fig. 1.2.

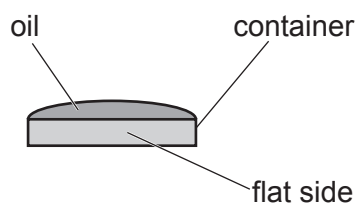


Fig. 1.1

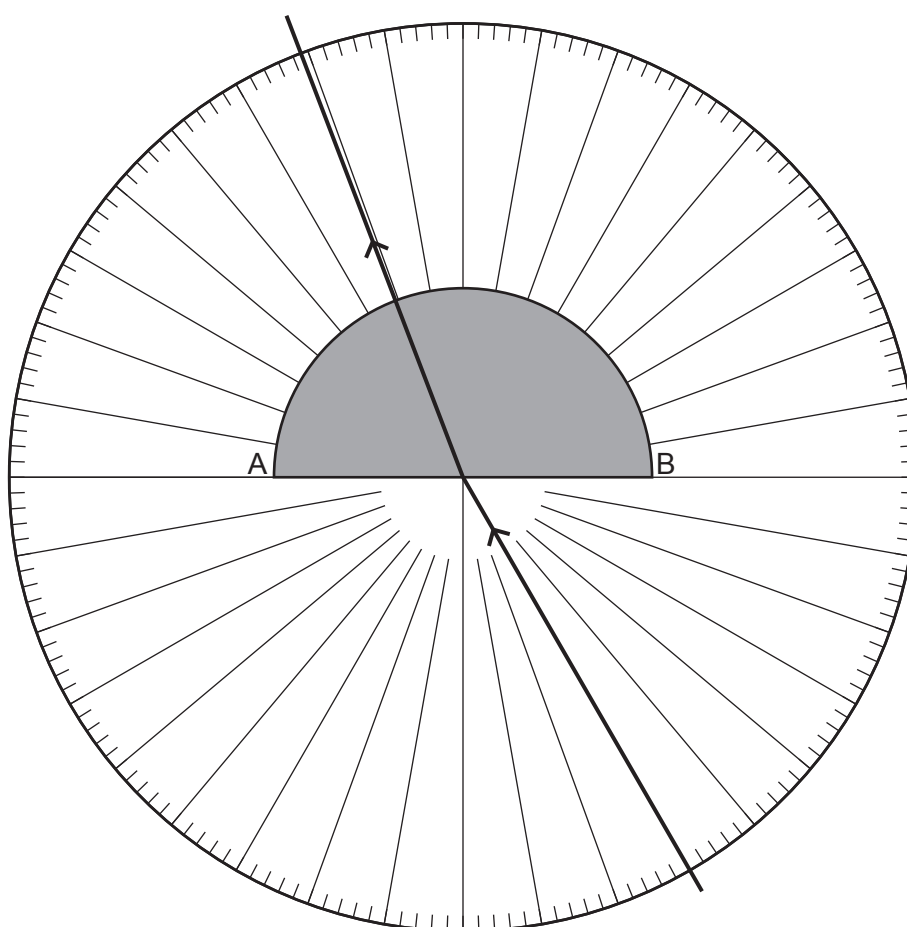


Fig. 1.2
(viewed from above)

(a) The line AB shows the position of the flat side of the plastic container.

A ray of light is incident at the midpoint of AB with an angle of incidence $i = 30^\circ$ as shown in Fig. 1.2.

(i) State **one** property of the oil that is needed to ensure that the experiment works.

..... [1]

(ii) On Fig. 1.2, measure the angle of refraction r of the light in the oil.

$r =$ ° [1]

- (b) The student repeats the procedure described in (a) and measures the angle of refraction r for angles of incidence $i = 15^\circ, 45^\circ, 60^\circ$, and 75° . The results are shown in Table 1.1.

Table 1.1

$i/^\circ$	15	30	45	60	75
$r/^\circ$	11		31	39	45

- (i) Complete Table 1.1 with your value of r from (a)(ii).

On the grid provided in Fig. 1.3, plot a graph of r on the y-axis against i on the x-axis. Start your axes from (0,0). Draw a smooth curve of best fit.

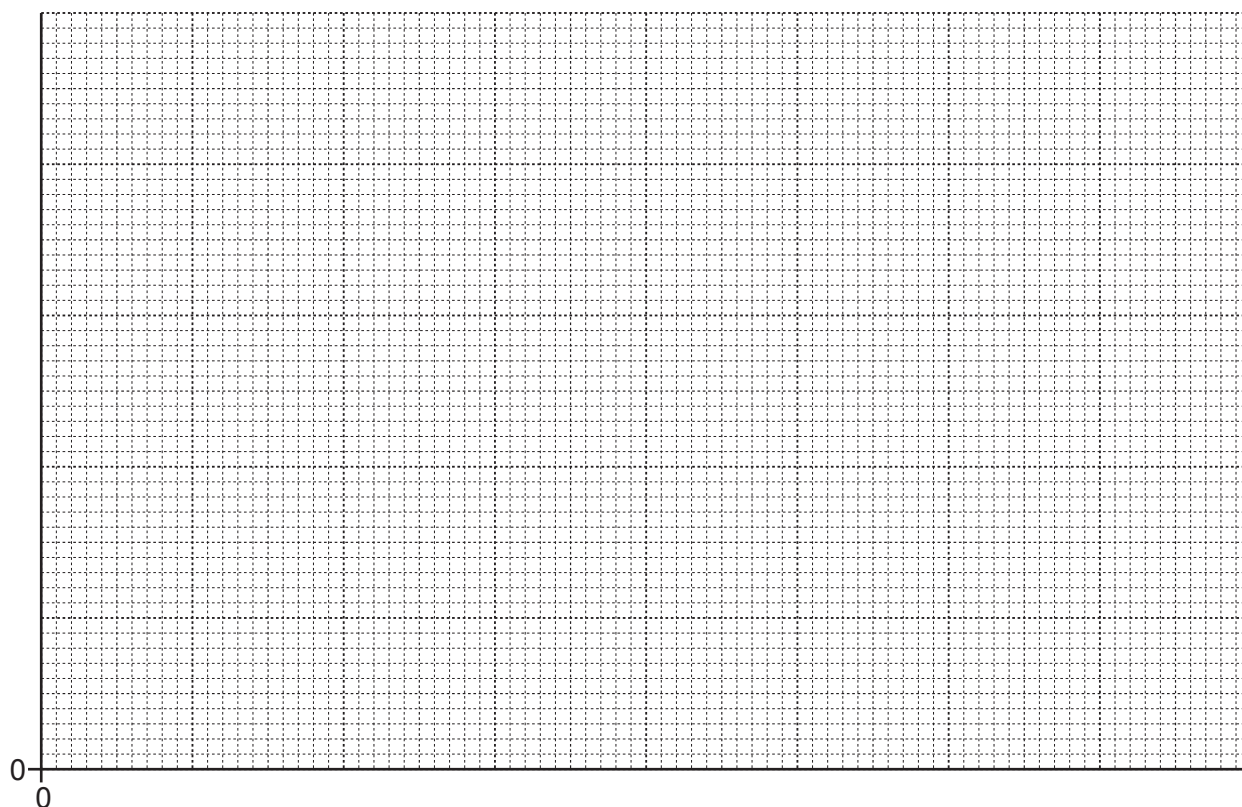


Fig. 1.3

[4]

- (ii) Describe the relationship between i and r shown by the graph.

.....
 [1]

- (iii) Use your graph to find the value of r when $i = 50^\circ$.

Show on the graph how you determine your answer.

$r = \dots\dots\dots^\circ$ [2]

- (iv) Theory suggests that the refractive index n of the oil is given by:

$$n = \frac{\sin i}{\sin r}$$

Using i and your value of r from (b)(iii), calculate a value for n . Give your answer to an appropriate number of significant figures.

$n = \dots\dots\dots$ [2]

- (v) On Fig. 1.4, sketch the graph when $\sin r$ is plotted against $\sin i$. No calculations are required.

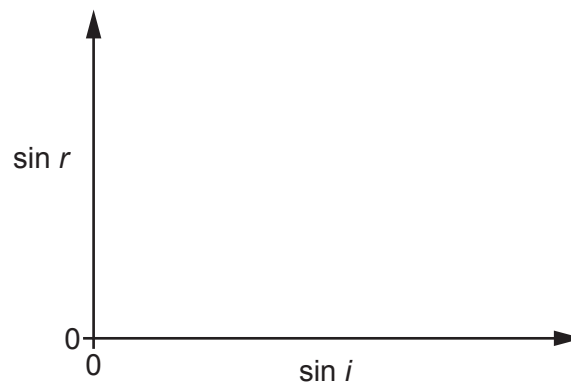


Fig. 1.4

[1]

- (c) Suggest **one** reason why the practical method used in this investigation might not give an accurate value for n .

.....

 [1]

[Total: 13]

Question 2 starts over the page.

- 2 A student investigates the cooling of water. The apparatus used is shown in Fig. 2.1.

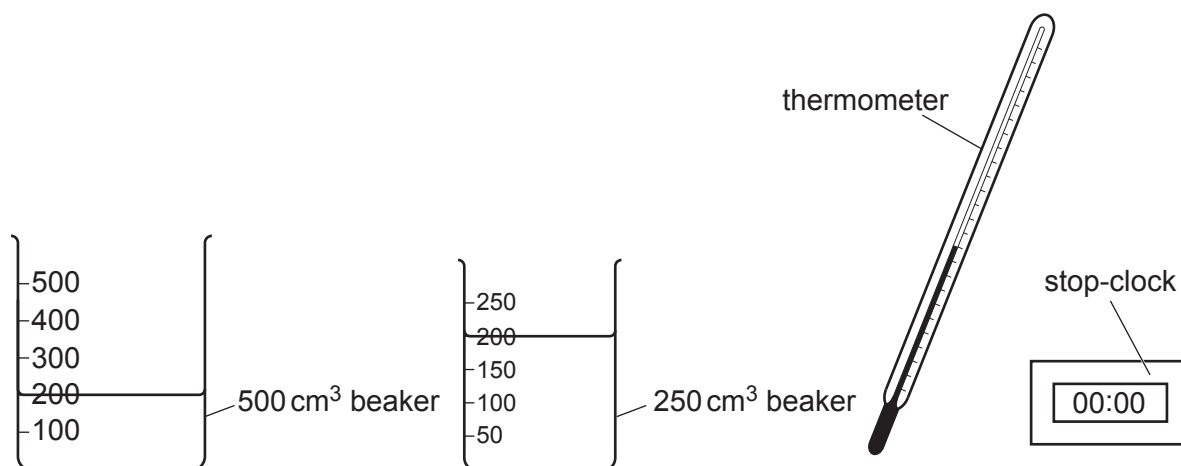


Fig. 2.1

- (a) The student:

- pours 200 cm^3 of hot water into the 500 cm^3 beaker
- places the thermometer in the water
- stirs the water
- measures the initial temperature of the water
- uses the clock to find the time taken for the water to cool by 5.0°C and by 10.0°C
- repeats the experiment three times.

- (i) Explain why the water is stirred before taking a temperature reading.

.....
 [1]

- (ii) The student uses 200 cm^3 of hot water in the same beaker in each test.

State **one** other experimental variable that the student keeps constant to make a fair comparison of the three sets of results.

..... [1]

- (b) Table 2.1 shows the results obtained by the student.

Table 2.1

temperature decrease/ $^\circ\text{C}$	time / s			average time / s
	trial 1	trial 2	trial 3	
5.0	82	84	82	
10.0	173	184	185	181

- (i) Complete Table 2.1 by calculating the average time taken for the water to cool by 5.0°C .
Give your answer to an appropriate number of significant figures.

[2]

- (ii) Suggest **one** reason why the time taken for the water to cool by 10.0°C is **not** double the time taken for the water to cool by 5.0°C .

.....

 [1]

- (c) The student repeats the experiment using the 250 cm^3 beaker. All other experimental variables remain the same.

Table 2.2 shows the average times taken for the 250 cm^3 beaker to cool by 5.0°C and by 10.0°C .

Table 2.2

temperature decrease/ $^{\circ}\text{C}$	average time/s
5.0	110
10.0	250

- (i) Describe the difference in the cooling of the water in the two beakers.

Refer to the results recorded in Table 2.1 and Table 2.2 in your answer.

.....

 [1]

- (ii) Suggest a reason for the difference.

.....
 [1]

[Total: 7]

- 3 A student measures the density of a sample of modelling clay. The clay is moulded into a cube as shown in Fig. 3.1.

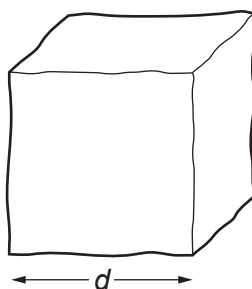


Fig. 3.1

- (a) Suggest **one** difficulty the student finds when moulding the clay into a cube.

..... [1]

- (b) (i) On Fig. 3.1, measure the length d of one side of the cube.

$d =$ cm [1]

- (ii) Calculate the volume V of the modelling clay using the equation:

$$V = d^3$$

$V =$ cm³ [1]

- (iii) The student uses a balance to find the mass m of the modelling clay as shown in Fig. 3.2.

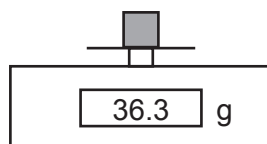


Fig. 3.2

Calculate the density ρ of the modelling clay using the equation:

$$\rho = \frac{m}{V}$$

Give the unit of your answer.

$\rho =$ unit [2]

[Total: 5]

- 4 A student investigates the current in a resistor of fixed resistance.

The following apparatus is available:

- ammeter
- electrical connecting leads
- a resistor of fixed resistance
- lamp
- switch
- variable resistor
- 6 V battery
- LED
- voltmeter.

- (a) State which piece of apparatus is used to measure current.

..... [1]

- (b) (i) The student measures the current I for a range of potential differences.

Draw a circuit diagram to show the circuit the student uses.

You may use some or all of the apparatus available.

[3]

- (ii) Describe how the student obtains different values of the potential difference across the fixed resistor.

.....

 [1]

[Total: 5]

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