Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

PHYSICS **5054/41**

Paper 4 Alternative to Practical **October/November 2022**

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 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.

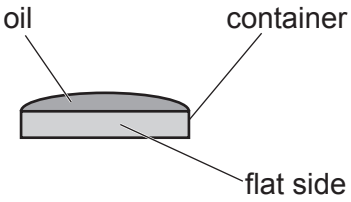

Fig. 1.1

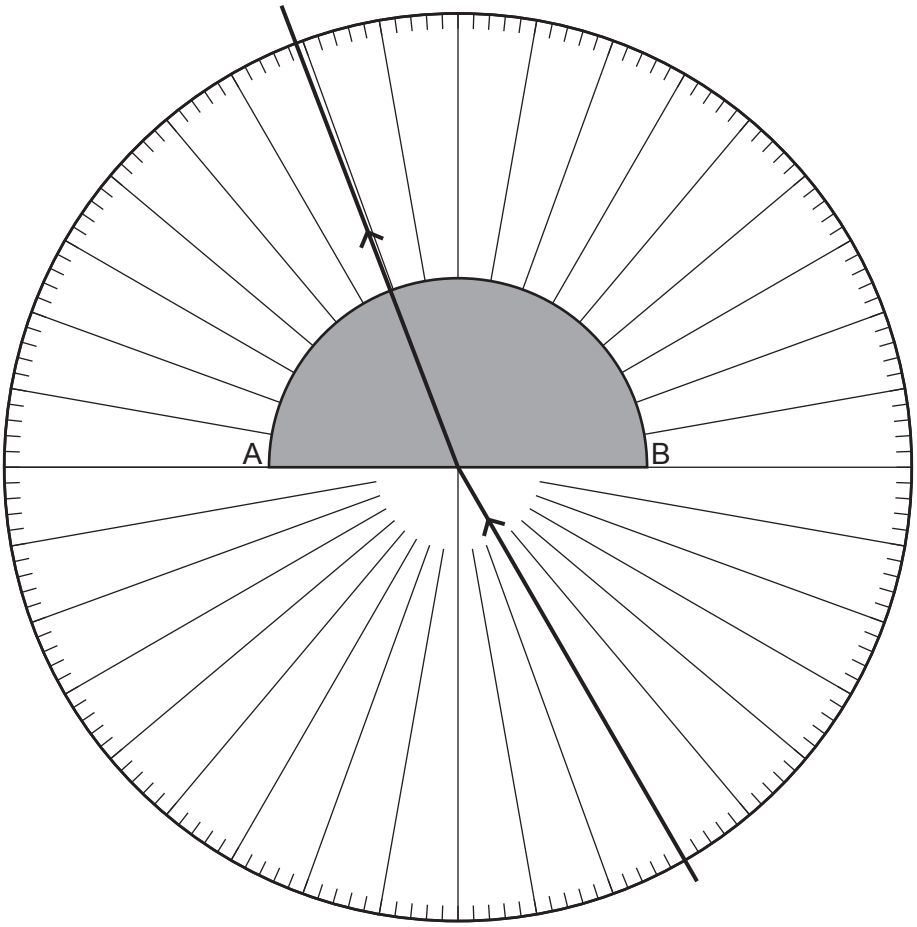

Fig. 1.2
(viewed from above)

(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° 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°, 45°, 60°, and 75°. The results are shown in Table 1.1.

Table 1.1

i / °	15	30	45	60	75
r / °	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.

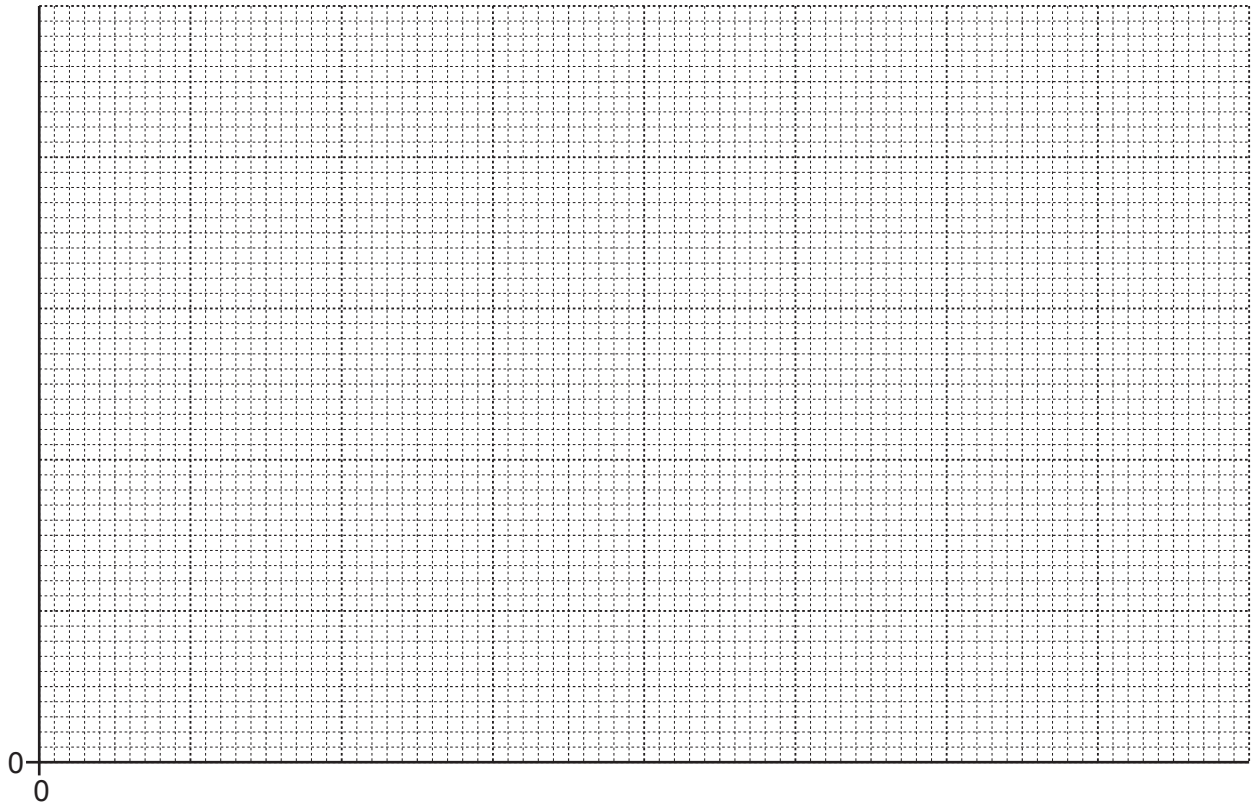

Fig. 1.3

[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°.

Show on the graph how you determine your answer.

r = ... ° [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 = ... [2]

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

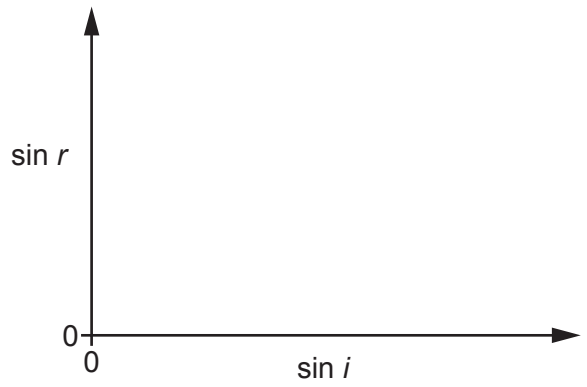

Fig. 1.4

[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.

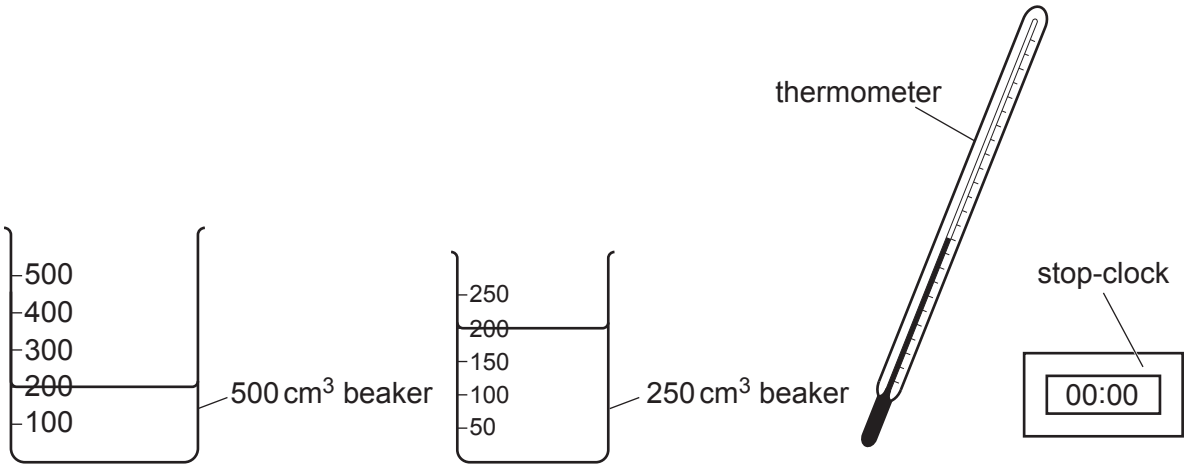

Fig. 2.1

(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 / °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 / °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.

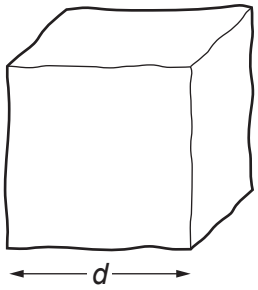

Fig. 3.1

(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 = ... cm^3 [1]

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

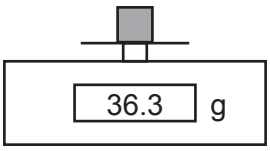

Fig. 3.2

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

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

Give the unit of your answer.

ρ = ... 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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