Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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PHYSICS **5054/42**

Paper 4 Alternative to Practical **May/June 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.

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[Turn over

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1 A student determines the thickness of the glass in a test-tube.

(a) The student uses a ruler and two rectangular wooden blocks to help him measure the external diameter *D* of the test-tube.

Describe, with the aid of a diagram, how the student determines an accurate value for *D*.

.....

.....

..... [1]

(b) The student:

- clamps the test-tube in a stand
- fills a measuring cylinder to the 100 cm^3 mark with water
- pours some water from the measuring cylinder into the test-tube.

The arrangement of apparatus is shown in Fig. 1.1. The test-tube containing water is also shown full size in Fig. 1.1.

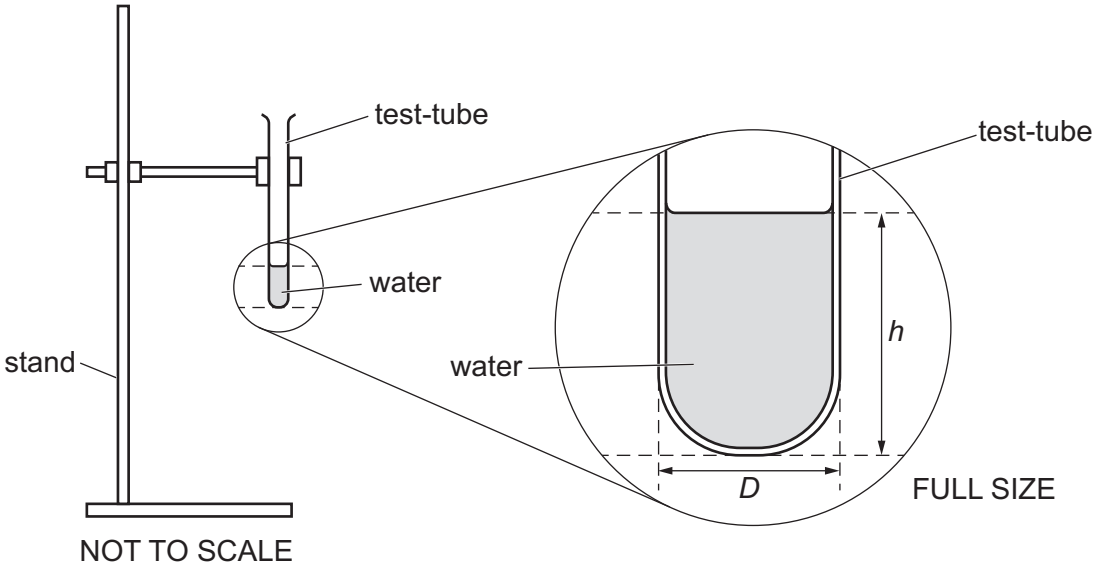


Fig. 1.1

Measure the height *h* of the water in the full size test-tube in Fig. 1.1.

Record *h* in centimetres to the nearest millimetre in the second row in Table 1.1. [1]

(c) Fig. 1.2 shows the volume V_R of water remaining in the measuring cylinder.

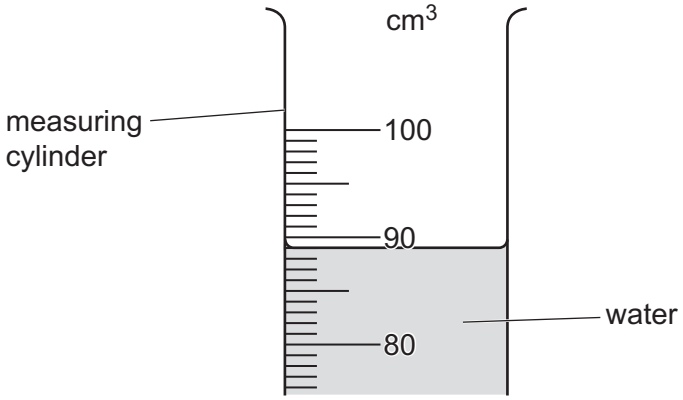


Fig. 1.2

(i) Record V_R in Table 1.1. [1]

(ii) Calculate the volume *V* of water in the test-tube.

Record your answer in Table 1.1.

[1]

(d) The student:

- adds more water from the measuring cylinder into the test-tube
- measures and records the new values of h and V_R in Table 1.1
- repeats the procedure for three more values of h and V_R.

The student's results are shown in Table. 1.1.

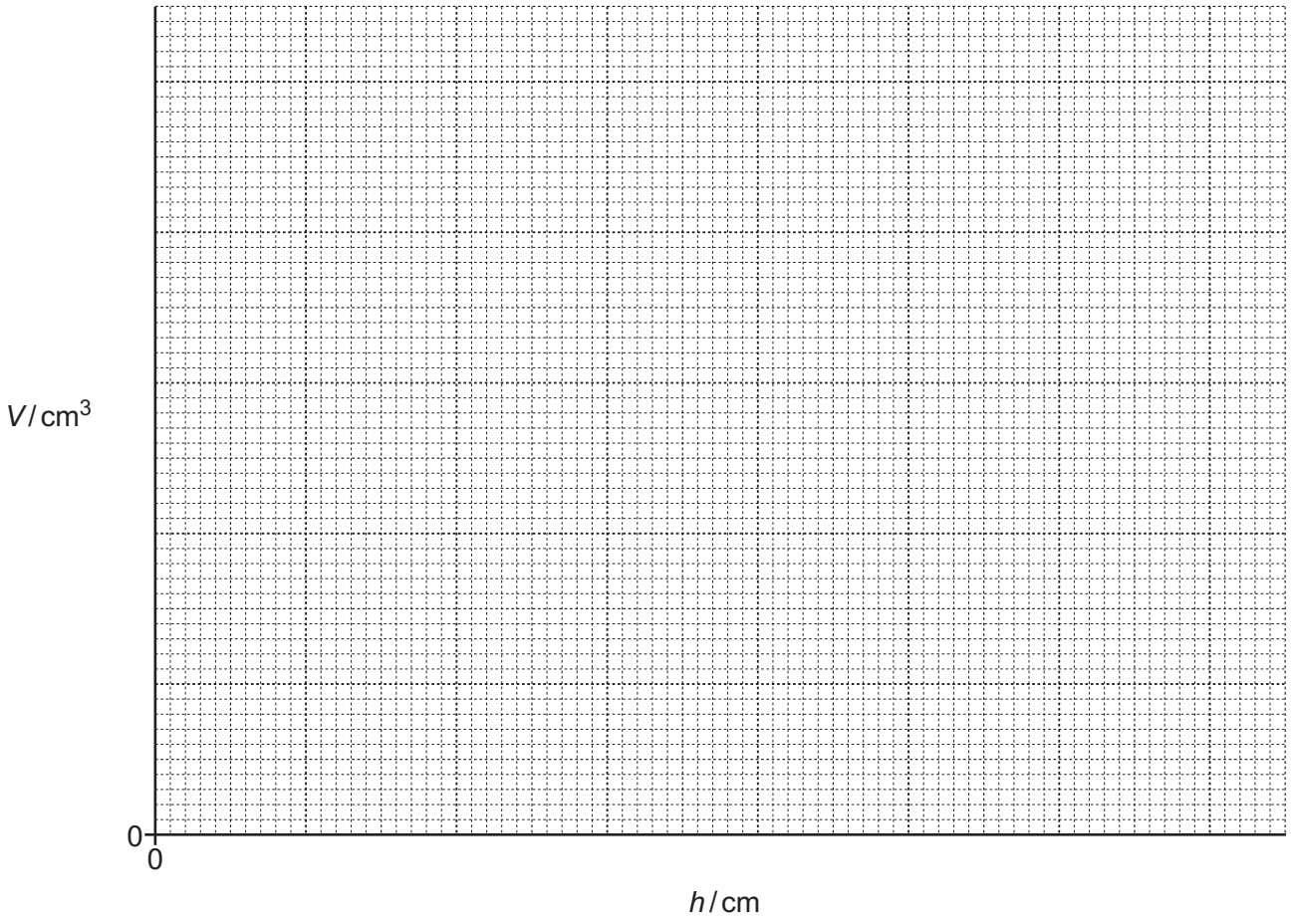
Table 1.1

h / cm	V_R / cm^3	V / cm^3
5.6	79	21
8.9	66	34
12.5	54	46
14.2	47	53

On the grid provided, plot a graph of V on the y-axis against h on the x-axis.

Start both axes from the origin (0, 0).

Draw the best-fit straight line.



[3]

(e) **(i)** Calculate the gradient m of your line. Show all working and indicate on the graph the values you use.

m = ... [2]

(ii) If the test-tube is a perfect cylinder, then the internal diameter d is given by the equation:

$$d = \sqrt{\frac{4m}{\pi}}$$

Use your value of m from **(e)(i)** and the equation to calculate d.

d = ... cm [1]

(f) Your value for d is approximate.

(i) State **one** difficulty in measuring the height h of the water in the test-tube and suggest how this difficulty can be overcome.

difficulty .....

suggestion .....

.....
[2]

(ii) Suggest another reason why your calculated value for d is only approximate.

.....

..... [1]

(g) (i) Measure the external diameter *D* of the full size test-tube in Fig. 1.1.

Record *D* in centimetres to the nearest millimetre.

D = ... cm [1]

(ii) Use your answers for **(e)(ii)** and **(g)(i)** to calculate the thickness of the glass in the test-tube.

thickness of the glass = ... cm [1]

[Total: 15]

2 A student investigates the cooling of hot water in a beaker.

The student measures the room temperature before starting the investigation. The room temperature is 24.0 °C.

The student:
- pours 150 cm^3 of hot water into a beaker
- places a thermometer into the hot water
- waits for 30 s
- reads the initial temperature of the hot water and starts a stop-watch
- records the temperature θ of the hot water every 60 s for 300 s.

The student's readings are shown in Table 2.1.

Table 2.1

time t / s	temperature θ / °C
0	89.5
60	83.0
120	77.5
180	73.0
240	69.0
300	66.0

(a) Suggest why the student waits for 30 s before reading the initial temperature of the hot water.

.....

..... [1]

(b) **(i)** Calculate the average rate of cooling R_1 of the hot water during the first 60 s. Use the equation:

$$R_1 = (\theta_0 - \theta_{60})/60$$

where θ_0 is the temperature of the hot water at the start, and θ_{60} is the temperature of the hot water after 60 s.

R_1 = ... °C / s [1]

(ii) Calculate the average rate of cooling R_2 of the hot water between t = 240 s and t = 300 s.

R_2 = ... °C / s [1]

(c) Use the values you calculated in part **(b)** to describe how the rate of cooling of the hot water changes as the hot water cools.

.....

..... [1]

(d) At the end of the investigation, the student leaves the water in the beaker.

Predict the final temperature of the water 2 hours later.

..... [1]

(e) Suggest how the student ensures that the temperature readings are as accurate as possible.

.....

..... [1]

[Total: 6]

3 Three students, A, B and C, measure the speed of sound in air.

- Students A and B stand at opposite ends of a football pitch.
- Student A strikes two large blocks of wood together.
- Student B starts a stop-watch when she sees the blocks hit each other and stops the stop-watch when she hears the sound.
- The students repeat this procedure twice.
- Student C measures the distance *d* between students A and B.

The times *t* recorded are shown.

0.45 s 0.41 s 0.51 s

(a) Calculate the average value of *t*. Give your answer to 2 significant figures.

t = ... s [2]

(b) The distance *d* between students A and B is 119 m.

(i) Suggest a device that can be used for measuring this distance.

..... [1]

(ii) Calculate a value for *v*, the speed of sound in air. Use the equation:

$$v = \frac{d}{t}$$

v = ... m/s [1]

(c) Suggest **one** reason why the value calculated in **(b)(ii)** for the speed of sound in air is only approximate.

.....

..... [1]

[Total: 5]

4 A student investigates how the resistance of a filament lamp changes when the current through it is varied.

The student connects the circuit shown in Fig. 4.1.

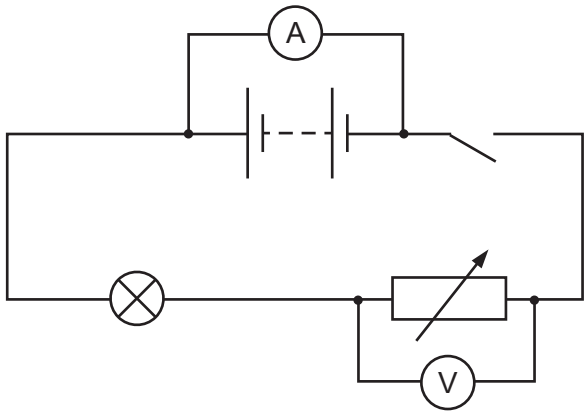


Fig. 4.1

(a) The student has connected the circuit incorrectly.

In the space below re-draw the circuit with the voltmeter and ammeter connected in the correct positions.

[2]

(b) When the switch is closed in the corrected circuit, the student observes that the lamp does not appear to light up. The filament of the lamp is not broken, and the battery is not run down.

(i) What observation does the student make to confirm quickly that the filament of the lamp is not broken?

.....

..... [1]

(ii) Suggest why the lamp does not appear to light.

.....

..... [1]

[Total: 4]

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