Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8141243441

PHYSICS **5054/42**

Paper 4 Alternative to Practical **October/November 2020**

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. Blank pages are indicated.

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[Turn over

1 A student investigates the balancing of a metre rule.

She uses a metre rule that has a small hole drilled through it at the 5.0 cm mark.

- She pivots the rule at the 5.0 cm mark.
- She supports the other end of the rule using a newton meter attached to a loop of string placed at the 95.0 cm mark.
- She suspends a 200 g mass from the rule using a loop of thread.
- The student moves the loop of thread supporting the 200 g mass until it is at the 25.0 cm mark on the metre rule.

Fig. 1.1 shows the apparatus set up by the student.

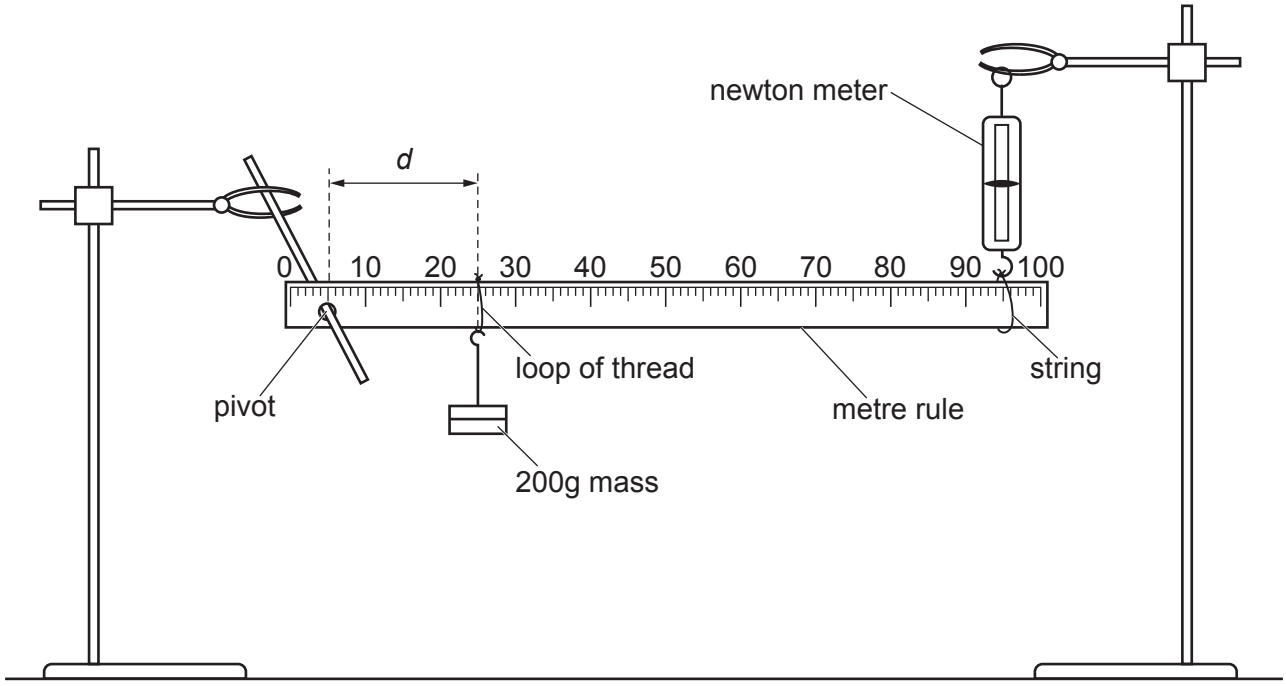


Fig. 1.1

- She calculates the distance *d* of the mass from the pivot and records her value in the first row of Table 1.1.
- She adjusts the height of the clamp supporting the newton meter until the rule is horizontal.
- She records the reading *F* on the newton meter in the first row of Table 1.1.
- The student repeats this procedure with the loop of thread supporting the mass at the 40.0 cm, 55.0 cm, 65.0 cm and 80.0 cm marks on the metre rule.

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Table 1.1

reading on rule / cm	distance *d* from pivot / cm	newton meter reading *F* / N
25.0	20.0	1.1
40.0	35.0	1.4
55.0		
65.0	60.0	2.0
80.0	75.0	2.3

(a) Fig. 1.2 shows the newton meter reading when the 200 g mass is placed at the 55.0 cm mark on the metre rule.

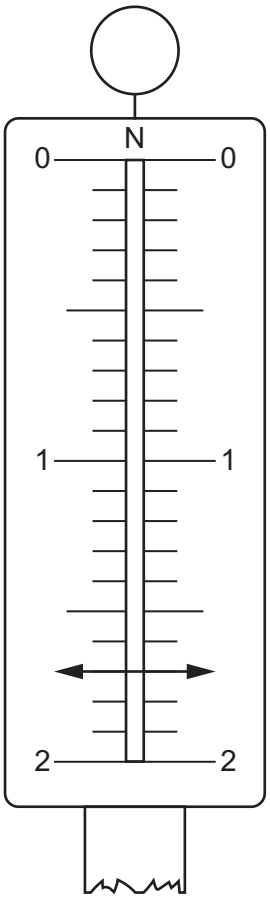


Fig. 1.2

(i) In Table 1.1, record the distance *d* of the mass from the pivot. [1]

(ii) In Table 1.1, record the reading *F* on the newton meter. [1]

(b) On Fig. 1.3, plot a graph of F on the y-axis against d on the x-axis. Start both axes from the origin. Draw the straight line of best fit. [4]

(c) **(i)** Calculate the gradient m of your line.

Show all working and indicate on the graph the values you choose.

m = ... N / cm [2]

(ii) Extend your line so that it cuts the y-axis. Write down the intercept c that your line makes with the y-axis.

c = ... N [1]

(iii) Calculate w, where $w = \frac{c}{m}$.

w = ... cm [1]

(iv) The weight W of the metre rule is given by the equation shown

$$W = \frac{w}{k}$$

where k = 22.5 cm / N.

Calculate W. Give your answer to an appropriate number of significant figures.

W = ... N [2]

(d) **(i)** When performing the investigation, the student rests a spirit level on the rule to check that the rule is horizontal before taking each newton meter reading.

Suggest why using a spirit level in this way is **not** suitable for carrying out the check in this instance.

.....

..... [1]

(ii) Describe a method, other than using a spirit level, of checking that the rule is horizontal.

.....

.....

..... [1]

[Total: 14]

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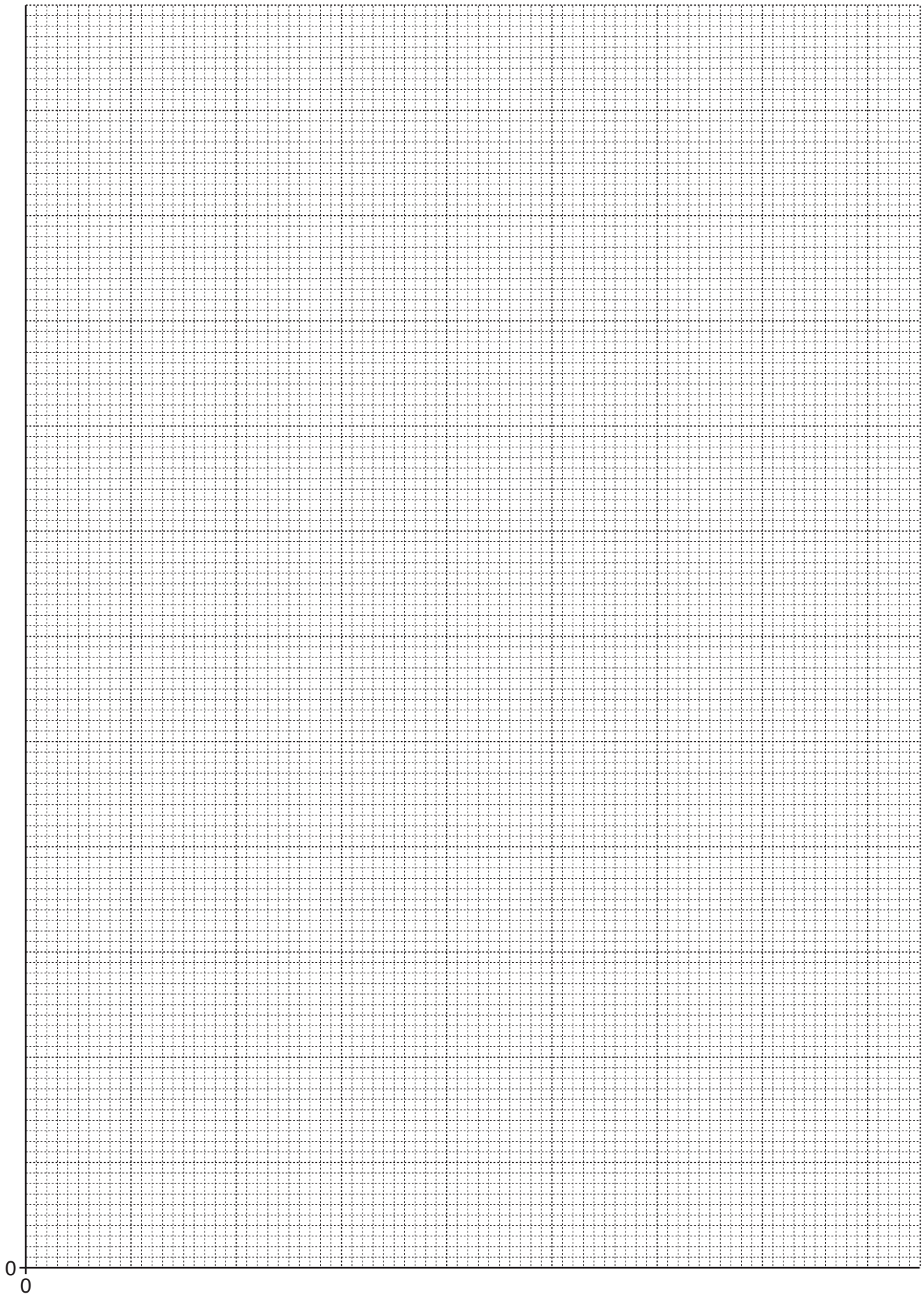


Fig. 1.3

2 A student investigates the resistances of two lamps X and Y.

He sets up the circuit shown in Fig. 2.1.

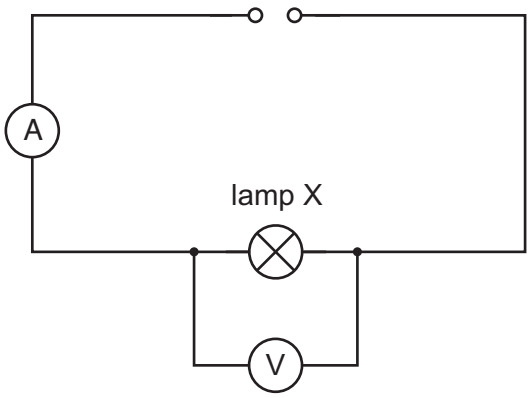


Fig. 2.1

- He measures the current I in the circuit.
- He measures the potential difference (p.d.) V across lamp X.
- He replaces lamp X with lamp Y and repeats the measurements of current and voltage.
- He re-connects lamp X into the circuit so that it is in parallel with lamp Y.
- He measures the total current I in the circuit.
- He measures the p.d. V across lamps X and Y in parallel.

The student's results are shown in Table 2.1.

Table 2.1

	p.d. V/	current I/	resistance R/ .....
lamp X only	1.4	0.23	
lamp Y only	1.3	0.22	
lamps X and Y in parallel	1.4	0.45	

(a) Draw the circuit when lamps X and Y are connected in parallel.

[2]

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(b) (i) Complete the column headings in Table 2.1. [1]

(ii) Calculate the resistance R for each lamp arrangement using the equation

$$R = \frac{V}{I}.$$

Record your answers in Table 2.1.

[1]

(c) The student states that the combined resistance of lamps X and Y when connected in parallel is equal to twice the average resistance of lamp X and lamp Y.

He is incorrect.

Use the results in Table 2.1 to suggest a correct conclusion about the combined resistance.

.....

.....

..... [2]

[Total: 6]

3 A student investigates reflection and refraction of light using a semi-circular glass block.

- He places a glass block on a sheet of paper.
- He draws around the outline of the block with a pencil.
- He uses a ray box to direct a ray of light onto the centre C of the flat face AB of the block.
- He labels AB and point C.

Fig. 3.1 shows what the student observes.

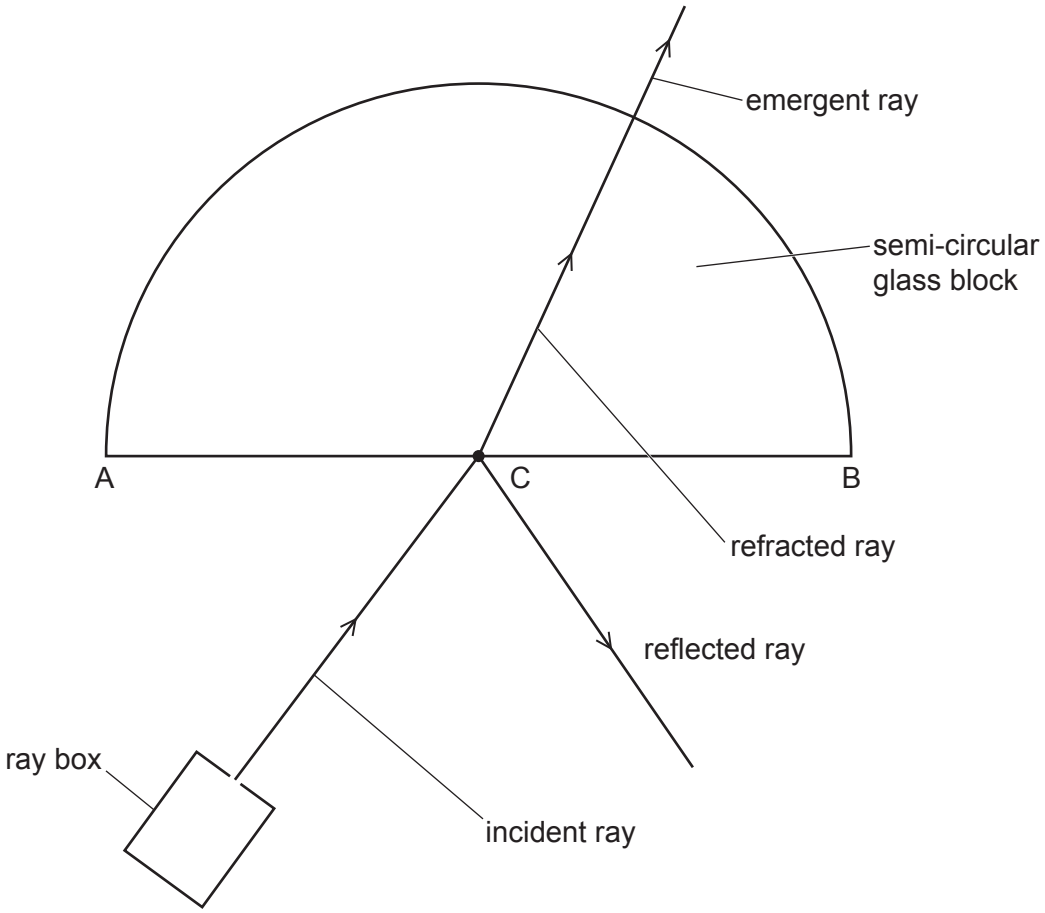


Fig. 3.1

- He uses a pencil to place two crosses X_1 and X_2 on the incident ray.
- He uses a pencil to place two crosses X_3 and X_4 on the emergent ray.
- He uses a pencil to place two crosses X_5 and X_6 on the ray reflected from the face AB.
- He removes the glass block and the ray box.

Fig. 3.2 shows the student's sheet of paper.

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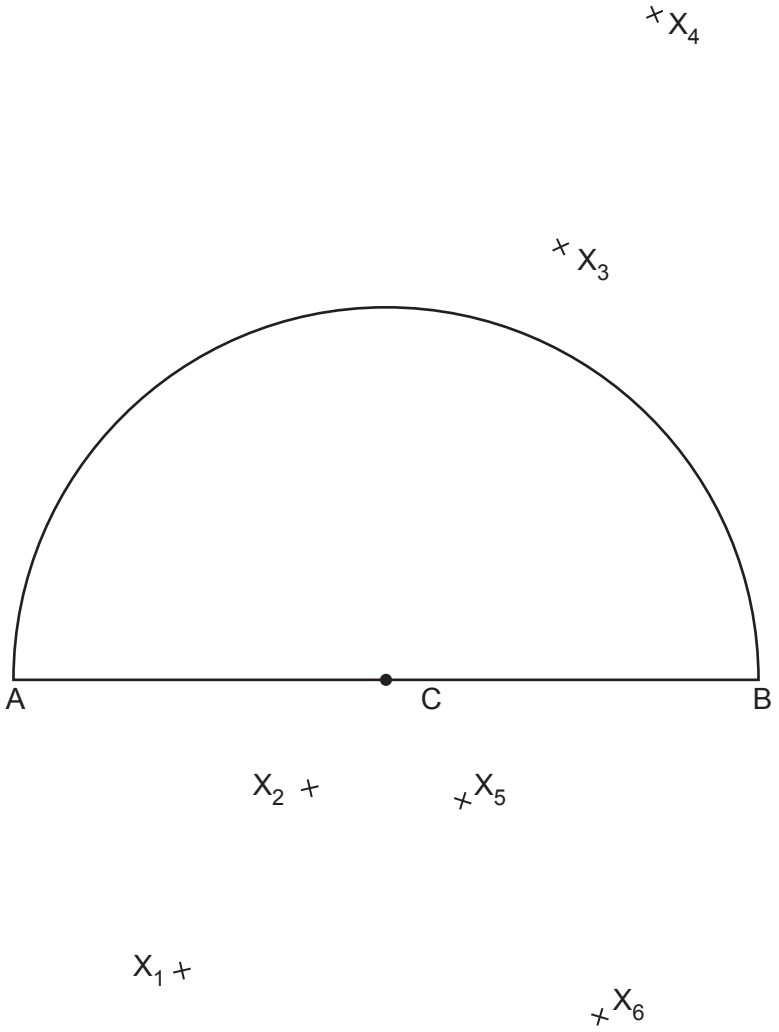


Fig. 3.2

(a) Draw the normal to the surface of the glass block at C. [1]

(b) **1.** Draw a line joining X_1 to X_2. Continue the line to C.
2. Draw a line joining X_4 to X_3. Continue the line to C.
3. Draw a line joining X_6 to X_5. Continue the line to C. [1]

(c) **(i)** Measure the angle of incidence *i* of the ray of light on face AB.

i = ... ° [1]

(ii) Measure the angle of refraction *r* at point C of this ray.

r = ... ° [1]

(d) Calculate the refractive index *n* of the glass. Use the equation shown.

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

n = ... [1]

(e) Measure the angle of reflection *R* of the light from face AB.

R = ... °

The angle of incidence *i* should be equal to the angle of reflection *R*.

State **one** practical reason why the angles *i* and *R* that you have measured may not be equal.

.....

..... [1]

[Total: 6]

4 A student investigates the effect of using a lid on the speed of cooling of hot water in a beaker.

- She pours 200 cm^3 of hot water into a beaker.
- She places a thermometer into the water, as shown in Fig. 4.1.

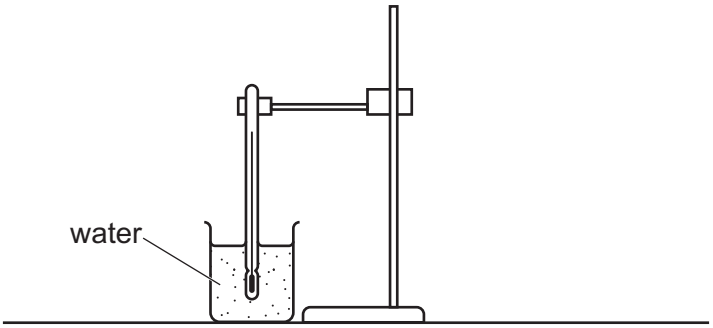


Fig. 4.1

- She waits for a short time.
- She records the temperature of the water and at the same time she starts a stopwatch.

This is at time $t = 0$.

Fig. 4.2 shows the thermometer at time $t = 0$.

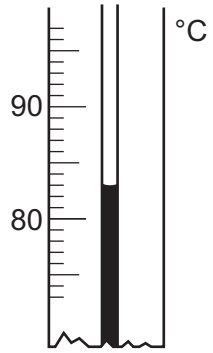


Fig. 4.2

(a) (i) Record the temperature θ shown by the thermometer at time $t = 0$.

θ = ... °C [1]

Add your value of temperature to Table 4.1 on page 12.

(ii) State why the student waits for a short time before reading the thermometer at time $t = 0$.

.....

..... [1]

(b)

- The student lets the water cool for 5.0 minutes and records the temperature of the water at the end of this time.
- She then pours 200 cm^3 of hot water into an identical beaker, covers the beaker with a lid, and repeats the procedure.

The set-up is shown in Fig. 4.3.

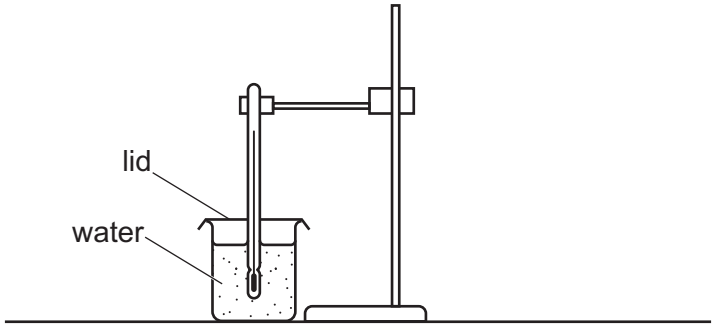


Fig. 4.3

Table 4.1

	without lid	with lid
time *t* / minutes	temperature / °C	temperature / °C
0		85
5.0	65	80

Explain how the results in Table 4.1 show that the water cools more quickly without a lid.

.....

.....

..... [1]

(c) Name **one** quantity that the student must keep the same to make a fair comparison between the speeds of cooling of the two beakers.

..... [1]

[Total: 4]

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