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.

DC (CE/FC) 210311/3 **R**

[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.

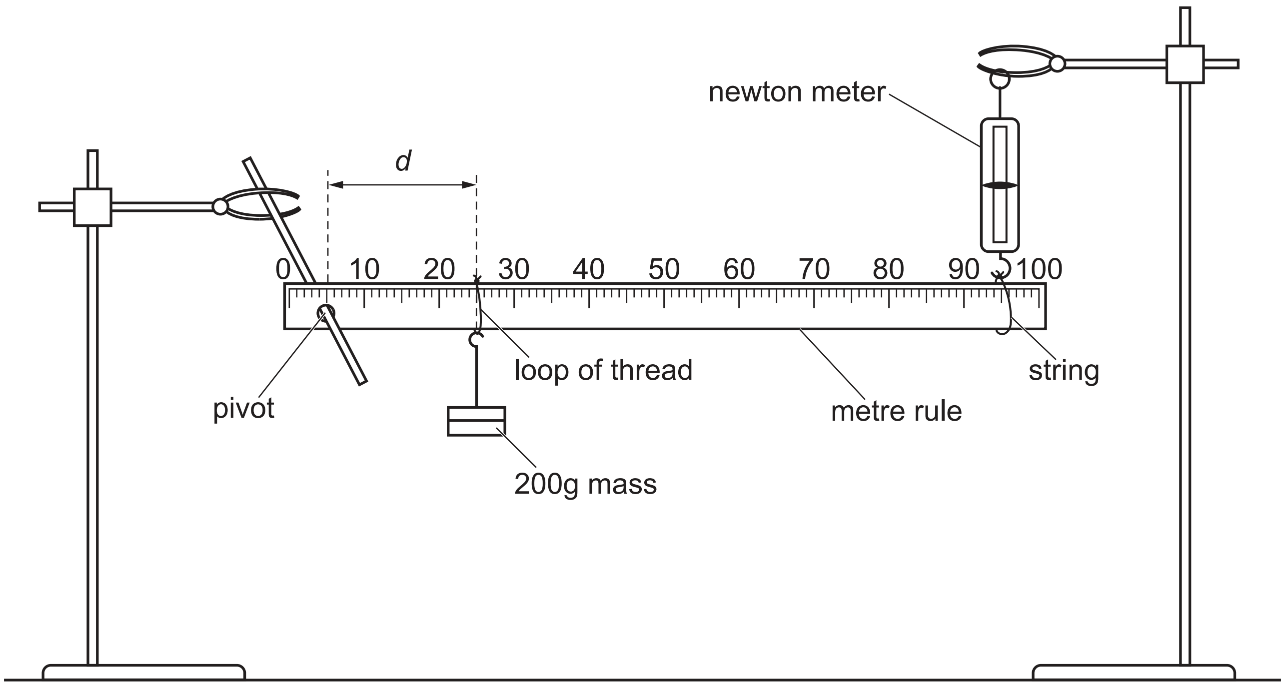

Fig. 1.1

- 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.

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.

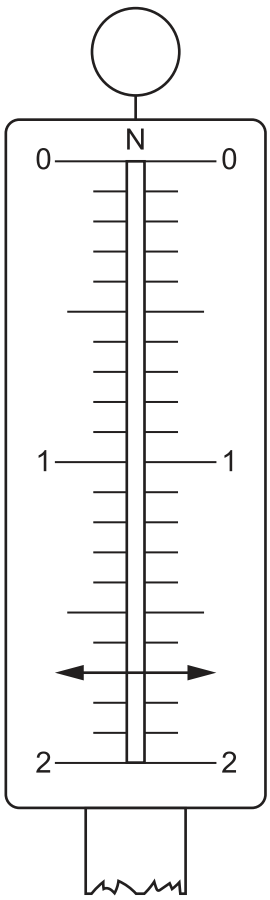

Fig. 1.2

(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]

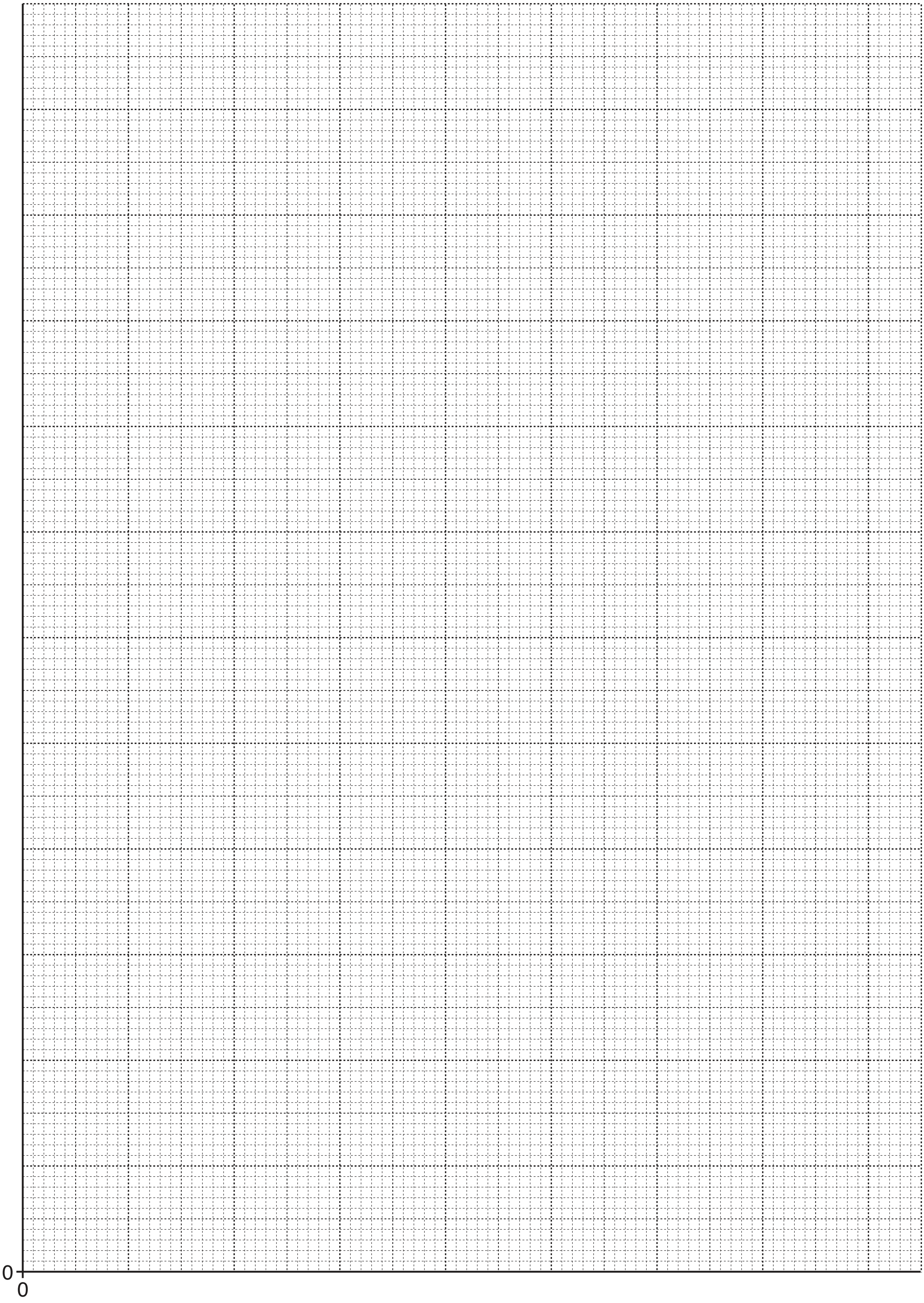

Fig. 1.3

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

He sets up the circuit shown in Fig. 2.1.

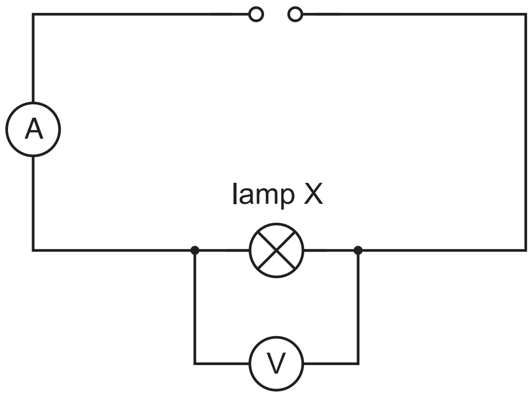

Fig. 2.1

- 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]

(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.

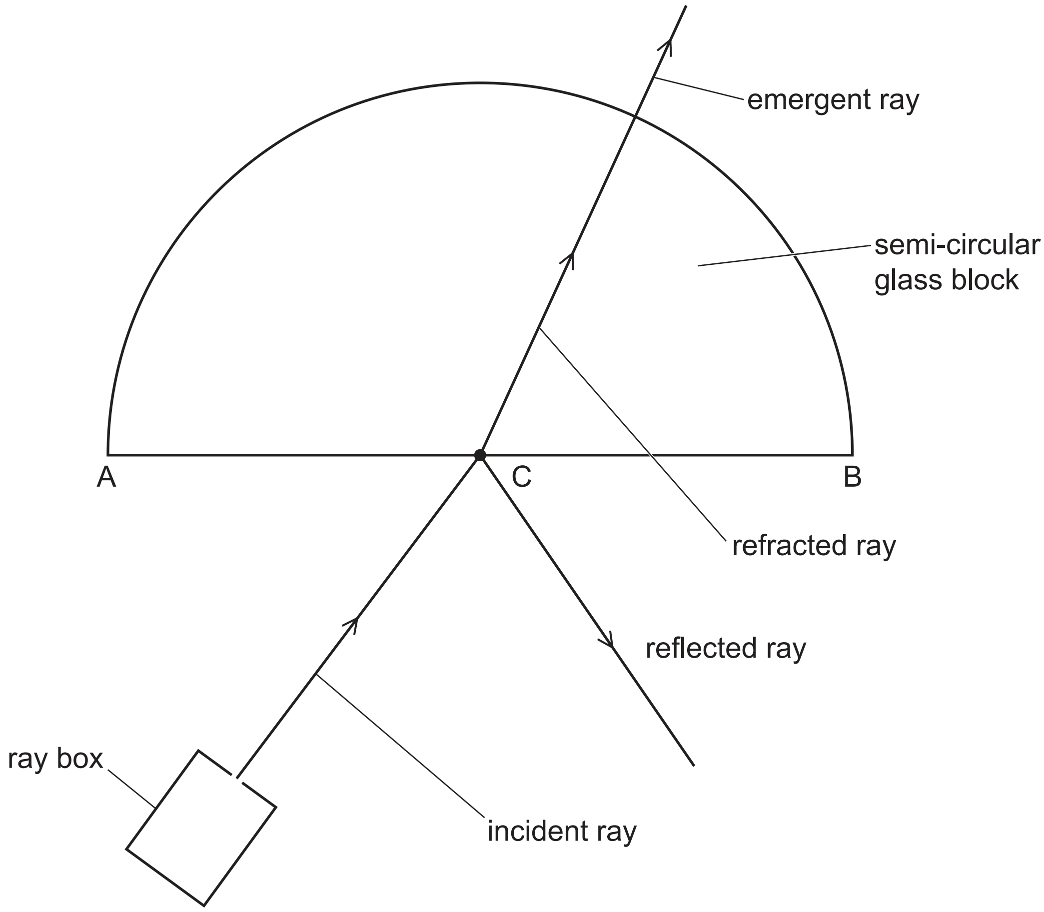

Fig. 3.1

- 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.

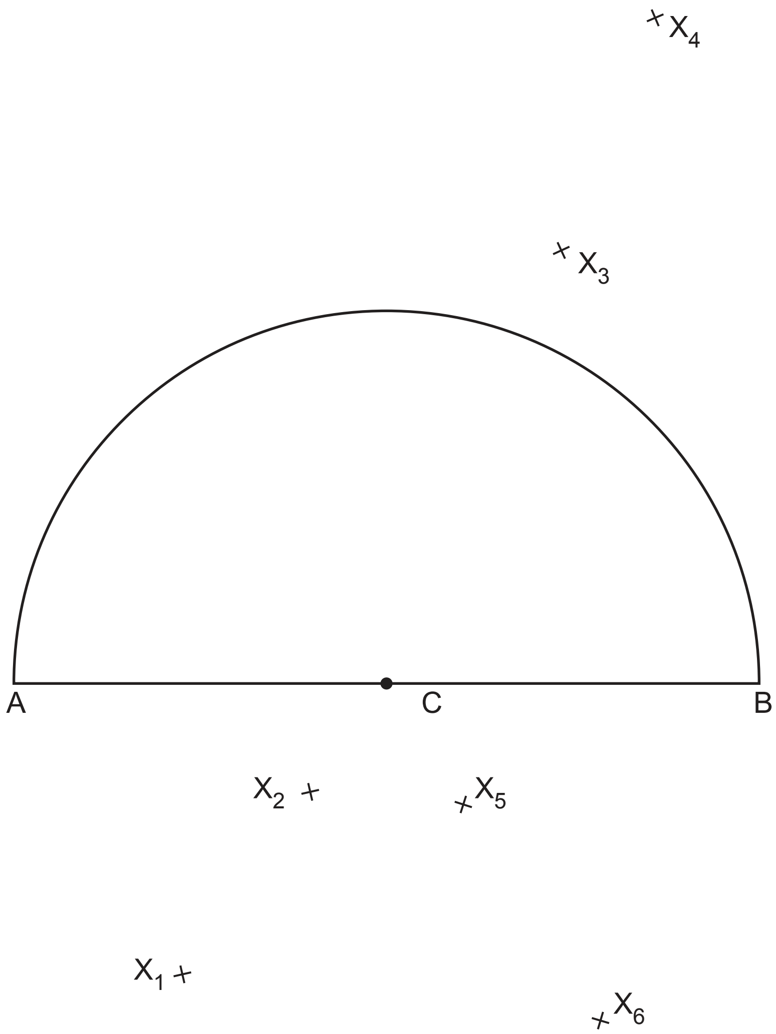

Fig. 3.2

(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]

[Turn over

(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.

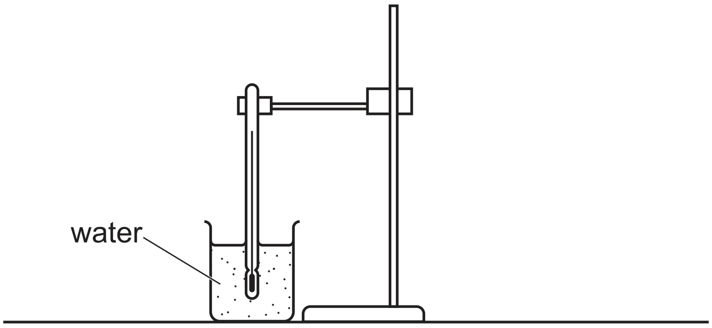

Fig. 4.1

- 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.

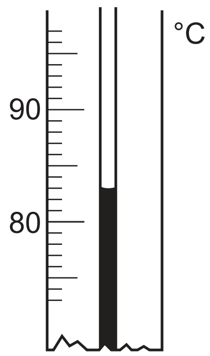

Fig. 4.2

(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.

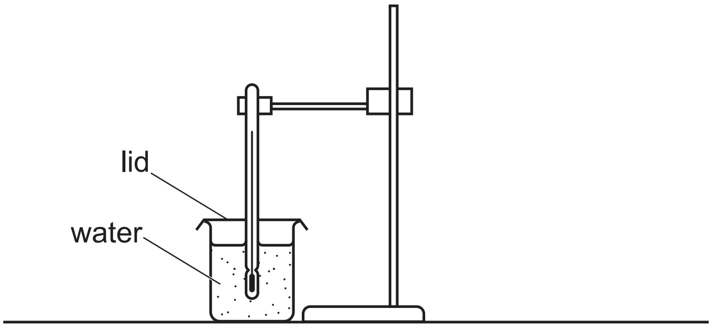

Fig. 4.3

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]