Cambridge O Level

Cambridge Assessment International Education
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2643581046

PHYSICS **5054/42**

Paper 4 Alternative to Practical **May/June 2019**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **10** printed pages and **2** blank pages.

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1 A student determines an approximate value for the specific heat capacity of water by an electrical method.

The specific heat capacity of a substance is the amount of thermal energy needed to raise the temperature of 1 g of the substance by 1 °C.

He sets up the apparatus as shown in Fig. 1.1.

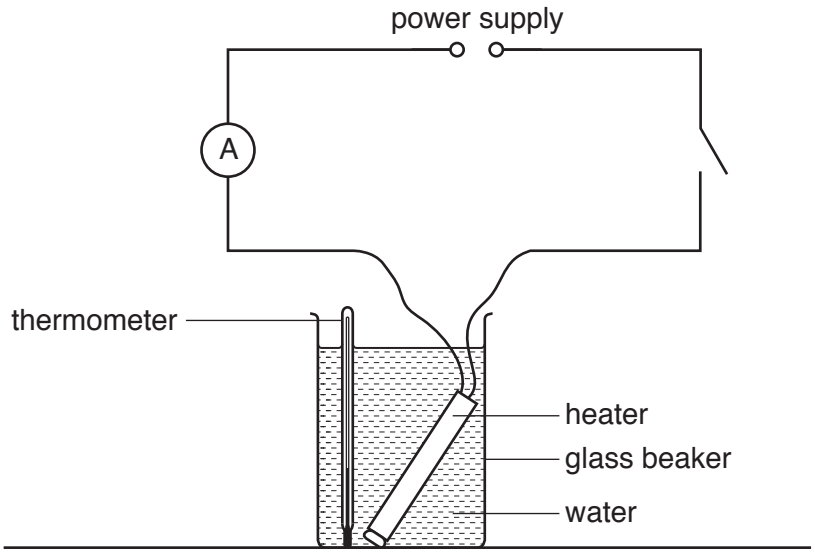


Fig. 1.1

- He pours a mass *m* of water into a beaker, where *m* = 100 g.
- He places a heater into the water in the beaker.
- He connects a voltmeter to measure the potential difference across the heater.

(a) Draw a voltmeter symbol on the circuit diagram of Fig. 1.1 to show the voltmeter measuring the potential difference across the heater. [1]

(b) The student measures the initial temperature of the water and records it at time $t = 0$ in Table 1.1.

Table 1.1

time t/s	temperature θ/°C
0	21.5
60	27.0
120	32.0
180	37.0
240	
300	45.5
360	48.5

- He closes the switch, starts a stopwatch and records the temperature θ of the water every 60 s for 6 minutes.
- He records the current I in the heater and the potential difference V across the heater.

His measurements are:

$I = 4.0\,\text{A}$ $V = 14.8\,\text{V}$.

- He opens the switch.

(i) The reading of the thermometer at time $t = 240\,\text{s}$ is shown in Fig. 1.2.

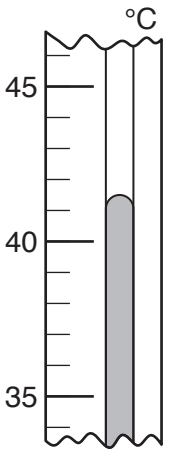


Fig. 1.2

Read the thermometer and record the temperature in Table 1.1. [1]

(ii) State why it is important to:

1. ensure that the heating coil is completely immersed in the water

.....

..... [1]

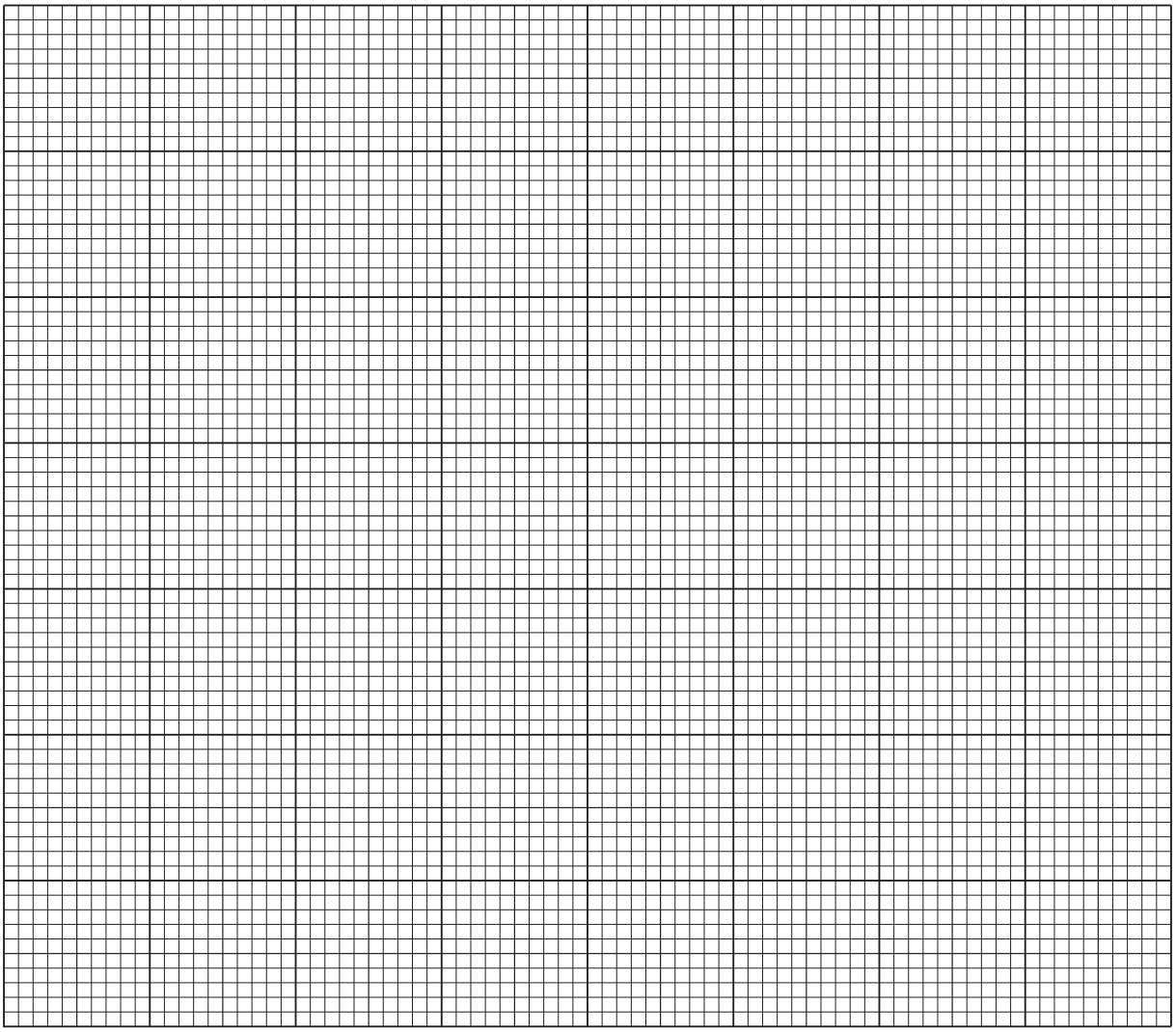
2. stir the water before recording each temperature.

.....

..... [1]

(c) (i) On the grid in Fig. 1.3, plot the graph of θ/°C (y-axis) against t/s (x-axis).
Start the temperature axis at 20 °C.

Draw the smooth curve of best fit.



[4]

Fig. 1.3

(ii) Use your graph to calculate the temperature rise $\Delta\theta$ of the water in the first 200 s of heating.

$\Delta\theta$ = ... [2]

[Turn over

(d) **(i)** Calculate the thermal energy E supplied by the heater in the first 200 s and give the unit. Use the equation shown:

$$E = V \times I \times t$$

E = ... [1]

(ii) Calculate a value for the specific heat capacity c of water. Use the mass given at the start of this question, your answers to **(c)(ii)** and **(d)(i)**, and the equation:

$$E = m \times c \times \Delta\theta$$

c = ... J/(g °C) [2]

(e) **(i)** The specific heat capacity of water is 4.2 J/(g °C).

Examine the apparatus set-up shown in Fig. 1.1.

Suggest one practical reason why your calculated value of c is inaccurate.

.....

..... [1]

(ii) State one improvement to the apparatus that produces a more accurate result.

.....

..... [1]

(f) Another student repeats the experiment and forgets to switch off the heater at the end of the experiment. The temperature of the water continues to rise until it reaches 82 °C and then remains constant at this value.

Suggest one reason why the temperature of the water stops increasing when it reaches 82 °C.

.....

..... [1]

[Total: 16]

2 A student uses a ray box to investigate the refraction of a ray of blue light as it passes through a glass prism.

He sets up the apparatus as shown in Fig. 2.1 on a piece of paper.

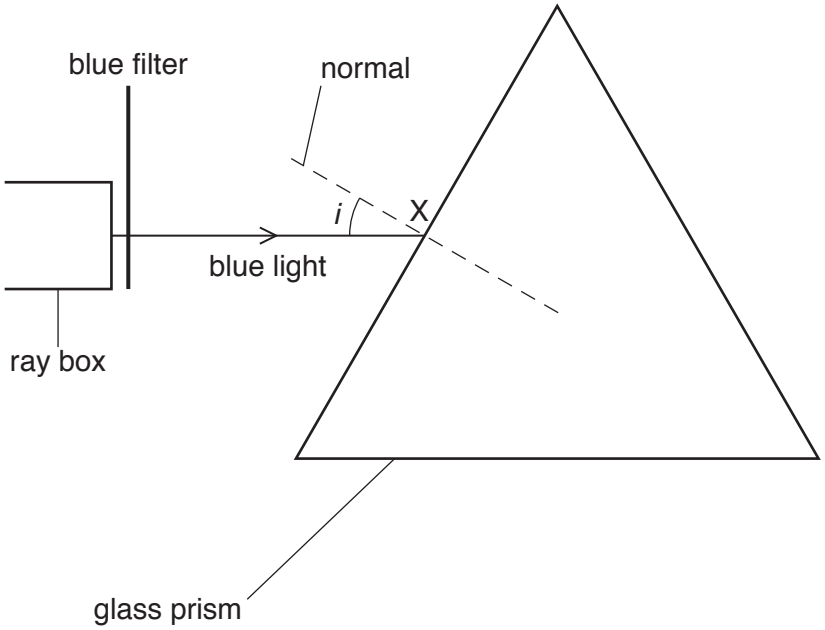


Fig. 2.1

(a) Measure the angle of incidence *i* of the ray on the prism at point X.

i = ... [1]

(b) The angle of refraction at X is 19°.

On Fig. 2.1:

(i) Draw the refracted ray inside the prism. [1]

(ii) Mark with the letter Y, the point where the refracted ray emerges from the prism. Draw the normal at point Y. [1]

(c) The ray emerges from the prism at Y.

Describe how the student can mark the path of the emergent ray accurately on the paper.

.....

.....

.....

..... [1]

[Total: 4]

3 A student investigates the maximum height *h* to which a ball bounces after hitting a laboratory bench.

She sets up her apparatus as shown in Fig. 3.1.

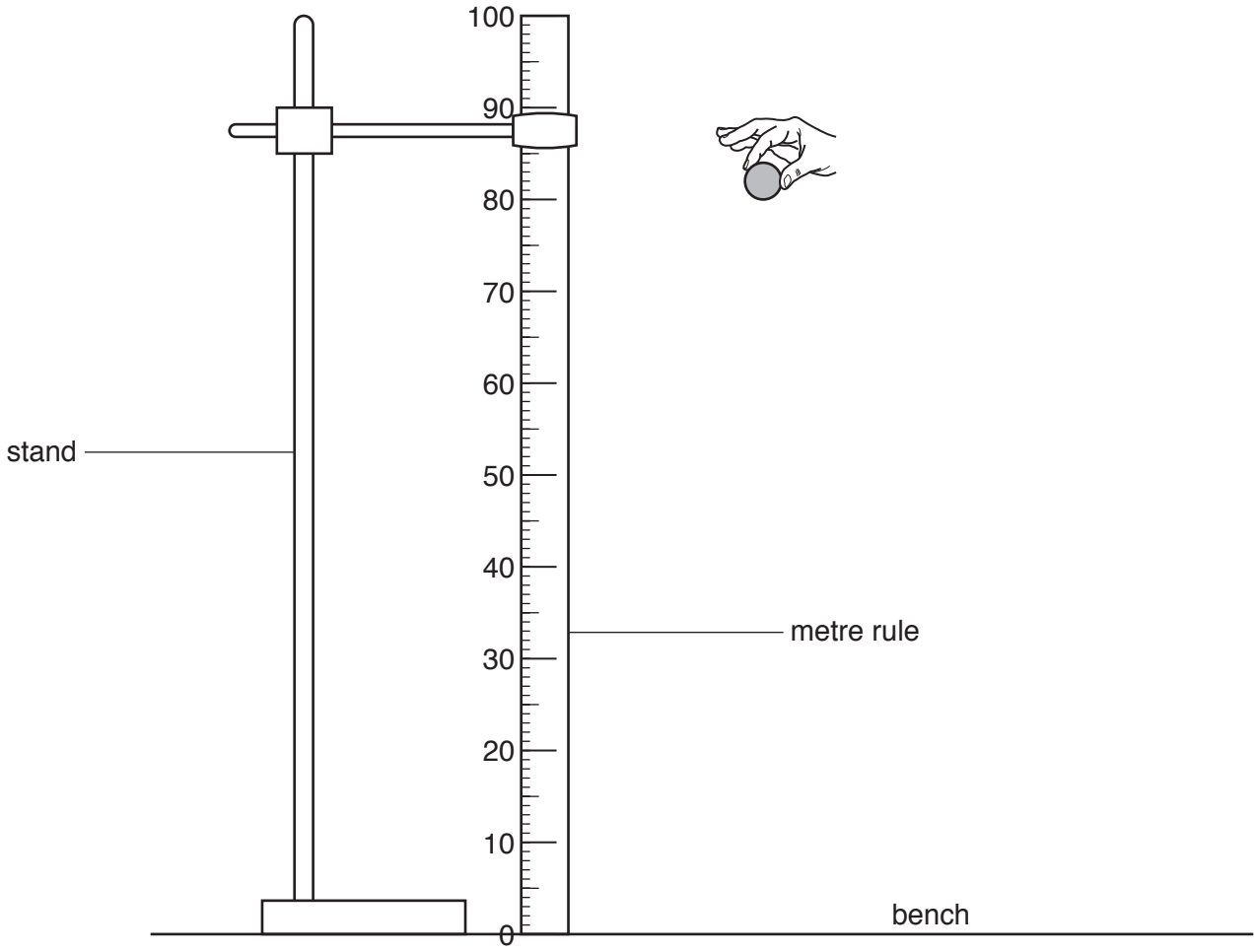


Fig. 3.1

(a) She drops the ball from a height of 80 cm above the bench, as shown in Fig. 3.1.

After one bounce, the ball reaches a maximum height h of 55 cm.

(i) On Fig. 3.1, draw the ball when $h = 55$ cm. [1]

(ii) On Fig. 3.1, draw the position of the student's eye placed correctly to view the ball at a height of 55 cm. [1]

(b) She repeats this procedure three more times and obtains the following results for h:

54 cm 57 cm 53 cm

(i) Use **all** her results to find the mean value of the maximum height h reached.

Give your answer to an appropriate number of significant figures.

mean value for h = ... cm [2]

(ii) The student uses a metre rule graduated in millimetres.

Suggest why her results are **not** recorded to the nearest millimetre.

.....

..... [1]

(c) The student repeats the procedure but now drops the ball from a height of 10 cm.

Suggest why she now finds the maximum height reached difficult to measure.

.....

..... [1]

[Total: 6]

4 A box contains an unknown electrical component. This component is connected to two terminals P and Q on the outside of the box.

A battery, an ammeter, a switch, a lamp and two crocodile clips are connected as shown in the circuit diagram of Fig. 4.1.

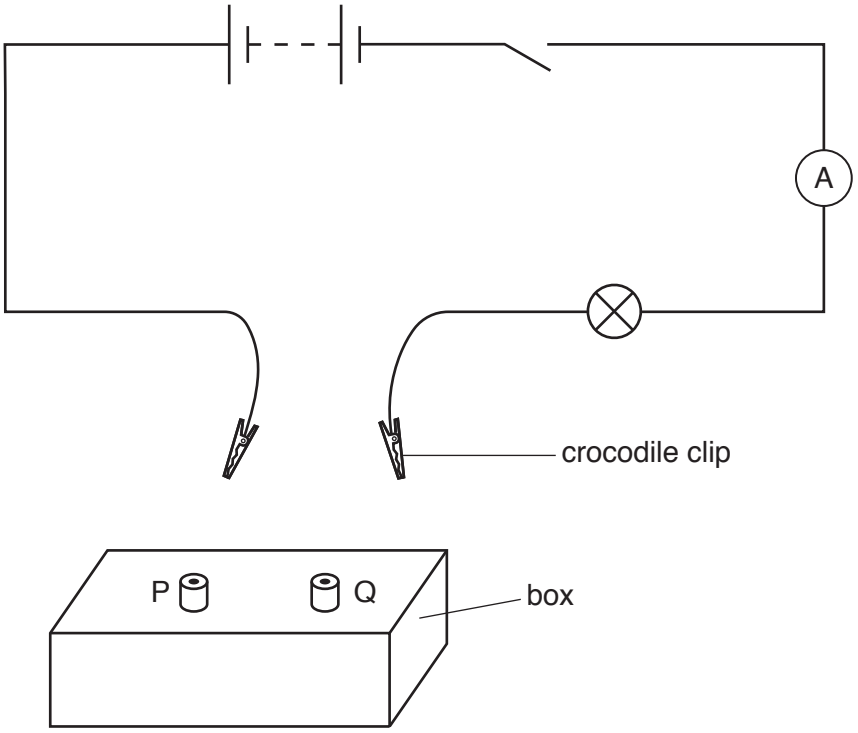


Fig. 4.1

The unknown component is either a broken wire or a connecting wire or a diode.

(a) Describe how to use the apparatus to determine whether the component in the box is:

(i) a broken wire

.....

..... [1]

(ii) a connecting wire

.....

..... [1]

(iii) a diode.

.....

..... [1]

(b) The component in the box is a low resistance connecting wire. A second box looks identical, but contains a higher resistance resistor.

Describe how to use the apparatus to determine which box contains the resistor.

.....

..... [1]

[Total: 4]

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