Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8216481190

PHYSICS **5054/42**

Paper 4 Alternative to Practical **October/November 2021**

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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1 A student measures a value for the specific latent heat of vaporisation L_V of water.

The student:

- pours 100 g of water at room temperature into a beaker placed on a top-pan balance
- connects an immersion heater into a circuit with a suitable power source, an ammeter and a switch
- places the immersion heater into the water
- reads and records the mass of the beaker and water.

The apparatus is shown in Fig. 1.1.

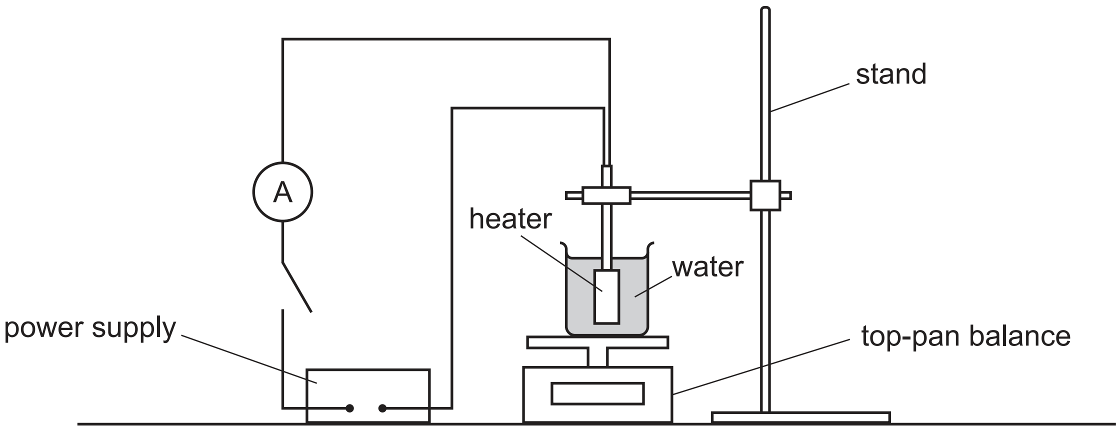

Fig. 1.1

(a) On Fig. 1.1, draw a voltmeter connected to measure the potential difference V across the heater. [1]

(b) The student closes the switch.

The scales of the voltmeter and ammeter are shown in Fig. 1.2.

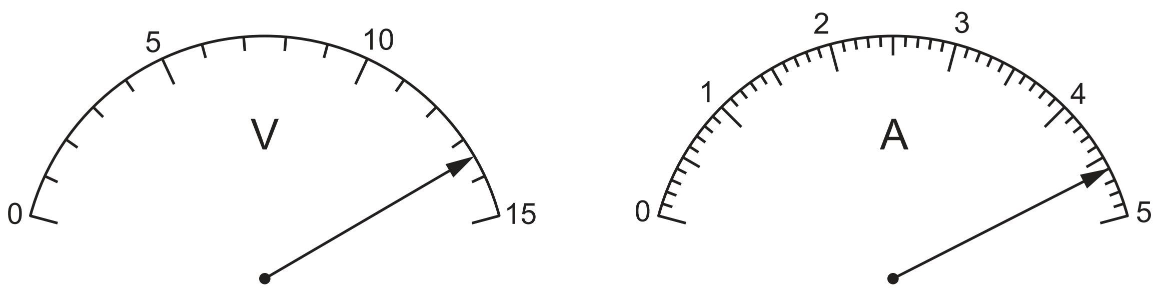

Fig. 1.2

Record the readings from the meter scales.

reading on voltmeter V = ... V

reading on ammeter I = ... A

[2]

(c) The student:

- waits a few minutes until the water starts to boil
- records the reading on the top-pan balance when the water starts to boil and starts a stopclock
- records the reading on the top-pan balance every minute for 6 minutes
- opens the switch.

The student's results are shown in Fig. 1.3 and in Table 1.1.

mass of beaker and water at room temperature = 154.5 g

mass of beaker and water when the water starts to boil = 152.3 g

Fig. 1.3

Table 1.1

time t / minutes	mass of beaker and water / g	mass m of water boiled away / g
0	152.3	0
1.0	150.9	1.4
2.0	149.1	3.2
3.0	147.4	
4.0	145.6	6.7
5.0	144.2	8.1
6.0	142.6	9.7

(i) Complete Table 1.1 by filling in the value of the mass m of water boiled away at time t = 3.0 minutes. [1]

(ii) On the grid provided in Fig. 1.4 on page 5, plot a graph of mass m / g on the y-axis against time t / minutes on the x-axis.

Draw the best-fit straight line. [4]

(d) Determine the gradient G of your line.

Show your working. Indicate on the graph the values you use.

G = ... [2]

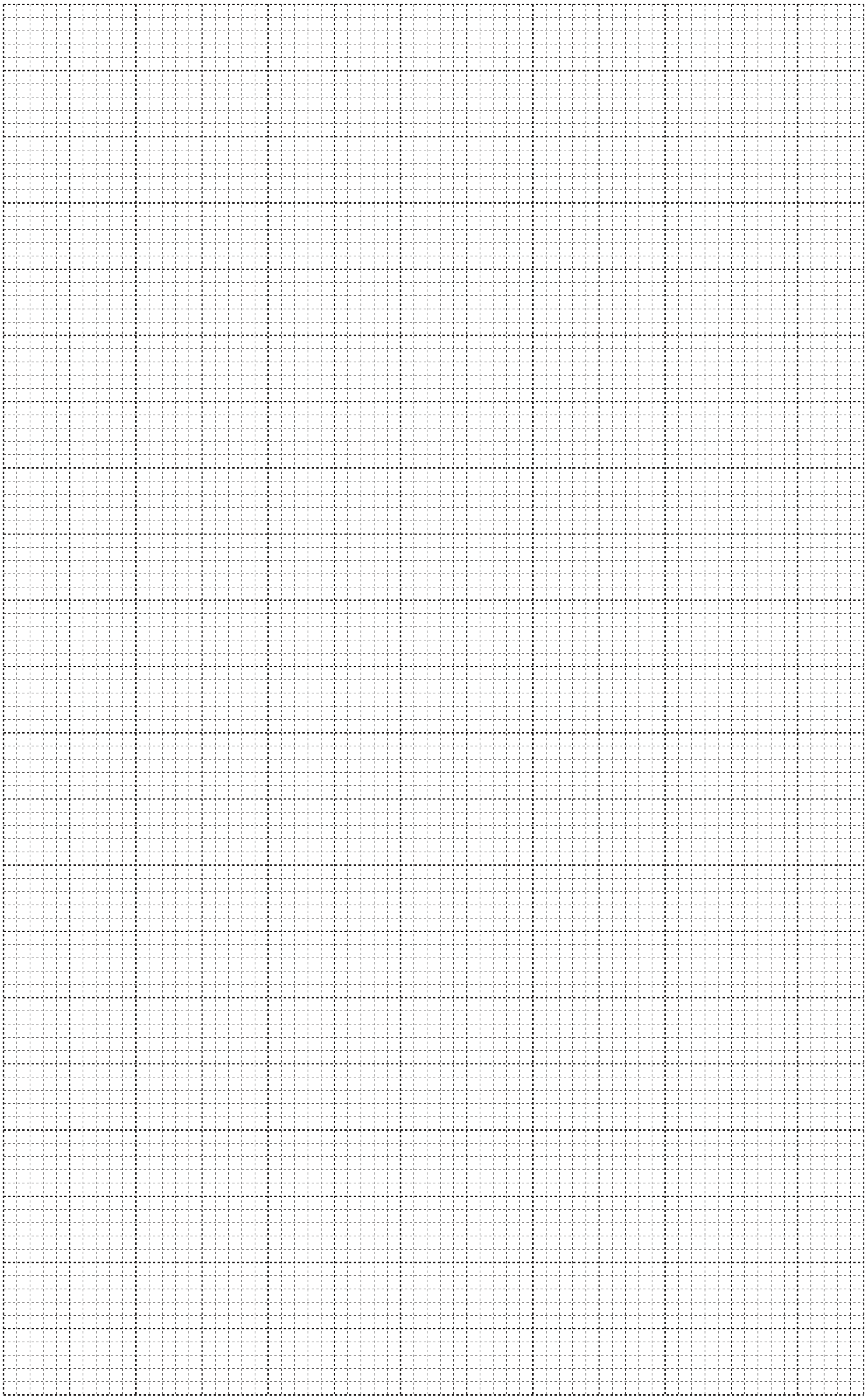

Fig. 1.4

(e) **(i)** Use your readings from **(b)** to calculate the thermal energy Q supplied to the water in 1.0 minute using the equation:

$$Q = VIT$$

where $T = 60\,\text{s}$.

Q = ... J [2]

(ii) Use your answers from **(d)** and **(e)(i)** to calculate a value for the specific latent heat of vaporisation of water L_V using the equation:

$$L_V = \frac{Q}{G}$$

L_V = ... J/g [1]

(f) The student's results in **(c)** show that the mass of the beaker and water just as the water starts to boil is less than the mass of the beaker and water at room temperature.

Explain the difference in mass.

....

....

.... [1]

(g) Thermal energy is lost by conduction through the sides of the beaker during the experiment. This means that the value determined for L_V in this experiment is greater than the accepted value.

(i) Explain how the loss of energy through the sides of the beaker causes this difference.

....

....

.... [1]

(ii) State how the loss of thermal energy can be reduced.

....

....

.... [1]

[Total: 16]

2 A student uses a 30 cm ruler graduated in millimetres to estimate the thickness of a sheet of paper by two different methods.

(a) Method 1

The student:

- takes 1 sheet of paper from a pack of 500 sheets and folds it in half
- folds the paper in half again
- repeats this process until the paper has been folded in half 5 times
- measures and records the thickness of the folded sheet.

Thickness of folded paper = 0.4 cm

The folded sheet is now 32 sheets of paper thick.

Calculate the mean thickness of 1 sheet of paper.

mean thickness of 1 sheet = ... cm [1]

(b) Method 2

The student:

- takes the remainder of the pack of paper and measures the thickness of the entire pack
- repeats the measurement twice more at different places around the edge of the pack.

The student's results are:

4.3 cm 4.4 cm 4.3 cm

(i) Calculate the mean thickness of the pack.

Give your answer to 2 significant figures.

mean thickness of pack = ... cm [2]

(ii) Calculate the mean thickness of 1 sheet of paper.

mean thickness of 1 sheet = ... cm [1]

(c) State which method of measuring the mean thickness of a sheet of paper is more accurate. Give **one** reason for your answer.

....

.... [1]

[Total: 5]

3 A student uses pins to locate the image of an object formed by a plane mirror.

The student:

- places an object pin P in front of the mirror
- looks into the mirror and sees an image of P
- places two more pins W and X in front of the mirror and adjusts their positions so that the image of P and pins W and X are exactly in line, one behind the other.

The position of the pins is shown in Fig. 3.1.

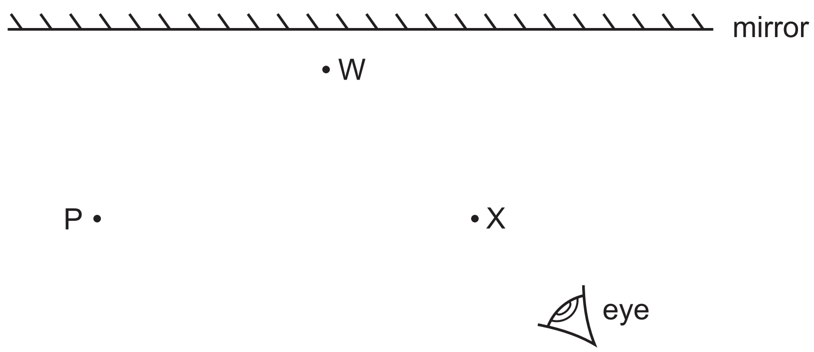

Fig. 3.1

Without moving the object pin P, the student views the image of P from a different position and repeats the procedure with two more pins, Y and Z.

The position of all the pins is shown in Fig. 3.2.

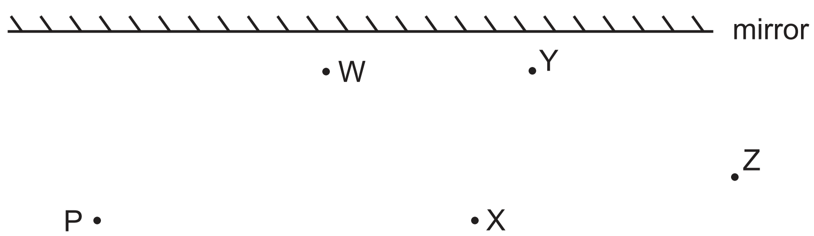

Fig. 3.2

(a) **(i)** On Fig. 3.2, draw a line joining X to W and continue the line until it hits the mirror.

Label the point where the line meets the mirror with the letter A.

Repeat this for points Z and Y.

Label the point where this line meets the mirror with the letter B. [1]

(ii) On Fig. 3.2 draw the two incident rays from P that produce the reflected rays that you have drawn in **(i)**. [1]

(iii) Measure the angle of incidence *i* of the ray PA.

i = ...° [1]

(b) On Fig. 3.2, continue the rays XW and ZY until they meet behind the mirror. This is the position of the image.

Label the position of the image with the letter I. [1]

(c) A second student says that the distance of the object pin P from the mirror is equal to the distance of the image I from the mirror.

(i) Measure and record the object distance and the image distance from Fig. 3.2.

Give the unit of your answers.

object distance = ... unit ....

image distance = ... unit ....
[1]

(ii) State, giving a reason, whether your results agree with the statement made by the second student.

....

.... [1]

[Total: 6]

4 A student connects three identical lamps P, Q and R to a cell and a switch to make a circuit.

Lamp P is connected in series with lamp R, the switch and the cell.

Lamp Q is connected in parallel with both lamps P and R.

(a) Draw the circuit diagram.

[1]

(b) The student disconnects the lamps from the circuit in **(a)** and reconnects them as shown in Fig. 4.1.

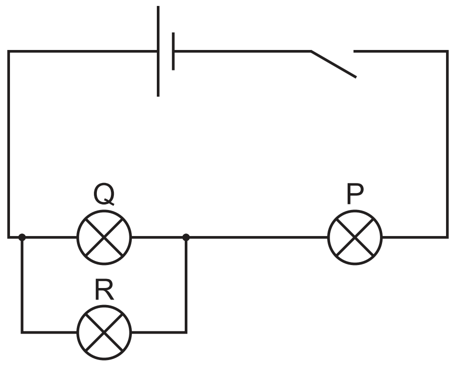

Fig. 4.1

When the switch is closed, the student notices that lamp P lights dimly and lamps Q and R do not light.

Five possible explanations for this are shown in Table 4.1.

Table 4.1

the cell needs recharging	
the currents in lamps Q and R are too small	
the filament of lamp P is broken	
the filaments of lamps Q and R are broken	
there is a break in the lead connecting the cell to lamps Q and R	

Place a tick in the boxes opposite the **two** possible correct explanations. [2]

[Total: 3]

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