Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

PHYSICS **5054/41**

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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1 A student investigates how the temperature of a volume of water changes as hotter water is added to it.

160 cm^3 of water at 20 °C is poured into a glass measuring cylinder.

Fig. 1.1 shows the measuring cylinder.

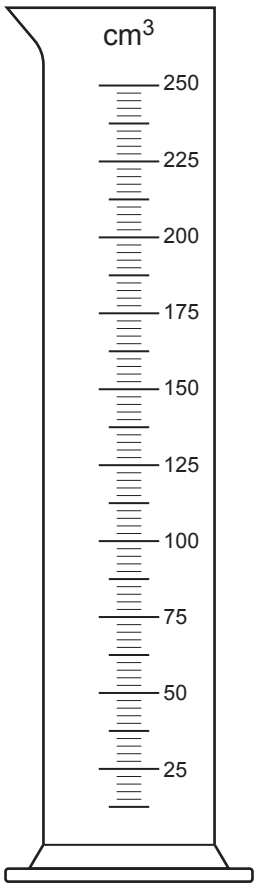

Fig. 1.1

(a) The measuring cylinder contains 160 cm^3 of water.

On Fig. 1.1, draw the level of the water, showing the meniscus. [2]

(b) The student pours 100 cm^3 of water from the measuring cylinder into a large beaker.

He then:

- uses a kettle to provide a constant supply of hot water
- adds 50 cm^3 of hot water at 70 °C to the beaker
- stirs the mixture
- records the new temperature of the water in the beaker
- continues to add 50 cm^3 of hot water at a time, recording the new temperature for each addition, until a total of 300 cm^3 of hot water has been added.

(i) The student ensures that the temperature of the water added each time is 70 °C.

Suggest how this is done.

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..... [2]

(ii) The student repeats the experiment and obtains three sets of results, as shown in Table 1.1.

Table 1.1

total volume of hot water added V / cm^3	temperature θ / °C			average temperature θ_{av} / °C
0	20	20	20	20
50	33	34	33	33
100	42	40	40	41
150	47	49	46	
200	51	52	51	51
250	53	54	53	53
300	54	55	54	54

Calculate the average temperature θ_{av} when total volume of hot water added V = 150 cm^3.

Record, in Table 1.1, your answer to an appropriate number of significant figures.

[2]

(iii) On Fig. 1.2, plot a graph of θ_{av} / °C on the *y*-axis against V / cm^3 on the *x*-axis. Start both axes from the origin (0,0).

Draw a smooth curved line of best fit. [4]

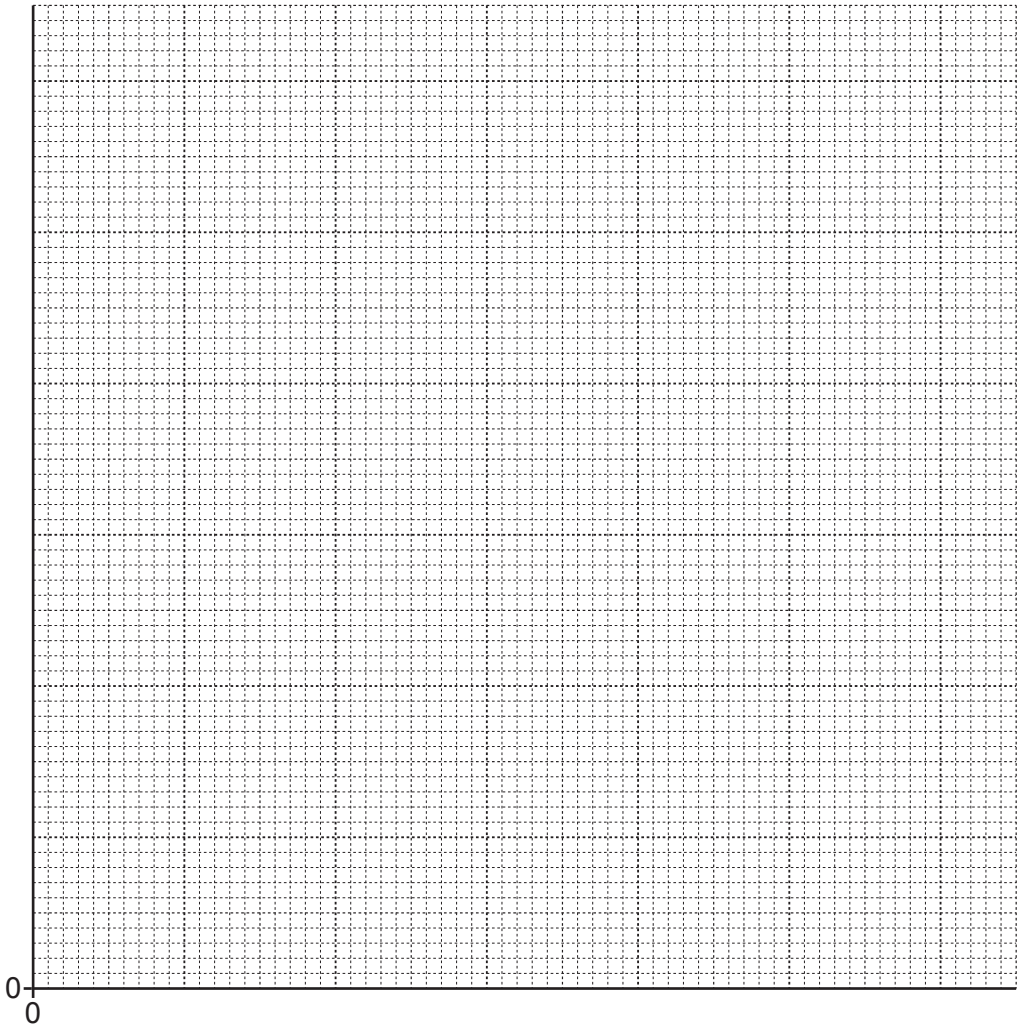

Fig. 1.2

(iv) Your graph shows that θ_{av} is **not** directly proportional to V.

Describe how your graph shows this and suggest why θ_{av} is not directly proportional to V.

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.....

.....

..... [2]

(c) The student repeats the experiment with a layer of insulation around the beaker.

On your graph in Fig. 1.2, sketch a line to show the results with a layer of insulation around the beaker. Label this line with the letter A. [2]

[Total: 14]

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2 A student investigates the resistance of two resistors.

Fig. 2.1 shows the apparatus used to find the current I in resistor X and the potential difference V across it.

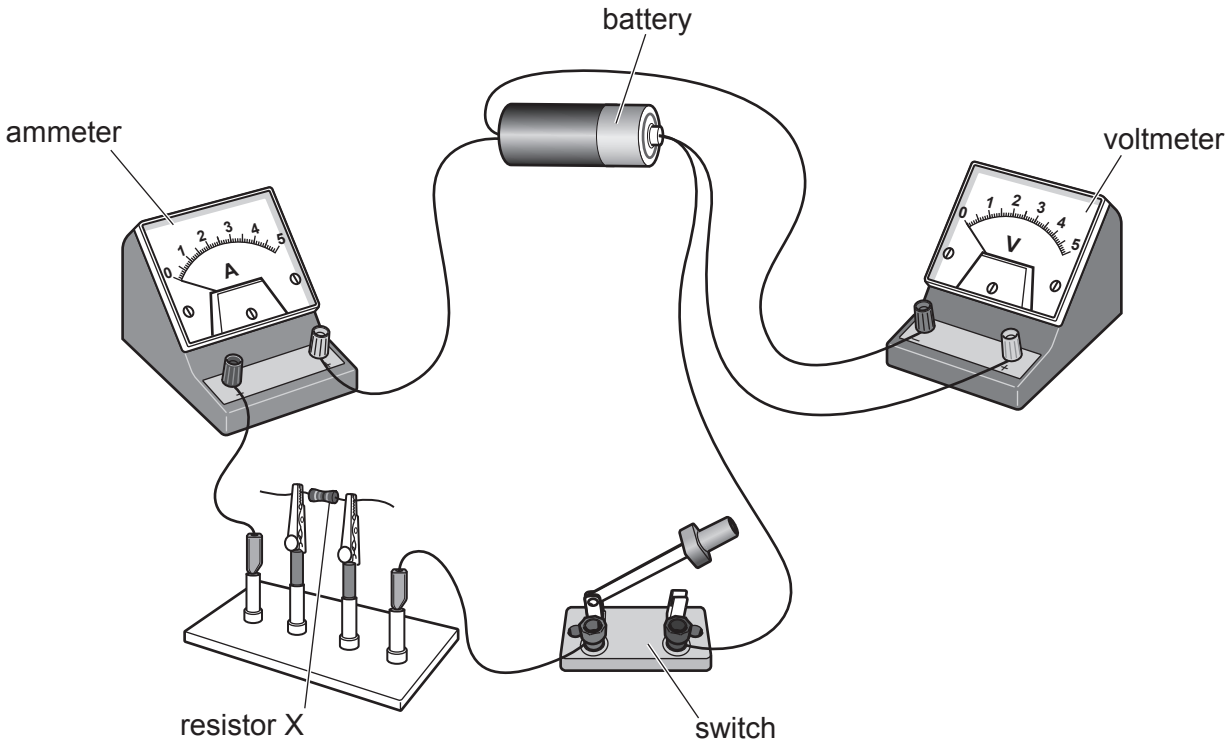

Fig. 2.1

(a) Draw a circuit diagram for the arrangement shown in Fig. 2.1.

[2]

(b) The student records the current I and the potential difference V across resistor X when the switch is closed. He calculates the resistance R_X of resistor X.

He replaces resistor X with resistor Y and repeats the experiment.

The values recorded for both resistors are shown in Table 2.1.

Table 2.1

resistor	I/A	V/V	resistance /Ω
X	0.10	1.0	10
Y	0.07	1.0	

(i) Calculate the resistance R_Y of resistor Y and complete Table 2.1.

Use the equation:

$$\text{resistance} = \frac{V}{I}$$

Give your answer to the nearest whole number.

[2]

(ii) The student combines resistors X and Y in a parallel arrangement. He uses this combination in the circuit in Fig. 2.1 in place of the single resistor Y.

Fig. 2.2 shows the ammeter reading for the parallel arrangement.

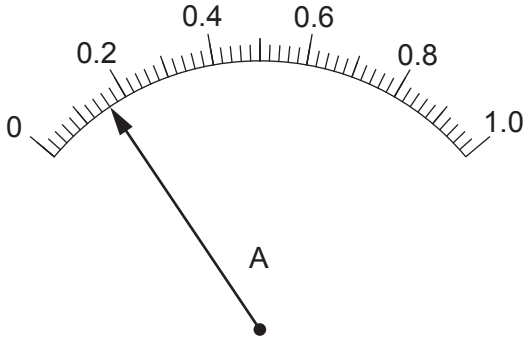

Fig. 2.2

Record the reading of I shown in Fig. 2.2.

I = ... A [1]

(iii) The potential difference stays at 1.0 V.

Using the value of I in **(b)(ii)** and the equation in **(b)(i)**, calculate the resistance R_C of the parallel combination.

R_C = ... Ω [1]

(c) Theory suggests that the resistance R_C of the two resistors X and Y arranged in parallel is given by:

$$R_C = \frac{R_X R_Y}{R_X + R_Y}$$

State, giving a reason, whether your value for R_C in (**b)(iii)** agrees with this suggestion.

.....

..... [1]

[Total: 7]

3 A student directs two parallel rays of light, ray 1 and ray 2, towards the side of a transparent plastic block, as shown in Fig. 3.1. The block rests on a sheet of paper.

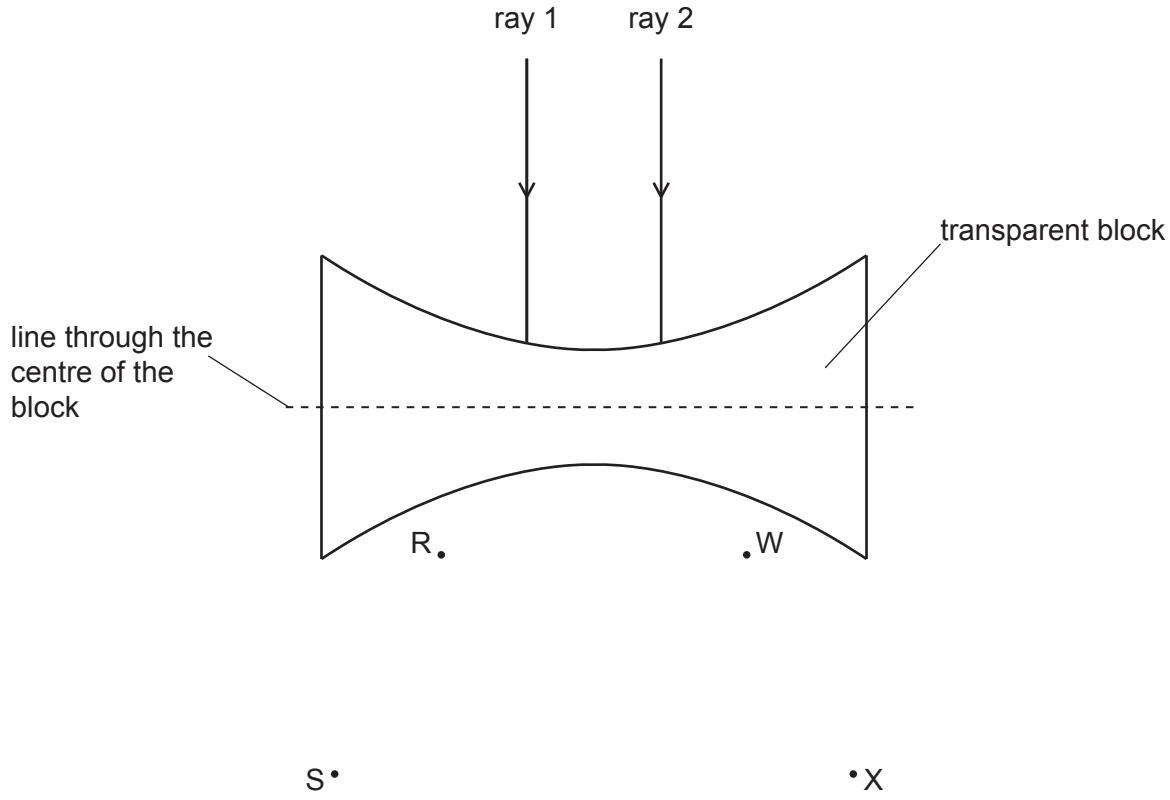

Fig. 3.1

(a) The student marks two points R and S on the path of ray 1 after it has passed through the block.

(i) On Fig. 3.1, draw a line joining S and R and continue the line to meet the block. [1]

(ii) On Fig. 3.1, draw a line to complete the path of ray 1 through the block. [1]

(b) The student marks two points W and X on the path of ray 2 after it has passed through the block.

On Fig. 3.1, complete the path of ray 2. [1]

(c) **(i)** Extend lines SR and XW back until they meet at a point. Label this point F. [1]

(ii) Measure the perpendicular distance from F to the centre of the block.

distance = ... cm [1]

[Total: 5]

4 A student determines the diameter of a thin wire.

The apparatus available is:

- 2.0 m length of thin wire
- wire cutters
- ruler

(a) Suggest how the student determines an accurate value for the diameter of the wire using **only** the apparatus listed.

Draw a diagram to illustrate your method.

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..... [3]

(b) A second student determines the diameter using a different piece of apparatus. His value for the diameter is more accurate.

State the name of the different piece of apparatus he uses.

..... [1]

[Total: 4]

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