For Examiner's Use

Section A

1 *In this experiment, you will investigate the refraction of light in a transparent block.*

You have been provided with

- a transparent block marked with a spot,
- a light source with a slit,
- an A4 piece of card (Do NOT write on it),
- a ruler,
- a protractor.

(a) **Fig. 1.1** is on page 3 of your Question Paper.

Turn on the light source to illuminate the slit.

On **Fig. 1.1**:

- position the illuminated slit at the top of the page so that a single ray of light is along the line **LM**. You may hold the A4 piece of card above the set-up to block some light from the surroundings in order to see the ray of light more clearly.
- place the block inside the area marked **ABCD** with the short edges of the block parallel to **LM**.
- adjust the position of the block so that the spot in the centre of the block is directly above point **S** on **Fig. 1.1**.
- mark the point where the ray of light crosses the line **XY**; label this point **W**. [1]

(b) Rotate the block slowly through approximately 30˚ about point **S**. Keep the spot in the centre of the block directly above point **S**.

(i) Describe the relationship between the angle of rotation of the block and the displacement of light from point **W**.

……

…… [1]

(ii) Describe how the direction of rotation of the block affects the displacement of the ray of light along the line **XY**.

……

…… [1]

(c) Explain why **(b)** cannot be answered when the block is rotated through large angles approaching 90˚.

……

…… [1]

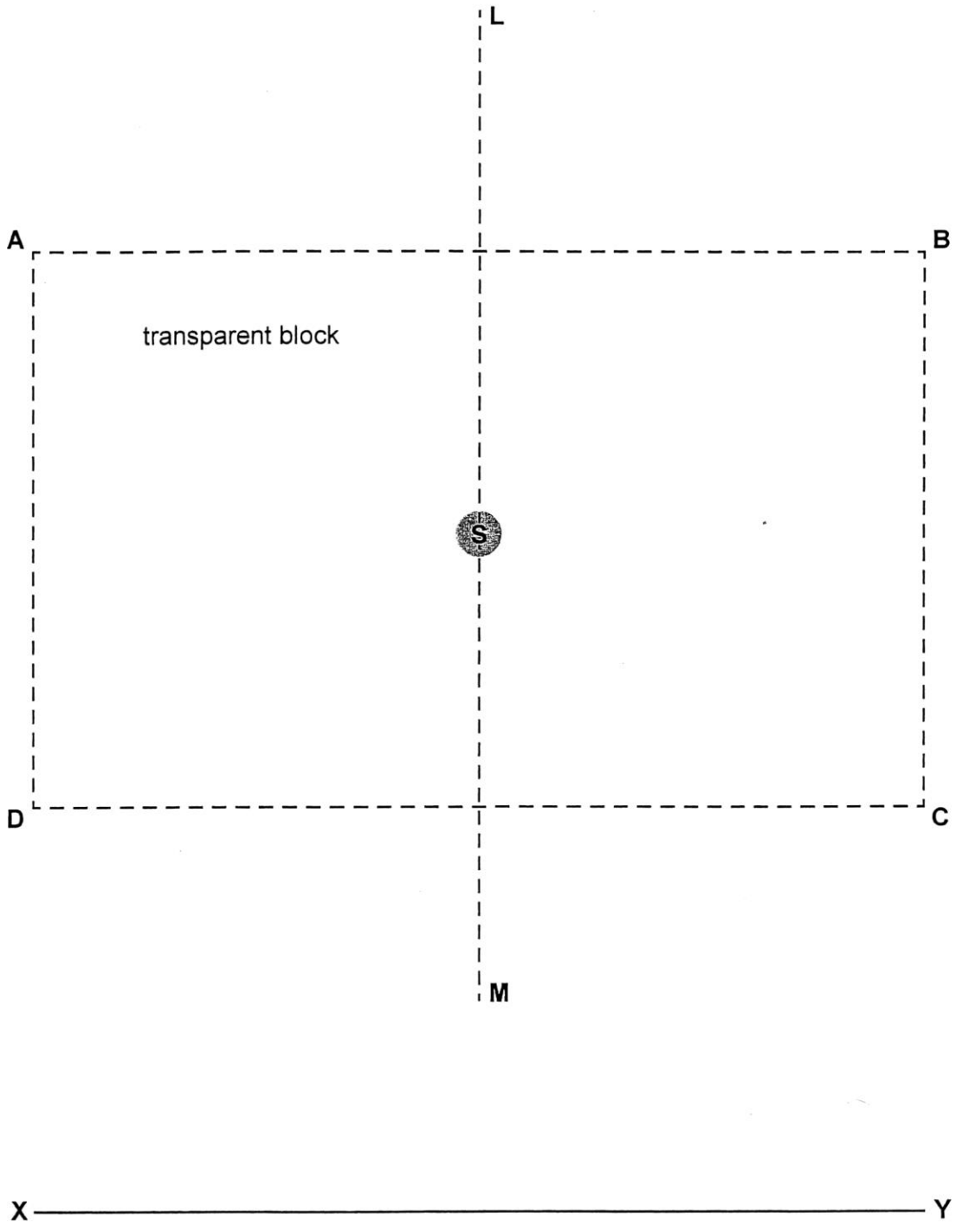

Fig. 1.1

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(d) A student claims that the displacement of the ray from point **W** is **directly** proportional to the angle of rotation of the block about point **S**.

Plan an experiment to find out if the student's claim is correct.

In your plan, you should:

- state the quantities that you will keep constant
- describe in detail how you will perform the experiment
- sketch the graph that you would obtain if the suggested relationship is correct.

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.... [6]

2 *In this experiment, you will investigate the mass and volume of a dry cell.*

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You have been provided with

- a dry cell
- a ruler
- two set squares
- an electronic balance

(a) (i) Describe **one** precaution you must take before measuring the mass of the dry cell using an electronic balance.

……

…… [1]

(ii) Measure and record the mass of the dry cell.

mass = …… [1]

(b) (i) Draw a labelled diagram to show how to use a ruler and set squares to measure the diameter of the dry cell.

[2]

(ii) Measure and record the diameter *d* of the dry cell.

d = …… [1]

(c) (i) Measure and record the total length *l* of the dry cell, as shown in **Fig. 2.1**.

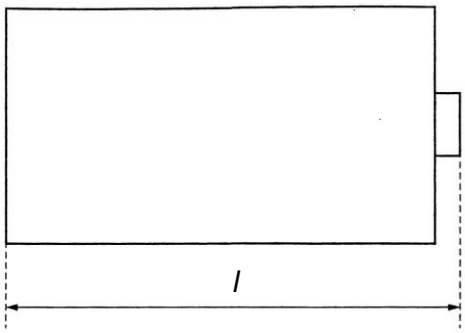

Fig. 2.1 (not to scale)

l = …… [1]

(ii) Estimate the volume V of the dry cell using the equation

$$V = \frac{\pi}{4} l d^2$$

V = …….. [1]

(iii) The volume calculated in **(c)(ii)** is an estimate of the volume of the dry cell.

Explain why it is only an estimate and why it is a good estimate of the actual volume of the dry cell.

……

……

…… [2]

(iv) Describe how the method for determining the volume of the dry cell may be improved.

……

……

…… [1]

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Section B

3 *In this experiment, you will investigate the potential difference (p.d.) across a resistance wire.*

You have been provided with

- a resistance wire taped to a metre rule
- an ammeter
- a voltmeter
- a power supply
- a switch
- a jockey
- six leads with crocodile clips at both ends

A small length of the resistance wire is coiled around a piece of wood.

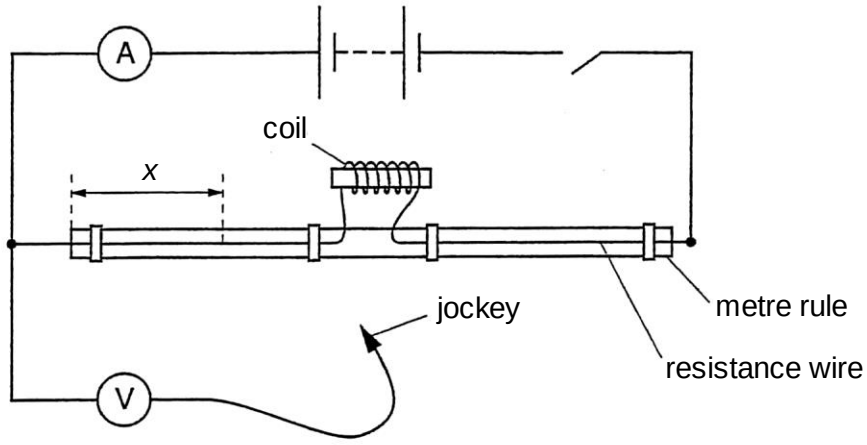

Fig. 3.1

(a) Assemble the apparatus as shown in **Fig. 3.1**. Close the switch.
Record the current *I* shown on the ammeter.

I = ... [1]

(b) Place the jockey on the wire at $x = 10$ cm.
Record the potential difference (p.d.) *V* shown on the voltmeter.

V = ... [1]

(c) Repeat **(b)** with the jockey placed on the wire at x = 15 cm, 25 cm, 35 cm, 45 cm, 60 cm, 65 cm, 75 cm, 85 cm and 90 cm. Open the switch.

Record your values for V and x in a suitable table. Include your values from **(b)**.

[4]

(d) Using the grid provided, plot a graph of V against x. Start your axes at the origin (0,0). The x-axis must start at 0 cm and end at 100 cm.

Draw **two** lines of best fit,

- one for x = 10 cm to x = 45 cm, label this **A**,
- one for x = 60 cm to x = 90 cm, label this **B**. [4]

(e) **(i)** Determine the gradient G_A of line **A**.

G_A = ...

(ii) Determine the p.d. V_A when x = 0 cm for line **A**.

V_A = ... [2]

(f) **(i)** Determine the gradient G_B of line **B**.

G_B = ...

(ii) Determine the p.d. V_B when x = 0 cm for line **B**.

V_B = ... [2]

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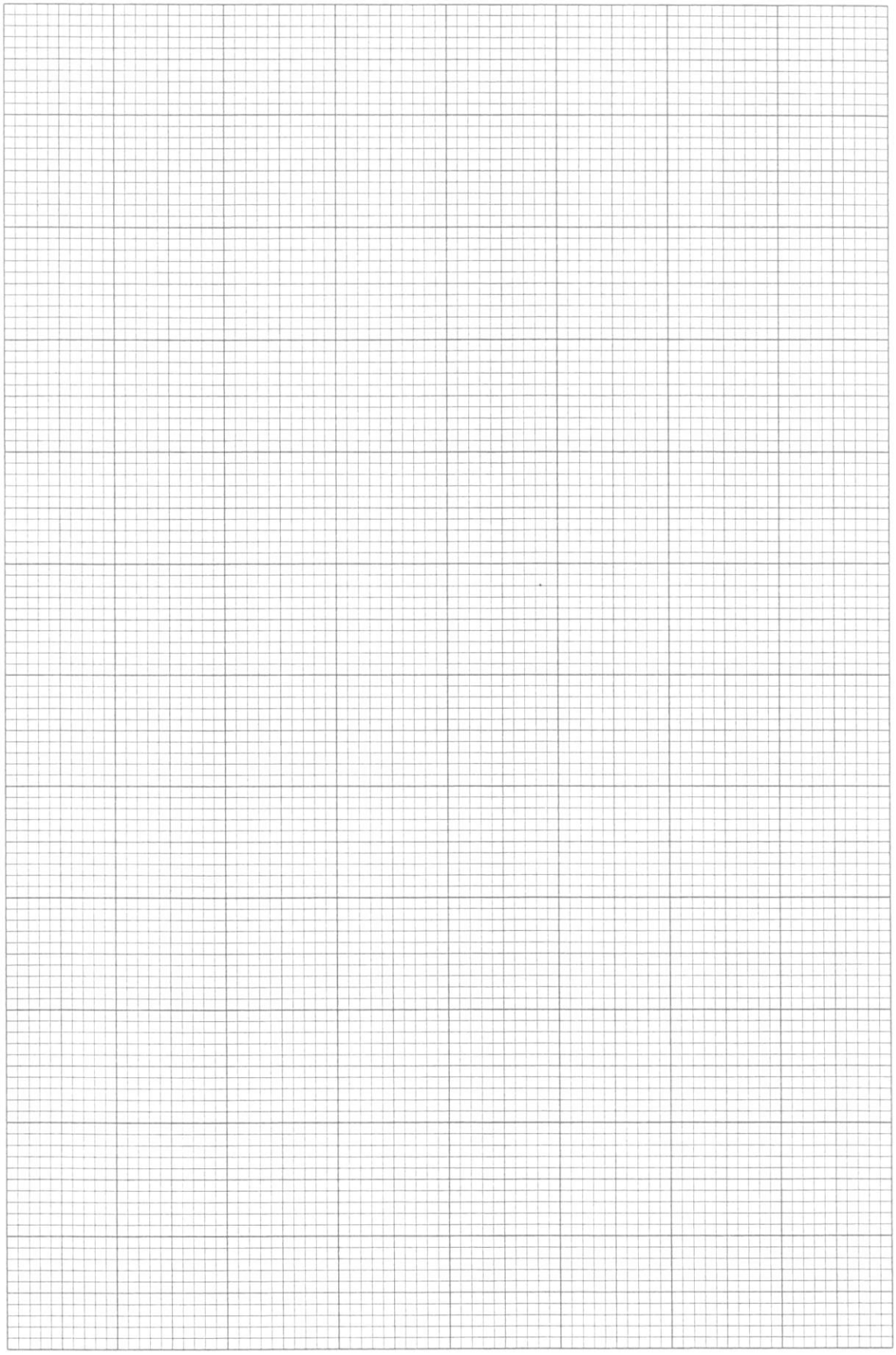

(g) It is suggested that G_A should be equal to G_B.

State whether you agree with this suggestion. Justify your answer by reference to your results.

……

……

…… [2]

(h) **(i)** An estimate for the length of L of resistance wire in the coil can be determined from the equation

$$L = \frac{2(V_B - V_A)}{(G_A + G_B)}.$$

Determine L.

L = …… [2]

(ii) Suggest **two** reasons why the actual length L of the resistance wire in the coil is different from the value calculated in **(h)(i)**.

1. ……

……

2. ……

…… [2]

End of paper