Cambridge
O Level

Cambridge Assessment International Education
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5924015880

PHYSICS **5054/41**

Paper 4 Alternative to Practical **October/November 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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Cambridge Assessment International Education

1 A student is asked to find the focal length *f* of a lens. He uses an arrow-shaped slit in a piece of card as an object, as shown in Fig. 1.1.

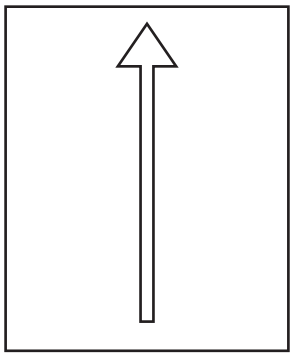


Fig. 1.1

The object is placed at one end of a metre rule and the lens is fixed a distance *u* from the object, as shown on Fig. 1.2. The slit is illuminated from behind using a lamp.

A screen is then placed on the metre rule so that a sharp, focussed image of the arrow is formed. The distance *v* from the lens to the screen is then measured.

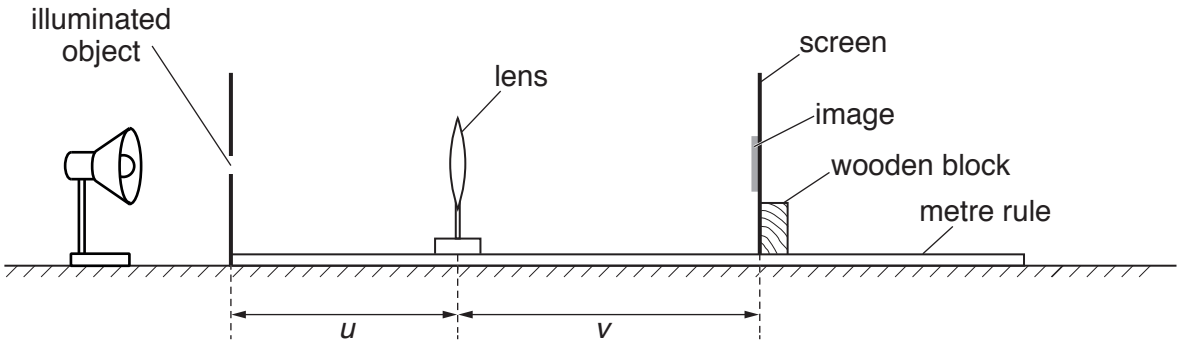


Fig. 1.2

(a) Explain how the student ensures that the image is sharply focussed on the screen.

.....

..... [1]

(b) Fig. 1.3 is a full-scale diagram showing the positions of the object, centre of lens and screen when the sharp, focussed image is obtained.

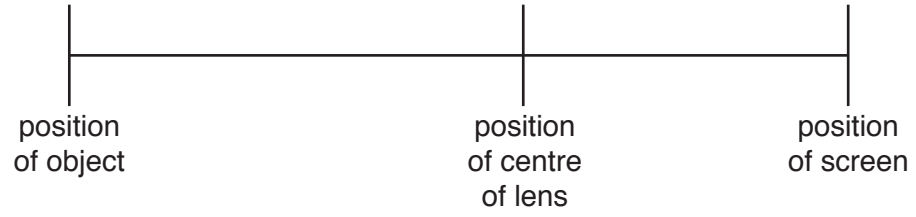


Fig. 1.3 (full scale)

(i) Take measurements from Fig. 1.3 to find u and v.

u = ... cm

v = ... cm
[1]

(ii) The focal length f of the lens is given by the equation:

$$f = \frac{uv}{v + u}$$

Calculate f, using your measurements in **(b)(i)**.

f = ... cm [1]

(iii) Suggest **one** way the student ensures that his value for f is accurate.

.....

..... [1]

[Total: 4]

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2 A student carries out an experiment to find the mass of a metre rule. She uses a number of identical metal rings and a pivot. Each ring has a mass of 3.3 g.

The apparatus is set up as shown in Fig. 2.1.

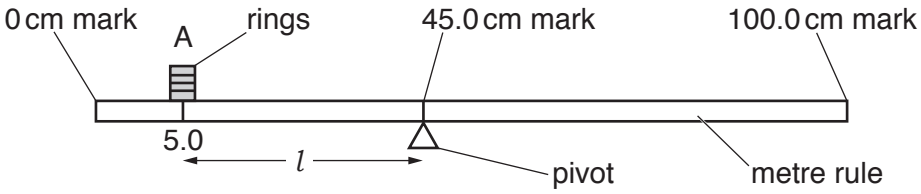


Fig. 2.1

The student places the pivot under the 45.0 cm mark on the metre rule. She then places rings, one at a time, on the metre rule at point A, 5.0 cm along the rule. She adjusts the number of rings until the rule is as close to balance as possible.

She records the number N of rings needed to balance the rule.

(a) (i) The rings are circular with a central hole, as shown in Fig. 2.2.

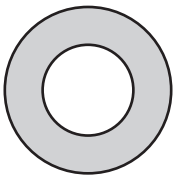


Fig. 2.2 (full scale)

1. Measure the outer diameter of the ring.

diameter = ... cm [1]

2. Fig. 2.3 shows a section of the metre rule.

On Fig. 2.3, draw one ring correctly placed at the 5.0 cm mark.

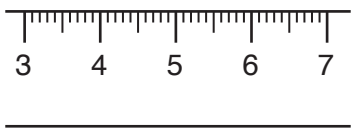


Fig. 2.3

[1]

(ii) Explain why the student adds the rings carefully, one at a time.

.....

..... [1]

(b) The distance l between the pivot and point A is changed by moving the pivot closer to A.

The student repeats the experiment for different values of l and draws a table of results, as shown in Table 2.1.

Table 2.1

l/cm	N
40.0	4
35.0	9
30.0	17
25.0	28
20.0	43
15.0	70

(i) On Fig. 2.4 on page 7, draw a graph of N on the y-axis against l/cm on the x-axis. Start your axes from (0, 0). Draw the best-fit curve. [4]

(ii) Use your graph to estimate the number N_{18} of rings required to balance the rule when l is 18.0 cm. Show your working clearly on your graph.

N_{18} = ... [2]

(iii) Theory suggests that the mass M of the metre rule is given by the equation:

$$M = \frac{3.3 \times N_{18} \times l}{45 - l}$$

Using your answer in **(ii)**, calculate a value for M. Give your answer to 2 significant figures.

M = ... g [2]

(iv) Name a piece of apparatus that can be used to check whether the theory is correct.

..... [1]

(c) Suggest **one** way in which this method of measuring the mass M of the metre rule can be improved.

.....

..... [1]

[Total: 13]

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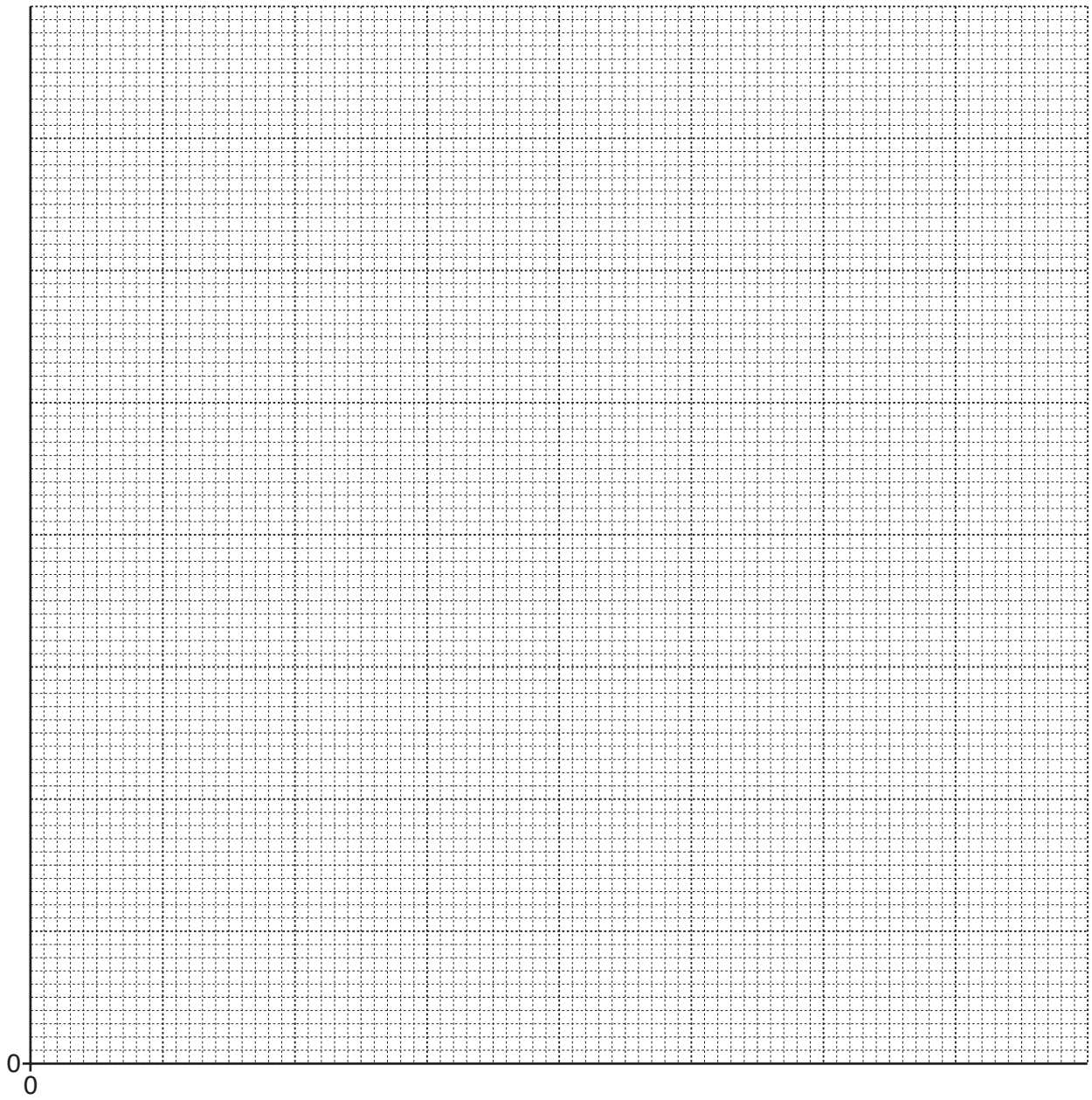


Fig. 2.4

3 A student investigates how the resistance of a filament lamp changes as the potential difference V across it changes. He uses the circuit shown in Fig. 3.1.

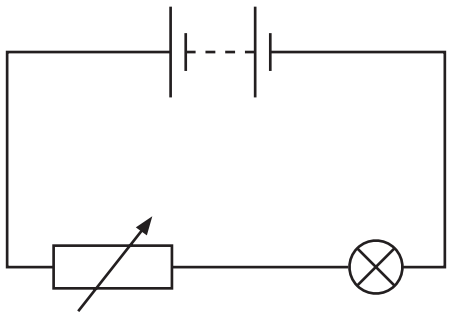


Fig. 3.1

(a) On Fig. 3.1, draw the symbol for an ammeter and the symbol for a voltmeter in the correct positions for this investigation. [2]

(b) The student takes two different sets of readings of current and potential difference.

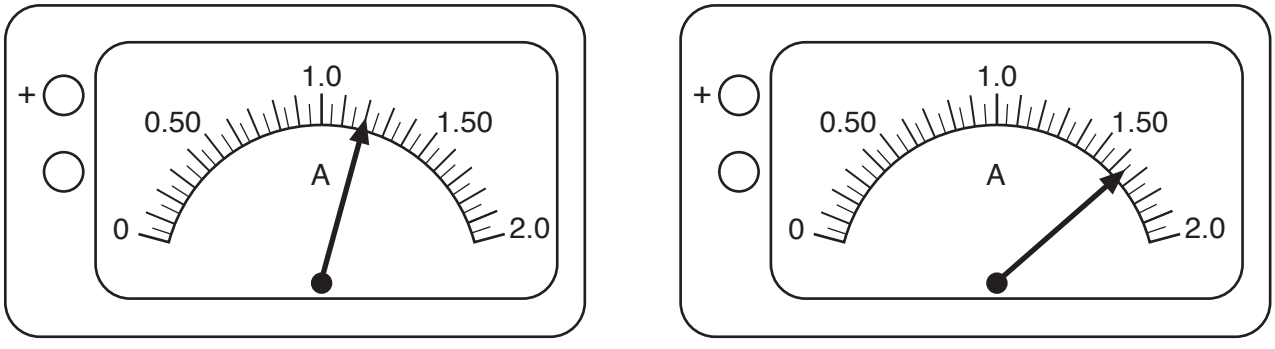
(i) Suggest how he adjusts his circuit to do this.

.....

..... [1]

(ii) He adjusts his circuit so that the voltmeter shows 4.0 V and he reads the ammeter. He repeats the experiment at 8.0 V.

Fig. 3.2 shows the readings of current I on the ammeter for each voltage.



when V = 4.0 V

when V = 8.0 V

Fig. 3.2

Record the values of I shown on the meter for each voltage.

When V is 4.0 V, I = ... A

When V is 8.0 V, I = ... A [1]

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(iii) Use the equation:

$$R = \frac{V}{I}$$

to calculate the resistance R of the lamp at 4.0 V and at 8.0 V.

State the unit in your answers.

When V is 4.0 V, R = ...

When V is 8.0 V, R = ...

[1]

(c) State **two** physical changes in the lamp that are observed as the potential difference V is increased.

1 .....

.....

2 .....

.....

[2]

[Total: 7]

4 A student has a thermometer which has no temperature markings, as shown in Fig. 4.1.

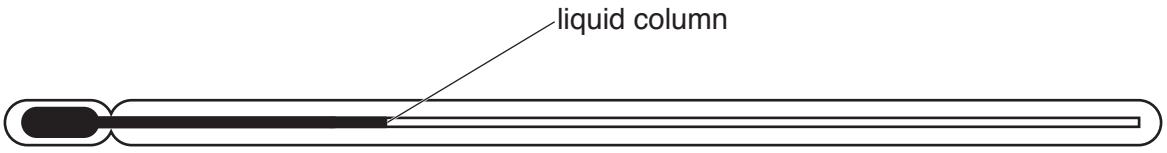


Fig. 4.1

(a) He finds the length of the liquid column when the temperature is 0 °C.

State the apparatus he needs to do this and explain how he uses his apparatus. You may use a diagram if you wish.

.....

.....

.....

..... [2]

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(b) He finds the length of the liquid column when the temperature is 100 °C.

State the apparatus he needs to do this and explain how he uses his apparatus. You may use a diagram if you wish.

.....

.....

.....

..... [2]

(c) Suggest how he then uses his thermometer to find room temperature.

.....

.....

.....

..... [2]

[Total: 6]

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