



CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
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## 5054/32

May/June 2023

**1 hour 30 minutes**

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential 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.

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
3	
4	
Total	

This document has **16** pages. Any blank pages are indicated.

1 In this experiment you will measure the capacity of a drinks cup by three different methods.

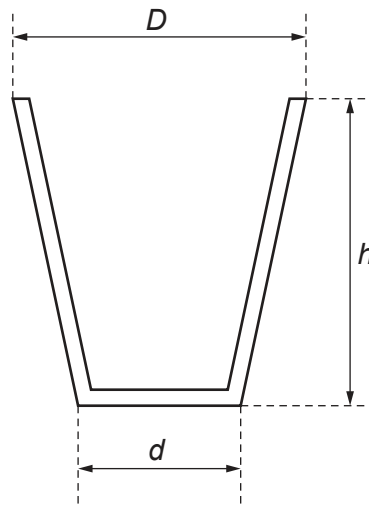
The capacity of a cup is the maximum volume of liquid that it can hold.

You are provided with:

- a drinks cup with a capacity of approximately  $200 \text{ cm}^3$
- a 30 cm ruler
- a metre rule
- approximately 80 cm of thin string
- a  $250 \text{ cm}^3$  measuring cylinder
- a supply of water.

(a) **method 1**

Fig. 1.1 shows the measurements to be taken.



**Fig. 1.1**

(i) Measure the height  $h$ , the diameter  $D$  and the diameter  $d$  of the cup provided.

$h =$  ..... cm

$D =$  ..... cm

$d =$  ..... cm  
[2]

- (ii) Calculate the average diameter  $d_A$  of the cup using your readings from (a)(i) and the equation:

$$d_A = \frac{(D + d)}{2}$$

$$d_A = \dots\dots\dots \text{ cm [1]}$$

- (iii) Calculate a value for the capacity  $V_1$  of the cup using the equation:

$$V_1 = \frac{\pi d_A^2 h}{4}$$

$$V_1 = \dots\dots\dots \text{ cm}^3 \text{ [1]}$$

**(b) method 2**

Use the string and the metre rule to determine the average circumference  $C$  of the cup.

- (i) Describe the method you use and show your working.

You may draw a diagram, if you wish.

.....

.....

.....

.....

$$C = \dots\dots\dots \text{ cm [2]}$$

- (ii) Calculate a value for the capacity  $V_2$  of the cup using the equation:

$$V_2 = \frac{C^2 h}{4\pi}$$

$$V_2 = \dots\dots\dots \text{ cm}^3 \text{ [1]}$$

**(c) method 3**

Pour water into the measuring cylinder up to a level that is greater than  $200\text{ cm}^3$  and record the volume. This is reading  $R_1$ .

Pour water from the measuring cylinder into the cup until it is full and record the volume of water left in the measuring cylinder. This is reading  $R_2$ .

Determine the volume of water  $V_3$  in the cup. Show your working.

$$R_1 = \dots\dots\dots \text{ cm}^3$$

$$R_2 = \dots\dots\dots \text{ cm}^3$$

$$V_3 = \dots\dots\dots \text{ cm}^3 \text{ [1]}$$

- (d)** All three methods of determining the capacity of the drinks cup give values which are approximate.

State **one** reason why the volume calculated in **method 2** and **one** reason why the volume calculated in **method 3** are **not** accurate.

**method 2** .....

.....

.....

**method 3** .....

.....

.....

[2]

[Total: 10]

**Question 2 is on page 6.**

- 2 In this experiment you will investigate the effective resistance of different combinations of resistors and lamps in circuits.

You are provided with:

- power source
- a switch
- an ammeter
- a voltmeter
- three identical resistors
- three identical lamps
- one additional connecting lead.

The supervisor has set up the apparatus as shown in Fig. 2.1.

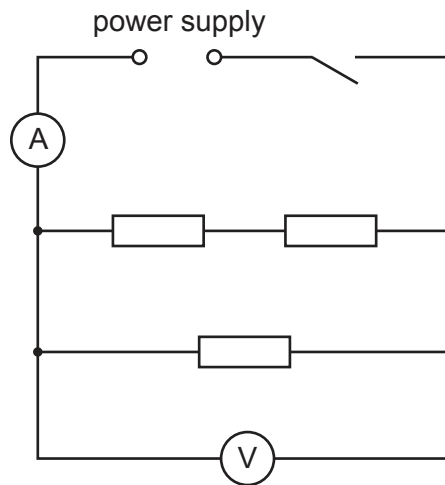


Fig. 2.1

- (a) (i) Close the switch.

Record the potential difference  $V_1$  across the resistors, and the current  $I_1$  in the circuit.

Open the switch.

$V_1 = \dots\dots\dots$  V

$I_1 = \dots\dots\dots$  A  
[1]

- (ii) Calculate the effective resistance  $R_1$  of the combination of resistors using the equation:

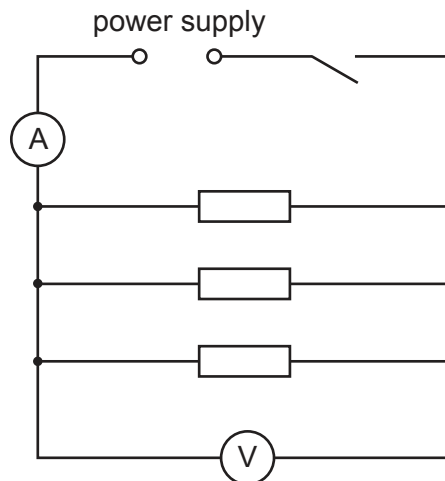
$$R_1 = \frac{V_1}{I_1}$$

$$R_1 = \dots\dots\dots \Omega \quad [1]$$

- (iii) Suggest why the switch is opened after the readings of potential difference and current have been taken.

.....  
 ..... [1]

- (b) Rearrange the circuit so that the resistors are connected as shown in Fig. 2.2.



**Fig. 2.2**

- (i) Close the switch.

Record the potential difference  $V_2$  across the resistors and the current  $I_2$  in the circuit.

Open the switch.

$$V_2 = \dots\dots\dots \text{ V}$$

$$I_2 = \dots\dots\dots \text{ A} \quad [1]$$

- (ii) Calculate the effective resistance  $R_2$  of the combination of resistors using the equation:

$$R_2 = \frac{V_2}{I_2}$$

Record your answer on the answer line.

Write down the value of  $2R_2$

$$R_2 = \dots\dots\dots \Omega$$

$$2R_2 = \dots\dots\dots \Omega$$

[1]

- (c) If the resistors are identical, theory suggests that  $R_1 = 2R_2$ .

Two quantities can be considered to be equal within the limits of experimental accuracy if their values are within 10% of each other.

State whether your results indicate that the resistors are identical. Support your statement with a calculation.

calculation

statement ..... [2]

- (d) Set up the circuit shown in Fig. 2.1 on page 6, replacing the resistors with the lamps.

Close the switch.

Calculate the effective resistance  $R_3$  of the combination of lamps.

Record any readings you take and show your working.

$$R_3 = \dots\dots\dots \Omega$$

[1]



- (e) Rearrange the circuit as shown in Fig. 2.2 on page 7, replacing the resistors with the lamps.

Close the switch.

Calculate the effective resistance  $R_4$  of the combination of lamps.

Record any readings you take and show your working.

$$R_4 = \dots\dots\dots \Omega$$

[1]

- (f) The teacher explains that the resistance of the lamp filaments changes due to a heating effect and therefore  $R_3$  is not equal to  $2R_4$ .

Describe **one** observation that you made while doing the experiment that supports the teacher's explanation.

.....

..... [1]

[Total: 10]

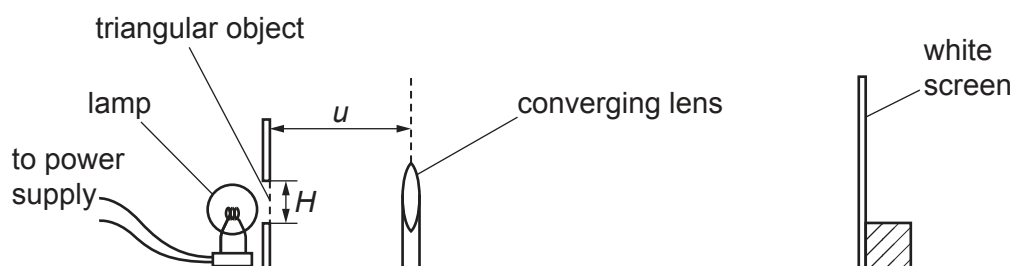


**3** In this experiment you will investigate the image formed by a converging lens.

You are provided with:

- a converging lens in a lens holder
- a metre rule
- a 30 cm ruler
- a white screen
- a triangular object in a piece of white card
- a lamp with a power supply to illuminate the triangular object.

Set up the apparatus as shown in Fig. 3.1.



**Fig. 3.1**

- (a)** Measure and record the height  $H$  of the triangular object provided.

$H =$  ..... cm [1]

- (b)** Switch on the lamp and place the lens a distance  $u = 20.0$  cm from the triangular object.

Adjust the position of the screen until a sharp, focussed image of the triangular object is formed on the screen.

- (i)** Measure the height  $h$  of the image on the screen.

$h =$  ..... [1]

- (ii)** Calculate the value of  $\frac{1}{h}$ .

Give your answer to 2 significant figures.

$\frac{1}{h} =$  ..... [1]

- (c) Repeat (b) for values of  $u$  between  $u = 25.0\text{ cm}$  and  $u = 50.0\text{ cm}$ .

Record all your readings and calculations in Table 3.1. Include your readings from (b).

Add appropriate headings with units to each column.

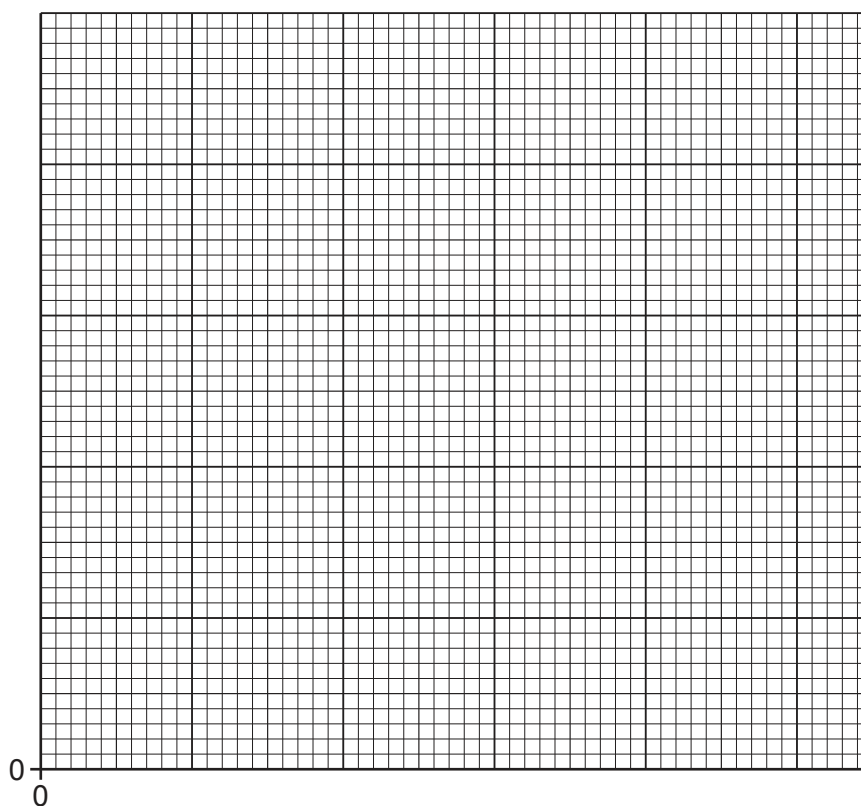
**Table 3.1**

...../.....	...../.....	...../.....

[3]

- (d) On the grid provided, plot a graph of  $\frac{1}{h}$  on the  $y$ -axis against  $u$  on the  $x$ -axis.

Start both axes from the origin (0, 0). Draw the straight line of best fit.



[4]

- (e) (i) Calculate the gradient  $m$  of your line. Show all working and indicate on the graph the values you use.

$$m = \dots\dots\dots [2]$$

- (ii) Calculate the focal length  $f$  of the lens. Use your value of  $H$  from (a) and the equation:

$$f = \frac{1}{mH}$$

$$f = \dots\dots\dots \text{ cm } [1]$$

- (f) When measuring the height of the image on the screen, your hand and the ruler may obstruct the light from the object and prevent it from reaching the screen.

Suggest **one** improvement to the apparatus provided to overcome this problem.

.....  
 ..... [1]

[Total: 14]

- 4 A student investigates the time taken for ice cubes to melt when they are placed in a beaker of hot water.

Plan an experiment to investigate how the thickness of the cardboard insulation around a beaker affects the time taken for the ice cubes in the beaker to melt.

You are **not** required to do this experiment.

The following apparatus is available:

250 cm<sup>3</sup> beaker  
supply of hot water  
supply of ice cubes  
thermometer  
stopwatch  
supply of 2 mm thick cardboard sheets.

In your plan you should:

- explain briefly how to carry out the investigation
- state the key variables to keep constant
- draw a table with column headings to show how to display the readings
- explain how to use your readings to reach a conclusion.

.....

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