Cambridge Assessment International Education

# Cambridge O Level

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| CANDIDATE NAME | | | | | | | | | |
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*3039539750*

**PHYSICS** **5054/32**

Paper 3 Practical Test **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

**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 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.


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**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 $cm^3$
- a 30 cm ruler
- a metre rule
- approximately 80 cm of thin string
- a 250 $cm^3$ measuring cylinder
- a supply of water.

**(a) method 1**

Fig. 1.1 shows the measurements to be taken.

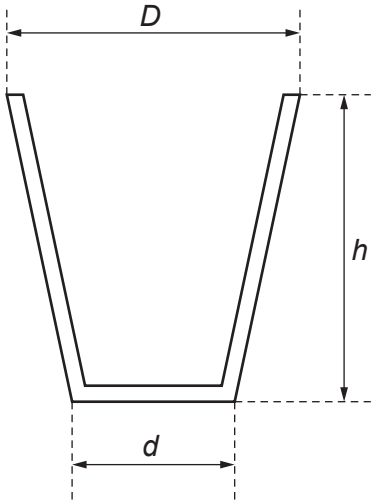



**Fig. 1.1**

**(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:

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

$d_A$ = ..... cm [1]

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

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

$V_1$ = ..... $cm^3$ [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.

.....

.....

.....

.....

$C$ = ..... cm [2]

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

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

$V_2$ = ..... $cm^3$ [1]

**(c) method 3**

Pour water into the measuring cylinder up to a level that is greater than 200 $cm^3$ 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.

$R_1$ = ..... $cm^3$

$R_2$ = ..... $cm^3$

$V_3$ = ..... $cm^3$
[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]

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**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.

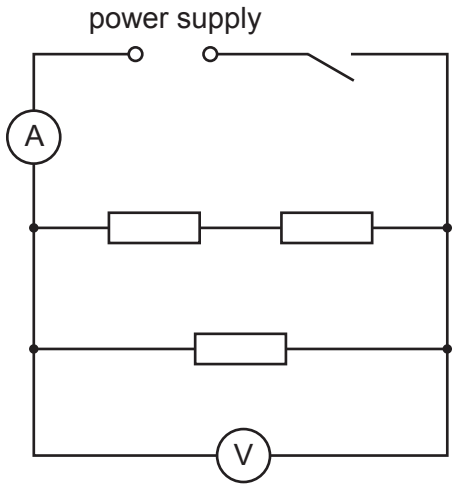



**Fig. 2.1**

**(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.

$V_1$ = ..... V

$I_1$ = ..... A
[1]

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

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

$R_1$ = ..... Ω [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.

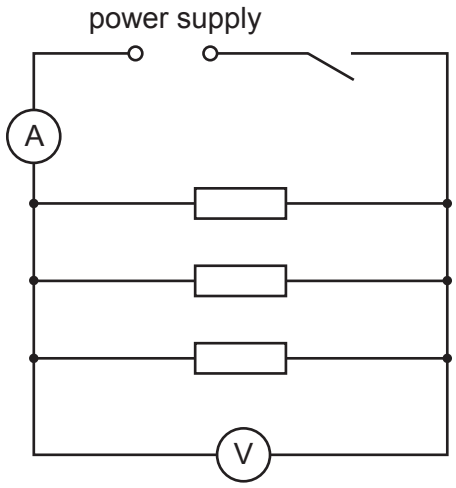



**Fig. 2.2**

**(i)** Close the switch.

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

Open the switch.

$V_2$ = ..... V

$I_2$ = ..... A
[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 $2R_2$

$R_2$ = ..... Ω

$2R_2$ = ..... Ω
[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.

$R_3$ = ..... Ω [1]

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**(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.

$R_4$ = ..... Ω
[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]

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**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.

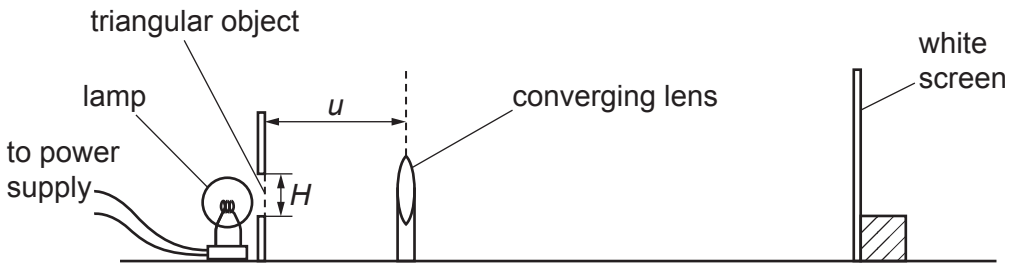



**Fig. 3.1**

**(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.

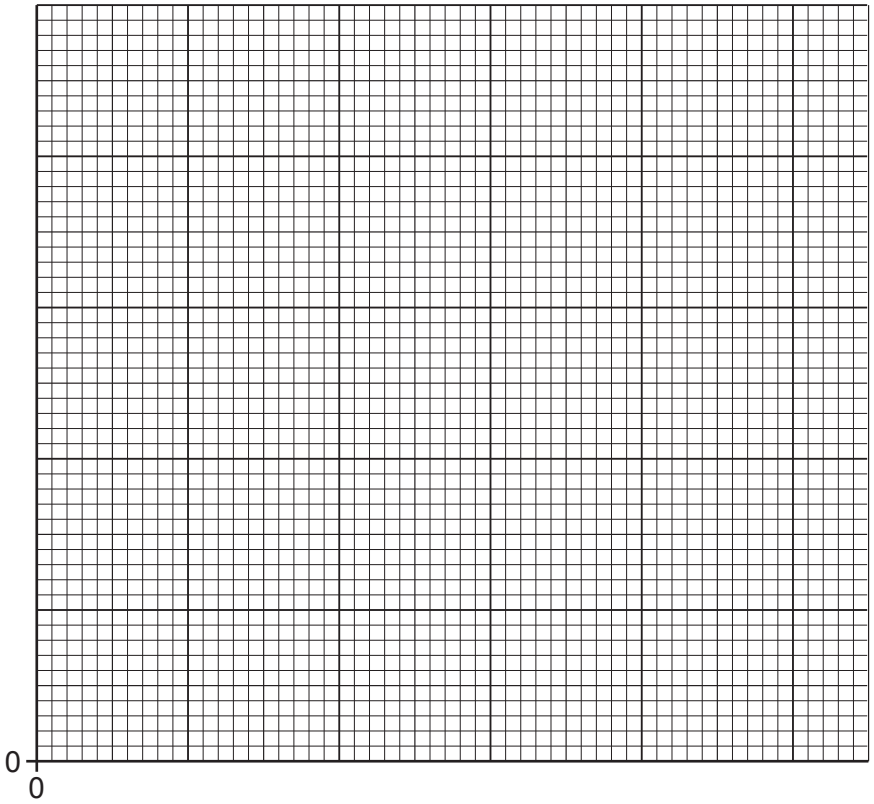
**Table 3.1**

| ...../..... | ...../..... | ...../..... |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

[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.

$m$ = ..... [2]

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

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

$f$ = ..... 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 $cm^3$ 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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[6]

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