



CANDIDATE
NAME

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5054/32

May/June 2024

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 investigate the resistance of a diode when different currents flow through it.

You are provided with:

- a power source
- an ammeter
- a voltmeter
- a diode
- a $3.3\ \Omega$ resistor, a $6.8\ \Omega$ resistor and a $10\ \Omega$ resistor
- a switch
- a resistor labelled P
- two spare connecting leads.

The supervisor has set up the circuit shown in Fig. 1.1.

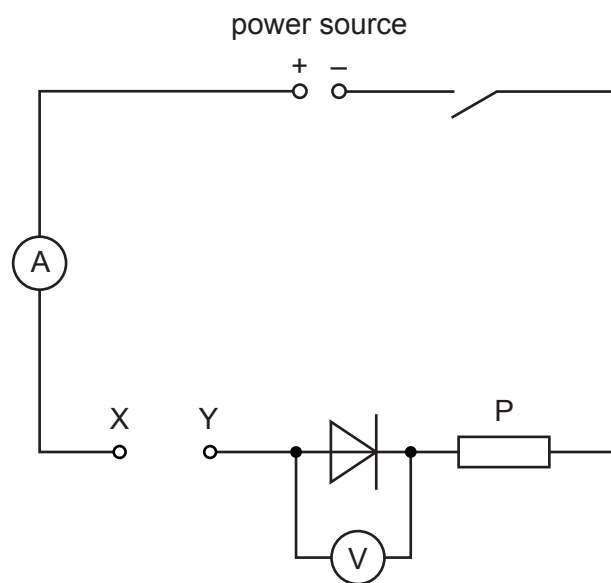


Fig. 1.1

- (a)
- Use a spare connecting lead to connect the terminals X and Y together.
 - Close the switch.
 - Record the voltmeter reading V in the top row of Table 1.1.
 - Record the ammeter reading I in the top row of Table 1.1.
 - Open the switch and remove the connecting lead.

[2]

Table 1.1

resistance between X and Y/ Ω	voltmeter reading V/V	ammeter reading I/A	resistance R of diode/ Ω
0			
3.3			
6.8			
10			

- (b) • Use both spare connecting leads to connect the 3.3Ω resistor between terminals X and Y.
 • Close the switch.
 • Record the voltmeter reading V in Table 1.1.
 • Record the ammeter reading I in Table 1.1.
 • Open the switch and remove the connecting leads and the 3.3Ω resistor.

[2]

- (c) Repeat the procedure in (b) for the resistors of 6.8Ω and 10Ω .

[1]

- (d) Calculate the resistance R of the diode for each pair of readings of V and I , using the equation:

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

Record your answers in Table 1.1.

[2]

- (e) As the resistance between terminals X and Y is changed, the current in the circuit changes.

Examine your results in Table 1.1.

Describe how the change in **current** affects:

- (i) the voltage across the diode
 [1]

- (ii) the resistance of the diode
 [1]

- (f) A student sets up a circuit using the diagram shown in Fig. 1.1.

The student finds that, when the connecting lead is connected across the terminals X and Y and the switch is closed, the ammeter does not give a reading.

The ammeter is not broken.

Suggest the error that the student has made while assembling the circuit.

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

[Total: 10]

- 2 In this experiment you will investigate the rate of cooling of hot water in a test-tube under different conditions.

You are provided with:

- a test-tube
- a 250cm³ glass beaker
- a thermometer, –10 °C to 110 °C, graduated in 1 °C intervals
- a 100cm³ or 250cm³ measuring cylinder
- a stop-watch
- a clamp, boss and stand
- a supply of hot water (approximately 80 °C)
- a supply of cold water (at room temperature)
- a supply of warm water (approximately 40 °C).

- (a) The test-tube has been arranged as shown in Fig. 2.1.

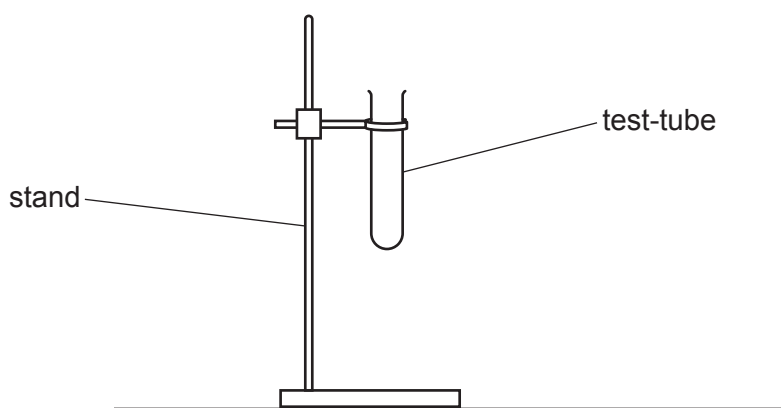


Fig. 2.1

- Pour 200cm³ of cold water into the beaker.
- Ask the supervisor to pour hot water into the test-tube until it is approximately one-third full.
- Lower the test-tube into the beaker of cold water until the level of the hot water in the test-tube is below the level of the cold water in the beaker. See Fig. 2.2.

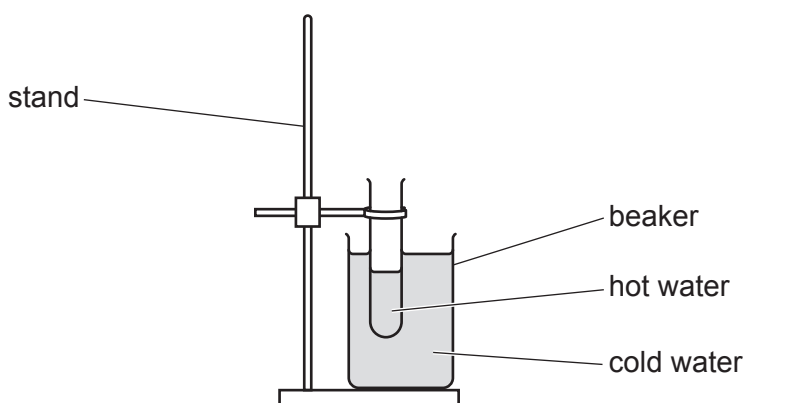


Fig. 2.2

- Place the thermometer into the test-tube.
- Wait for approximately 30s before measuring the temperature and starting the stop-watch.

- (i) Measure the temperature θ of the hot water in the test-tube and start the stop-watch immediately.

Record the temperature at time $t = 0$ in the second column of Table 2.1.

[1]

Table 2.1

time t/s	test-tube cooling in cold water temperature $\theta/^\circ\text{C}$	test-tube cooling in warm water temperature $\theta/^\circ\text{C}$
0		
30		
60		
90		
120		
150		
180		

- (ii) Measure the temperature θ of the hot water every 30 s for 180 s. Record your readings in the second column of Table 2.1. [2]

- (b) Describe in detail **one** precaution that you take to make sure that the temperature measurements are as accurate as possible.

.....

..... [1]

- (c)
- Empty the test-tube.
 - Empty the cold water from the beaker.
 - Pour 200 cm³ of **warm** water into the beaker.
 - Ask the supervisor to pour hot water into the test-tube until it is approximately one-third full.
 - Lower the test-tube into the beaker of warm water until the level of the water in the test-tube is below the level of the warm water in the beaker.
 - Place the thermometer into the test-tube.
 - Wait for approximately 30 s before measuring the temperature and starting the stop-watch.

Repeat the steps described in (a)(i) and (a)(ii), recording your results in the third column of Table 2.1. [2]

- (d) Calculate the temperature decrease of the hot water in the test-tube after cooling for 180 s in both the beaker of cold water and the beaker of warm water.

Use your temperature readings in Table 2.1.

temperature decrease when cooling in the cold water = °C

temperature decrease when cooling in the warm water = °C [1]

- (e) (i) Use your answers to (d) to decide how the temperature of the water in the beaker affects the **rate** of cooling of hot water in the test-tube.

State your conclusion.

.....

 [2]

- (ii) Suggest **one** improvement to the experimental procedure described in (a) and (c) that allows a more valid comparison to be made between the two rates of cooling.

.....
 [1]

[Total: 10]

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3 In this experiment you will investigate the balancing of a loaded metre rule.

You are provided with:

- a metre rule with a load of mass M fixed to it
- a pivot
- a set of 10g slotted masses.

The position of the load has been fixed, with its centre directly above the 5.0cm mark.

Do **not** attempt to adjust the position of the fixed load during the experiment.

- (a)
- Place the pivot under the 50.0cm mark of the rule.
 - Using the 10g slotted masses, place another load of mass $m = 50\text{g}$ on the rule.
 - Adjust the position of the load of mass $m = 50\text{g}$ until the rule is as close to balanced as possible as shown in Fig. 3.1.

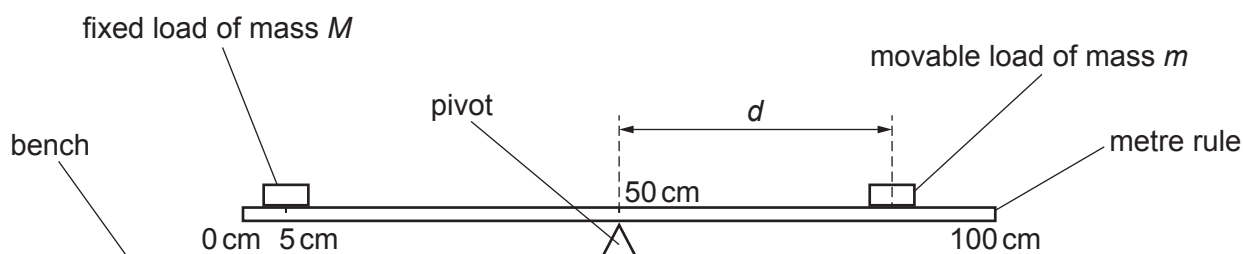


Fig. 3.1

Measure and record, to the nearest 0.1 cm, the distance d from the **centre** of the 50g mass to the 50.0cm mark on the rule when the rule is balanced.

$d =$ cm [1]

- (b) It is difficult to balance the rule exactly.

Describe the technique you use to make sure that your value of d is as accurate as possible.

.....

.....

..... [1]

- (c) (i) Repeat (a) for values of mass m from 60 g to 100 g.

Record all your readings in Table 3.1. Include your readings from (a).

Table 3.1

mass m /g	distance d /cm	$\frac{1000}{d} / \frac{1}{\text{cm}}$

[2]

- (ii) Calculate the value of $\frac{1000}{d}$ for each value of d .

Record your values of $\frac{1000}{d}$ in Table 3.1 to an appropriate number of significant figures for this experiment. [2]

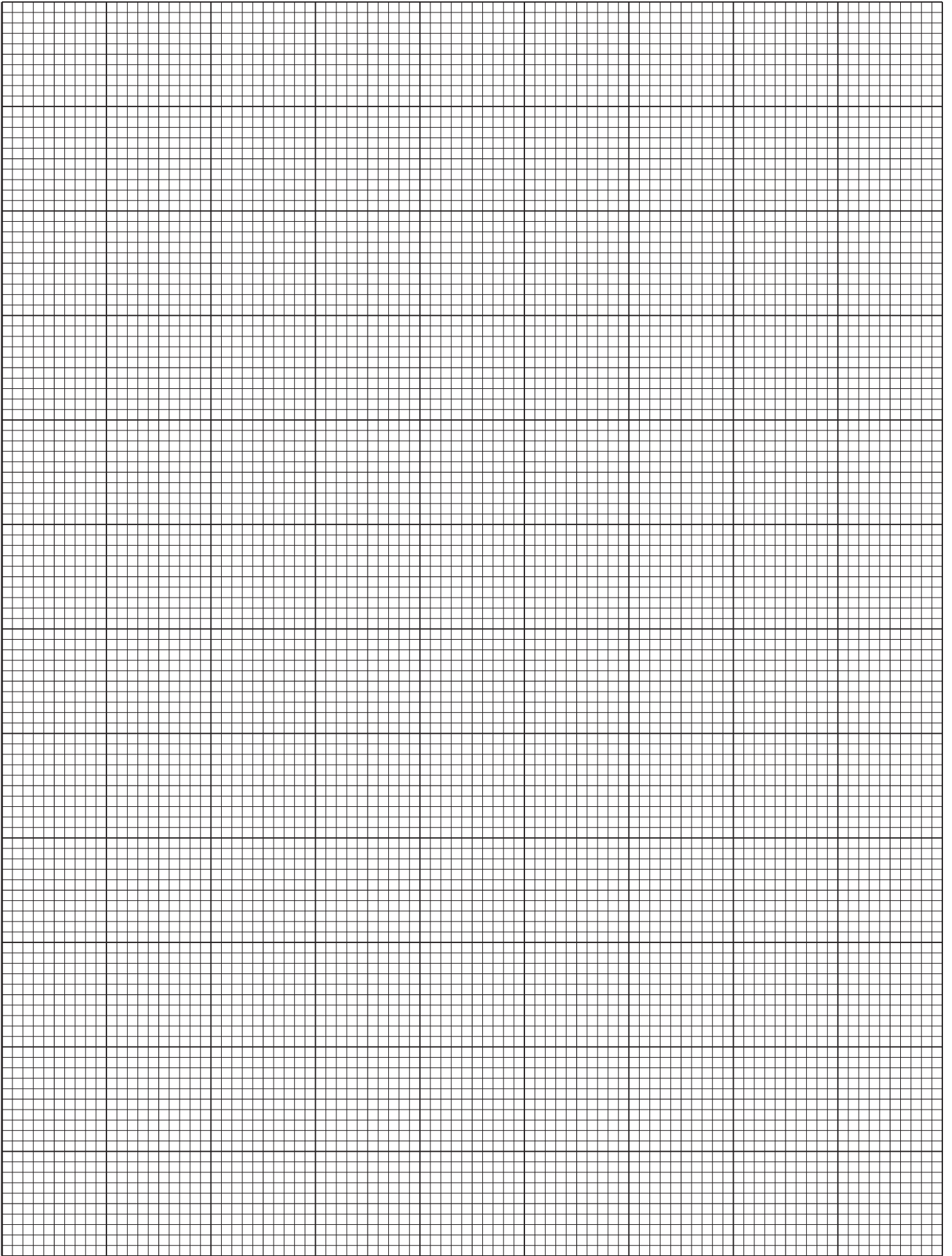
- (d) On the grid provided in Fig. 3.2 on page 11, plot a graph of m on the y -axis against $\frac{1000}{d}$ on the x -axis. The axes do not need to start from the origin (0, 0).

Draw the straight line of best fit.

[4]

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

$G =$ [2]

**Fig 3.2**

- (f) The mass M of the load fixed to the rule can be determined using the equation:

$$M = 22.2 \times G$$

Use your value of G from (e) to calculate the mass M of the load fixed to the rule.

mass $M =$ g [1]

- (g) Suggest why this method of determining the mass M of the load fixed to the rule is unsuitable if a movable load of mass $m = 40$ g is used.

.....

..... [1]

[Total: 14]

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- 4 A student has a converging (convex) lens and needs to determine its focal length.

Plan an experiment that will enable the student to measure an accurate value for the focal length f of the lens.

The focal length f of a lens can be calculated using the equation:

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

where u is the distance between an object and the lens and v is the distance between the focussed image of the object and the lens.

Fig. 4.1 shows some of the apparatus available.

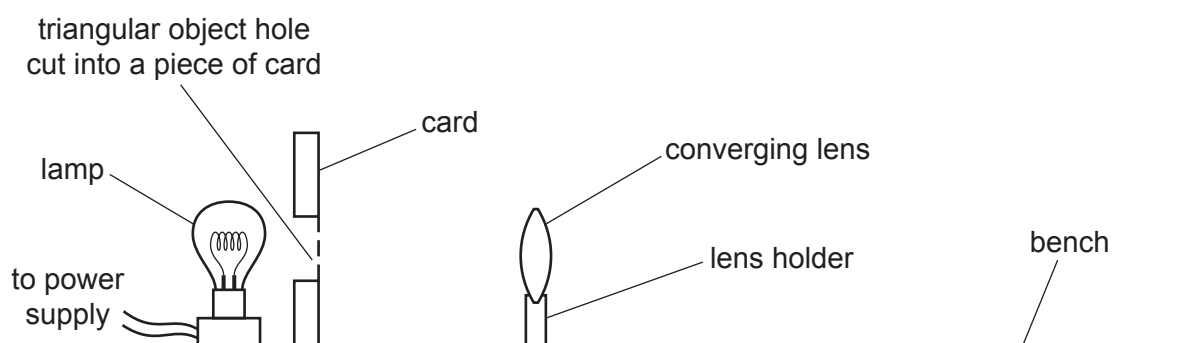


Fig. 4.1

The lamp is connected to a power supply and can be switched on and off as required.

Write a plan for the experiment.

You are not required to do this experiment.

In your plan you should:

- list any additional apparatus needed
- draw a diagram of the arrangement of the apparatus, labelling u and v
- explain briefly how to do the experiment
- state the steps taken to obtain a sharp, focussed image
- explain how to use your readings to determine f .

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