



Time: 2 hours 15 minutes

Instructions to candidates

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Write your name, centre number and candidate number in the spaces provided on the **Answer Booklet**.

Answer all questions.

Write your answers in the spaces provided in the **Answer Booklet**.

For each of the questions in **Section A**, you will be allowed to work with the apparatus for a maximum of 20 minutes. For the question in **Section B**, you will be allowed to work with the apparatus for a maximum of 1 hour.

You should record all your observations as soon as these observations are made.

All of your answers should be written in the Answer Booklet, scrap paper should not be used.

An account of the method of carrying out the experiments is not required.

At the end of the examination, hand in only the Answer Booklet and the card.

Information for candidates

Graph paper is provided.

The sheets of graph paper should be attached securely to the **Answer Booklet**.

Cell phones are not allowed in the examination room.

Section A

Answer **all** questions.

- 1** In this experiment you will measure the resistivity of Nichrome wire. The experiment has been set for you.

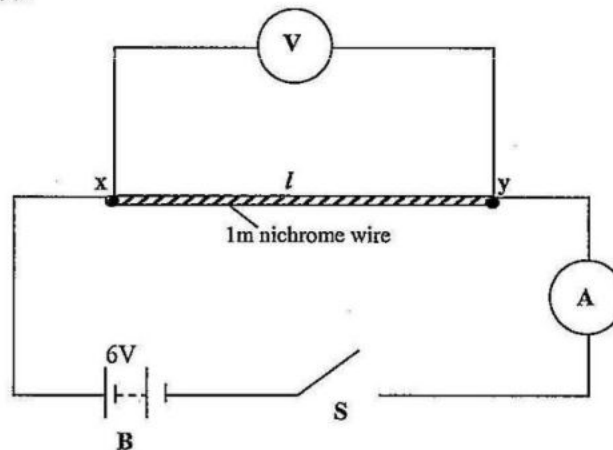


Figure 1.0

- (a) (i) Close the switch S and record the reading on the ammeter **A** and voltmeter **V**.
(ii) Calculate the resistance of the Nichrome wire **R₁**. [1]
- (b) Repeat the procedure in (a) but reduce the voltage to 4.5V. Find **R₂** and record it in the answer booklet.
Find **R** the average of **R₁** and **R₂**. [1]
- (c) (i) Using a micrometer screw gauge, measure the diameter of the Nichrome wire at three different positions as far apart as possible and record them in your answer booklet as **d₁**, **d₂** and **d₃**.
(ii) Find the average diameter (**d**) of **d₁**, **d₂** and **d₃**, write your answer in the answer booklet. [1]
- (d) Measure the length (**l**) of the Nichrome wire and record it in your answer booklet.
- (e) Calculate the resistivity (**P**) of the wire using the formula below
- $$P = \frac{R \times \pi \left(\frac{d}{2}\right)^2}{l}$$
- [1]
- (f) Comment on the values of **R₁** and **R₂**, justify your answer. [1]

Total [5]

2 In this experiment you will determine the specific latent heat of fusion of ice.

- (a) (i) Measure 100cm^3 of water from the supply, using the measuring cylinder. This water has a mass $M_w = 100\text{g}$. Pour the water into the cup. Measure the temperature θ_1 of the water.
- (ii) Take a spoonful of ice, pour off excess water and dry the ice with a paper towel. Place the ice into the cup. Stir the mixture and note the temperature when all the ice has melted. Continue adding spoonfuls of dried ice and stirring until the temperature of the water after the ice has melted is below 15°C . Record the final temperature θ_2 of the water. [1]

- (b) (i) Carefully pour the water from the cup into the empty measuring cylinder and determine the final volume of water.
- (ii) Calculate the volume of water produced from the melted ice. [1]
- (iii) A volume of 2.0cm^3 of water has a mass of 2.0g . Calculate the mass M_i of ice that was added to the water. [1]

- (c) (i) Calculate the thermal energy (heat) Q_1 lost by the water initially at room temperature using the relationship.

$$Q_1 = M_w C_w (\theta_1 - \theta_2)$$

where $C_w = 4.2\text{J/g}^\circ\text{C}$ and $M_w = 100\text{g}$. [1]

- (ii) Using your value from (b) (iii), calculate the thermal energy Q_2 gained by the water formed from the melted ice using the relationship $Q_2 = M_i C_w \theta_2$

- (d) Calculate the specific latent heat of fusion L of ice using the relationship

$$L = \frac{(Q_1 - Q_2)}{M_i} \quad [1]$$

Total [5]

3 In this experiment, you will investigate the images formed by a converging lens.

(a) Set up the apparatus as shown in **Figure 3.1**.

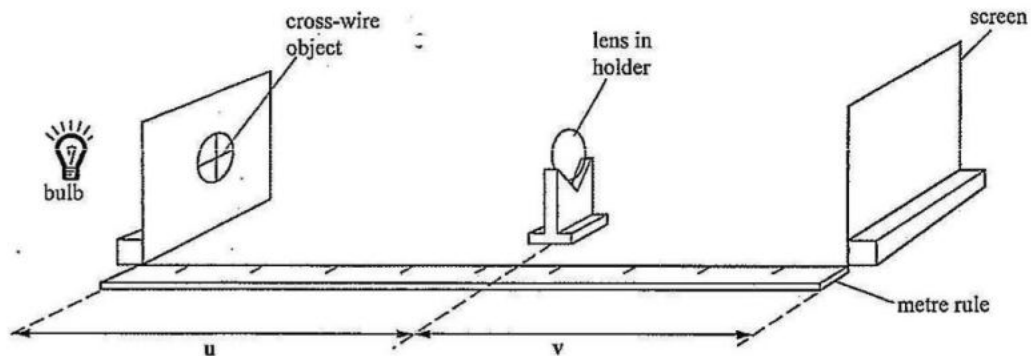


Figure 3.1

The illuminated cross wire object should be at the 0.0cm end of the meter rule and the screen should be at the 100.0cm end.

(i) Adjust the position of the lens to produce an image on the screen that is smaller than the object. Describe the technique that you use to obtain an image that is in sharp focus. [2]

(ii) The distance between the object and the lens is u and the distance between the lens and the screen is v as shown in **Figure 3.1**. Determine accurate values for u and v when the image is in sharp focus on the screen. [1]

(b) Without moving the position of the object and the screen, adjust the position of the lens until an image is formed on the screen that is larger than the object. Determine accurate values for u and v when the image is in sharp focus on the screen. [2]

Total [5]

Section B

- 4 In this experiment, you will determine the mass of half-metre rule. The half-metre rule is suspended from the nail using the hole at the 1.0cm mark. The plumb-line is also suspended from the nail. Pass the free end of the string over the pulley and hung the hook on the 10g mass hanger from the loop in the free end of the string as shown in **figure 4.1**.

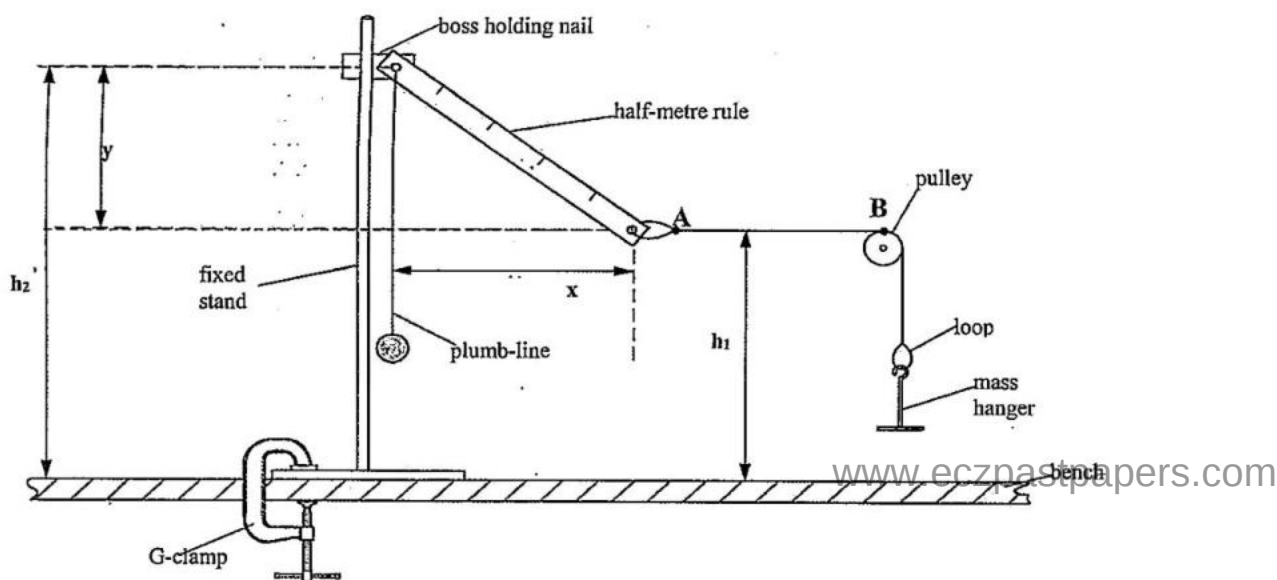


Figure 4.1

Adjust the height of the pulley and the distance of the pulley from the fixed stand until the section of the string labelled **AB** is horizontal.

- (a) Explain how you made sure that the string **AB** was horizontal [1]
- (b) Measure and record:
 - (i) the height h_1 of the string **AB** above the bench.
 - (ii) the height h_2 of the centre of the nail above the bench [1]
 - (iii) the horizontal distance x between the centres of the two holes in the half meter rule as shown in **figure 4.1** (the plumb-line will help you to do this) [1]
- (c) Calculate
 - (i) a value for the vertical distance y between the centres of the two holes as shown in **figure 4.1**.
 - (ii) a value $\tan \theta$ where θ is the angle between the rule and vertical using relationship $\tan \theta = \frac{x}{y}$ [1]

- (d) Repeat (b) and (c) for a range of values of the total mass M suspended from the string. In each case ensure that the section **AB** of the string is horizontal. Record your results in the table in *figure 4.2* in the answer booklet with readings M , h_1 , h_2 , x , y and $\tan \theta$. Also include your results for $M = 10\text{g}$ from (b) and (c). [3]
- (e) Plot a graph of $\tan \theta$ on the y -axis against m/g on the x -axis. [4]
- (f) Determine
- (i) the gradient of the line of best fit. [1]
- (ii) the mass M of the half-meter rule using the relationship
- $$M = \frac{2}{\text{gradient}} \quad [2]$$

Total [15]

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