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Rewarding Learning

ADVANCED SUBSIDIARY
General Certificate of Education
2018

Physics

Assessment Unit AS 3A
assessing
Practical Techniques
and Data Analysis

MV18

[SPH31]
THURSDAY 3 MAY, MORNING

Time

1 hour, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all** the questions in this booklet. Rough work and calculations must also be done in this booklet. Except where instructed, do **not** describe the apparatus or experimental procedures. The Teacher/Supervisor will tell you the order in which you are to answer the questions. One hour is to be spent on four short experimental tests.

After 12 minutes you must stop using the apparatus so that it can be rearranged for the next candidate. At 14 minutes you will be instructed to move to the station for the next question.

At the end of the test a 4 minute period will be provided for you to complete your answer to any question, but you will not have access to the apparatus during this time.

Information for Candidates

The total mark for this paper is 40.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

You may use an electronic calculator.

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(Questions start overleaf)

1   In this experiment you will determine the density of a liquid.

On the bench has been placed a container which contains a liquid as shown in **Fig. 1.1**. Also on the bench there is a vernier calliper, a half metre rule, an empty beaker and an electronic balance.
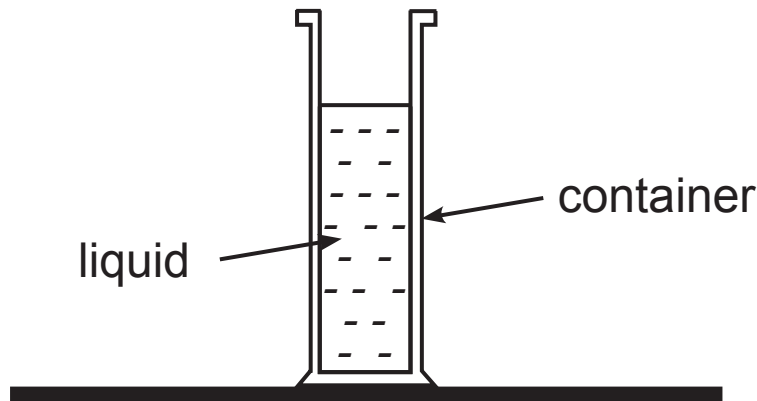
Fig. 1.1

(a) (i)   By choosing the most appropriate measuring instrument, measure the internal diameter of the container. Give your answer to an appropriate number of significant figures.   [2 marks]

Diameter of container: _____ cm

(ii)   Hence calculate the internal cross-sectional area of the container.   [1 mark]

Area = _____ cm²

(b) (i) Using the half metre rule, measure the height h of the liquid in the container. [1 mark]

h = _____ cm

(ii) Outline any difficulties encountered in obtaining an accurate value of h. [2 marks]

_____

_____

_____

_____

(c) Using the electronic balance provided, find the mass of the liquid. [1 mark]

Mass of liquid = _____ g

(d) Calculate the density of the liquid. [3 marks]

Density = _____ $g\,cm^{-3}$

2 In this experiment you will investigate the effect of temperature on the resistance of a thermistor.

A thermistor and a thermometer are clamped and submerged in a beaker of water. A circuit is set up to measure the current I through the thermistor and the potential difference V across the thermistor.

(a) Draw a circuit diagram of the set-up to measure I and V using the correct symbols for all the components.
[3 marks]

(b) (i) Read the temperature T of the water from the thermometer. Close the switch and read the I and V values. Record your results in **Table 2.1** opposite.

Use the spoon provided to add three spoons of crushed ice into the beaker. Do not adjust any of the apparatus as you add the ice.

Allow the temperature to drop by at least 10 °C and obtain a second set of results. Record these in **Table 2.1** opposite.   [3 marks]

Table 2.1

T/°C	I/mA	V/V	R/Ω

(ii) Calculate the resistance of the thermistor at both temperatures and complete the final column of **Table 2.1**.   [3 marks]

(c) From your results explain why the thermistor is said to be a negative temperature coefficient thermistor.
[1 mark]

_____

_____

_____

3 In this experiment you will verify that the magnification is equal to the ratio of the image distance v to the object distance u.

In addition to the converging lens of focal length 200 mm you are provided with an illuminated object, a screen, a metre rule and a 30 cm rule. The illuminated object consists of two crossed lines with a flat circular ring of internal diameter d_o as shown in **Fig. 3.1**. d_o has been measured as 10 mm.
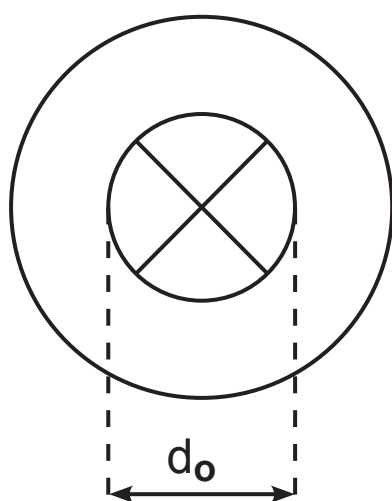
Fig. 3.1

(a) What range of object distances will produce a **real**, **enlarged** image?   [2 marks]

_____

_____

_____

(b) Draw a labelled diagram of the experimental arrangement you will use to verify that the magnification is equal to the ratio of v to u.   [2 marks]

(c) Set up the experimental arrangement and obtain an enlarged image of the object on the screen. Measure the internal diameter d_i of the image and record it in **Table 3.1** along with the values of object distance u and image distance v.   [3 marks]

Table 3.1

u/mm	v/mm	d_o/mm	d_i/mm
		10	

(d) Explain the uncertainty that arises in finding the position of the image.   [1 mark]

_____

_____

_____

_____

(e) Use the results recorded in **Table 3.1** to calculate values that may be used to verify that the magnification is equal to the ratio of v to u.   [2 marks]
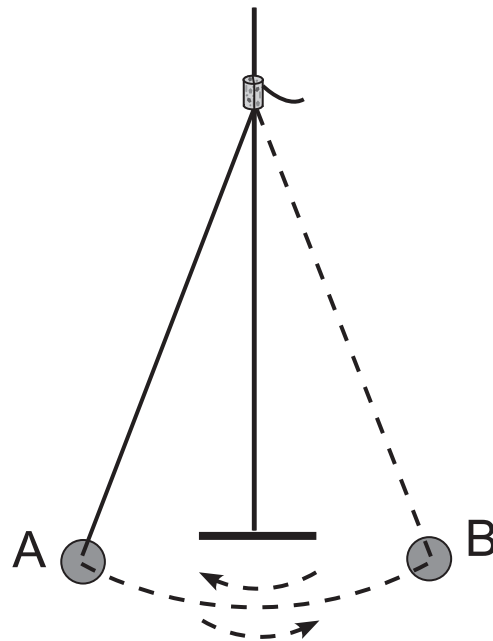
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(Questions continue overleaf)

4 In this experiment you will investigate the relationship between the period of oscillation T of a pendulum and its length l.

Fig. 4.1 shows the arrangement of the apparatus which has been set up for you.
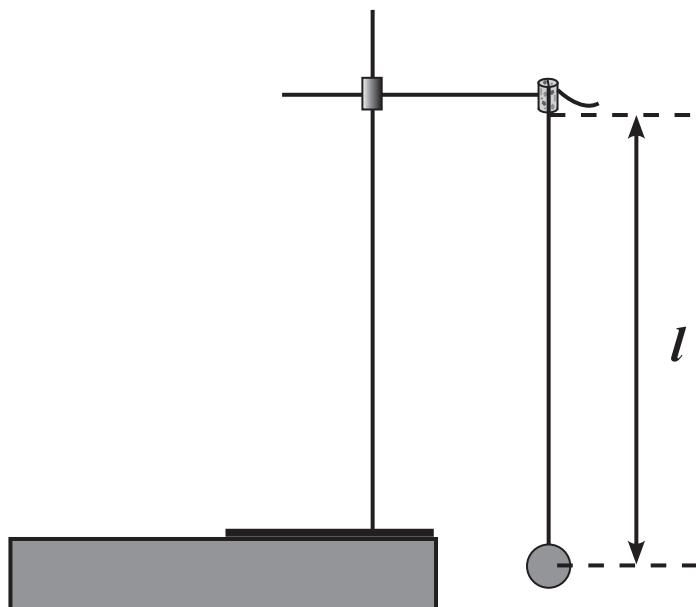
Fig. 4.1 (side view)   **Fig. 4.2 (front view)**

The pendulum bob is suspended by a string inserted in a split cork. The length of the string can be adjusted by pulling it through the cork.

The length of the string is measured between the point of suspension and the centre of the bob.

The pendulum is set into oscillation by displacing the pendulum bob a small distance to one side, as shown in **Fig. 4.2**.

The period of oscillation is the time taken for the pendulum to swing from A to B and back to A again as shown in **Fig. 4.2**.

(a) l has been set at 50.0 cm. Use the stopclock to find a reliable value for T at this length. Shorten the string to a second value of l and repeat. Record all your results in **Table 4.1**.   [5 marks]

Table 4.1

l/cm		T/s	T^2/s^2
50.0			

(b) The relationship between l and T is given by **Equation 4.1**. k and n are constants.

$$T^2 = kl^n \qquad \textbf{Equation 4.1}$$

(i) Calculate values for T^2 and insert them into the final column of **Table 4.1**.   [1 mark]

(ii) Use your results in **Table 4.1** to choose the best value for n in **Equation 4.1**. Indicate your choice by placing a tick (✓) in the appropriate box.   [2 marks]

n = 1   ☐

n = $\frac{1}{2}$ ☐

n = −2   ☐

Explain your answer.

_____

_____

_____

_____

(iii) Use **all** of your results to find a value for k.
[2 marks]

k = _____

_____

THIS IS THE END OF THE QUESTION PAPER
_____

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