4.4 PHYSICS (232)

4.4.1 Physics Paper 1 (232/1)

SECTION A (25 marks)

*Answer **all** the questions in this section in the spaces provided.*

1. (a) State what is meant by "*Area*". (1 mark)

(b) State the SI unit of area. (1 mark)

2. Explain why water in a glass tube forms a concave meniscus. (2 marks)

3. **Figure 1** shows how water is drawn from a large tank into a low lying container using a rubber tube.

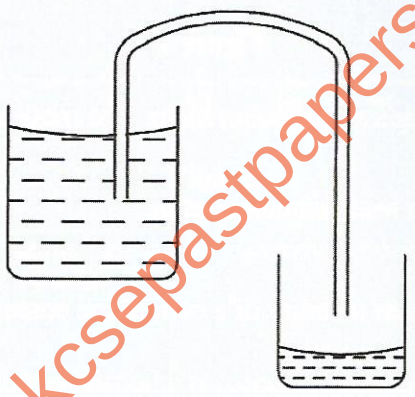


Figure 1

Explain how the process takes place. (2 marks)

4. State how a piece of paper can be used to demonstrate that matter is made of tiny particles. (1 mark)

5. **Figure 2** shows Six's maximum and minimum thermometer.

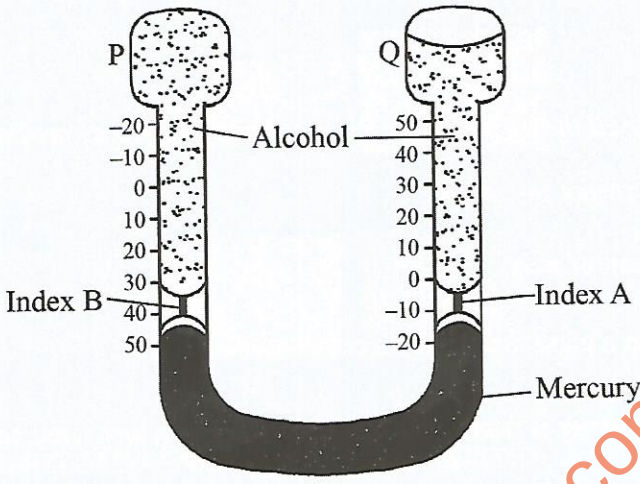


Figure 2

Explain how increase in temperature causes index A to move upwards. (2 marks)

6. State the difference between heat and temperature. (2 marks)

7. State **two** factors that affect the stability of a cylindrical container. (2 marks)

8. **Figure 3** shows a set up in which a spring with a pointer is attached to a wooden strip that has a hanging hook. A graph paper is fixed along the strip to be used to calibrate the spring.

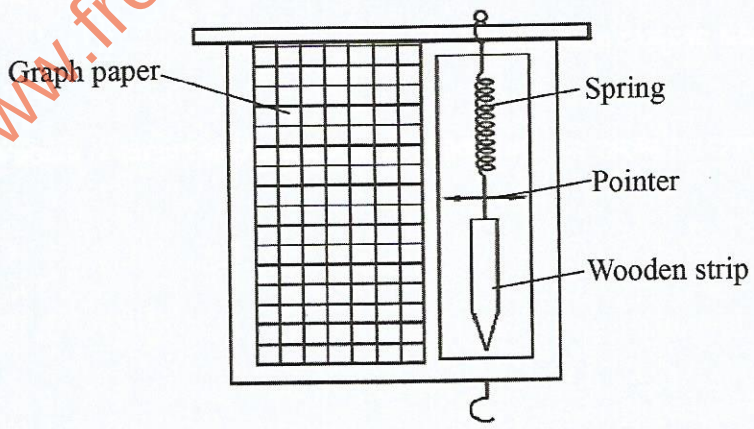


Figure 3

A mass of 100 g is provided. Explain how the spring balance can be calibrated. (3 marks)

9. Water enters a pipe at a velocity V_1 at a point where the cross-sectional area is A_1. It leaves the pipe at a velocity V_2 at a point where the cross-sectional area is A_2. Show that $A_1V_1 = A_2V_2$. (3 marks)

10. Sketch the displacement – time graph for a body moving with decreasing velocity. (1 mark)

11. **Figure 4** shows a graph of force against time when a tennis ball is hit.

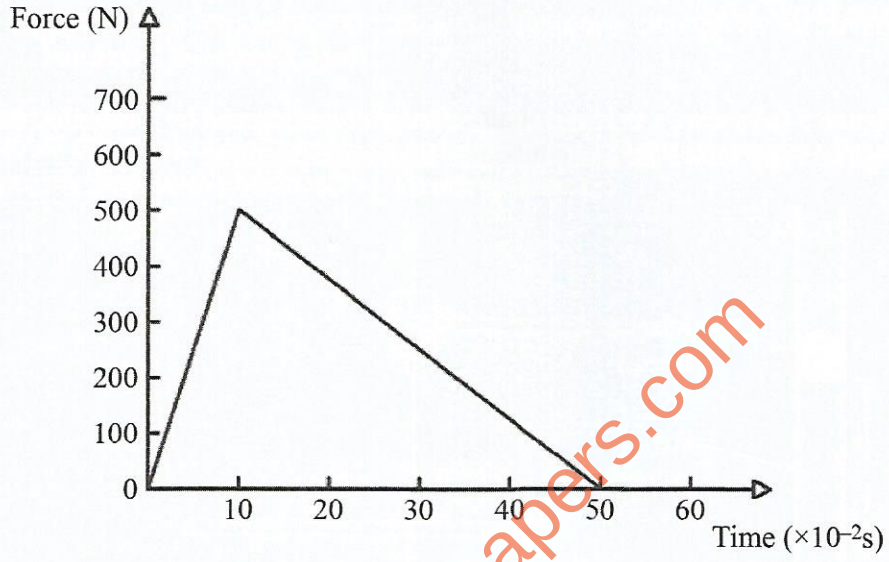


Figure 4

Determine the mass of the tennis ball whose velocity is 60 ms^{-1}. (Assume the ball is stationary before it is hit). (3 marks)

12. State the energy transformations that take place as a pendulum bob swings. (1 mark)

13. When determining the specific latent heat of fusion of ice by electrical method, other than mass, voltage and current, state **one** other measurement that should be taken. (1 mark)

SECTION B (55 marks)

*Answer **all** the questions in this section in the spaces provided.*

14. (a) State Boyle's law. (1 mark)

(b) **Figure 5 (a)** shows a column of air of length 6 cm trapped by a mercury thread in a tube. **Figure 5 (b)** shows the same tube in a horizontal position.

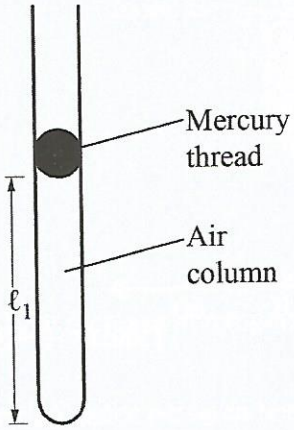


Figure 5 (a)

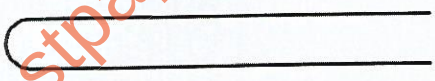


Figure 5 (b)

(i) Draw the mercury thread in **Figure 5 (b)**. (2 marks)

(ii) Explain why the thread appears as in 14(b)(i). (2 marks)

(c) (i) State what is meant by "*absolute zero temperature*". (1 mark)

(ii) A balloon contains hydrogen gas at a temperature of 2 °C and a pressure of 6 mmHg. Determine the pressure in the balloon when the temperature is raised to 80 °C. (3 marks)

15. (a) State **two** ways in which the centripetal force acting on a body of mass M can be reduced. (2 marks)

(b) A stone of mass 0.5 kg tied to a string is whirled in a vertical plane along a circular path of radius 2 m and that its frequency is 2 cycles per second.

($\pi = 3.142$)

(i) Determine the:

I. velocity of the stone (3 marks)

II. tension in the string when the stone is at the top most part of the circular path (3 marks)

(ii) State with a reason how the tension in the string changes as the stone gets to the bottom of the circular path. (2 marks)

16. (a) **Figure 6** shows a cube of mass 2 kg and sides 5 cm fully immersed in a liquid of density 0.8 gcm^{-3}. The cube is balanced by a stone of mass M.

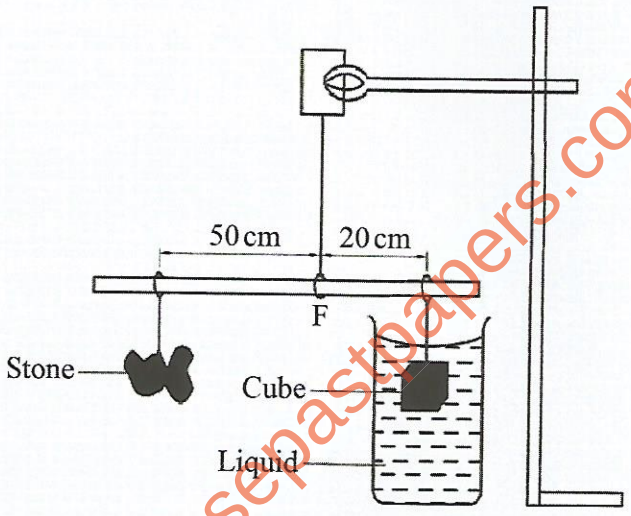


Figure 6

Given that the gravitational field strength, g, is 10 Nm^{-2}, determine the:

(i) upthrust acting on the cube (3 marks)

(ii) apparent weight of the cube (3 marks)

(iii) weight of the stone (3 marks)

(b) A block of mass 500 g floats in water. Determine the volume of the block under the water. (*density of water is 1 gcm^{-3}*). (3 marks)

17. (a) State **two** factors that affect the boiling point of a substance. (2 marks)

(b) A well lagged calorimeter contains a liquid of mass 200 g at a temperature of 10 °C. An electric heater rated 80 W is used to heat the liquid. **Figure 7** shows a graph of temperature against time for the liquid.

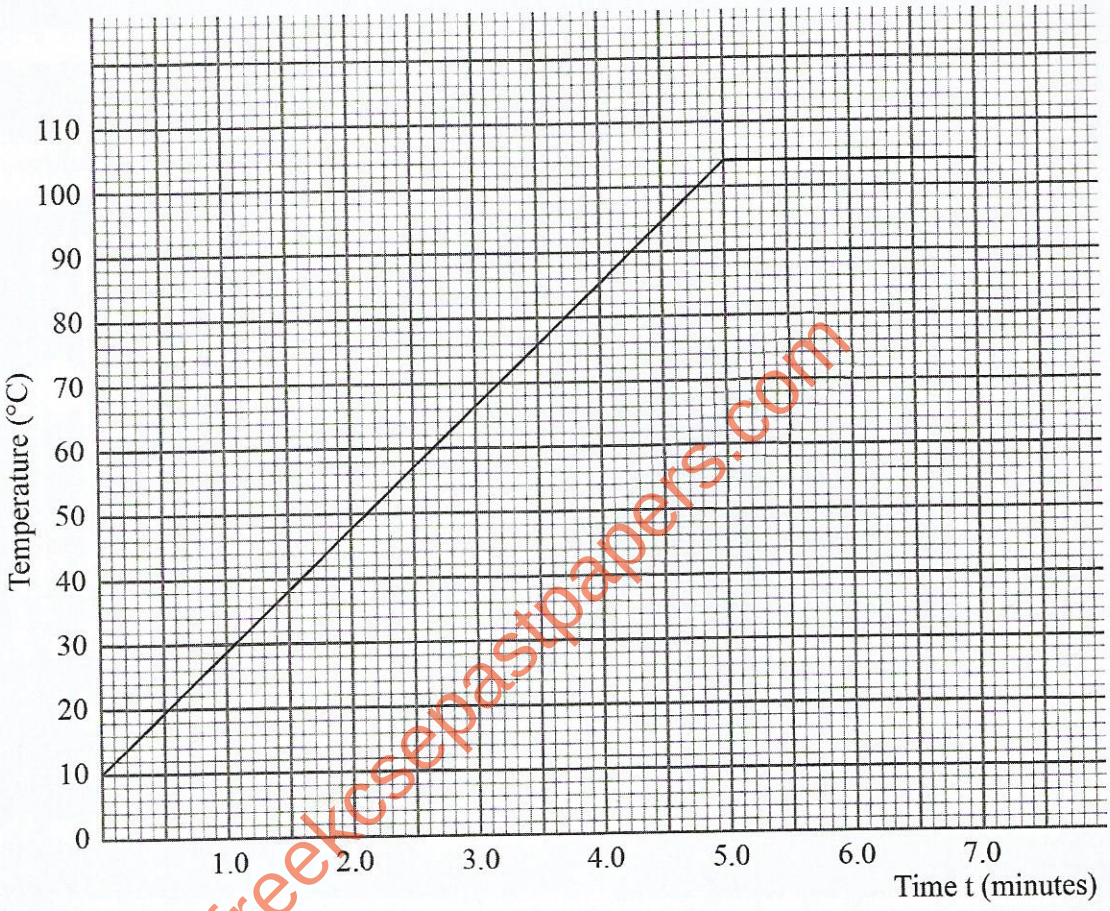


Figure 7

From the graph, determine the:

(i) boiling point of the liquid (1 mark)

(ii) quantity of heat given out by the heater between time t = 1 minute and time t = 4.5 minutes (3 marks)

(c) Based on (b)(ii), determine the:

(i) temperature change between the time t = 1 minute and time t = 4.5 minutes (1 mark)

(ii) specific heat capacity of the liquid (3 marks)

(d) 2 g of vapour was collected from the liquid between times t = 5.4 minutes and t = 6.3 minutes. Determine the specific latent heat of vaporisation of the liquid. (3 marks)

18. (a) A weighing balance placed on the floor of a lift is used to measure the weight of a body of mass 80 kg. Determine the reading on the balance when the lift moves upwards: (*acceleration due to gravity g is* $10 ms^{-2}$)

(i) with uniform velocity (3 marks)

(ii) with an acceleration of $3 ms^{-2}$ (3 marks)

(b) Explain why a person standing on a boat is likely to fall into the water when attempting to jump to the shore. (3 marks)

(c) A box is moved 30 m along a surface whose frictional force is 1000 N with uniform velocity. Determine the work done against friction. (2 marks)

4.4.2 Physics Paper 2 (232/2)

SECTION A (25 marks)

*Answer **all** the questions in this section in the spaces provided.*

1. **Figure 1** shows three cardboards A, B and C with holes placed between a source of light and an observer.

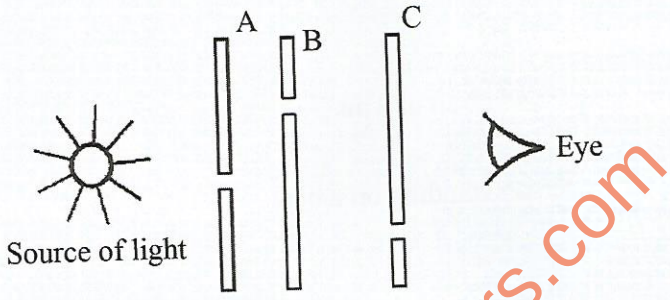


Figure 1

Explain what is observed. (2 marks)

2. State how a polythene rod acquires a negative charge when it is rubbed by a piece of cloth. (1 mark)

3. State **one** device that can be used to detect microwaves. (1 mark)

4. **Figure 2** shows an incomplete circuit.

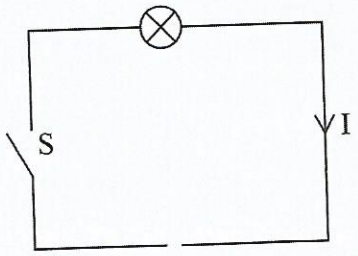


Figure 2

Complete the circuit by inserting a cell so that the current I flows in the direction shown when the switch S is closed. (1 mark)

5. State the basic law of magnetism. (1 mark)

6. **Figure 3** shows a vertical object O placed in front of a concave mirror whose principal focus is at F.

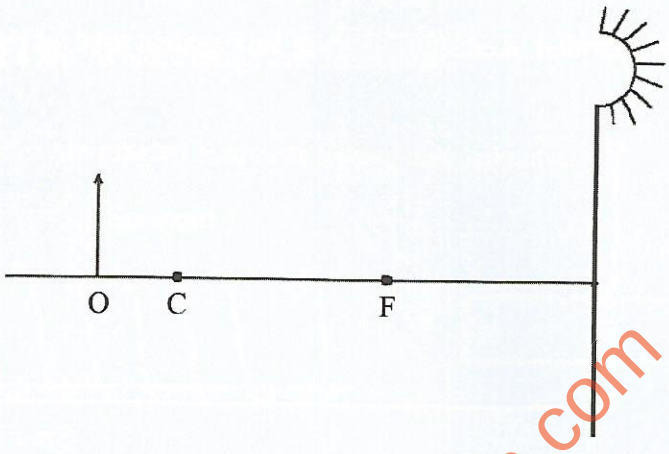


Figure 3

Draw a ray diagram to show how the image is formed. (3 marks)

7. State **two** properties of soft iron that makes it suitable for use as the core of the electromagnet of an electric bell. (2 marks)

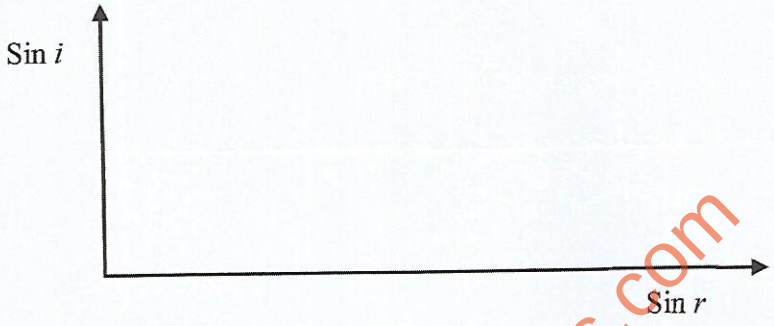
8. (a) State **one** reason why sound travels faster at sea level than on high mountains. (1 mark)

(b) State **one** condition necessary for two progressive waves to form a standing wave. (1 mark)

9. Two students stand 300 m from a wall. One bangs two pieces of wood together and at the same time, the other starts a stop watch. They hear an echo after 1.8 seconds. Determine the speed of sound in air. (3 marks)

10. During an experiment to investigate the relationship between the angle of incidence i, and angle of refraction r for a ray of light travelling from air to glass, the values of sin i and sin r were determined.

(a) On the axes provided, sketch the graph of sin i against sin r for the values that were obtained. (1 mark)



(b) State how the refractive index of the glass can be obtained from the graph. (1 mark)

11. **Figure 4** shows a circuit consisting of two resistors of 4 Ω and 8 Ω, a cell and voltmeters V_1 and V_2.

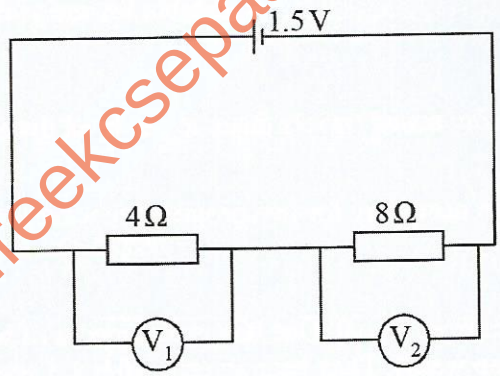


Figure 4

It is observed that voltmeter V_2 shows a higher reading than V_1. Explain this observation. (2 marks)

12. A heating element is rated 3 kW, 240 V. Determine the resistance of the element. (3 marks)

13. State **two** characteristics of images formed by diverging lenses. (2 marks)

SECTION B (55 marks)

*Answer **all** the questions in this section in the spaces provided.*

14. (a) State Lenz's law of electromagnetic induction. (1 mark)

(b) **Figure 5** shows a magnet held near a stationery solenoid.

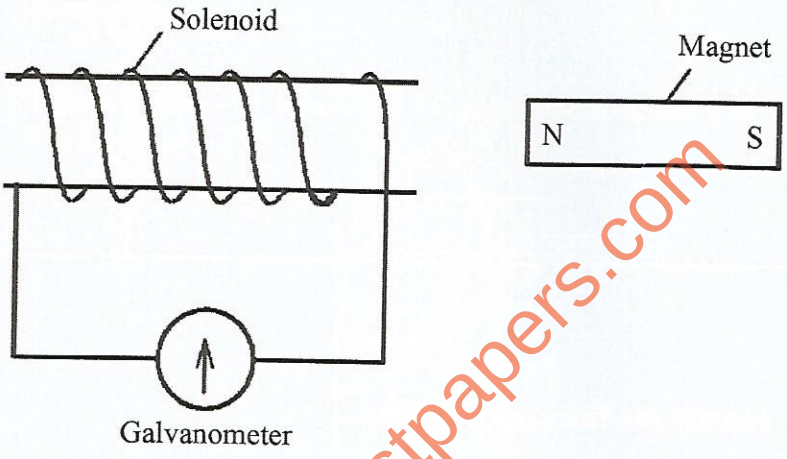


Figure 5

State what will be observed on the galvanometer when the:

(i) north pole end is pushed into the solenoid (1 mark)

(ii) magnet is held stationary inside the solenoid (1 mark)

(iii) north pole end is pulled out of the solenoid (1 mark)

(c) Explain what would be observed if the North pole of the magnet is now moved into the solenoid at a higher speed. (3 marks)

(d) State **two** causes of energy losses in a transformer. (2 marks)

15. (a) State the function of the ring main circuit in a domestic wiring system. (1 mark)

(b) **Figure 6** shows a circuit consisting of switches S_1, S_2, S_3 and three identical lamps L_1, L_2 and L_3 connected to the mains supply through a fuse.

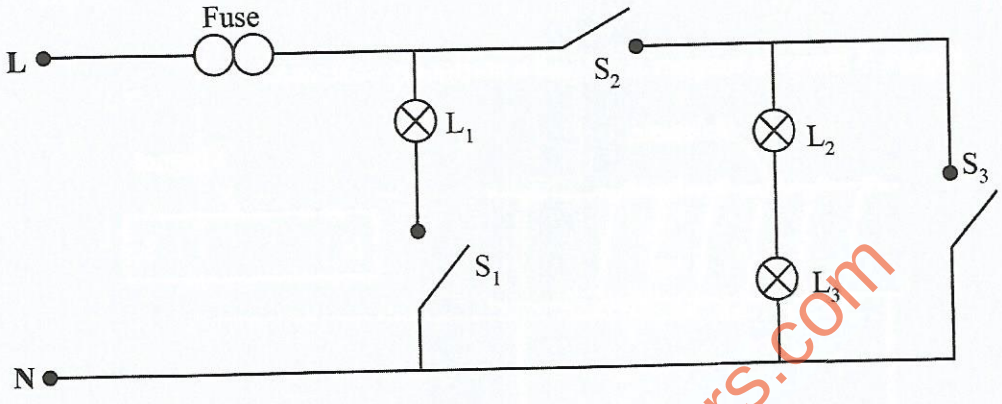


Figure 6

(i) Identify **two** faults in the circuit. (2 marks)

(ii) State the reasons for the answers in 15(b)(i). (2 marks)

(iii) Describe how the brightness of lamps L_1, L_2 and L_3 compare when the switches S_1 and S_2 are closed. (2 marks)

(iv) Explain the answer in 15(b)(iii). (2 marks)

16. (a) **Figure 7** shows a circuit consisting of a cell in series with a galvanometer and two metal plates A and B.

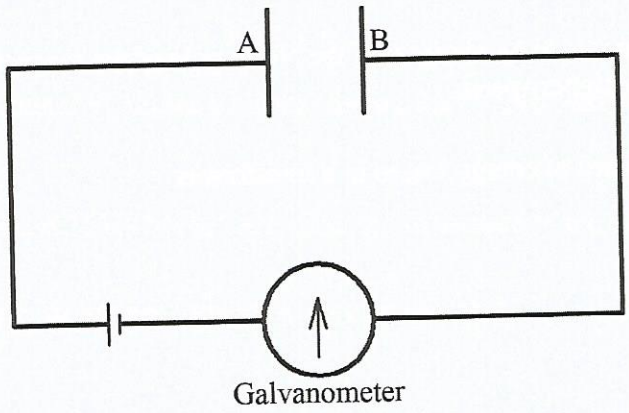


Figure 7

(i) It is observed that when a beam of UV radiation falls on plate B, the galvanometer deflects. Explain this observation. (3 marks)

(ii) Explain what would be observed on the galvanometer when a more intense beam of UV radiation is used. (2 marks)

(b) (i) State with a reason how the intensity of an X-ray beam can be increased in an X-ray tube. (2 marks)

(ii) **Figure 8** shows the trace of an AC signal on the screen of a Cathode Ray Oscilloscope (CRO).

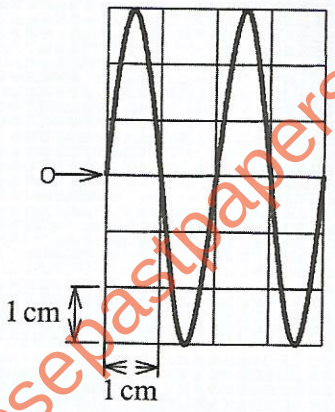


Figure 8

Given that the time base setting is 8.5 milliseconds per cm. Determine the:

I. wavelength of the AC signal (1 mark)

II. frequency of the AC signal (3 marks)

(iii) State the functions of the following parts of a Cathode Ray Oscilloscope:

I. The grid (1 mark)

II. The filament (1 mark)

17. (a) State **one** hazard of radioactivity. (1 mark)

(b) **Figure 9** shows a decay curve of a radioactive element.

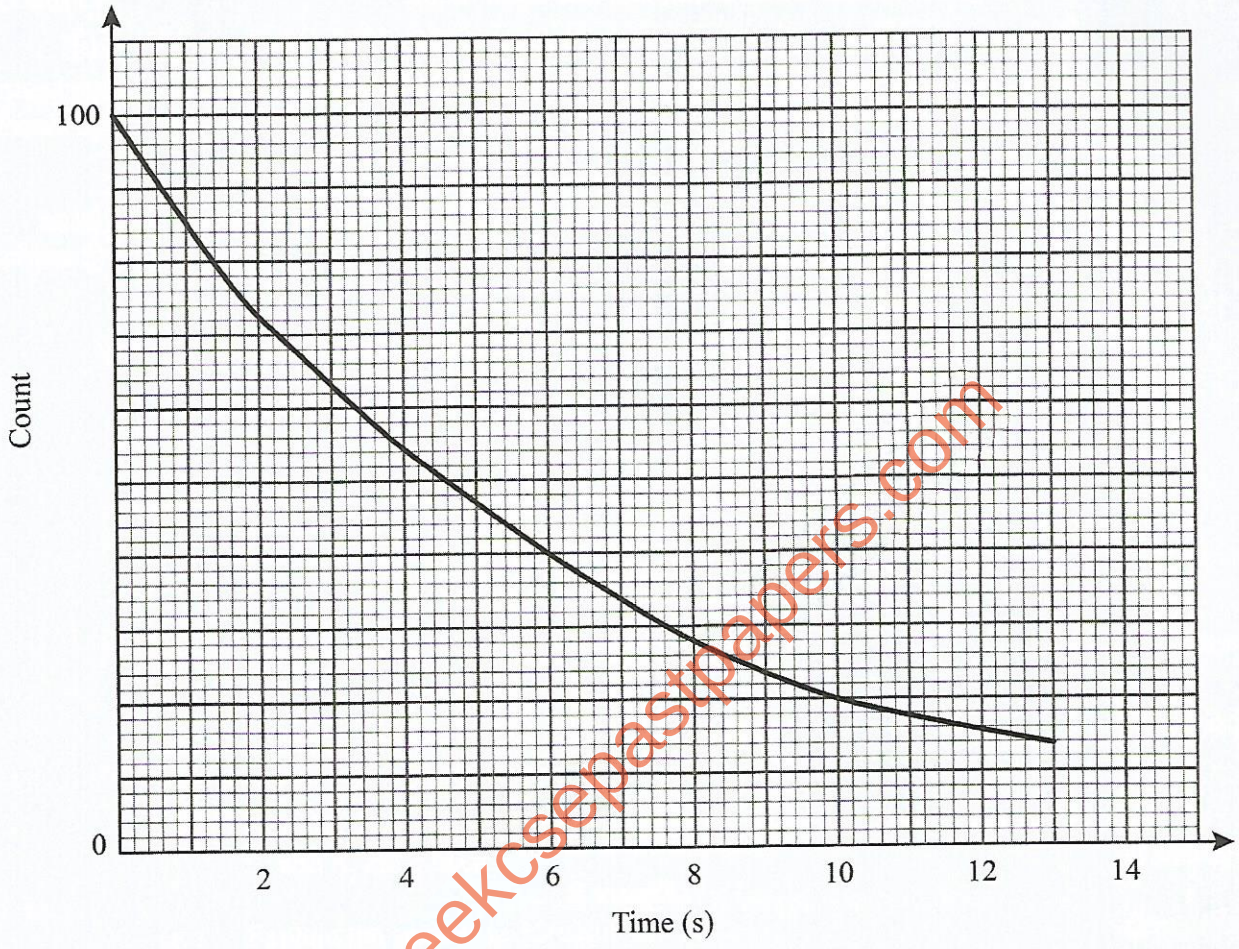


Figure 9

From the graph determine:

(i) the half life of the element (1 mark)

(ii) the number of half lives it will have undergone when the count is 12.5 (2 marks)

(c) (i) State the effect of doping on a semiconductor. (1 mark)

(ii) Explain how doping produces an n-type semiconductor from a pure semiconductor. (3 marks)

(iii) **Figure 10** shows a circuit consisting of two galvanometers G_1 and G_2, two switches S_1 and S_2, a cell and two diodes D_1 and D_2.

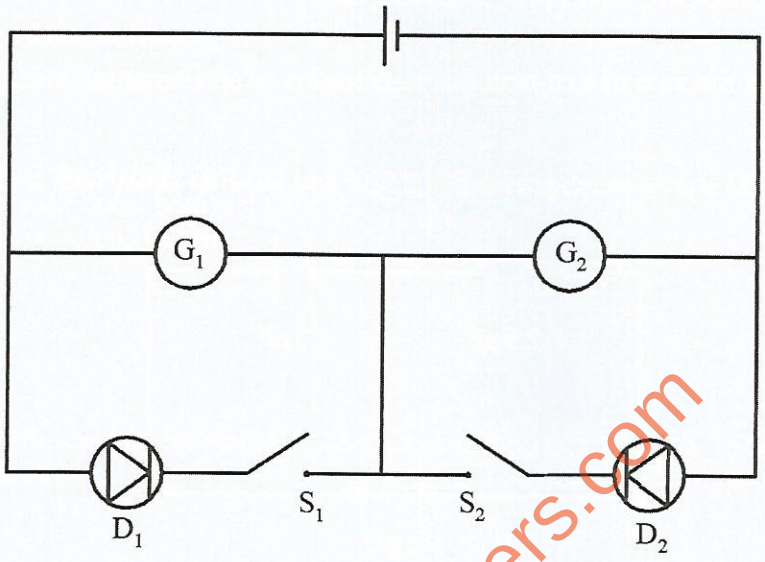


Figure 10

Explain what is observed when S_1 and S_2 are closed. (4 marks)

18. (a) Explain the effect on resistance of a diode when the forward bias voltage is increased. (2 marks)

(b) **Figure 11** shows a circuit consisting of a 12 V battery, 1.5 kΩ resistor, a Light Dependent Resistor (LDR) and a lamp of negligible resistance. The circuit can be used as a light detector.

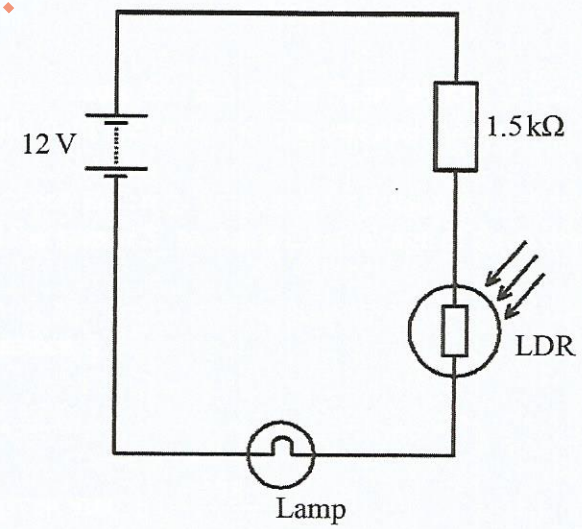


Figure 11

(i) Explain what would be observed if the lighting conditions are changed from total darkness to bright light. (3 marks)

(ii) If the resistance of the LDR in bright light is $1 \times 10^3\ \Omega$, determine the potential difference across the 1.5 kΩ resistor. (3 marks)

(c) State the function of a capacitor in rectification of an alternating voltage. (1 mark)

(d) **Figure 12** shows two capacitors of 2.5 μF and 10 μF in series with a 12 V battery.

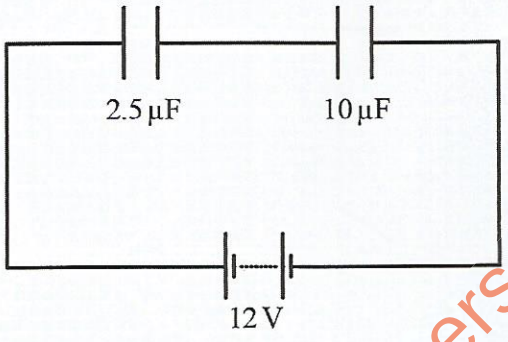


Figure 12

Determine the total charge stored by the capacitors. (3 marks)

4.4.3 Physics Paper 3 (232/3)

QUESTION 1

You are provided with the following:

- A metre rule
- A candle
- A plain white screen labelled S_2
- A white screen with cross-wires labelled S_1
- A lens mounted on a lens holder

Proceed as follows:

PART A

(a) (i) Arrange the candle, the screen S_1, the lens and the plain screen S_2 in that order as shown in **Figure 1**.

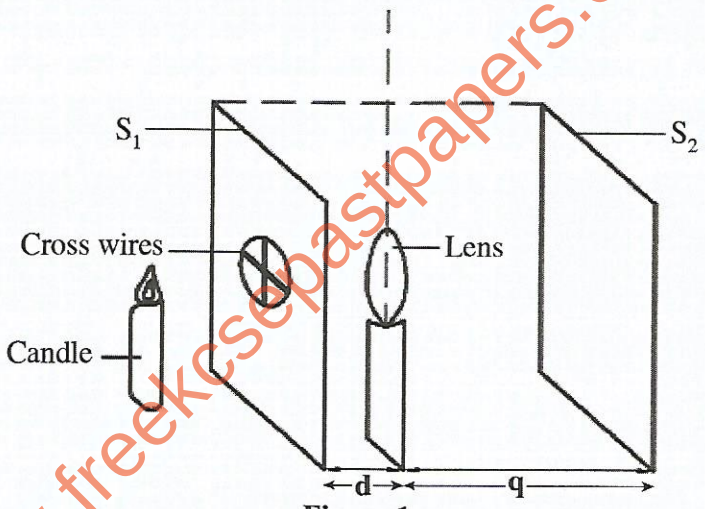


Figure 1

(ii) Light the candle. Ensure that the candle flame is close to the cross-wire and it is in a horizontal line with the centres of the lens and the screens.

(b) Set the distance **d** between the cross-wires and the lens at **d** = 16 cm. Adjust the distance **q** between the lens and the screen S_2 so that a sharp image of the cross-wires is formed on Screen S_2.

(i) Record the distance **q**.

q = ... cm (1 mark)

(ii) Determine h given that: $h = \dfrac{16q}{q+16}$ (2 marks)

(c) Place screen S_2 aside and adjust the position of the lens until a sharp image of the flame is formed on the screen beside the cross-wires.

(i) Measure the distance x between the screen S_1 and the lens.

$x =$ ..... cm (1 mark)

(ii) Determine r given that: $r = \dfrac{xh}{x-h}$ (2 marks)

(ii) Determine m given that: $\dfrac{r}{h} = 2(m-1)$ (1 mark)

(d) Place the plain screen S_2 back to its original position as in **Figure 1**. Set the distance **d** between the cross-wires and the lens at **d** = 14 cm.

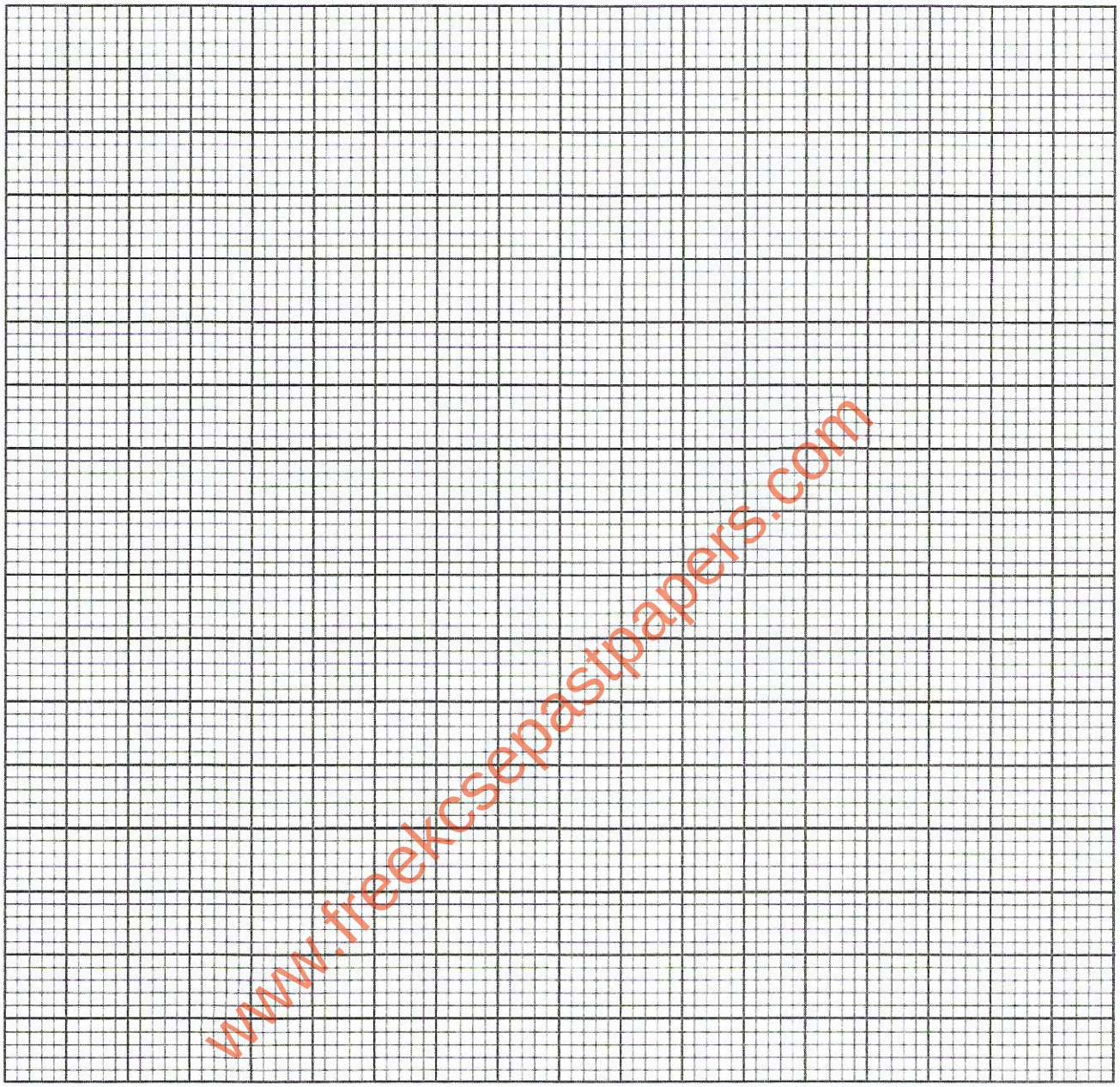
(i) Adjust the position of the plain screen S_2 to obtain a sharp image of the cross-wire. Measure the distance **q** between the image and the lens. Record the distance **q** in **Table 1**

(ii) Repeat part (d)(i) for other values of **d** shown in **table 1** and complete the **table**. (5 marks)

Table 1

d (cm)	14	15	18	21	24	30	35
q (cm)							
S = **d** + **q** (cm)							

(e) Plot a graph of S (y-axis) against **q**. (5 marks)



(f) From the graph, determine the:

(i) minimum distance S_0 between the object and its real image (1 mark)

(ii) focal length f given that: $f = \frac{S_0}{4}$ (1 mark)

(iii) image distance v when S is minimum (1 mark)

QUESTION 2

You are provided with the following:

- A piece of thread
- A metre rule
- A triangular glass prism
- A 50 g mass
- A boss, a clamp and a stand
- Some water in a beaker
- Some tissue paper
- Liquid **L**
- An ammeter
- A voltmeter
- A wire labelled **P**
- A wire labelled **Q**
- A switch
- Two dry cells
- 9 connecting wires
- A wire mounted on a metre rule labelled **AB**
- A centre zero galvanometer
- A jockey

Proceed as follows:

PART A

(a) Using a piece of thread, a clamp and a stand, suspend the metre rule so that it balances horizontally about its centre of gravity.

(b) On the metre rule, suspend the glass prism at the 70 cm mark and the 50 g mass at a distance X cm from the Centre of Gravity (CoG) so that the metre rule balances horizontally as shown in **Figure 2.**

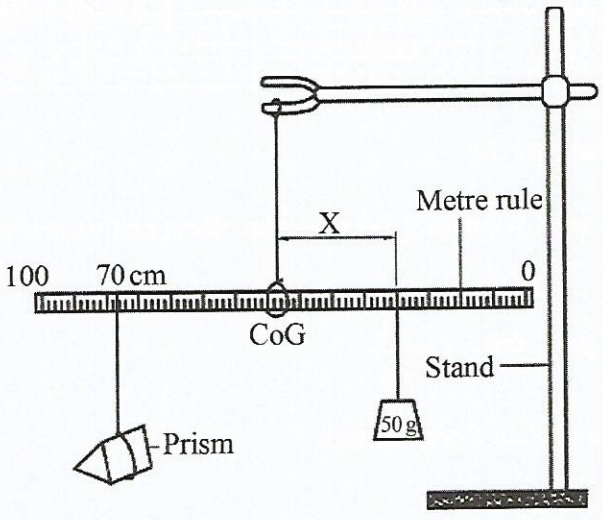


Figure 2

Maintain the prism at the 70 cm mark throughout the experiment.

(i) Record the balance length X.

X = ... cm (1 mark)

(ii) Using the principle of moments, determine the mass M_o of the prism. (3 marks)

(c) While maintaining the position of the prism on the metre rule, lower the clamp to adjust the height of the prism until it is fully submerged in water as shown in **Figure 3.**

Ensure that the prism does not touch the sides of the beaker.

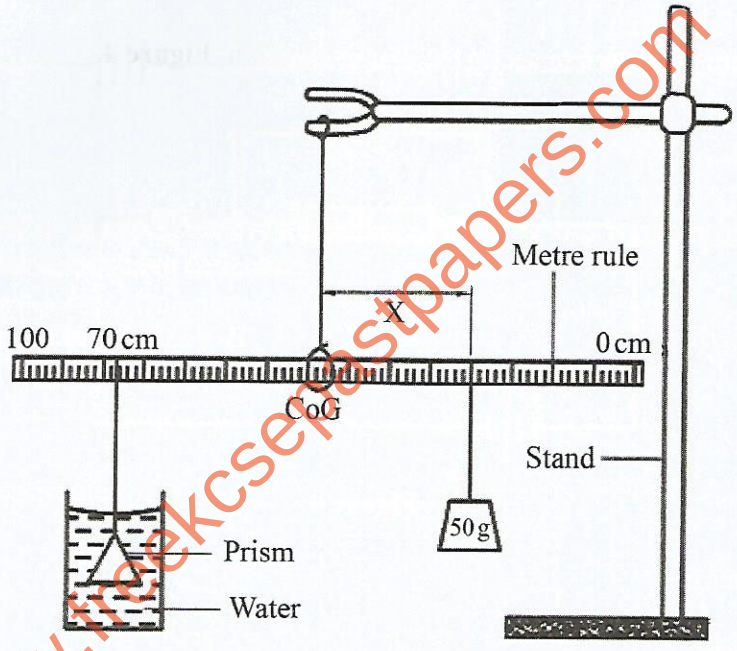


Figure 3

(d) Adjust the distance X to restore the balance of the metre rule.

(i) Record the new balance length X_1.

X_1 = ... cm (1 mark)

(ii) Using the principle of moments, determine the apparent loss in mass M_1 of the prism in water. (3 marks)

(iii) Determine the value of μ given that: $M_1 = M_0 - \mu$. (1 mark)

(iv) State the quantity represented by μ. (1 mark)

(e) Using tissue paper, dry the prism. Replace the water with liquid L and repeat the procedure in part (c) and adjust the distance X to restore the balance of the metre rule.

(i) Record the new balance length X_2.

$X_2 =$ ..... cm (1 mark)

(ii) Given that $X = \dfrac{RX_1 - SX_2}{R - S}$, where $S = 1000\,\text{kg m}^{-3}$, determine the quantity R and state its SI unit. (3 marks)

PART B

(f) Use the apparatus provided to set up the circuit shown in **Figure 4.**

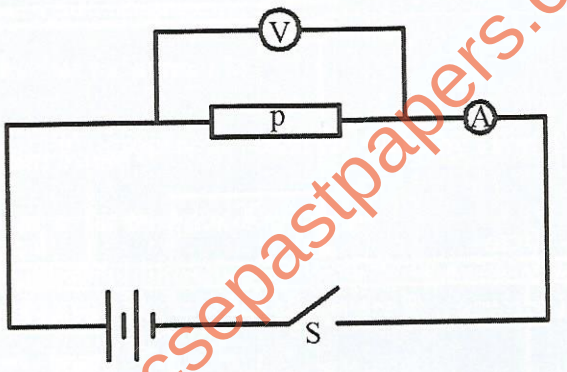


Figure 4

(g) Close the switch S.

(h) Read and record:

(i) Current I = ... (A) (1 mark)

(ii) Voltage V = ... (V) (1 mark)

(i) Determine resistance of P. (1 mark)

(j) Disconnect the circuit in **Figure 4** and use the apparatus to connect the circuit in **Figure 5**.

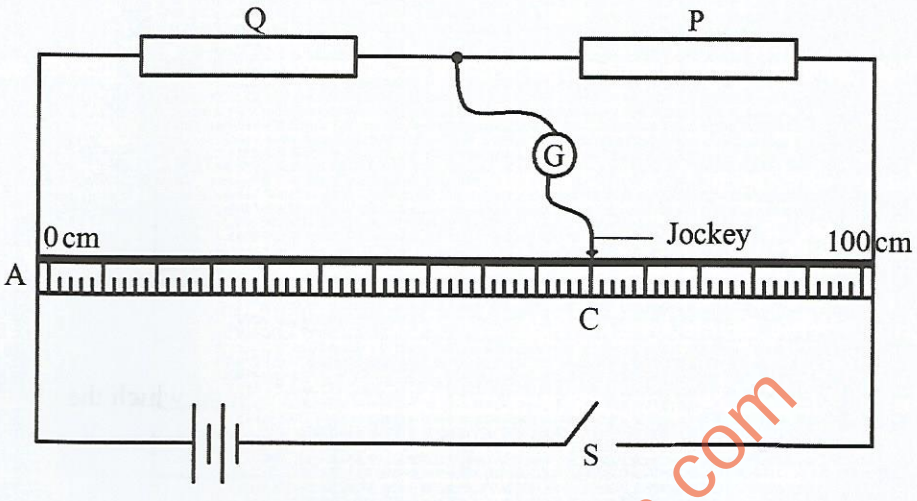


Figure 5

(k) Close the switch S. Using the jockey tap the wire AB at various points to obtain point C where the galvanometer shows zero deflection.

(l) Record the balance length $AC = L$

$L =$ ..... cm (1 mark)

(m) Determine the resistance of Q. Given that $\frac{Q}{L} = \frac{P}{100 - L}$ (2 marks)