Name ..... Index Number .....

232/1
PHYSICS
Paper 1
Nov. 2016
2 hours

Candidate's Signature .....

Date .....

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
PHYSICS
Paper 1
(THEORY)
2 hours

Instructions to candidates

(a) *Write your name and index number in the spaces provided above.*
(b) *Sign and write the date of examination in the spaces provided above.*
(c) *This paper consists of **two** sections; **A** and **B**.*
(d) *Answer **all** the questions in sections **A** and **B** in the spaces provided.*
(e) ***All** workings **must** be clearly shown.*
(f) *Silent non programmable electronic calculators may be used.*
(g) ***This paper consists of 16 printed pages.***
(h) ***Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.***
(i) ***Candidates should answer the questions in English.***

For Examiner's Use Only

Section	Question	Maximum Score	Candidate's Score
A	1–13	25	
B	14	13	
	15	13	
	16	10	
	17	11	
	18	08	
	Total Score	80	

SECTION A: (25 marks)

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

1. State what mechanics as a branch of physics deals with. (1 mark)

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2. **Figure 1** shows a change in volume of water in a measuring cylinder when an irregular solid is immersed in it.

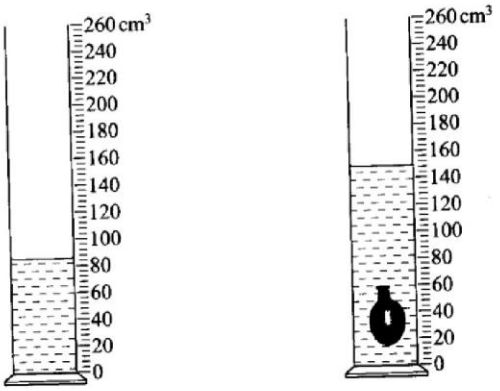

Figure 1

Given that the mass of the solid is 567 g, determine the density of the solid in g/cm³ (Give your answers correct to 2 decimal places). (3 marks)

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3. When a drop of an organic acid of known volume is dropped on the surface of water in a large trough, it spreads to form a large circular patch. State one assumption made when the size of the molecule of the acid is estimated by determining the area of the patch. (1 mark)

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4. **Figure 2(a)** and **2(b)** show capillary tubes inserted in water and mercury respectively.

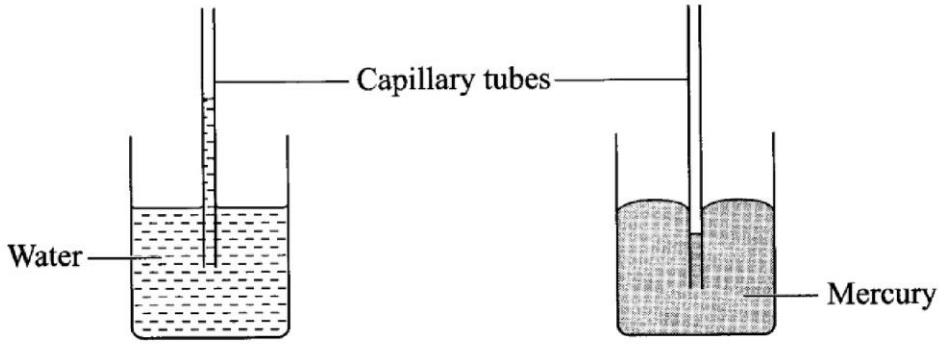

Figure 2(a) **Figure 2(b)**

It is observed that in water the meniscus in the capillary tube is higher than the meniscus in the beaker, while in mercury the meniscus in the capillary tube is lower than the meniscus in the beaker. Explain these observations. (3 marks)

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5. **Figure 3** shows a hot water bath with metal rods inserted through one of its ends. Some candle wax is fixed at the end of each rod. Use this information to answer questions **5**(a) and **5**(b).

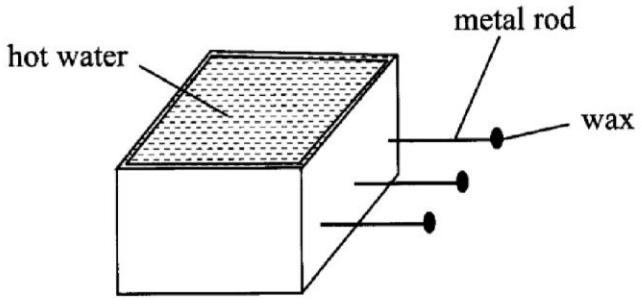

Figure 3

(a) What property of metals could be tested using this set-up? (1 mark)

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(b) Besides the length of the rods that is kept constant, what else should be kept constant when comparing the property for the different metal rods? (1 mark)

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6. **Figure 4** shows a uniform light bar resting horizontally on corks floating on water in two beakers **A** and **B**.

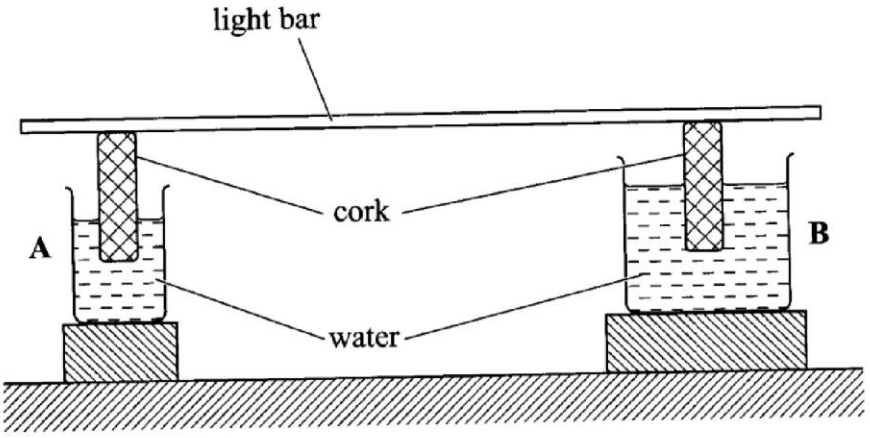

Figure 4

Explain why the bar tilts towards side **A** when equal amount of heat is supplied to each beaker (2 mark)

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7. **Figure 5** shows an aluminium tube tightly stuck in a steel tube.

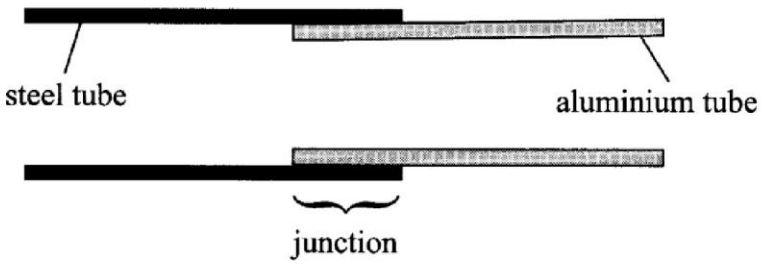

Figure 5

Explain how the two tubes can be separated by applying a temperature change at the junction given that aluminium expands more than steel for the same temperature rise. (2 marks)

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8. (a) An aeroplane is moving horizontally through still air at a uniform speed. It is observed that when the speed of the plane is increased, its height above the ground increases. State the reasons for this observation. (1 mark)

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(b) **Figure 6** shows parts **A**, **B** and **C** of a glass tube.

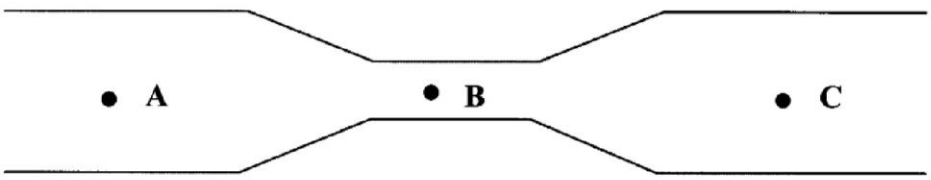

Figure 6

State with a reason the part of the tube in which the pressure will be lowest when air is blown through the tube from **A** towards **C**. (2 marks)

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9. The three springs shown in **Figure 7** are identical and have negligible weight. The extension produced on the system of springs is 20 cm.

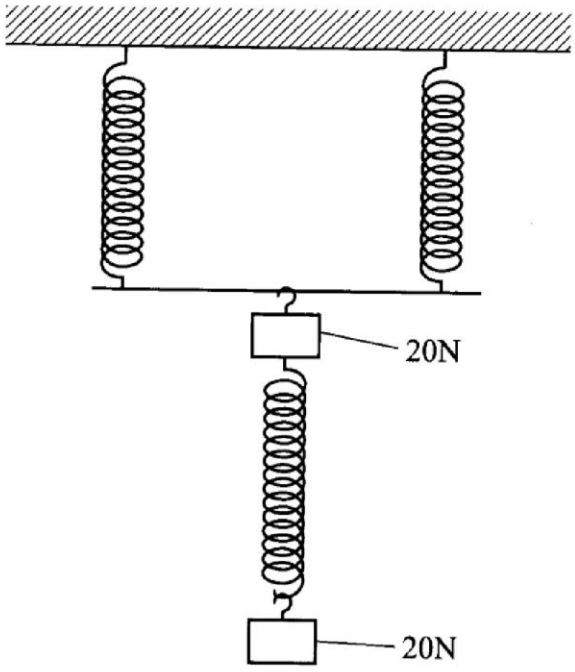

Figure 7

Determine the spring constant of each spring. (2 marks)

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10. **Figure 8** shows two cylinders of different cross-sectional areas connected with a tube. The cylinders contain an incompressible fluid and are fitted with pistons of cross-sectional areas $4\,cm^2$ and $24\,cm^2$.

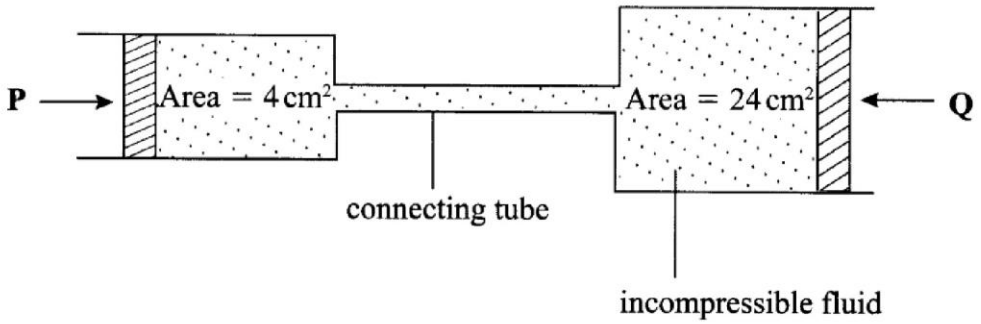

Figure 8

Opposing forces **P** and **Q** are applied to the pistons such that the pistons do not move. If the pressure on the smaller piston is $5N/cm^2$, determine force **Q**. (2 marks)

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11. **Figure 9** shows a uniform cardboard in the shape of a parallelogram.

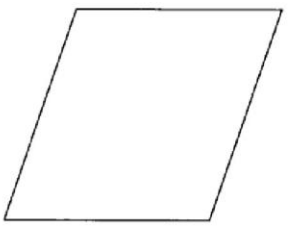

Figure 9

Locate the centre of gravity of the cardboard. (1 mark)

12. State why it is easier to separate water into drops than to separate a solid into smaller pieces. (1 mark)

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13. The graph in **Figure 10** shows the velocity of a car in the first 8 seconds as it accelerates from rest along a straight line.

Determine the distance travelled 3.0 seconds after the start. (2 marks)

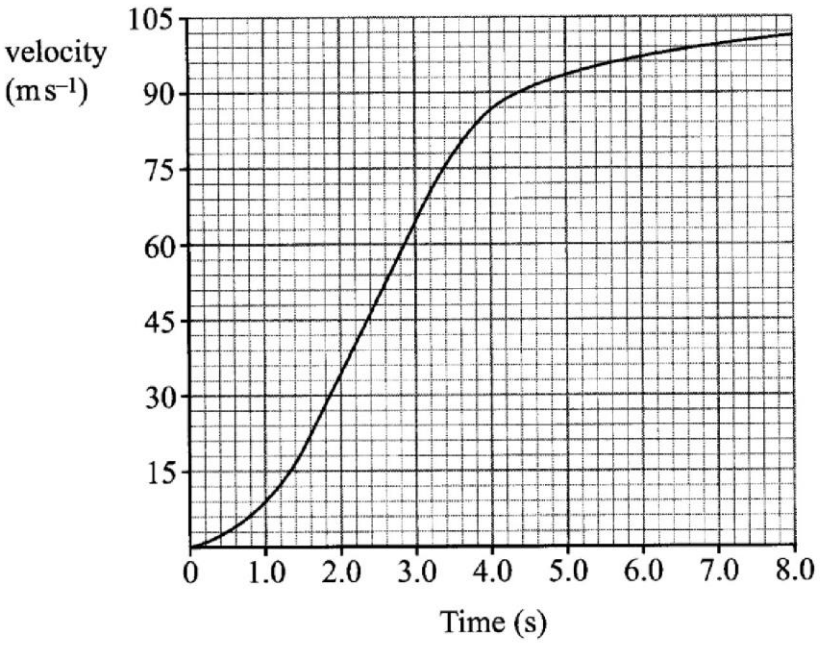

Figure 10

SECTION B: (55 marks)

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

14. (a) Explain why it is advisable to use a pressure cooker for cooking at high altitudes. (2 marks)

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(b) Water of mass 3.0 Kg at 20 °C is heated in an electric kettle rated 3.0 KW. The water is heated until it boils at 100 °C. Given that the specific heat capacity of water = 4200 $JKg^{-1}K^{-1}$, heat capacity of the kettle = 450 JK^{-1}, specific latent heat of vaporisation of water = 2.3 $MJKg^{-1}$.

Determine:

(i) the heat absorbed by the water. (3 marks)

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(ii) heat absorbed by the electric kettle. (2 marks)

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(iii) the time taken for the water to boil. (3 marks)

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(iv) how much longer it will take to boil away all the water. (3 marks)

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15. (a) State the meaning of the term ideal gas. (1 mark)

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(b) The pressure acting on a gas in a cylinder was changed steadily while the temperature of the gas was maintained constant. The value of volume **V** of the gas was measured for various values of pressure. The graph in **Figure 11** shows the relation between the pressure **P**, and the reciprocal of volume, $\frac{1}{v}$.

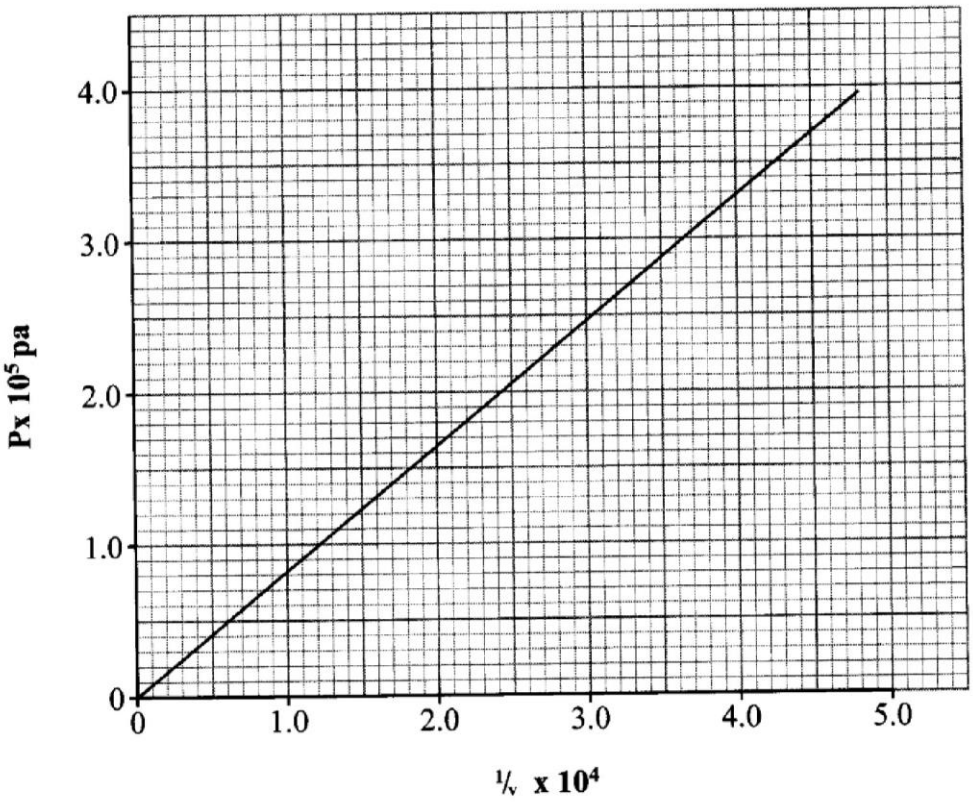

Figure 11

(i) Suggest how the temperature of the gas could be kept constant. (2 marks)

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(ii) Given that the relation between the pressure $\mathbf{P}_1$ and the volume, $\mathbf{V}_1$ of the gas is given by $\mathbf{PV} = K$, where K is a constant, use the graph to determine the value of K. (4 marks)

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(iii) What physical quantity does K represent? (1 mark)

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(iv) State **one** precaution you would take when performing such an experiment. (1 mark)

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(c) A gas occupies a volume of 4000 litres at a temperature of 37 °C and normal atmospheric pressure. Determine the new volume of the gas if it is heated at constant pressure to a temperature of 67 °C (Normal atmospheric pressure, $\mathbf{P} = 1.01 \times 10^5$ Pa). (4 marks)

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16. (a) Define the term velocity ratio of a machine. (1 mark)

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(b) **Figure 12** shows part of a hydraulic press. The Plunger is the piston where effort is applied while the Ram piston is the position where the load is applied. The Plunger has cross-section area a m^2 while the Ram piston has cross-section, A m^2.

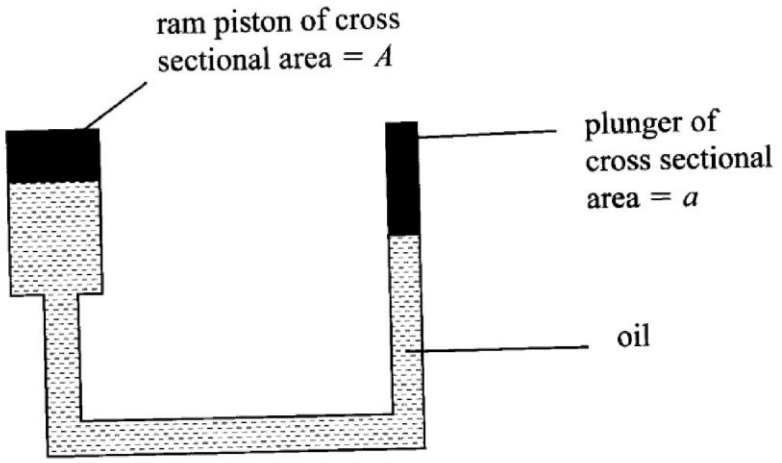

Figure 12

When the Plunger moves down a distance d the Ram piston moves up a distance D. Derive an expression for the Velocity Ratio (V.R.) in terms of A and a. (4 marks)

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(c) A machine of velocity ratio 45 overcomes a load of 4.5×10^3 N when an effort of 135 N is applied. Determine:

(i) the mechanical advantage (M.A) of the machine; (2 marks

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(ii) efficiency of the machine; (2 marks)

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(iii) the percentage of the work that goes to waste. (1 mark)

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17. (a) When a bus goes round a bend on a flat road, it experiences a centripetal force. State what provides the centripetal force. (1 mark)

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(b) State the purpose of banking roads at bends. (2 marks)

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(i) Determine the slope, s, of the graph. (2 marks)

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(ii) Given that $U^2 = 20kd$, where k is constant for the bench surface, determine the value of k from the graph. (2 marks)

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(c) A car of mass 800 Kg starts from rest and accelerates at $1.2\,ms^{-2}$. Determine its momentum after it has moved 400 m from the starting point. (3 marks)

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Name ..... Index Number .....

232/2
PHYSICS
Paper 2
Nov. 2016
2 hours

Candidate's Signature .....

Date .....

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
PHYSICS
Paper 2
(THEORY)
2 hours

Instructions to candidates

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(i) Candidates should answer the questions in English.

For Examiner's Use Only

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A	1–13	25	
B	14	10	
	15	9	
	16	12	
	17	11	
	18	13	
Total Score		80	

SECTION A: (25 marks)

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

1. **Figure 1** shows a ray of light incident on a mirror, at an angle of 45°. Another mirror is placed at an angle of 45° to the first ones as shown.

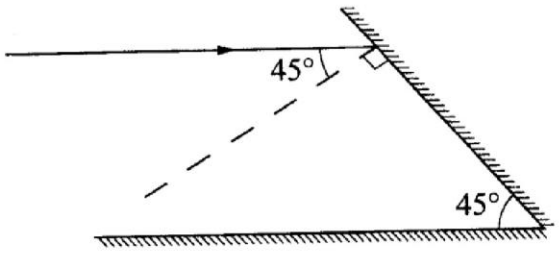

Figure 1

Sketch the patch of the ray until it emerges. (2 marks)

2. An unmagnetized steel rod is clamped facing North-South direction and then hammered repeatedly for some time. When tested, it is found to be magnetized. Explain this observation. (2 marks)

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3. **Figure 2** shows a solenoid carrying an electric current.

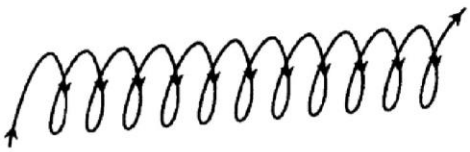

Figure 2

Sketch the magnetic field pattern inside and at the ends of the solenoid. (1 mark)

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4. **Figure 3** shows how the displacement of a point varies with time as a wave passes it.

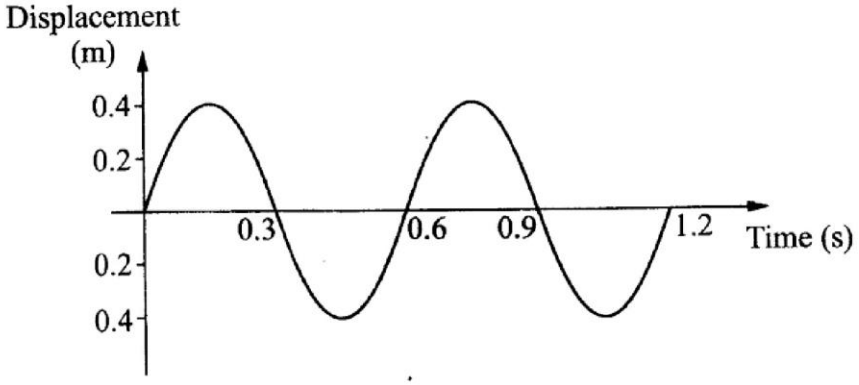

Figure 3

On the same diagram, draw a wave which passes the point with half the amplitude and twice the frequency of the one shown. (2 marks)

5. State the reason why a convex mirror is preferred over a plane mirror for use as a driving mirror. (1 mark)

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6. **Figure 4** shows straight waves incident on a diverging lens placed in a ripple tank to reduce its depth. Complete the diagram to show the waves in both the shallow region and beyond the lens. (2 marks)

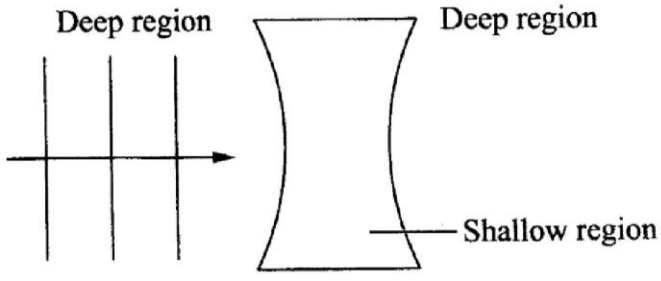

Figure 4

7. **Figure 5** shows the cross-section of a dry cell. Use the information on the figure to answer **Question 7**.

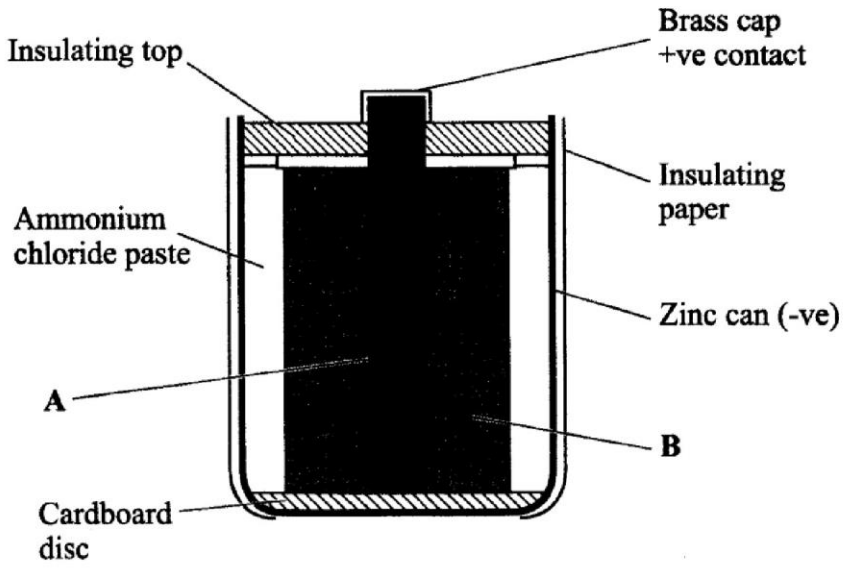

Figure 5

(a) Name the parts labelled **A** and **B**. (2 marks)

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(b) State the use of the manganese (IV) oxide in the cell. (1 mark)

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8. The following is part of a radioactive series.

$$^{234}_{83}Bi \xrightarrow{\beta} {}^{a}_{84}X \longrightarrow {}^{230}_{b}Y$$

Determine the values of a and b (2 marks)

a = ..., b = ...

9. Draw a ray diagram to show how a ray of light may be totally internally reflected two times in an isosceles right-angled glass prism. (Assume that the critical angle of glass is 42°.) (2 marks)

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10. **Figure 6** shows a narrow beam of X-rays passing between two metal plates in air. The plates are connected in series with a switch, a cell and a milliameter.

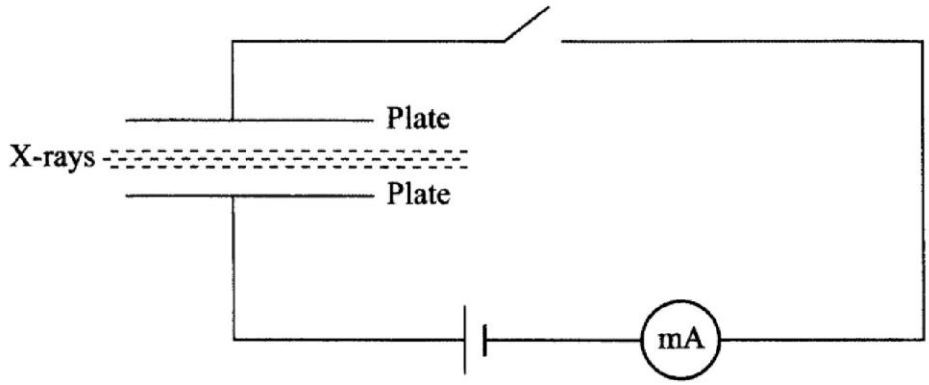

Figure 6

It is observed that when the switch is closed a current flows in the milliameter. Explain this observation. (2 marks)

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11. A heater of resistance R_1 is rated P watts, V volts while another of resistance R_2 is rated 2P watts, V/2 volts. Determine R_1/R_2. (2 marks)

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12. When a germanium crystal is doped with arsenic, it becomes an N-type semi-conductor. Explain how this change occurs. (2 marks)

(Number of electrons in the outermost shell for germanium = 4, Arsenic = 5)

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13. A boy standing in front of a cliff blows a whistle and hears the echo after 0.5 s. He then moves 17 metres further away from the cliff and blows the whistle again. He now hears the echo after 6.0 s. Determine the speed of the sound. (2 marks)

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SECTION B: (55 marks)

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

14. (a) **Figure 7** shows a simple electric bell circuit.

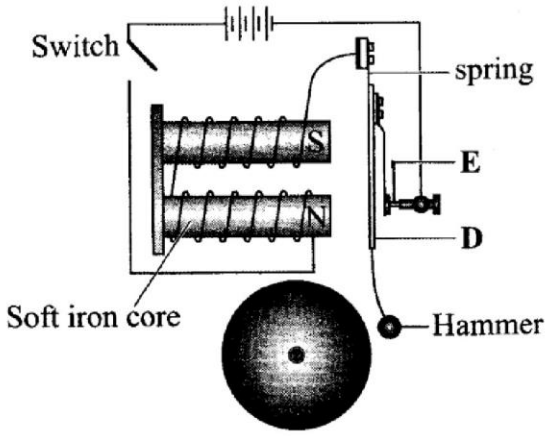

Figure 7

(i) Name the parts labelled:

I. **D** ..... (1 mark)

II. **E** ..... (1 mark)

(ii) When the switch is closed, the hammer hits the gong repeatedly. Explain why:

I. the hammer hits the gong. (2 marks)

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II. the hammer hits the gong repeatedly. (2 marks)

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(b) An electric bulb is rated 60 W, 240 V. Determine:

(i) the current that flows through it when it is connected to a 240 V supply. (2 marks)

(ii) the resistance of the bulb (2 marks)

15. **Figure 8** shows two coils **A** and **B** placed close to each other. **A** is connected to a steady direct current (d.c.) supply and a switch, **B** is connected to a sensitive galvanometer.

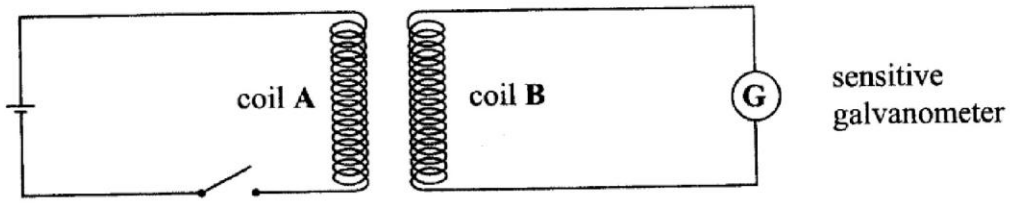

Figure 8

(a) (i) The switch is now closed. State the observation made on the galvanometer. (1 mark)

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(ii) Explain what would be observed if the switch is then opened. (1 mark)

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(b) The primary coil of a transformer has 1000 turns and the secondary coil has 200 turns. The primary coil is connected to a 240 V alternating current (a.c.) mains supply.

(i) Explain how an e.m.f. is induced in the secondary coil. (2 marks)

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(ii) Determine the secondary voltage. (2 marks)

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(iii) Determine the efficiency of the transformer given that the current in the primary coil is 0.20 A and in the secondary coil is 0.80 A. (3 marks)

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16. (a) **Figure 9**, shows a circuit that may be used to charge a capacitor.

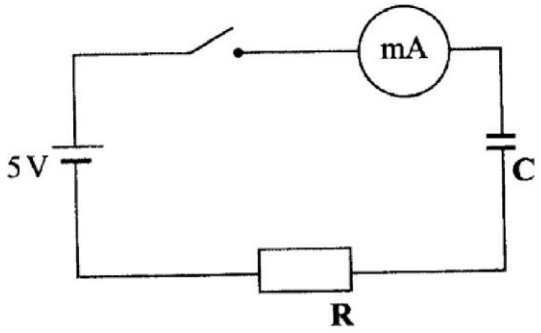

Figure 9

(i) State the observation on the milliameter when the circuit is switched on. (1 mark)

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(ii) Explain the observation in a (i) above. (2 marks)

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(b) The circuit in **Figure 9** is left on for duration of time. State the value of potential difference (p.d.) across

(i) the resistor **R**; (1 mark)

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(ii) the capacitor **C**; (1 mark)

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(c) Sketch the graph of potential difference **V** across **R** against time. (1 mark)

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(d) **Figure 10** shows three capacitors connected to a 10 V battery.

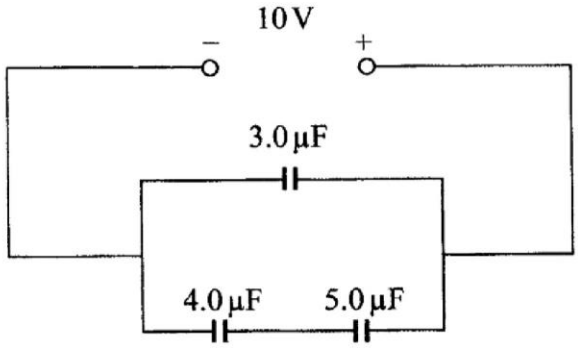

Figure 10

Calculate:

(i) the combined capacitance of the three capacitors (3 marks)

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(ii) the charge on the 5.0μF capacitor. (3 marks)

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17. (a) When a radiation was released into a diffusion chamber, short thick tracks were observed. State with a reason, the type of radiation that was detected. (2 marks)

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(b) The half-life of an element X is 3.83 days. A sample of this element is found to have an activity of 1.0×10^3 disintegrations per second at a particular time. Determine its activity rate after 19.15 days. (3 marks)

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(c) State what is meant by an extrinsic semi-conductor. (1 mark)

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(d) **Figure 11** shows a depletion layer in an unbiased **p–n** junction.

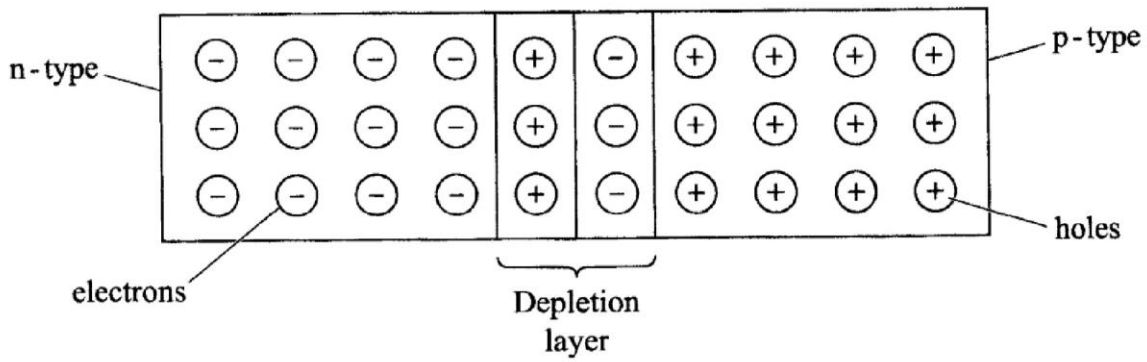

Figure 11

State how a battery can be used to make the depletion layer narrower. (1 mark)

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(e) **Figure 12** shows an incomplete circuit of a full wave rectified.

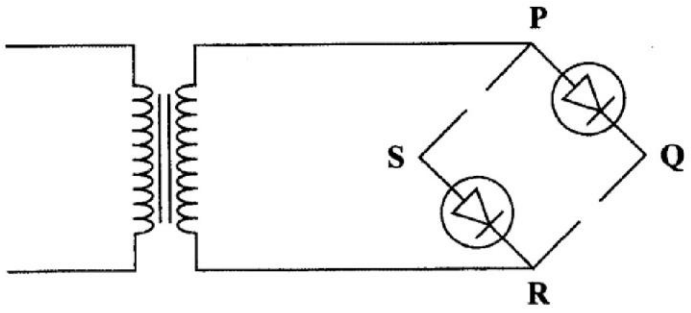

Figure 12

Draw in the **Figure 12** two more diodes to complete the circuit. (2 marks)

(ii) Show on the **Figure 12** the points across which the output of the rectifier should be obtained. (2 marks)

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18. (a) State **one** factor that affects the speed of sound in a solid. (1 mark)

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(b) An observer stands half-way between two vertical cliffs that are L metres apart. He strikes a gong and measures the time interval, ***t***, between the echoes heard from the two cliffs. He moves a further 10m and again strikes the gong and measures the time interval between the echoes. The process is repeated several times. The graph in **Figure 13** shows the relation between the time interval, ***t*** and the distance, ***x***, from the centre.

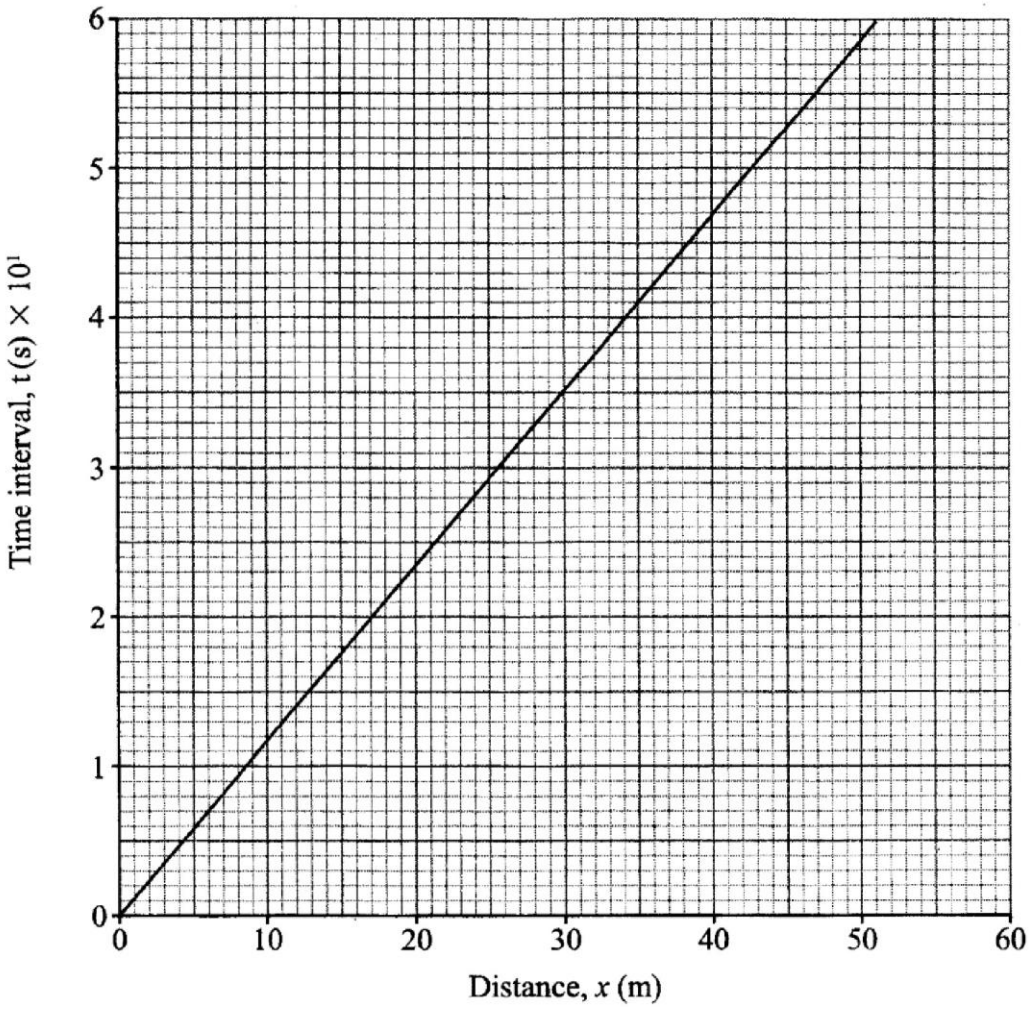

Figure 13

(i) From the graph, determine the value of x for which the time interval was 0.55 seconds. (1 mark)

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(ii) Given that $t = 4x/v$, where v is the speed of sound in air, determine the value of v from the graph. (3 marks)

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(iii) If the maximum time measured by the observer was $t = 4.75$ s, determine the distance L between the cliffs. (3 marks)

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(c) A search boat uses a signal of frequency 6.0×10^4 Hz to detect a sunken ship directly below. Two reflected signals are received; one after 0.1 seconds from the sunken boat and the other after 0.14 seconds from the sea bed. If the sea bed is 98 m below the boat, determine:

(i) the speed of the signal in water. (3 marks)
(You may use the value of v of (ii) on page 14).

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(ii) the depth of the sunken ship below the boat. (2 marks)

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Name ..... Index Number .....

Candidate's Signature .....

Date .....

232/3
PHYSICS
(PRACTICAL)
Paper 3
Nov. 2016
2½ hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education
PHYSICS
(PRACTICAL)
Paper 3
2½ hours

Instructions to candidates

(a) Write your name and index number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided above.
*(c) Answer **ALL** the questions in the spaces provided in the question paper.*
(d) You are supposed to spend the first 15 minutes of the 2½ hours allowed for this paper reading the whole paper carefully before commencing your work.
(e) Marks are given for a clear record of the observations actually made, their suitability, accuracy and the use made of them.
(f) Candidates are advised to record their observations as soon as they are made.
*(g) **Non-programmable** silent electronic calculators **and** KNEC mathematical tables may be used.*
*(h) **This paper consists of 10 printed pages.***
*(i) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.***
*(j) **Candidates should answer the questions in English.***

For Examiner's Use Only

Question 1

	e	f	g	i	j	o	p	q	r
Maximum Score	3	3	4	4	1	2	1	1	1
Candidate's Score									

Total ☐

Question 2

	c	d	e	f	g	h	i
Maximum Score	2	1	2	6	4	3	2
Candidate's Score							

Total ☐

Grand Total ☐

1. You are provided with the following:

- A triangular glass prism
- A piece of soft board
- Four optical pins
- Four office pins
- A sheet of plain paper
- A voltmeter
- An ammeter
- A galvanometer
- Two cells and two cell holders
- A resistance wire mounted on a metre rule with the ends marked F & H
- A copper wire labelled C
- A resistance wire labelled R
- A switch
- Connecting wires
- A glass tube

PART A

Proceed as follows:

(a) Place the plain sheet of paper on the soft board and pin it using the office pins at the corners. Trace the triangular prism outline of the prism on the sheet of paper (use the upper part to leave space for two other outlines on the same page). Label the vertices of the outline at A, B and C. Remove the prism from the paper.

(b) On the outline at a point O near the centre of side AB draw a normal ON.

(c) Draw a line PO at an angle of 30° to the normal ON as shown in **Figure 1**.

(d) Replace the prism accurately on the outline. Fix two optical pins vertically on line PO at different points (**see Figure 1**).

(e) View the images of the two pins through side AC of the outline. Fix a third and fourth pin vertically such that they are in line with the images of the first and second pin. Remove the prism and the pins. Draw a line joining the marks made by the third and fourth pins and extend it to join line PO (also extended) as shown in **Figure 1**.

(1 mark)

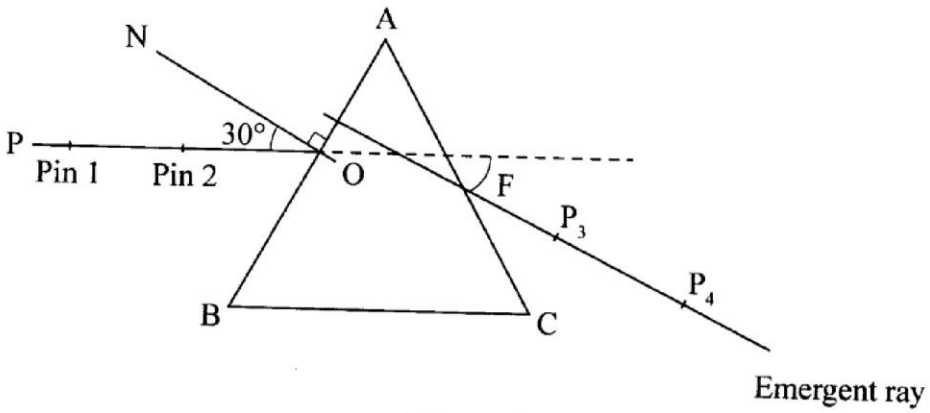

Figure 1

Measure F, the angle of deviation of the emergent ray. (2 marks)

(f) Repeat part (e) for other angles of incidence shown in **Table 1**. (Draw a fresh outline of the prism for each angle of incidence)

Complete table 1 (3 marks)

Table 1

Angle of incidence	30°	50°	70°
Angle of deviation			

(g) Determine:

(i) E the angle of emergence (between the emergent ray and the normal at the point of emergence) at the least angle of deviation. (2 marks)

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(ii) K given that $K = 2 \sin \left(\frac{30 + F_0}{2} \right)$ (where F_0 is the least angle of deviation). (2 marks)

(Attach the plain sheet of paper to your question paper and hand them in).

PART B

Proceed as follows:

Set up the circuit shown in **Figure 2**.

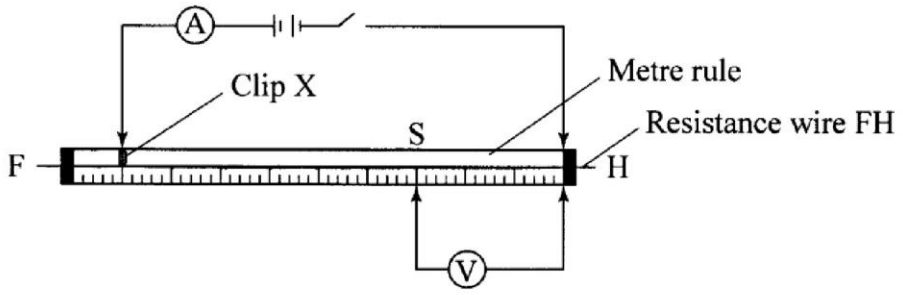

Figure 2

(S is a point on wire FH such that SH = 30 cm).

(h) Close the switch. Adjust the position of Clip X along FH until the current is 0.2A. Record the potential difference (V) across length SH in **Table 2**.

(i) Repeat part (a) for the values of current in **Table 2**.

Complete Table 2 (4 marks)

Table 2

Current I (A)	0.2	0.3	0.4
Potential difference V(v)			
Resistance $R = \frac{V}{I}$ (Ω)			

(j) Determine **Rm**, the mean resistance of wire SH. (1 mark)

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(k) Open the switch, disconnect the voltmeter and remove the cells.

(l) Using a glass rod, wind the copper wire (C) into a coil. Slightly pull out the ends to ensure that adjacent turns of the coil do not touch.

(m) Join the coil to the resistance wire R by winding about 1 cm of the coil end onto one end of resistance wire R (see **Figure 3**).

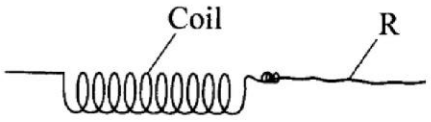

Figure 3

(n) Set up the circuit as shown in **Figure 4**.

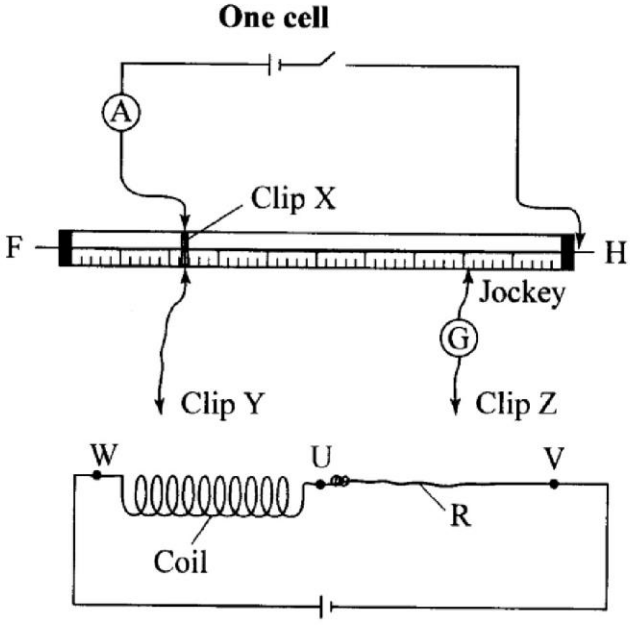

Figure 4

Close the switch and adjust clip X to a point O along FH so that the current is now 0.1A. Record the centimetre mark of point O.

Centimetre mark of point O ..... cm.

(o) Move the jockey along OH and obtain a point T, where the galvanometer reads zero. Record the centimetre mark of T_1

Centimetre mark of T_1 ..... cm (1 mark)

Determine length **Lc** of OT_1

Lc = ... (1 mark)

(p) Connect clip Y at U and clip Z at V and repeat part (h) to obtain the point T_2 (where the galvanometer reads zero), the balance point of wire R.

Record the centimetre mark of T_2 for R.

Centimetre mark of T_2 = ... cm (1 mark)

(q) Determine the balance length L_R for the resistance wire R.

L_R = ... (1 mark)

(r) Determine the constant R_C given that:

$$R_C = \frac{L_C}{L_R} \bullet \frac{R_M}{3}$$ (1 mark)

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2. You are provided with the following:

- Two half metre rules
- One metre rule
- One stopwatch
- Two pieces of thread
- Some sellotape
- Stand boss and clamp

Proceed as follows:

(a) Using the retort stand, clamp one half-metre rule at its centre, such that the scale is horizontal in a vertical plane (see **Figure 5**). Using sellotape and two strings, suspend the second half-metre rule in a horizontal plane such that;

(i) its scale is horizontal

(ii) the strings are equidistant from the centres of the half-metre rules and distance $d_1 = 40\,cm$ apart.

(iii) The height between the two half-metre rules is L = 65 cm. (see **Figure 5**).

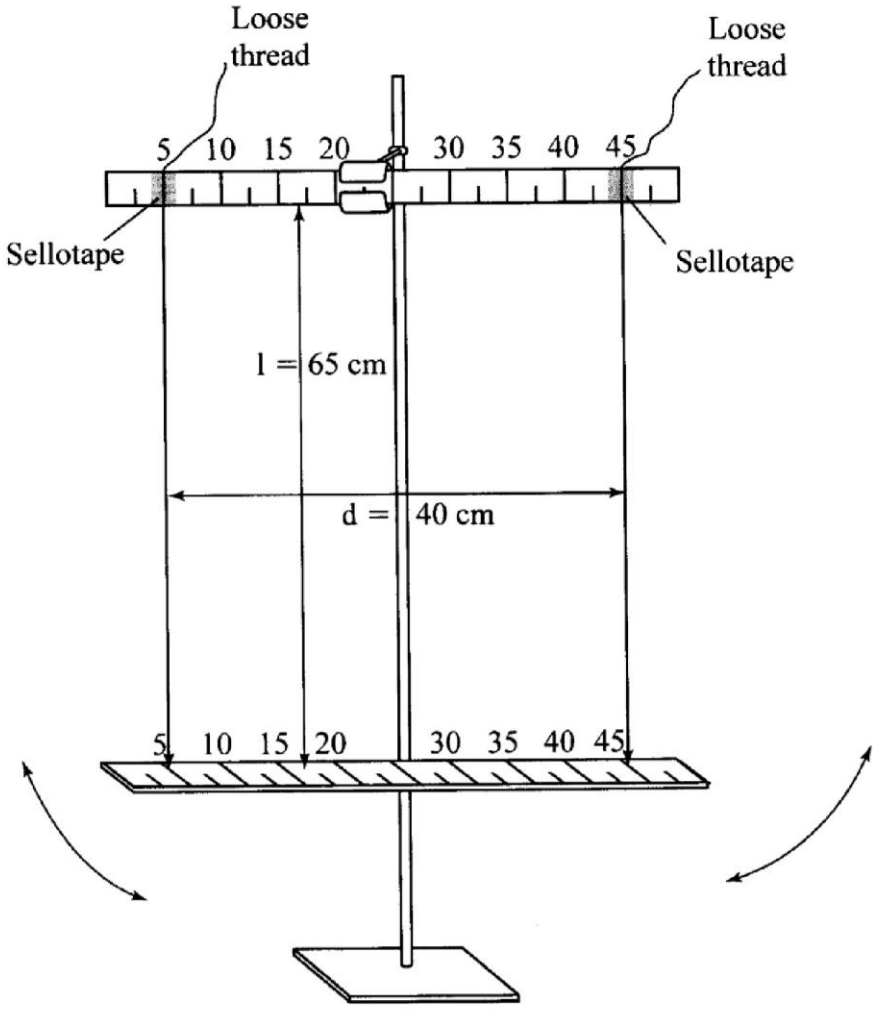

Figure 5

(b) Set the suspended rule into small oscillations in a horizontal plane about a vertical axis through its centre. (see **Figure 5**).

(c) (i) using the stopwatch, record the time t, for oscillations.

t_1 = ... s (1 mark)

(ii) Determine the period T, the time for one oscillation.

T_1 = ... (1 mark)

(d) With l still at 65 cm, change the distance between the strings from 40 cm to d_2 = 20 cm. Repeat part C to obtain period T_2.

T_2 = ... (1 mark)

(e) Determine constant r given that (2 marks)

$$r = \frac{\log(T_1/T_2)}{\log(d_1/d_2)}$$

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For the rest of the experiment the distance between the strings should remain 20 cm.

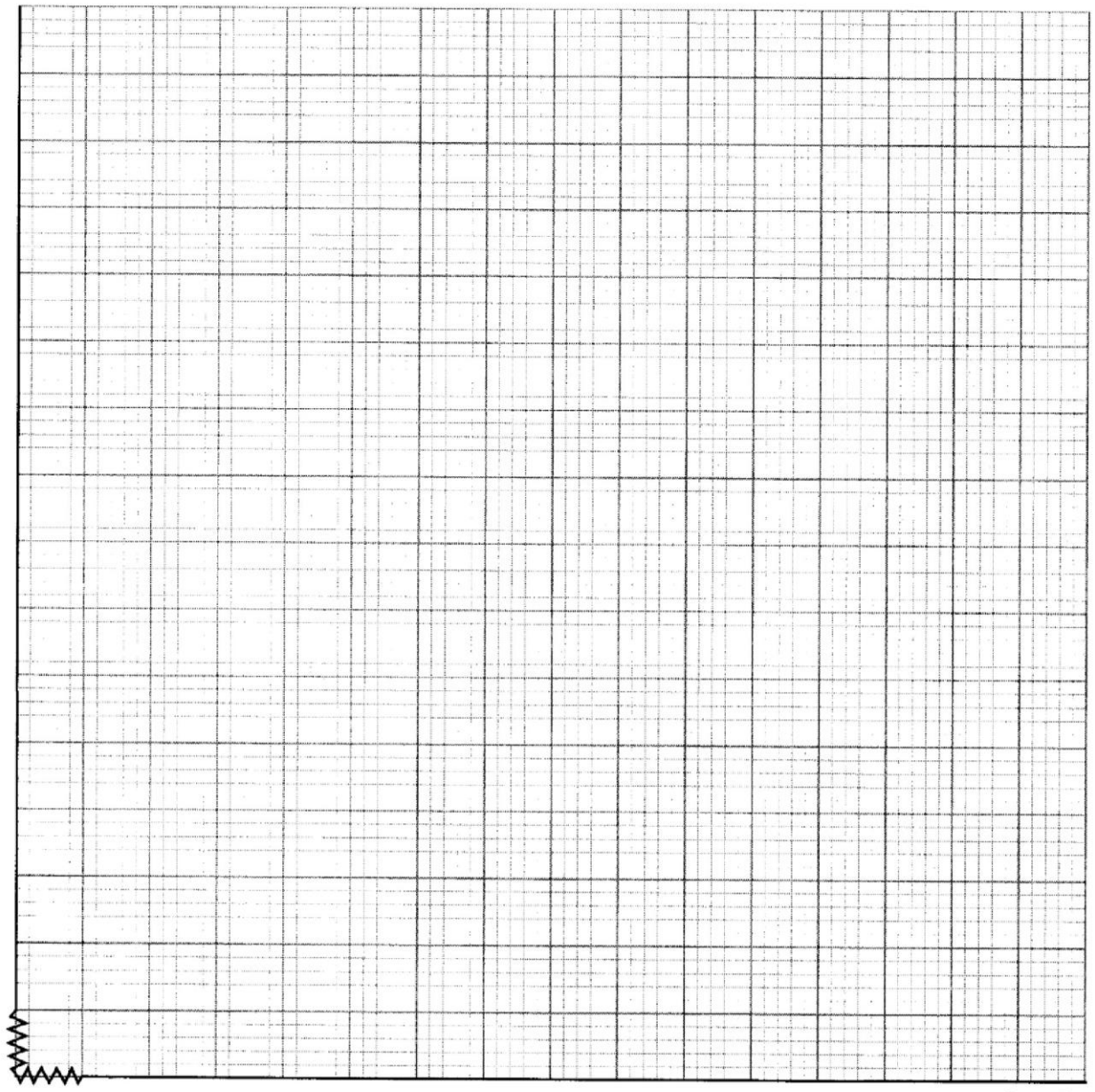
(f) Repeat part (c) for values of l Shown in **Table 3**. Complete **Table 3** (6 marks)

Table 3

Length l cm	60	55	50	45	40	35
time for 20 oscillations t(s)						
Period T (s)						
log T						
log L						

(g) Plot a graph of log T (y axis) against Log L (4 marks)

Log T



Log L

(h) Determine the S of the graph (3 marks)

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(i) Given that the time t for N oscillations is given by $t = KNL^{s}D^{r}$ where K is a constant, deduce an expression for the period T in terms of l and d with s and r correct to 1 decimal place. (2 marks)

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