

## 7.0 PHYSICS (232)

In the year 2010, KCSE Physics was tested in three papers; Paper 1 (232/1), Paper 2 (232/2) and Paper 3 (232/3).

Paper 1 and Paper 2 were theory papers with two sections A and B. Section A had short answer questions and section B had structured questions. Candidates were required to answer all the questions in both sections. Questions in Paper 1 were drawn from heat and mechanics while questions in Paper 2 were drawn from Optics Waves, Electricity, Magnetism, and modern Physics.

Paper 3 (232/3) was a practical paper testing a variety of skills in all areas of physics.

### 7.1 GENERAL CANDIDATES PERFORMANCE

The candidate's performance statistics in the KCSE Physics examination over the four years are as shown in the table below.

**Table 12: Candidates' overall performance in Physics in the years 2007 to 2010.**

| Year | Paper   | Candidature | Maximum score | Mean score | Standard deviation |
|------|---------|-------------|---------------|------------|--------------------|
| 2007 | 1       |             | 80            | 23.46      | 13.43              |
|      | 2       |             | 80            | 33.33      | 17.93              |
|      | 3       |             | 40            | 25.85      | 07.14              |
|      | overall | 83,162      | 200           | 82.63      | 35.00              |
| 2008 | 1       |             | 80            | 25.32      | 14.66              |
|      | 2       |             | 80            | 24.17      | 16.34              |
|      | 3       |             | 40            | 23.92      | 07.31              |
|      | overall | 93,692      | 200           | 73.42      | 35.43              |
| 2009 | 1       |             | 80            | 26.72      | 16.17              |
|      | 2       |             | 80            | 20.77      | 14.23              |
|      | 3       |             | 40            | 15.22      | 06.29              |
|      | overall | 104,883     | 200           | 62.62      | 34.02              |
| 2010 | 1       |             | 80            | 26.11      | 16.95              |
|      | 2       |             | 80            | 21.82      | 13.82              |
|      | 3       |             | 40            | 22.37      | 07.81              |
|      | overall | 109,811     | 200           | 70.22      | 35.73              |

From the table it can be observed that:

- 7.1.1 The candidature increased from **104,883** in the year 2009 to **109, 811** in the year 2010, an increase of **4.928** candidates (**4.69%**).
- 7.1.2 There was improvement in the performance of Paper 3 (232/3) which improved from a mean of **15.22** in the year 2009 to **22.37** in the year 2010.
- 7.1.3 Paper 1(232/1) and Paper 2 (232/2) recorded a **decline** in performance in the year 2010.
- 7.1.4 There overall performance of Physics improved from a mean of **62.62** in 2009 to **70.22** in 2010.

The following is a discussion of the questions in which candidates performed poorly.

## 7.2 PAPER 1(232/1)

### Question 2

A stopwatch started 0.50s after the start button was pressed. The time recorded using the stopwatch for a ball bearing falling through a liquid was 2.53s. Determine the time of fall.

(1 mark)

Candidates were required to determine the time of fall for a ball bearing falling through a liquid using an inaccurate stop watch.

### Weakness

Students were unable to realize that this was to be treated as an error hence the need to add the error to the time recorded.

### Expected response

Time = (2.53 + 0.50)s = 3.03s

### Question 8

A cart of mass 30kg is pushed along a horizontal path by a horizontal force of 8N and moves with a constant velocity. The force is then increased to 14N.

Determine:

- (a) the resistance to the motion of the cart; (1 mark)
- (b) the acceleration of the cart. (2 marks)

Candidates were required to determine the resistance of motion of a moving cart and the acceleration of the cart.

### Weakness

Students were unable to comprehend that when a body moved with uniform velocity, acceleration is zero. Some subtracted the two driving forces to find the resistance force in part (a).

### Expected response

(a) Resistance = 8N

(b)  $14 - 8 = 30 a$

$$\therefore a = \frac{6}{30} \text{ ms}^{-2}$$

$$= 0.2 \text{ ms}^{-2}$$

### Question 14

Figure 6 shows an athlete lifting weights while standing with the feet apart.

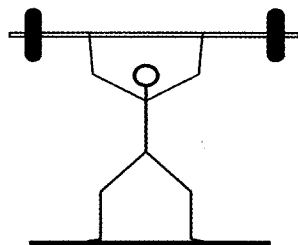


Figure 6

Explain why standing with the feet apart improves the athletes's stability.

(1 mark)

Candidates were required to explain why standing with feet apart improves stability.

### Weakness

Students were unable to relate increase the base area to lowering the position of the centre of gravity.

Some students related surface area to increased stability and were unable to relate center of gravity to stability.

### Expected response

Increase the base area or lower the c.g.

### Question 19

(a) Figure 9 shows a velocity-time graph for the motion of a certain body.

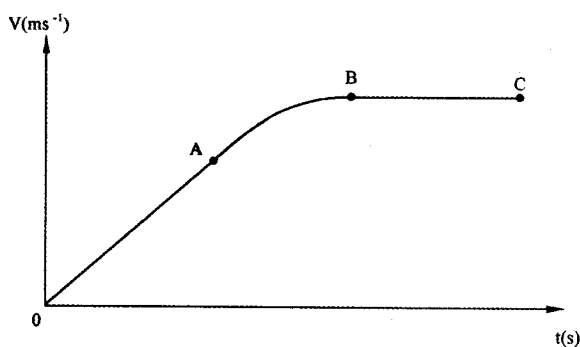


Figure 9

Describe the motion of the body in the region:

(i) OA;

(1 mark)

(ii) AB;

(1 mark)

(iii) BC.

(1 mark)

(b) A car moving initially at  $10\text{ms}^{-1}$  decelerates at  $2.5\text{ms}^{-2}$ .

(i) Determine:

(I) its velocity after 1.5s;

(2 marks)

(II) the distance travelled in 1.5s;

(2 marks)

(III) the time taken for the car to stop.

(2 marks)

- (ii) Sketch the velocity-time graph for the motion of the car up to the time the car stopped. (1 mark)
- (iii) From the graph, determine the distance the car travelled before stopping. (2 marks)

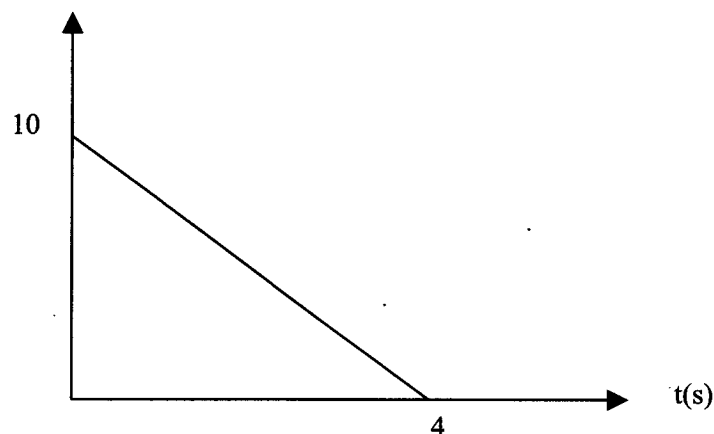
Candidates were required to describe the motion of a body from a v-t graph and determine v, s, and t of a car in uniform motion.<sup>5</sup>

### Weakness

Students were unable to relate area under the graph to distance covered, hence were not able to work out the distance covered.

### Expected response

- (a) (i) **OA** - Body moves from rest at constant acceleration.
- (ii) **AB** - Body moves with decreasing acceleration.
- (iii) **BC** - Body moves with constant velocity i.e. zero acceleration.
- (b) (i)  $u = 10 \text{ ms}^{-1}$   
 $a = -25 \text{ ms}^{-2}$   
 $t = 1.5\text{s}$   
 $V = u + at = 10 - 25 \times 1.5 = 6.25 \text{ ms}^{-1}$
- (ii)  $S = ut + \frac{1}{2}at^2$   
 $= 10(1.5) - \frac{1}{2}(2.5) 1.5^2 = 12.1875\text{m}$   
 $= 12.19\text{m}$
- (iii)  $V = 0$   
 i.e.  $0 = 10 - 2.5t$   
 $\Rightarrow t = \frac{10}{2.5} \text{ s} = 4\text{s}$
- (c) (i)  $V (\text{ms}^{-1})$



- (ii) Distance = Area of triangle

**Question 4**

A positively charged sphere is suspended by an insulating thread. A negatively charged conductor is suspended near it. The conductor is first attracted, after touching the sphere it is repelled. Explain this observation. (2 marks)

Candidates were required apply the law of electrostatics and understand the charging of bodies by contact.

**Weakness**

Many Students were unable to differentiate charges and poles of magnet i.e. confusion between basic law of electrostatics and the first law of magnetism. Some confused bodies touching to earthing of the bodies.

**Expected response**

Initially attracted because it is of opposite charge.

Then neutralised and charged positive and hence repel.

**Question 8**

A water wave of wavelength 18 mm is incident on a boundary of shallow water at right angles. If the wavelength in the shallow end is 14.4 mm, determine the refractive index of water for a wave moving from the deep to the shallow end. (3 marks)

Candidates were required to have the knowledge of the relationship between refractive index and wavelengths for a wave moving from deep to shallow regions.

**Weakness**

Students used  $\sin i / \sin r$  and could not relate it to wavelength.

**Expected response**

$$\begin{aligned} v_1 &= f\lambda_1 \\ v_2 &= f\lambda_2 \end{aligned}$$

Refractive index

$$\begin{aligned} &= \frac{v_1}{v_2} = \frac{f\lambda_1}{f\lambda_2} \\ &= \frac{\lambda_1}{\lambda_2} = \frac{18}{14.4} = 1.25 \end{aligned}$$

**Question 10**

A current  $I$  flowing through a wire of resistance  $R$  was increased seven times. Determine the factor by which the rate of heat production was increased. (3 marks)

Candidates were required to determine the factor by which the rate of heat dissipation was increased.

**Weakness**

Most Students squared  $I$  and not 7 i.e.  $7(I)^2R$  instead of  $(7I)^2R$ .

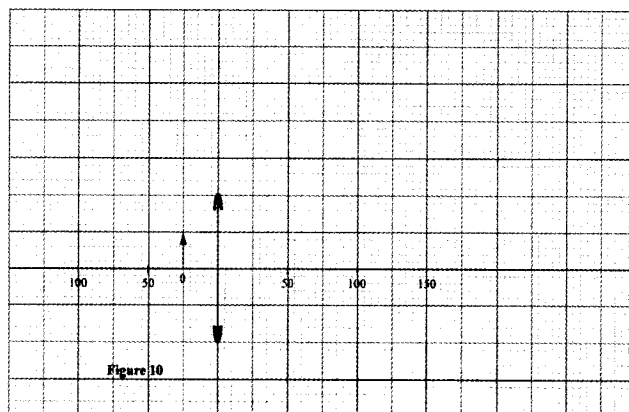
### Expected response

$$\begin{aligned} I_0 & \text{ - Initial current} \\ P & = I^2 R = I_0^2 R ; \\ I_2 & = 7I_0 \\ P & = (7I_0)^2 R = 49I_0^2 R ; \end{aligned}$$

Power is 49 times initial value.

### Question 16

- (a) **Figure 10**, shows an object placed in front of a converging lens of focal length 50mm.



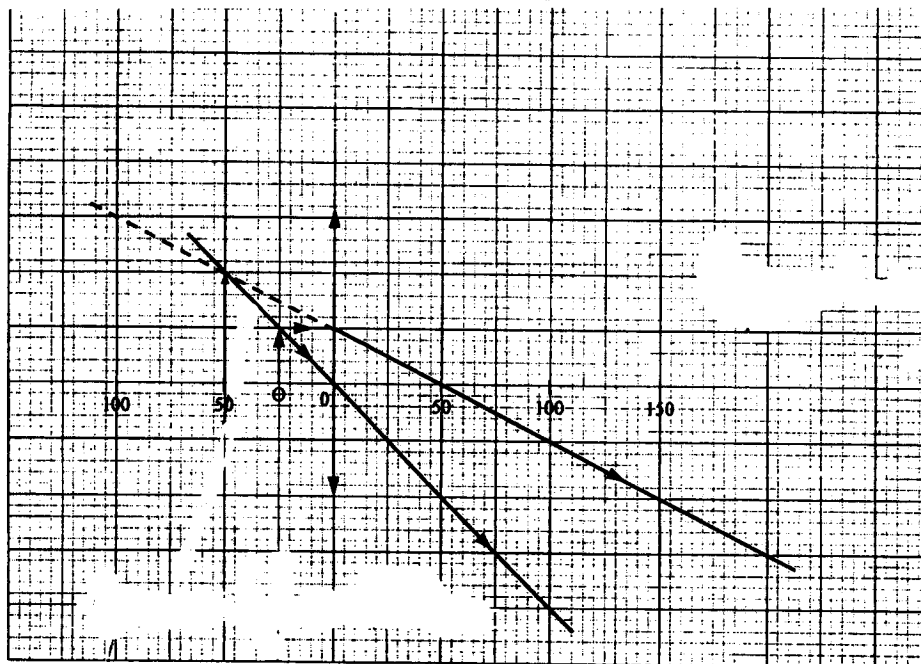
- (i) On the same figure, draw a ray diagram showing the location of the image. (3 marks)
- (ii) Use the ray diagram to determine the:  
(I) image distance; (1 mark)  
(II) magnification. (2 marks)
- (iii) State the adjustment that should be done to obtain a larger virtual image using the same lens. (1 mark)
- (iv) State **one** application of the arrangement in **figure 10**. (1 mark)

Candidates were required to construct ray diagrams and apply the lens formula in problem solving

### Weakness

A good number of Students drew lines instead of rays (without arrows) and extrapolated backwards with complete lines instead of dotted line. A number of students confused between thin lenses and curved mirrors.

## Expected response



**Question 1**

You are provided with the following:

- a metre rule;
- vernier callipers;
- a 300 g mass;
- two knife edges;
- some thread.

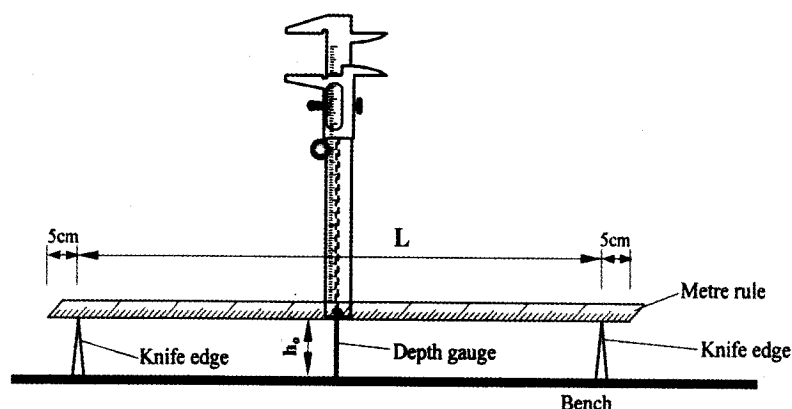
Proceed as follows:

- (a) Place the metre rule on the knife edges such that each knife edge is 45 cm from the 50 cm mark (centre of the rule). See **figure 1**. Ensure that the millimetre scale of the metre rule is facing upwards. The distance  $L$  between the knife edges is now 900 mm.

Place the vernier callipers vertically against the metre rule at the 50 cm mark with the depth gauge lowered to touch the bench as shown in figure 1.

Record the height  $h_0$  of the upper edge of the metre rule at the 50 cm mark. (see **figure 1**).

$h_0 = \dots\dots\dots$  mm (1 mark)



**Figure 1**

- (b) Using the thread provided, hang the 300g mass at the 50 cm mark of the metre rule. Ensure that the mass does not touch the bench. Measure and record in table 1, the height  $h$  of the edge of the metre rule at the 50 cm mark.
- (c) With the 300g mass still at the 50 cm mark, adjust the position of the knife edges so that  $L$  is now 800 mm. (The knife edges should be equidistant from the centre of the metre rule). Measure and record in table 1 the height  $h$  of the edge of the metre rule at the 50 cm mark.

- (d) Repeat the procedure in (c) for other values of  $L$  shown in table 1. Complete the table.

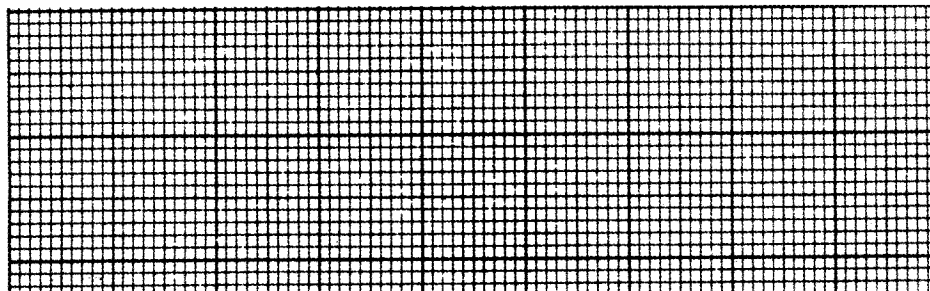
|                                 |     |     |     |     |     |
|---------------------------------|-----|-----|-----|-----|-----|
| Length $L$ (mm)                 | 900 | 800 | 700 | 600 | 500 |
| Height $h$ (mm)                 |     |     |     |     |     |
| Depression $d$ ( $h_0 - h$ ) mm |     |     |     |     |     |
| Log $L$                         |     |     |     |     |     |
| Log $d$                         |     |     |     |     |     |

**Table 1**

(7 marks)

- (e) Plot a graph of  $\log L$  (y-axis) against  $\log d$ .

(5 marks)



- (f) (i) Determine the slope  $s$  of the graph.

(3 marks)

- (ii) Evaluate  $y = \frac{1}{s}$

$y = \dots\dots\dots$

(1 mark)

- (iii) Determine  $G$ , the value of  $\log L$ , when  $\log d = 0$ .

$G = \dots\dots\dots$

(2 marks)

- (iv) Given that  $G = \frac{\log k}{y}$ , determine the value of  $k$ .

$k \dots\dots\dots$

(1 mark)

Candidates were required to set up the apparatus as per the diagram and follow the instructions (a to f). Candidates were also required to take measurements using a vernier caliper; record the readings to the correct number of significant figures, use logarithms and calculators, draw graphs and solve equations.

### Weakness

Students were unable to:

- Read the vernier caliper in the correct
- Convert of cm to mm, choosing suitable scales.
- Record logarithms to the correct number of significant figures.
- Extrapolate the graphs.

### Expected response

- (a)  $h_0 = 92.8 \text{ mm}$

(1 mark)

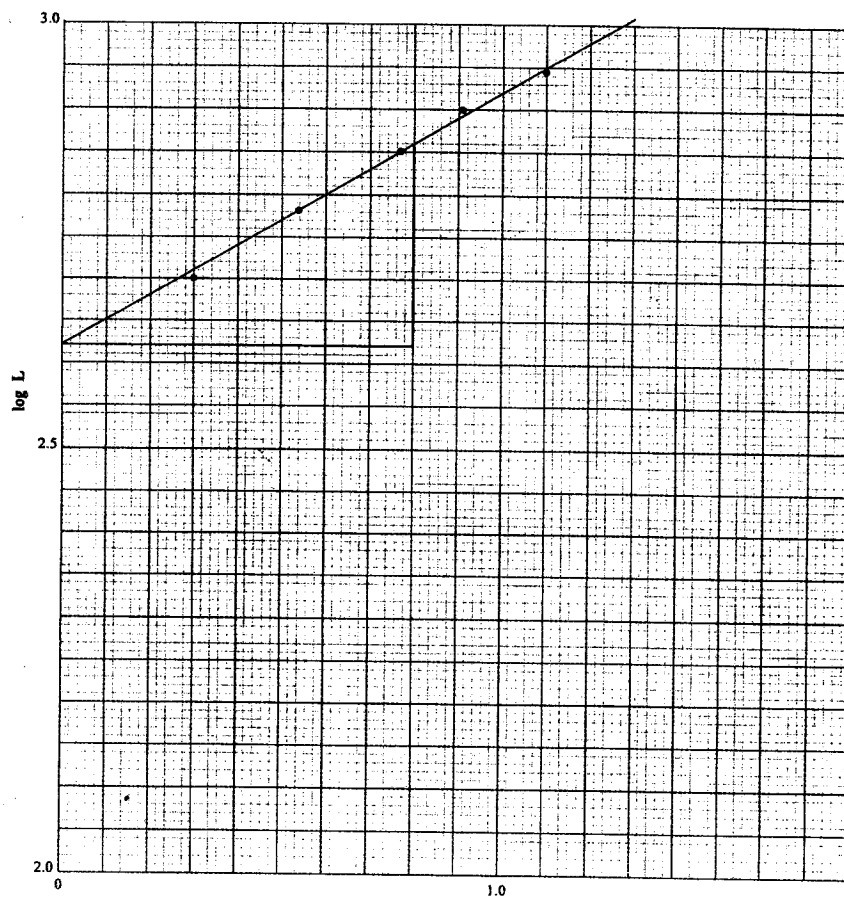
(d) Table 1

|                                     |      |      |      |      |      |
|-------------------------------------|------|------|------|------|------|
| Length L mm                         | 900  | 800  | 700  | 600  | 500  |
| Height h mm                         | 79.8 | 84.7 | 86.9 | 89.4 | 90.8 |
| Depression d(h <sub>0</sub> - h) mm | 12.9 | 8.1  | 5.9  | 3.4  | 2.0  |
| Log L                               | 2.95 | 2.90 | 2.85 | 2.78 | 2.70 |
| Log d                               | 1.11 | 0.91 | 0.77 | 0.53 | 0.30 |

(7 marks)

(e)

(5 marks)



(f) (i) Extraction  $\frac{2.86 - 2.62}{0.80 - 0}$  (1 mark)

Subtraction and division  $\frac{0.24}{0.80}$  (1 mark)

Value of S. 0.30 (1 mark)

f (ii)  $\frac{1}{0.30} = 0.33$  (1 mark)

f (iii) Extrapolation (1 mark)

Reading G = 2.62 (1 mark)

f(iv)

Correct substitution of  $\Delta X$  and  $\Delta Y$  in the equation ( $\frac{1}{2}$ )

Correct evaluation to the nearest whole number

or 1 decimal place ( $\frac{1}{2}$ ) (1 mark)

## **7.5 ADVICE TO TEACHERS**

- 7.5.1 Learners should be guided on meaning of terms for them to be able to define with ease.
- 7.5.2 All laws must be properly explained for learners to understand their application in various situations besides being able to state the law verbatimely.
- 7.5.3 Learners should be guided on proper use of formulae and language when responding to questions to show clearly their knowledge on certain concept and skills.
- 7.5.4 Most topics will be better understood if a practical approach is used. Candidates are unable to describe well due to lack of knowledge and poor mastery of content.
- 7.5.5 Graphical analysis should be included in the teaching of physics.
- 7.5.6 Candidates must be advised to follow instructions in the practical paper and use the recorded data appropriately.

## 29.5 PHYSICS (232)

### 29.5.1 Physics Paper 1 (232/1)

#### SECTION A (25 marks)

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

- 1 Figure 1 shows a vernier callipers being used to measure the internal diameter of a tube.

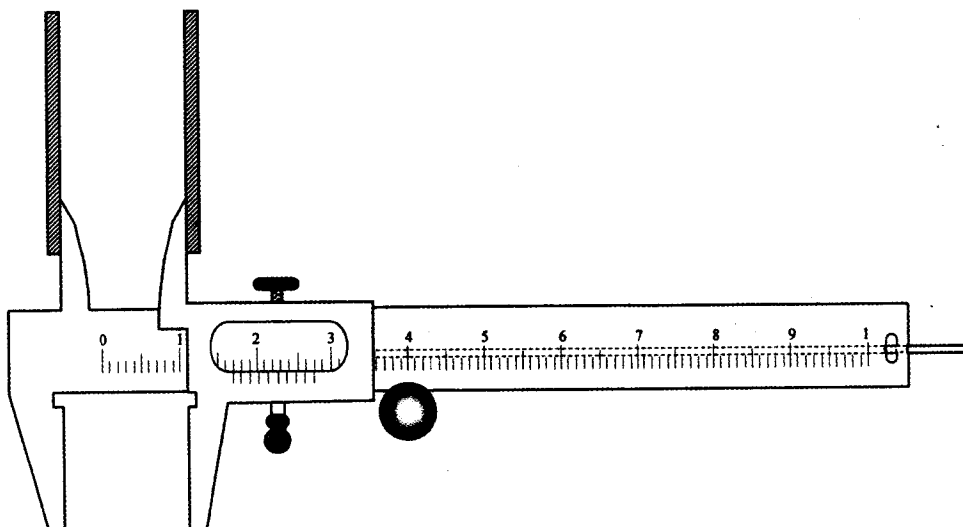
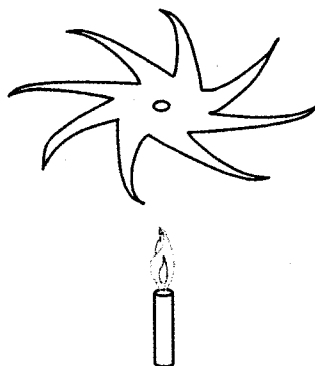


Figure 1

Record the diameter of the tube.

(1 mark)

- 2 A stopwatch started 0.50s after the start button was pressed. The time recorded using the stopwatch for a ball bearing falling through a liquid was 2.53s. Determine the time of fall.  
(1 mark)
- 3 Some water in a tin can was boiled for some time. The tin can was then sealed and cooled. After some time it collapsed. Explain this observation.  
(2 marks)
- 4 A paper windmill in a horizontal axis was placed above a candle as shown in figure 2.



Lit candle

Figure 2

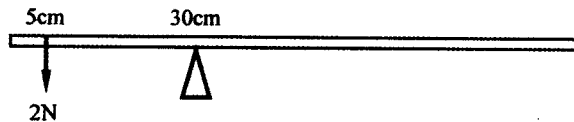
When the candle was lit the paper windmill begun to rotate.

Explain this observation.

(2 marks)

- 5 When a liquid is heated in a glass flask, its level at first falls, then rises. Explain this observation. (2 marks)

- 6 **Figure 3** shows a uniform metre rule pivoted at the 30cm mark. It is balanced by a weight of 2N suspended at the 5cm mark.

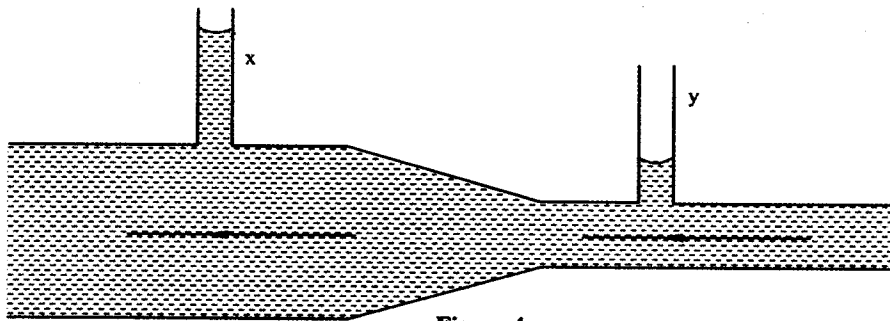


**Figure 3**

Determine the weight of the metre rule.

(2 marks)

- 7 **Figure 4** shows a horizontal tube with two vertical tubes x and y. Water flows through the horizontal tube from right to left. The water level in tube x is higher than water level in tube y.



**Figure 4**

Explain this observation.

(2 marks)

- 8 A cart of mass 30kg is pushed along a horizontal path by a horizontal force of 8N and moves with a constant velocity. The force is then increased to 14N. Determine:

(a) the resistance to the motion of the cart; (1 mark)

(b) the acceleration of the cart. (2 marks)

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

- 10 The weight of a solid in air is 5.0N. When it is fully immersed in a liquid of density  $800\text{Kg m}^{-3}$ , its weight is 4.04N.

Determine:

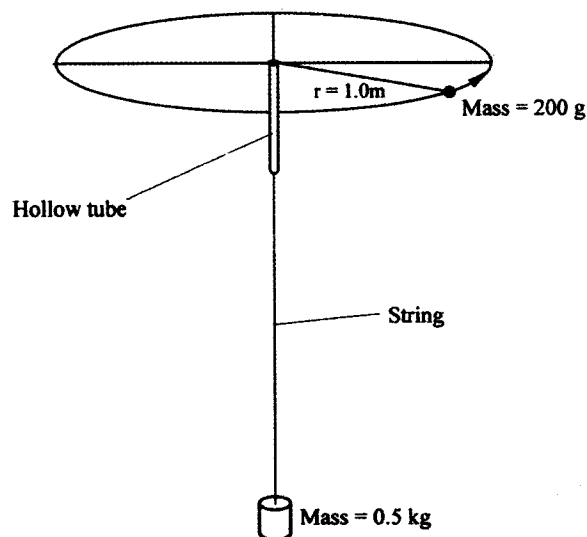
(a) the upthrust in the liquid; (1 mark)

(b) the volume of the solid.

(2 marks)

- 11 When a bicycle pump was sealed at the nozzle and the handle slowly pushed towards the nozzle, the pressure of the air inside increased.  
Explain this observation. (1 mark)

- 12 **Figure 5** shows a mass of 200g connected by a string through a hollow tube to a mass of 0.5kg. The 0.5kg mass is kept stationary in the air by whirling the 200g mass round in a horizontal circle of radius 1.0metre.



**Figure 5**

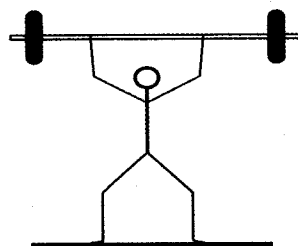
Determine the angular velocity of the 200g mass.

(3 marks)

- 13 State the SI unit of a spring constant.

(1 mark)

- 14 **Figure 6** shows an athlete lifting weights while standing with the feet apart.



**Figure 6**

Explain why standing with the feet apart improves the athletes's stability.

(1 mark)

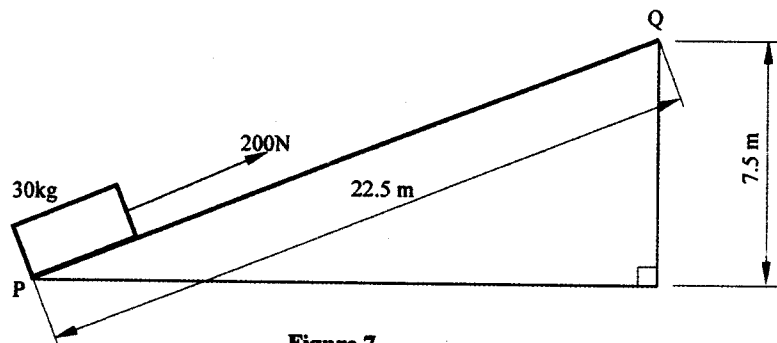
## SECTION B (55 marks)

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

- 15 (a) A cyclist initially at rest moved down a hill without pedalling. He applied brakes and eventually stopped. State the energy changes as the cyclist moved down the hill.

(1 mark)

- (b) **Figure 7** shows a mass of 30kg being pulled from point P to point Q, with a force of 200N parallel to an inclined plane. The distance between P and Q is 22.5m. In being moved from P to Q the mass is raised through a vertical height of 7.5m.



**Figure 7**

- (i) Determine the work done:
  - I by the force; (2 marks)
  - II on the mass; (2 marks)
  - III to overcome friction. (2 marks)
- (ii) Determine the efficiency of the inclined plane. (2 marks)
- (c) Suggest **one** method of improving the efficiency of an inclined plane. (1 mark)

- 16** In an experiment to determine the density of sand using a density bottle, the following measurements were recorded:

|   |   |       |
|---|---|-------|
| Mass of empty density bottle                              | = | 43.2g |
| Mass of density bottle full of water                      | = | 66.4g |
| Mass of density bottle with some sand                     | = | 67.5g |
| Mass of density bottle with the sand filled up with water | = | 82.3g |

Use the above data to determine the:

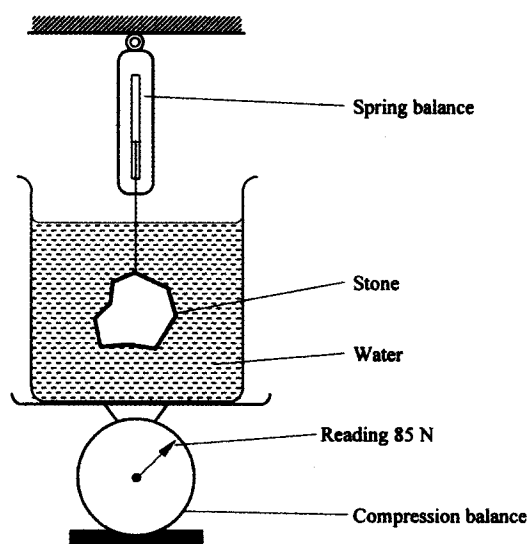
- (a) mass of water that completely filled the bottle; (2 marks)
  - (b) volume of water that completely filled the bottle; (1 mark)
  - (c) volume of the density bottle; (1 mark)
  - (d) mass of sand; (1 mark)
  - (e) mass of water that filled the space above the sand; (1 mark)
  - (f) volume of the sand; (3 marks)
  - (g) density of the sand. (2 marks)
- 17** (a) Explain why it is advisable to use a pressure cooker for cooking at high altitudes. (2 marks)

- (b) Water of mass 3.0kg initially at 20°C is heated in an electric kettle rated 3.0KW. The water is heated until it boils at 100°C. (Take specific heat capacity of water  $4200\text{Jkg}^{-1}\text{K}^{-1}$ , Heat capacity of the kettle =  $450\text{JK}^{-1}$ , Specific latent heat of vaporisation of water =  $2.3\text{mJkg}^{-1}$ )

Determine:

- (i) the heat absorbed by the water; (2 marks)
- (ii) heat absorbed by the electric kettle; (2 marks)
- (iii) the time taken for the water to boil; (3 marks)
- (iv) how much longer it will take to boil away all the water. (3 marks)

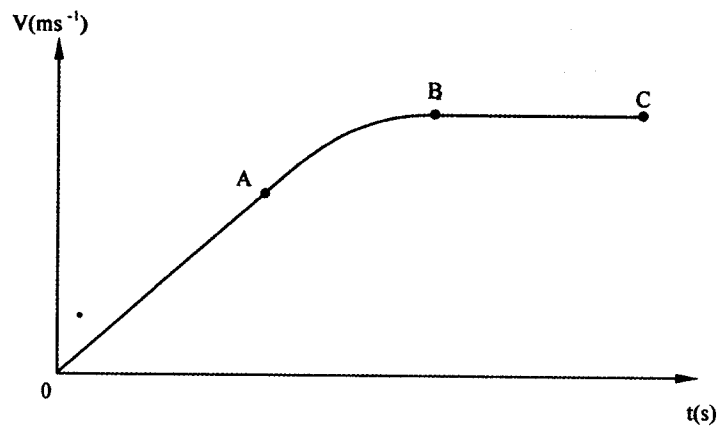
- 18 **Figure 8** shows a stone of mass 4.0kg immersed in water and suspended from a spring balance with a string. The beaker was placed on a compression balance whose reading was 85N. The density of the stone was  $3000\text{kgm}^{-3}$  while the density of the liquid was  $800\text{kgm}^{-3}$ .



**Figure 8**

Determine the:

- (a) volume of the liquid displaced; (2 marks)
  - (b) upthrust on the stone; (4 marks)
  - (c) reading of the spring balance; (2 marks)
  - (d) reading of the compression balance when the stone was removed from the water. (2 marks)
- 19 (a) **Figure 9** shows a velocity-time graph for the motion of a certain body.



**Figure 9**

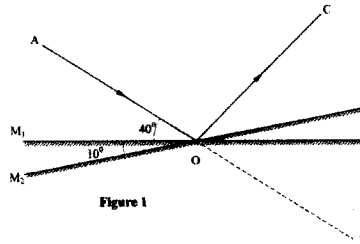
Describe the motion of the body in the region:

- (i)  $OA$ ; (1 mark)
  - (ii)  $AB$ ; (1 mark)
  - (iii)  $BC$ . (1 mark)
- (b) A car moving initially at  $10\text{ms}^{-1}$  decelerates at  $2.5\text{ ms}^{-2}$ .
- (i) Determine:
    - (I) its velocity after 1.5s; (2 marks)
    - (II) the distance travelled in 1.5s; (2 marks)
    - (III) the time taken for the car to stop. (2 marks)
  - (ii) Sketch the velocity-time graph for the motion of the car up to the time the car stopped. (1 mark)
  - (iii) From the graph, determine the distance the car travelled before stopping. (2 marks)

SECTION A (25 marks)

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

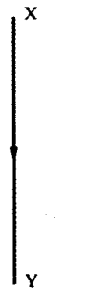
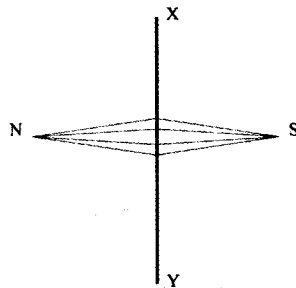
- 1 **Figure 1**, shows a ray of light incident on a plane mirror at O. The mirror is then rotated anticlockwise about O from position  $M_1$  to position  $M_2$  through an angle of  $10^\circ$ . The final reflected ray is OC.



Determine the angle of deviation BOC.

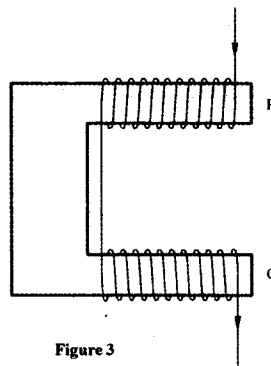
(2 marks)

- 2 **Figure 2(a)**, shows a magnetic compass placed under a horizontal wire XY



A large current is passed from X to Y. Draw the final position of the magnetic compass needle in figure 2b. (1 mark)

- 3 **Figure 3**, shows a diagram of a current-carrying wire wound on a U-shaped soft iron.

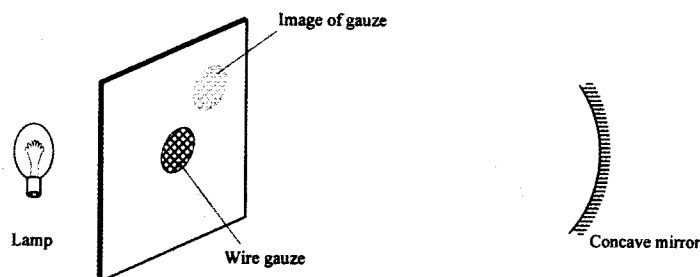


Draw the magnetic field pattern around P and Q.

(2 marks)

- 4 A positively charged sphere is suspended by an insulating thread. A negatively charged conductor is suspended near it. The conductor is first attracted, after touching the sphere it is repelled. Explain this observation. (2 marks)

- 5 **Figure 4**, shows a bright electric lamp placed behind a screen which has a hole covered with a wire gauze. A concave mirror of focal length 25cm is placed in front of the screen. The position of the mirror is adjusted until a sharp image of the gauze is formed on the screen.

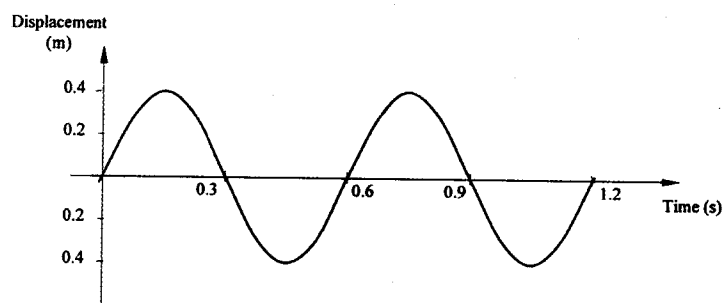


**Figure 4**

Determine the distance between the mirror and the screen. (1 mark)

- 6 Explain why electric power is transmitted over long distances at high voltages. (2 marks)

- 7 **Figure 5**, shows how the displacement of a point varies with time as a wave passes it.



**Figure 5**

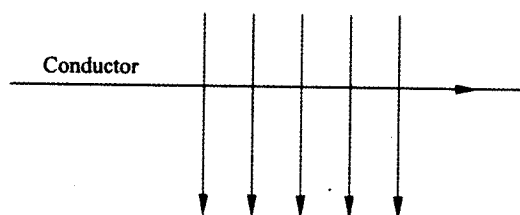
On the same diagram, draw a wave which passes the point with half the amplitude and twice the frequency of the one shown. (2 marks)

- 8 A water wave of wavelength 18 mm is incident on a boundary of shallow water at right angles. If the wavelength in the shallow end is 14.4 mm, determine the refractive index of water for a wave moving from the deep to the shallow end. (3 marks)

- 9 The initial mass of a radioactive substance is 20g. The substance has a half-life of 5 years. Determine the mass remaining after 20 years. (2 marks)

- 10 A current  $I$  flowing through a wire of resistance  $R$  was increased seven times. Determine the factor by which the rate of heat production was increased. (3 marks)

- 11 **Figure 6**, shows a horizontal conductor in a magnetic field parallel to the plane of the paper.



**Figure 6**

State the direction in which the wire may be moved so that the induced current is in the direction shown by the arrow. (1 mark)

- 12 An x-ray tube produces soft x-rays. State the adjustment that may be made so that the tube produces hard x-rays. (1 mark)

- 13 The wavelength of a radio wave is 1km. Determine its frequency. (2 marks)  
(Take the speed of light as  $3.0 \times 10^8 \text{ ms}^{-1}$ )
- 14 Figure 7, shows a block diagram of a p-n junction diode.

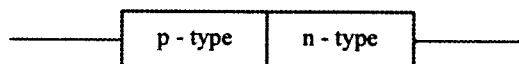


Figure 7

On the same diagram, show how a battery may be connected so that the diode is reverse biased. (1 mark)

### SECTION B (55 marks)

Answer ALL the questions in this section in the spaces provided.

- 15 (a) Figure 8, shows a circuit that may be used to charge a capacitor.

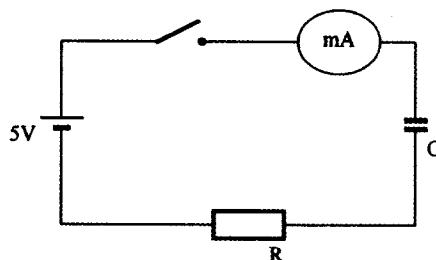


Figure 8

- (i) state the observation on the milliammeter when the circuit is switched on: (1 mark)
  - (ii) explain the observation in (i) above. (2 marks)
- (b) The circuit in figure 8 is left on for some time. State the value of p.d. across:
- (i) the resistor R; (1 mark)
  - (ii) the capacitor C; (1 mark)
- (c) sketch the graph of potential difference (V) across R against time. (1 mark)
- (d) Figure 9 shows three capacitors connected to a 10V battery.

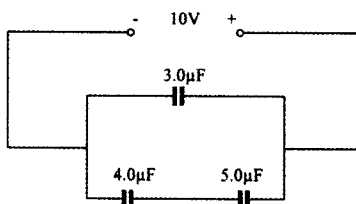


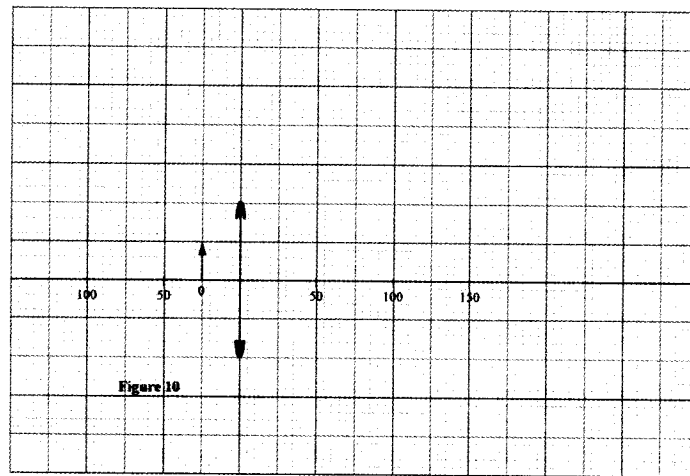
Figure 9

Calculate:

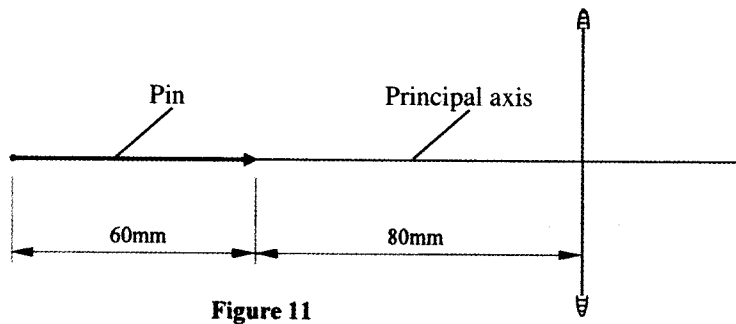
- (i) the combined capacitance of the three capacitors; (3 marks)

- (ii) the charge on the  $5.0 \mu\text{F}$  capacitor. (3 marks)

- 16 (a) **Figure 10**, shows an object placed in front of a converging lens of focal length  $50\text{mm}$ .

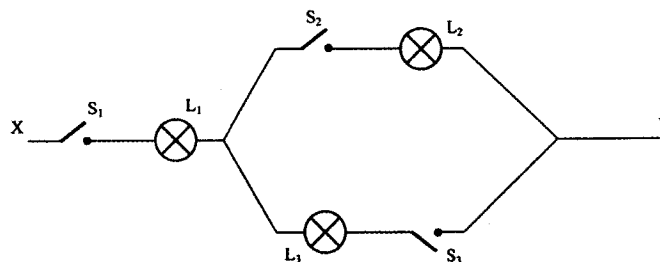


- (i) On the same figure, draw a ray diagram showing the location of the image. (3 marks)
  - (ii) Use the ray diagram to determine the:
    - (I) image distance; (1 mark)
    - (II) magnification. (2 marks)
  - (iii) State the adjustment that should be done to obtain a larger virtual image using the same lens. (1 mark)
  - (iv) State **one** application of the arrangement in **figure 10**. (1 mark)
- (b) **Figure 11**, shows a pin  $60\text{ mm}$  long placed along the principal axis of the lens used in part (a). The near end of the pin is  $80\text{ mm}$  from the lens.



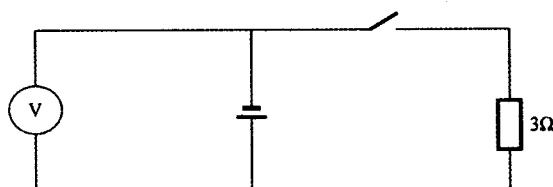
- Determine the length of the image. (5 marks)

- 17 (a) **Figure 12**, shows an electrical circuit including three switches,  $S_1$ ,  $S_2$ ,  $S_3$ , and three identical lamps  $L_1$ ,  $L_2$ ,  $L_3$ . A constant potential difference is applied across X and Y.



**Figure 12**

- (i) Other than  $L_1$ , state the lamp that will light when  $S_1$  and  $S_2$  are closed. (1 mark)
  - (ii) How does the brightness of  $L_1$  in (i) above compare with its brightness when all the switches are closed? (1 mark)
  - (iii) Explain the observation in part (ii) above. (1 mark)
- (b) **Figure 13**, shows a cell in series with a  $3\Omega$  resistor and a switch. A high resistance voltmeter is connected across the cell.

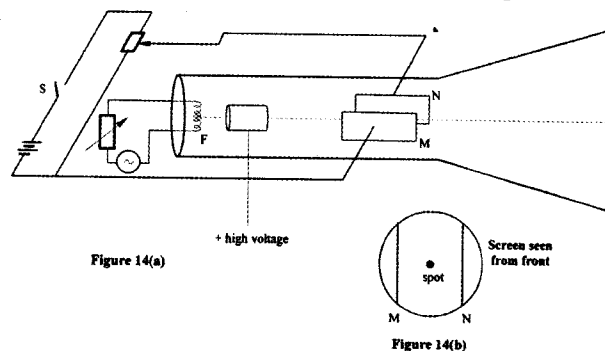


**Figure 13**

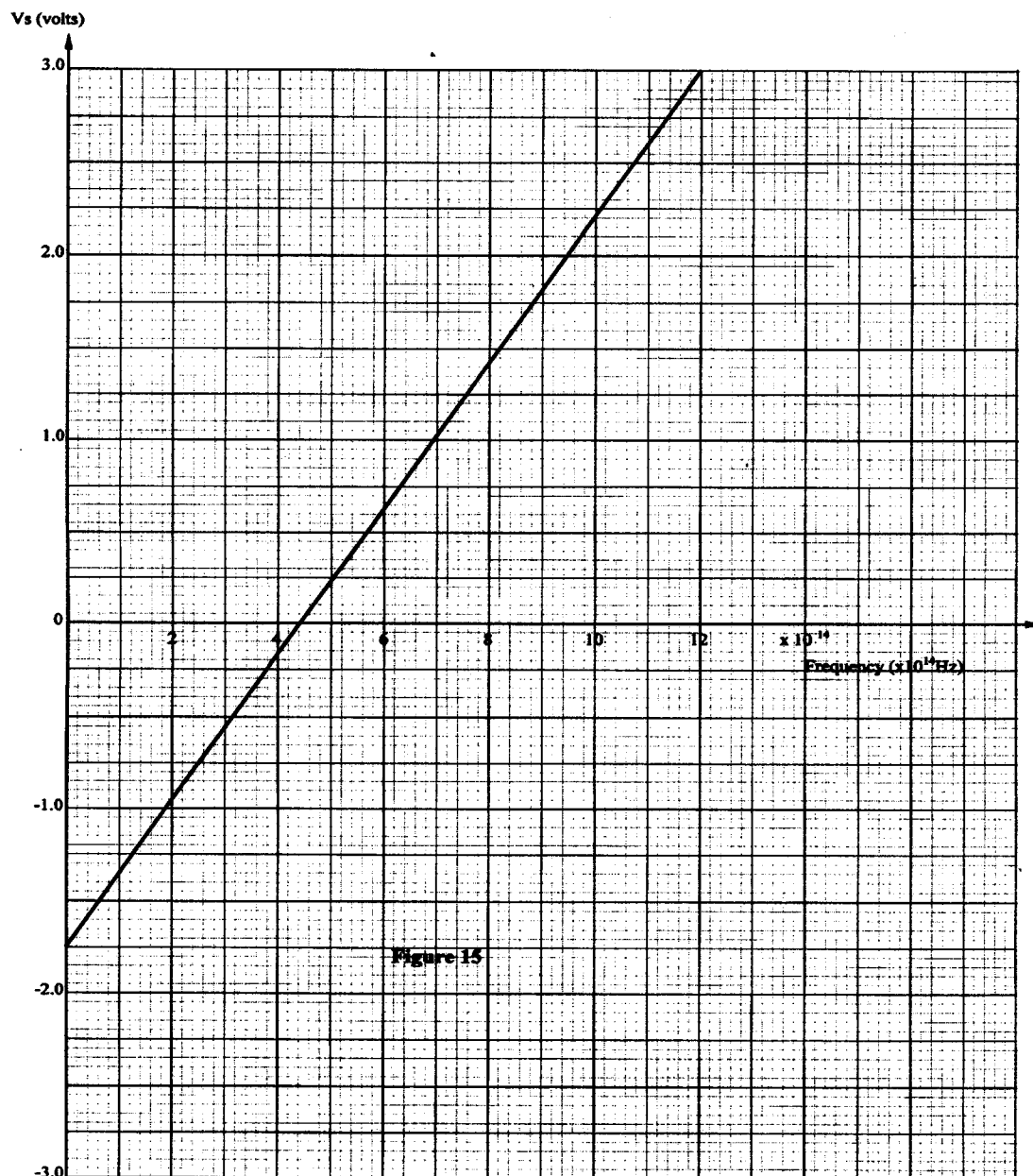
The voltmeter reads 1.5V with the switch open and 1.2V with the switch closed.

- (i) State the electromotive force of the cell. (1 mark)
  - (ii) Determine the current through the  $3\Omega$  resistor when the switch is closed. (2 marks)
  - (iii) Determine the internal resistance of the cell. (2 marks)
- (c) (i) Another resistor  $R$  is connected in series with the  $3\Omega$  resistor so that a current of 0.15A flows when the switch is closed. Determine the resistance of  $R$ . (3 marks)

- 18 **Figure 14a**, is a diagram of a cathode ray tube. M and N are parallel vertical plates.



- (a) When switch S is open, a spot is seen at the centre of the screen as shown in **figure 14(b)**.
- State what happens to the spot when S is closed. (1 mark)
  - State what would happen to the spot if the potential difference across MN is increased. (1 mark)
  - State what would be seen on the screen if the battery is replaced with an alternating emf of:
    - a low frequency of about 1 Hz; (1 mark)
    - a high frequency of about 50Hz. (1 mark)
- (b) Explain the process by which electrons are produced at F. (2 marks)
- (c) State with a reason how the brightness of the spot can be increased. (2 marks)
- (d) The accelerating voltage of the tube is 1000V and the electron current in the beam is 1.5mA. Determine the energy conveyed to the screen per second. (2 marks)
- 19 (a) State the property of radiation that determines the number of electrons emitted when a radiation falls on a metal surface. (1 mark)
- (b) **Figure 15** is a graph of the stopping potential  $V_s$  against frequency in an experiment on photoelectric effect.



(i) What is meant by stopping potential? (1 mark)

(ii) Given that the stopping potential  $V_s$  is related to the frequency by the equation.

$$V_s = \frac{h}{e}f - \frac{\omega_0}{e}, \quad \text{Where } e \text{ is the charge of an electron, } (e = 1.6 \times 10^{-19} \text{C})$$

Determine from the graph:

(I) plank's constant,  $h$ ; (4 marks)

(II) the work function  $\omega_0$  for the metal in electron volts (eV). (3 marks)

### 29.5.3 Physics Paper 3 (232/3)

1 You are provided with the following:

- a metre rule;
- vernier callipers;
- a 300 g mass;
- two knife edges;
- some thread.

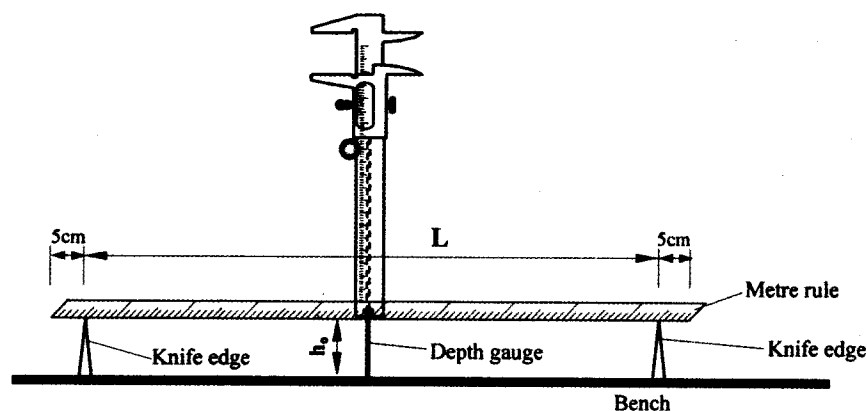
Proceed as follows:

- (a) Place the metre rule on the knife edges such that each knife edge is 45 cm from the 50 cm mark (centre of the rule). See **figure 1**. Ensure that the millimetre scale of the metre rule is facing upwards. The distance  $L$  between the knife edges is now 900 mm.

Place the vernier callipers vertically against the metre rule at the 50 cm mark with the depth gauge lowered to touch the bench as shown in figure 1.

Record the height  $h_0$ , of the upper edge of the metre rule at the 50 cm mark. (see **figure 1**).

$h_0 = \dots\dots\dots$  mm (1 mark)



**Figure 1**

- (b) Using the thread provided, hang the 300g mass at the 50 cm mark of the metre rule. Ensure that the mass does not touch the bench. Measure and record in table 1, the height  $h$  of the edge of the metre rule at the 50 cm mark.
- (c) With the 300g mass still at the 50 cm mark, adjust the position of the knife edges so that  $L$  is now 800 mm. (The knife edges should be equidistant from the centre of the metre rule). Measure and record in table 1 the height  $h$  of the edge of the metre rule at the 50 cm mark.

- (d) Repeat the procedure in (c) for other values of  $L$  shown in table 1. Complete the table.

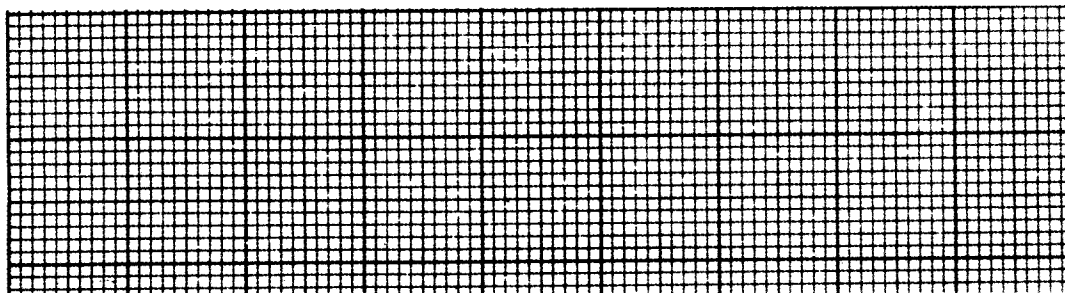
| Length $L$ (mm)                 | 900 | 800 | 700 | 600 | 500 |
|---------------------------------|-----|-----|-----|-----|-----|
| Height $h$ (mm)                 |     |     |     |     |     |
| Depression $d$ ( $h_0 - h$ ) mm |     |     |     |     |     |
| Log $L$                         |     |     |     |     |     |
| Log $d$                         |     |     |     |     |     |

**Table 1**

(7 marks)

- (e) Plot a graph of  $\log L$  (y-axis) against  $\log d$ .

(5 marks)



- (f) (i) Determine the slope  $s$  of the graph.

(3 marks)

- (ii) Evaluate  $y = \frac{1}{s}$

$y = \dots\dots\dots$

(1 mark)

- (iii) Determine  $G$ , the value of  $\log L$ , when  $\log d = 0$ .

$G = \dots\dots\dots$

(2 marks)

- (iv) Given that  $G = \frac{\log k}{y}$ , determine the value of  $k$ .

$k \dots\dots\dots$

(1 mark)

**2** You are provided with the following:

- a 100 ml beaker;
- a 600 ml beaker;
- 2 thermometers range  $-10^\circ\text{C}$  to  $110^\circ\text{C}$ ;
- a measuring cylinder; (to be shared)
- some plasticine;
- vernier callipers; (to be shared)
- a meter-rule or half metre rule;
- some boiling water;
- some cold water; (at room temperature).
- stopwatch;
- a stirrer.

Proceed as follows:

- (a) Using the vernier callipers, measure the internal diameter  $d_1$  and the external diameter  $d_2$  of the 100 ml beaker.

$d_1 = \dots\dots\dots$  cm

$d_2 = \dots\dots\dots$  cm (1 mark)

Determine the thickness  $X$  of the glass wall of the beaker, given that  $X = \frac{d_2 - d_1}{2}$

$X = \dots\dots\dots$  cm (1 mark)

- (b) Using the measuring cylinder provided, pour 75 ml of cold water into the small beaker. Measure the height  $h$ , of the water in the small beaker.

$h = \dots\dots\dots$  cm (1 mark)

Determine the area  $A$  of the glass walls in contact with water, given that

$$A = \pi d_1 h.$$

$A = \dots\dots\dots$  cm<sup>2</sup> (1 mark)

- (c) Use the plasticine provided to make a circular disc of about the same area as the bottom surface of the smaller beaker and about 1 cm thick. Place this disc at the bottom of the large beaker and place the small beaker on it. Now pour boiling water into the large beaker until the levels of the water in the two beakers are same. See figure 2.

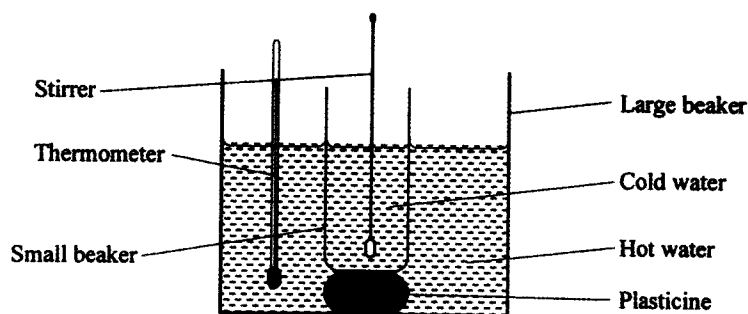


Figure 2

- (d) Place a thermometer in the hot water and stir gently until the temperature drops to 75°C. Now start the stopwatch and measure the temperature  $T_1$  of the hot water at intervals of 20 seconds. Record the values in Table 2.  
(Stir the water in the two beakers before taking the readings).  
Pour out the contents of the two beakers.
- (e) Measure another 75 ml of cold water and put it into the small beaker. Place the small beaker inside the large beaker on the plasticine disc as before.  
Again pour boiling water into the large beaker until the levels of the water in the two beakers are the same. Place one thermometer in the cold water and the other in the hot water. Stir gently until the temperature of the hot water drops to 75°C. Start the stopwatch and immediately read and record in Table 2 the temperature  $T_2$  of the cold water.  
(You may now remove the thermometer in the hot water).

Read other values of  $T_2$  at intervals of 20s and record in table 2.

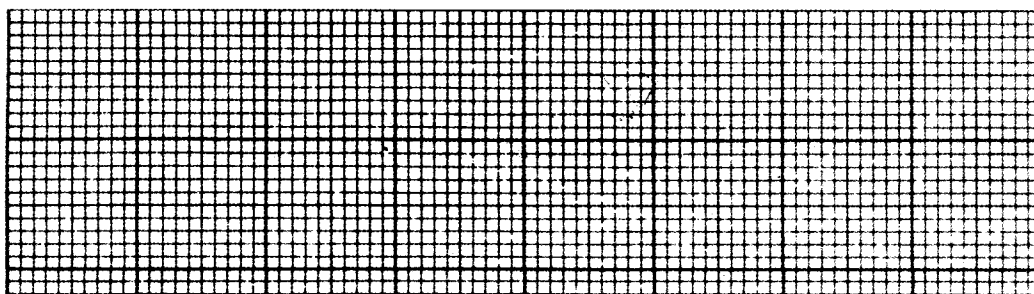
| Time t (seconds)     | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 |
|----------------------|---|----|----|----|----|-----|-----|-----|-----|-----|
| Temperature $T_1$ °C |   |    |    |    |    |     |     |     |     |     |
| Temperature $T_2$ °C |   |    |    |    |    |     |     |     |     |     |

Table 2

(6 marks)

- (f) Plot a graph of temperature  $T_2$  (y-axis) against time.

(5 marks)



- (g) (i) Determine the slope  $S$  of the graph at time  $t = 60$  seconds. (3 marks)
- (ii) Determine the constant  $k$ , given that  $k = \frac{315 SX}{A(T_1 - T_2)}$   
where  $T_1$  and  $T_2$  are the temperatures of the hot and the cold water at  $t = 60$ s,  
and  $X$  and  $A$  are in m and  $m^2$  respectively. (2 marks)

### 30.5 PHYSICS (232)

#### 30.5.1 Physics Paper 1 (232/1)



MANYAM FRANCHISE  
Discover! Learn! Apply

1. 1.62cm (1 mark)
2. Time =  $(2.53 + 0.50)s = 3.03s$  (1 mark)
3. Air molecules expelled by heating; cooling creates partial vacuum – pressure inside is less than atmospheric pressure. Therefore collapses; (2 marks)
4. Flame heats air which becomes less dense and hence moves upwards. This will push the blades upwards and cause clockwise rotation. This creates a conventional current (2 marks)
5. Flask which is in contact with the heat expands first. Then the liquid expands more than glass. (2 marks)
6.
 

5cm                      30cm                      50cm

$W \times 0.2 = 2 \times 0.25$  (1 mark)

$\therefore W = \frac{2 \times 0.25}{0.2} = 2.5N$  (1 marks)
7. The tube below Y is narrower than the tube below X. So water flows faster below Y. Pressure is therefore lower than Y (Benoulli effect). (2 marks)
8.
 

(a) Resistance = 8N

(b)  $14 - 8 = 30 \text{ a}$

$\therefore a = \frac{6}{30} \text{ ms}^{-2}$

$= 0.2 \text{ ms}^{-2}$  (2 marks)
9. Drop spreads out until the patch is one molecule thick/monolayer. (1 mark)
10.
 

(a) Upthrust =  $(5.0 - 4.04)N$   
 $= 0.96N$  (1 mark)

(b) Weight of liquid displaced = 0.96N  
 $\therefore$  Mass of liquid = 0.096kg  
 $\frac{m}{V} = \rho$   
 $\frac{0.096}{V} = 800$   
 $\therefore V = \frac{0.096}{800} \text{ m}^3$   
 $= 1.2 \times 10^{-4} \text{ m}^3$   
 $= 1.2 \times 10^2 \text{ cm}^3$   
 $= 120 \text{ cm}^3$  (2 marks)

11. Volume decreases, so more collisions per second – hence higher pressure. (1 mark)
12.  $F = mr \omega^2 = mg$   
 $0.200 \times 1 \times \omega^2 = 0.5 \times 10 = 5$  (1 mark)  
 $\omega^2 = \frac{5}{0.200}$  (1 mark)  
 $\therefore \omega = \sqrt{\frac{5}{0.200}} = 5 \text{ rad s}^{-1}$  (1 mark)
13.  $\text{Nm}^{-1}$  (1 mark)
14. Increase the base area or lower the c.g. (1 mark)
15. (a) Potential Energy  $\longrightarrow$  Kinetic energy  $\longrightarrow$  Heat (1 mark)
- (b) (i) Work done by the force =  $200 \times 22.5 \text{ J}$   
 $= 4500 \text{ J}$  (2 marks)
- (ii) Work done on the mass =  $mgh$   
 $= 30 \times 10 \times 7.5 \text{ J}$   
 $= 2250 \text{ J}$  (2 marks)
- (iii) Work done to overcome friction =  $(4500 - 2250 \text{ J})$   
 $= 2250 \text{ J}$  (2 marks)
- (iv) Efficiency =  $\frac{\text{work output}}{\text{work input}} \times 100\%$   
 $= \frac{2250}{4500} \times 100\% = 50\%$  (2 marks)
- (c) Reduce friction by use of rollers/smoothing (polishing surfaces)/oiling. (1 mark)
16. (a) Mass of water completely filling the bottle  
 $= (66.4 - 43.2) \text{ g}$   
 $= 23.2 \text{ g}$  (2 marks)
- (b) Volume of water completely filling the bottle =  $23.2 \text{ cm}^3$  (1 mark)
- (c) Volume of density bottle =  $23.2 \text{ cm}^3$  (1 mark)
- (d) Mass of sand =  $(67.5 - 43.2) \text{ g} = 24.3 \text{ g}$  (1 mark)
- (e) Mass of water filling space above sand =  $82.3 - 67.5$   
 $= 14.8 \text{ g}$  (1 mark)
- (f) Volume of sand =  $(23.2 - 14.8) \text{ cm}^3$   
 $= 8.4 \text{ cm}^3$  (3 marks)

$$\begin{aligned}
 \text{(g) Density of sand} &= \frac{m}{v} = \frac{24g}{8.4cm^3} \\
 &= 2.807 \text{ gcm}^{-3}
 \end{aligned}
 \quad (2 \text{ marks})$$

17. (a) At high altitudes pressure is low so boiling point is low. So pressure cooker increases pressure which raises the boiling point, hence faster cooking.

(2 marks)

$$\begin{aligned}
 \text{(b) (i) Heat absorbed by water} &= 3 \times 4200 \times 80 \text{ J} \\
 &= 1008000 \text{ J}
 \end{aligned}
 \quad (2 \text{ marks})$$

$$\begin{aligned}
 \text{(ii) Heat absorbed by kettle} &= 450 \times 80 \text{ J} \\
 &= 36000 \text{ J}
 \end{aligned}
 \quad (2 \text{ marks})$$

$$\begin{aligned}
 \text{(iii) Heat applied by heater} &= pt = 3000t \text{ J} \\
 &= 3000t = 1008000 + 36000 \text{ J} \\
 &= 1044000
 \end{aligned}$$

$$\begin{aligned}
 \therefore t &= \frac{1044000}{3000} \\
 &= 348s
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{348}{60} \text{ minutes} \\
 &= 5.8 \text{ minutes}
 \end{aligned}$$

(3 marks)

$$\begin{aligned}
 \text{(iv) Time taken to boil away} \\
 m_v &= Pt \\
 3 \times 2.3 \times 10^6 &= 3000t \\
 \therefore t &= \frac{3 \times 2.3 \times 10^6}{3000} \text{ s} = 2300 \text{ s}
 \end{aligned}$$

$$= \frac{2300}{60} \text{ minutes} = 38.3 \text{ minutes}
 \quad (3 \text{ marks})$$

$$18. \quad \text{(a)} \quad \frac{m}{v} = \rho$$

$$\frac{4}{v} = 3000$$

$$\therefore v = \frac{4}{3000} m^3$$

$$v = 1.33 \times 10^{-3} m^3$$

(2 marks)

$$\text{(b) Mass of liquid displaced} = m$$

$$\frac{m}{v} = 800 \Rightarrow m = 800 \times 1.33 \times 10^{-3} \text{ kg}$$

(1 mark)

$$= 1.064 \text{ kg}$$

(1 mark)

Weight of the displaced liquid = 10.64 N (1 mark)

Upthrust = 10.64 N (1 mark)

(c) Weight of stove in air = 40 N  
Reading of spring balance = (40 - 10.64) N (1 mark)  
= 29.36 N (1 mark)

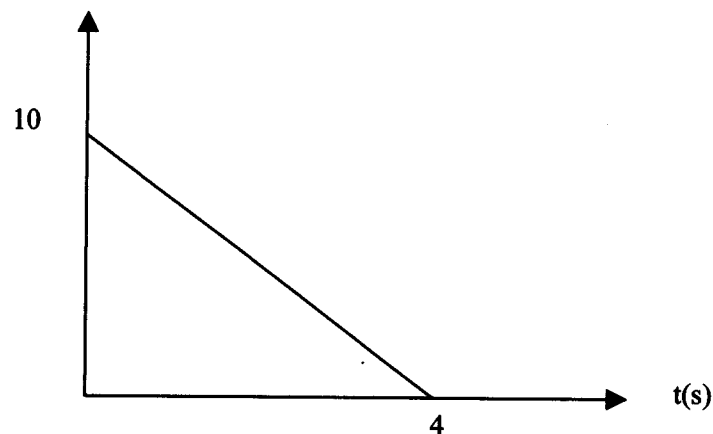
(d) When the stone is removed reading of compression balance  
= (85 - 10.64) N = 74.36 N (2 marks)

19. (a) (i) **OA** - Body moves from rest at constant acceleration.  
(ii) **AB** - Body moves with decreasing acceleration.  
(iii) **BC** - Body moves with constant velocity i.e. zero acceleration. (3 marks)

(b) (i)  $u = 10 \text{ ms}^{-1}$   
 $a = -25 \text{ ms}^{-2}$   
 $t = 1.5 \text{ s}$   
 $V = u + at = 10 - 25 \times 1.5 = 6.25 \text{ ms}^{-1}$   
(ii)  $S = ut + \frac{1}{2}at^2$   
 $= 10(1.5) - \frac{1}{2}(2.5) 1.5^2 = 12.1875 \text{ m}$   
 $= 12.19 \text{ m}$  (1 mark)  
(1 mark)

(iii)  $V = 0$   
i.e.  $0 = 10 - 2.5t$   
 $\Rightarrow t = \frac{10}{2.5} \text{ s} = 4 \text{ s}$  (1 mark)

(c) (i)  $V (\text{ms}^{-1})$

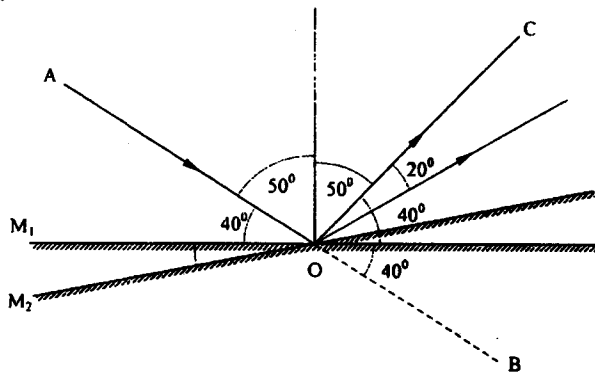


(1 mark)

(ii) Distance = Area of triangle  
 $= \frac{1}{2} \times 4 \times 10 = 20 \text{ m}$  (1 mark)  
(1 mark)

### 30.5.2 Physics Paper 2 (232/2)

1.



Figure

Initial deviation =  $80^\circ$

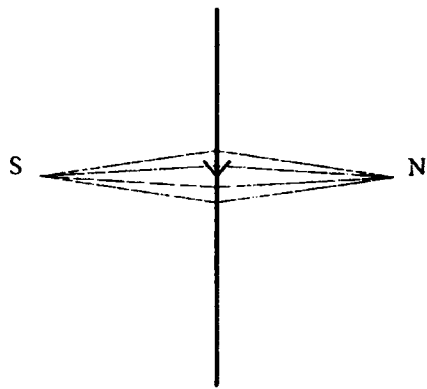
Reflected ray rotates  $2 \times 10 = 20^\circ$

Final deviation =  $(80 + 20)^\circ = 100^\circ$

(1 mark)

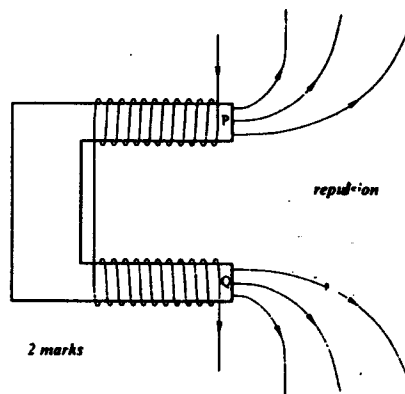
(1 mark)

2.



(1 mark)

3.



(2 marks)

Correct pattern – 1 mark

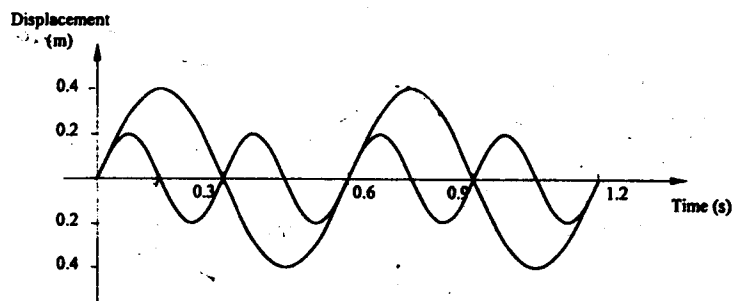
Arrow – 1 mark

4.

Initially attracted because it is of opposite charge.  
Then neutralised and charged positive and hence repel.

(2 marks)

5. Distance =  $2f = 2 \times 25 = 50 \text{ cm}$  (1 mark)
6. High voltages implies low current so reduces heat losses. (2 marks)
- 7.



(2 marks)  
Amplitude 1  
Frequency 1

8.  $v_1 = f\lambda_1$  (1 mark)  
 $v_2 = f\lambda_2$  (1 mark)

Refractive index

$$\begin{aligned} &= \frac{v_1}{v_2} = \frac{f\lambda_1}{f\lambda_2} \\ &= \frac{\lambda_1}{\lambda_2} = \frac{18}{14.4} = 1.25 \end{aligned} \quad (1 \text{ mark})$$

9.  $20\text{g} \longrightarrow 10\text{g} \longrightarrow 5\text{g} \longrightarrow 2.5\text{g} \longrightarrow 1.25\text{g}$

Mass remaining = 1.25g (1 mark)

Half-lives (idea) (1 mark)

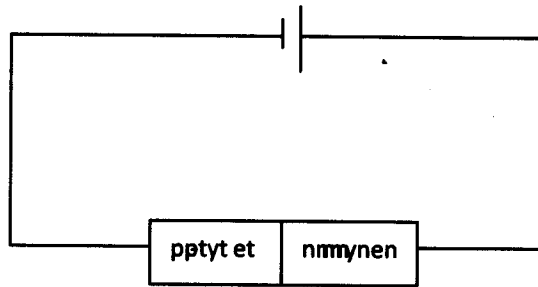
10.  $I_o$  - Initial current  
 $P = I^2R = I_o^2R$  ;  
 $I_2 = 7I_o$   
 $P = (7I_o)^2R = 49I_o^2R$  ;  
Power is 49 times initial value. (3 marks)

11. Motion out of paper. (1 mark)

12. Increase the acceleration voltage by setting a higher value. (1 mark)

13. 
$$f = \frac{v}{\lambda} = \frac{c}{\lambda} = \frac{3.0 \times 10^8}{1 \times 10^3} \text{ Hz}$$
  
$$= 3.0 \times 10^5 \text{ Hz}$$
 (2 marks)

14.



(1 mark)

15. (a) (i) High current which falls off to zero. (1 mark)  
 (ii) Current flows when the capacitor is charging. When fully charged current stop (no current) and p.d. is equal to charging voltage. (2 marks)

- (b) (i)  $V_R = 0$  volts (1 mark)  
 (ii)  $V_c = 5$  volts (1 mark)

- (c) (i)  $\frac{1}{C_s} = \frac{1}{4} + \frac{1}{5} = \frac{5+4}{20} = \frac{9}{20}$  (1 mark)

$$C_s = \frac{20}{9} \mu F$$

(1 mark)

$$C_T = \frac{20}{9} + 3.0 = 5\frac{2}{9} \mu F$$

$$= 5.22 \mu F$$

(1 mark)

- (ii) Charge on series section  
 $Q = CV = \frac{20}{9} \times 10 \mu C$  (1 mark)

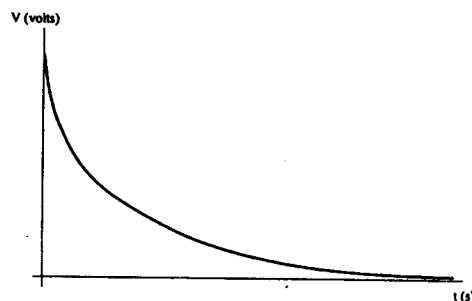
$$= \frac{200}{9} \mu C = 22.2 \mu C$$

(1 mark)

Same charge on each phase (series)  
 Charge on  $5.0 \mu F$  is  $22.2 \mu C$

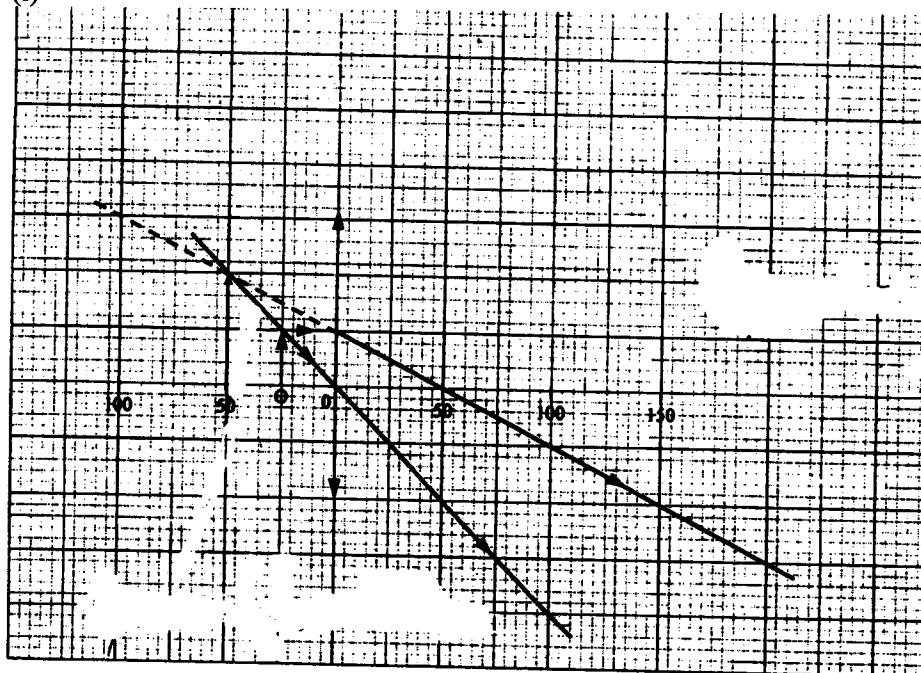
(1 mark)

- (iii)



16. (a)

(i)



(ii) (I)  $V = 50 \text{ cm}$  (1 mark)

(II)  $m = \frac{v}{u} = \frac{h_i}{h_o} = \frac{50}{25} = 2$  (2 marks)

(iii) Reduce the object distance. (1 mark)

(iv) Simple microscope (magnifying glass) (1 mark)

(b)  $U = 80 \text{ mm}$   
 $f = 50$

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{80} + \frac{1}{v} = \frac{1}{50} \quad \frac{1}{v} = \frac{1}{50} - \frac{1}{80} = \frac{3}{400}$$
 (1 mark)

$$v = \frac{400}{3}$$

When  $u = 80 + 60 \text{ mm} = 140 \text{ mm}$  (1 mark)

$$\frac{1}{v} = \frac{1}{50} - \frac{1}{140} = \frac{9}{700}$$

$$v = \frac{700}{9} \text{ mm}$$
 (1 mark)

$$\begin{aligned} \text{Length of image} &= \frac{400}{3} - \frac{700}{9} = 55.5 \\ &= 55.6 \text{ mm} \end{aligned}$$

(1 mark)

- (b) (i) Total resistance  
 $R_1 = 3 + 0.75 + R$   
 $R_T = R + 3.75$   
 $E = (IR_T)$  (1 mark)
- $1.5 = I(R + 3.75) = 0.15(R + 3.75)$
- $R + 3.75 = \frac{1.5}{0.15} = 10$  (1 mark)
- $R = 10 - 3.75\Omega$   
 $= 6.25\Omega$  (1 mark)
17. (a) (i) Lamps  $L_1$  and  $L_2$  (1 mark)  
(ii) Brighter (1 mark)  
(iii) Total resistance is less now. (1 mark)
- (b) (i) (I) E.m.f = 1.5V (1 mark)  
(II)  $1.5 = IR + Ir$   
 $IR = 1.2$   
 $3I = 1.2$   
 $I = 0.4 \text{ A}$  (2 marks)
- (III)  $Ir = 1.5 - 1.2 = 0.3$   
 $0.4r = 0.3$   
 $r = \frac{0.3}{0.4} \Omega = 0.75\Omega$  (2 marks)
18. (a) (i) Deflected towards the positive plate. (1 mark)  
(ii) E.m.f. increased deflection will be greater. (1 mark)
- (iii) (I) Spot moves back and forth. (1 mark)  
(II) there will be a horizontal line. (1 mark)
- (b) Electrons are given off as a result of heat produced by the current. (2 marks)
- (c) By increasing the filament current so that more electrons are released. (2 marks)
- (d)  $P = VI = 100 \times 1.5 \times 10^{-3} \text{ J} = 1.5 \text{ J s}^{-1}$  (2 marks)
19. (a) Intensity of radiation. (1 mark)
- (b) (i) The negative potential sufficient to just stop the ejection of the electron. (1 mark)
- (ii) (I) Gradient  
 $= \frac{3}{(12 - 4.4) \times 10^{14}} = 3.95 \times 10^{-15}$  (1 mark)

$$\frac{h}{e} = 3.95 \times 10^{-15}$$

$$\therefore h = 3.95 \times 10^{-15} \times 1.6 \times 10^{-19} \quad (1 \text{ mark})$$

$$= 6.32 \times 10^{-34} \text{ Js}$$

$$(iii) \quad -\frac{w}{e} = -1.75 \quad (1 \text{ mark})$$

$$w = 1.75 \times e$$

$$= 1.75 \times 1.6 \times 10^{-19} \text{ J} \quad (1 \text{ mark})$$

$$= \frac{1.75 \times 1.6 \times 10^{-19}}{1.6 \times 10^{-19}} \text{ eV}$$

$$= 1.75 \text{ eV} \quad (1 \text{ mark})$$

### 30.5.3 Physics Paper 3 (232/3)

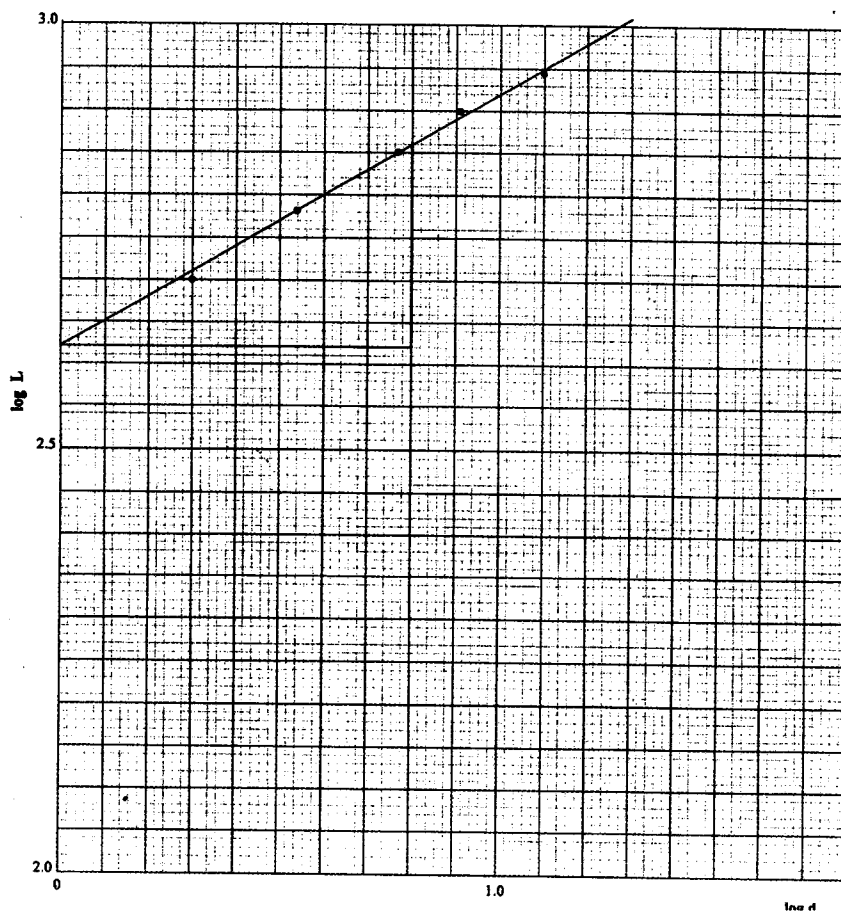
1. (a)  $h_0 = 92.8 \text{ mm}$  (1 mark)

(d) Table 1

|                            |      |      |      |      |      |
|----------------------------|------|------|------|------|------|
| Length L mm                | 900  | 800  | 700  | 600  | 500  |
| Height h mm                | 79.8 | 84.7 | 86.9 | 89.4 | 90.8 |
| Depression $d(h_0 - h)$ mm | 12.9 | 8.1  | 5.9  | 3.4  | 2.0  |
| Log L                      | 2.95 | 2.90 | 2.85 | 2.78 | 2.70 |
| Log d                      | 1.11 | 0.91 | 0.77 | 0.53 | 0.30 |

(7 marks)

(e) (5 marks)



(f) (i) Extraction  $\frac{2.86 - 2.62}{0.80 - 0}$  (1 mark)

Subtraction and division  $\frac{0.24}{0.80}$  (1 mark)

Value of S. 0.30 (1 mark)

f (ii)  $\frac{1}{0.30} = 0.33$  (1 mark)

f (iii) Extrapolation (1 mark)

Reading  $G = 2.62$  (1 mark)

f(iv)

Correct substitution of  $\Delta X$  and  $\Delta Y$  in the equation ( $\frac{1}{2}$ )  
 Correct evaluation to the nearest whole number  
 or 1 decimal place ( $\frac{1}{2}$ )

(1 mark)

2. (a)  $d_1 = 4.68 \text{ cm}$   
 $d_2 = 5.08$   
 $X = \frac{d_2 - d_1}{2} = \frac{5.08 - 4.68}{2} = \frac{0.4}{2} = 0.2$

(1 mark)

(b)  $h = 4.3$   
 $A = 68.8 \text{ cm}^2$

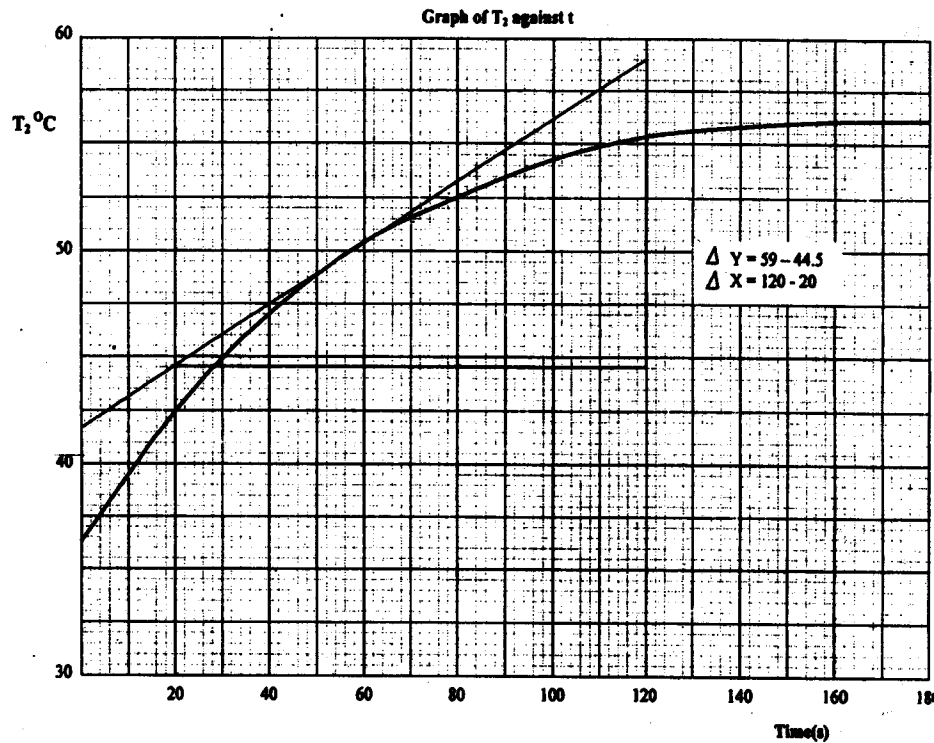
(1 mark)

(e)

| Time (s)             | 0  | 20   | 40   | 60   | 80 | 100  | 120  | 140  | 160  | 180  |
|----------------------|----|------|------|------|----|------|------|------|------|------|
| Temperature $T_1$ °C | 75 | 73.5 | 72.0 | 68.5 | 67 | 66.5 | 65.5 | 64.0 | 62.5 | 62.0 |
| Temperature $T_2$ °C | 37 | 37   | 42   | 51.5 | 52 | 54   | 55   | 55.5 | 56   | 56.5 |

(6 marks)

(f)



(g) (i) slope  $\frac{\Delta Y}{\Delta X} = \frac{14.5}{100} = 0.145$

(3 marks)

(ii)  $k = \frac{315SX}{A(T_1 - T_2)} = \frac{315 \times 0.145 \times 0.21 \times 10^{-2}}{68.8 \times 10^{-4} \times 17}$   
 $= 0.82$

(2 marks)