KCSE CHECKPOINT PHYSICS PAPER 2

A KCSE PHYSICS TOPICAL ANALYSIS 2006 - 2020

Well-illustrated, read – write enabled Physics revision topical with answers. Ideal for day to day revision in preparation for KCSE.

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PAPER 2 QUESTIONS

RECTILINEAR PROPAGATION OF LIGHT AND REFLECTION AT PLANE SURFACES

1. 2006 Q2

In a certain pinhole camera, the screen is 10 cm from the pinhole. When the camera is placed 6m away from a tree, a sharp image of the tree 16cm high is formed on the screen. Determine the height of the tree. (3 marks)

2. 2007 Q1

Figure 1 represents a pinhole camera

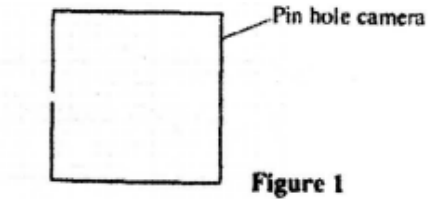


Figure 1

Sketch rays to show the formation of an enlarged image in the camera. Label both the object and the image. (2 marks)

3. 2008 Q1

Figure 1 shows three point sources of light with an opaque object placed between them and the screen.

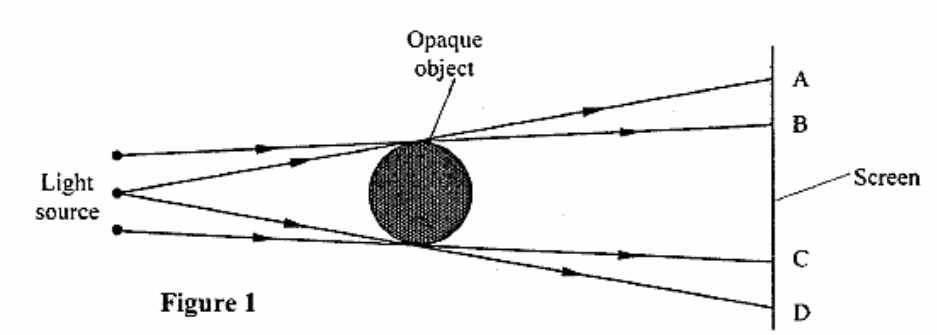


Figure 1

Explain the nature of the shadow formed along B and C. (2 marks)

4. 2009 Q1

State the number of images formed when an object is between two plane mirrors placed in parallel (1 mark)

5. 2009 Q2; 2016 Q1

Figure 1 shows a ray of light incident on a mirror at an angle of 45^0. Another mirror is placed at an angle of 45^0 to the first one as shown.

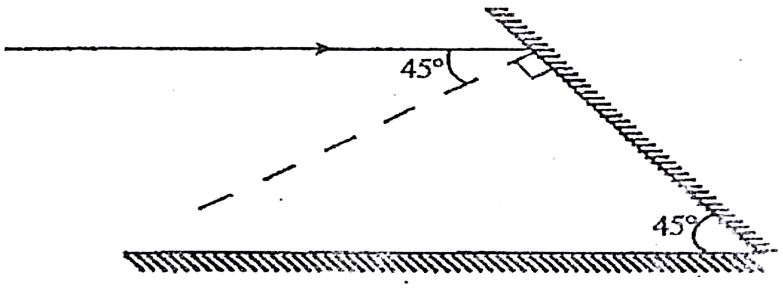


FIGURE 1

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

6. 2010 Q1

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°. The final reflected ray is OC.

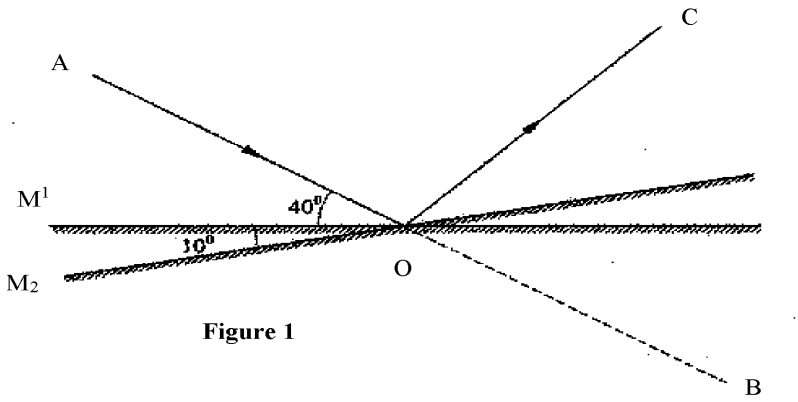


Figure 1

Determine the angle of deviation BOC. (2 marks)

7. **Figure 1** shows an object placed in front of a plane mirror.

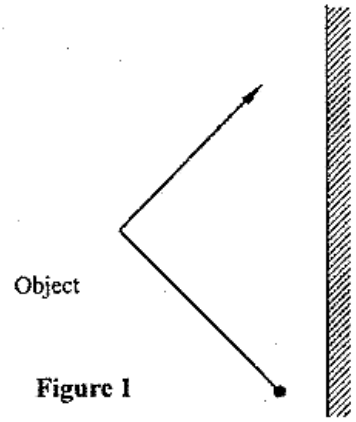


Figure 1

Sketch the image of the object as seen in the mirror. (1 mark)

13. 2015 Q1

Figure 1 shows three mirrors arranged at right angles to each other. A ray of light is incident on one of the mirrors.

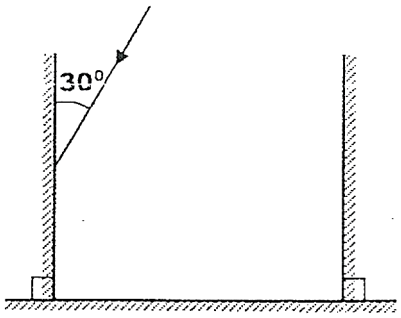


FIGURE 1

Complete the diagram to show the path of the ray after reflection on each of the mirror.

(3 marks)

14. 2018 Q4

State what happens to the image formed by a pin hole camera when the size of the hole is increased. (1 mark)

15. 2019 Q1

Figure 1 shows two plane mirrors inclined at an angle of 120° to each other. A ray of light makes an angle of 40° with the first mirror.

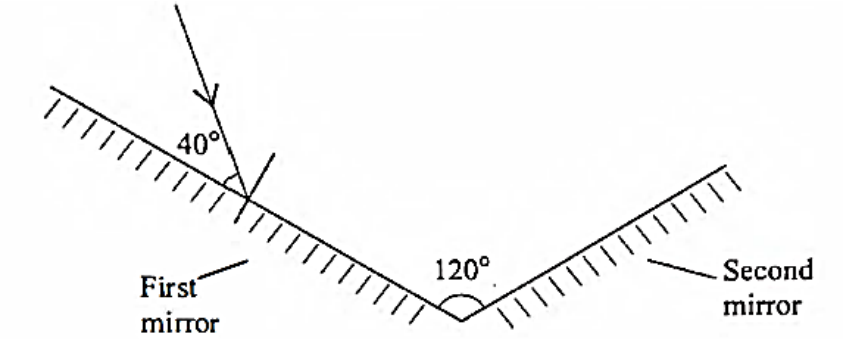


Figure 1

By completing the ray diagram determine the angle of reflection on the second mirror.

(2 marks)

State the observation made on the image in a pin hole camera when the distance between the object and the pin hole is reduced. (2 marks)

ELECTROSTATICS (I)

1. 2008 Q2

A leaf electroscope A is charged and placed on the bench. Another uncharged leaf electroscope B is placed on the same bench and moved close to A until the caps touch. State and explain what is observed on the leaves of A and B. (2 marks)

2. 2009 Q3

A conductor is slowly bought near the cap of a positively charged electroscope. The leaf first collapses and then diverges. State the charge on the conductor. (1 mark)

3. 2010 Q4

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)

4. 2011 Q2

Figure 2 shows two identical pith balls A and B suspended with insulated threads. They are separated by an insulator X. A is positively charged while B is negatively charged. The quantity of charge on A is three times the quantity of charge on B.

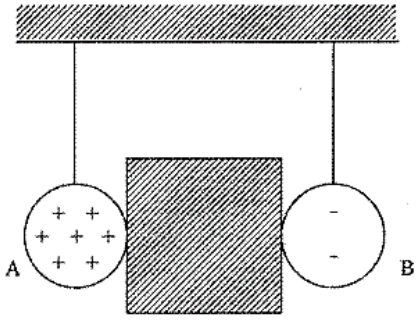


Figure 2

Sketch on the space beside the figure the final position of the pith balls after the insulator is removed. (1 mark)

5. 2013 Q15 (a)

Explain how a positively charged electroscope gets discharged when the cap is touched with a finger. (2 marks)

6. 2014 Q10

State **two** uses of a charged gold leaf electroscope. (2 marks)

State one advantage of an alkaline cell over a lead - acid cell. (1 mark)

3. 2011 Q4, 5; 2016 Q7

Figure 4 shows the cross-section of a dry cell. Use the information on the figure to answer the questions that follow.

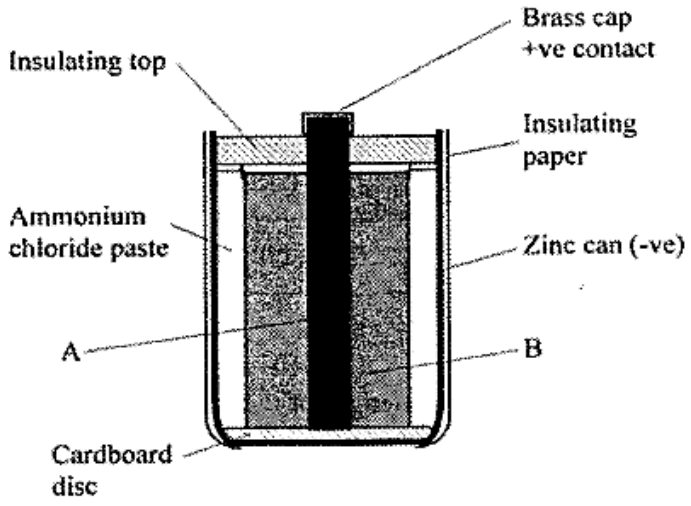


Figure 4

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

4. 2013 Q9

In domestic wiring systems, lamps in the lighting circuit are required to be in parallel and not in series. State two reasons for this requirement. (2 marks)

5. 2013 Q19 (c)

In a simple cell, the zinc plate gets negatively charged and the copper plate gets positively charged.

(i) Name the electrolyte in the cell (1 mark)

(ii) Explain how:

(I) Zinc gets negatively charged. (1 mark)

(II) Copper gets positively charged (1 mark)

(iii) State what constitutes the current when a wire is used to connect the zinc plate and the copper plate externally. (1 mark)

6. 2015 Q3

State the reason for topping up a lead - acid accumulator with distilled water. (1 mark)

7. 2017 Q4

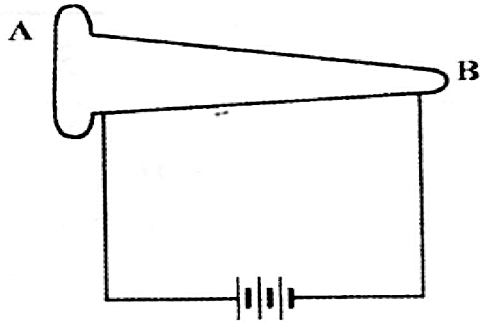


Figure 3

By drawing, show how the wire should be wound around the nail so that end A becomes a north pole and end B a south pole. (1 mark)

10. 2014 Q7

Figures 4 shows the magnetic field pattern around two bar magnets placed side by side.

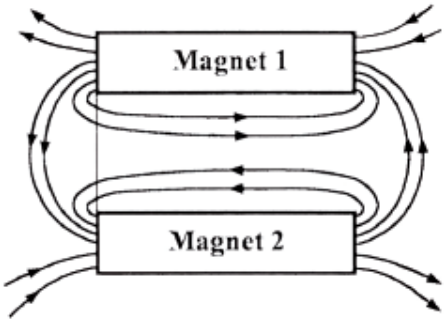


Figure 4

Indicate on the diagram the poles of each magnet. (1 mark)

11. 2015 Q4

Figure 2 shows a soft iron bar AB placed in a coil near a freely suspended magnet.

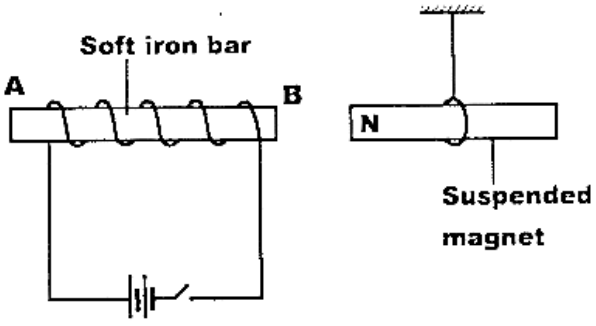


Figure 2

Explain the observation made when the switch is closed. (2 marks)

12. 2017 Q2

In a laboratory there are four metals - *tin, nickel, copper and cobalt.* Of these metals, name the

metals that are;

(a) magnetic, (1 mark)

(b) non-magnetic. (1 mark)

13. 2017 Q6

Figure 1 shows an insulated wire wound on a U-shaped iron core connected to a battery.

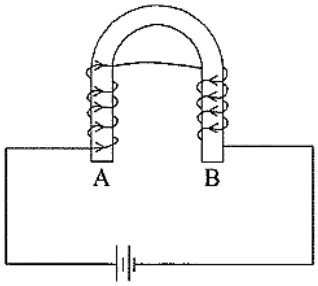


Figure 1

14. 2018 Q3

Figure 1 shows a bar magnet AB suspended by a string.

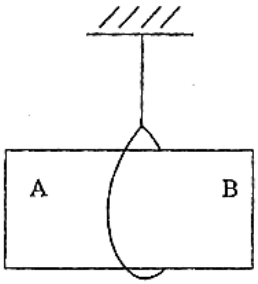


Figure 1

15. 2019 Q3

State **two** properties of magnetic field lines around a bar magnet. (2 marks)

16. 2019 Q18 (a-b)

(a) Describe how a magnet can be demagnetised using the electrical method. (2 marks)

(b) You are provided with two iron bars P and Q. One of the bars is magnetised while the other is not. Explain how the magnetised bar can be identified without using a magnet or magnetic material. (2 marks)

17. 2020 Q8

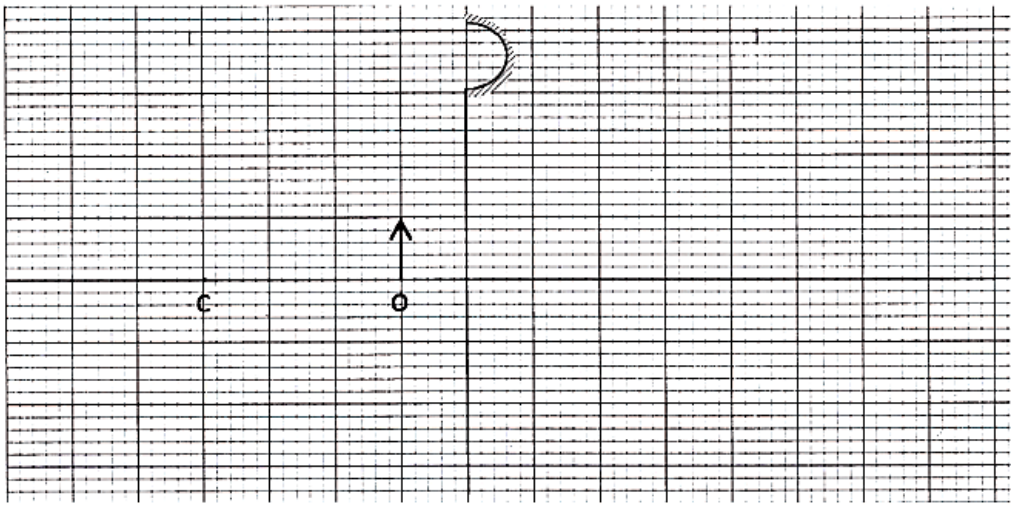


Figure 11

(3 marks)

(ii) Use the ray diagram to determine:

(I) the image distance; (1 mark)

(II) The magnification. (3 marks)

(iii) State where the position of the image would be if the object had been placed at the principal focus (1 mark)

(b) Draw a ray diagram show the formation of a partially dark shadow and a totally dark shadow during the eclipse of the sun. (3 marks)

7. 2015 Q5; 2016 Q5

State the reason why a convex mirror is preferred over a plane mirror for use as a driving mirror.

(1 mark)

8. 2017 Q5

State **two** advantages of using convex mirrors to monitor movements in a large supermarket.

(2 marks)

9. 2018 Q7

Figure 2 shows the image of an object O placed on the principle axis of a convex mirror.

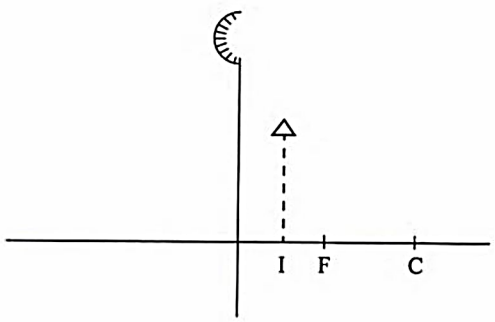


Figure 2

10. 2019 Q13

State the disadvantage of using a convex mirror as a driving mirror. (1 mark)

11. 2020 Q15 (a,b)

(a) Describe how the focal length of a concave mirror can be determined using a screen and a metre rule. (1 mark)

(b) An object is placed 8 cm from a concave mirror whose radius of curvature is 20 cm. Determine the position of the image. (3 marks)

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MAGNETIC EFFECT OF AN ELECTRIC CURRENT

1. 2006 Q6

Figure 4 shows a solenoid carrying an electric current.

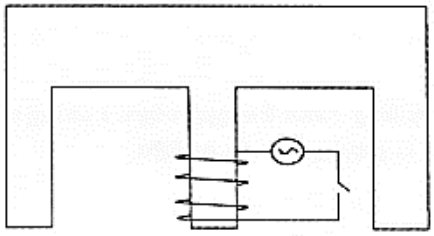


Figure 15

8. 2014 Q14 (a); 2016 Q14 (a)

Figure 6 shows a simple electric bell circuit.

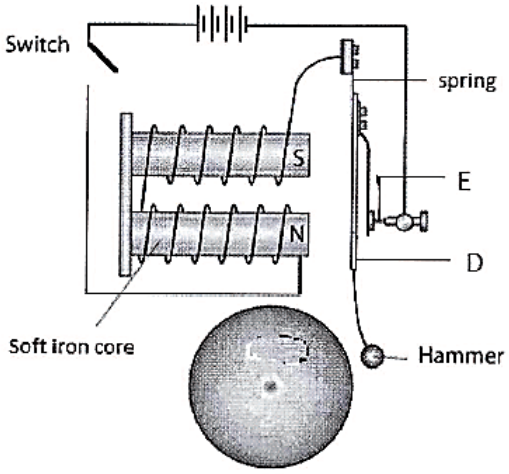


Figure 6

(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)

(ii) The hammer hits the gong repeatedly. (3 marks)

9. 2015 Q6

State two ways in which the strength of an electromagnet can be increased. (2 marks)

10. 2017 Q14

Figure 3 shows two current-carrying wires **A** and **B** passing through a cardboard.

(iii) Given that the frequency of the waves is 50 Hz, determine the:

(I) period (1 mark)

(II) speed of the wave (3 mark)

11. 2019 Q16 (a)

Define the following terms as used in waves:

(i) Amplitude (1 mark)

(ii) Wavelength (1 mark)

SOUND

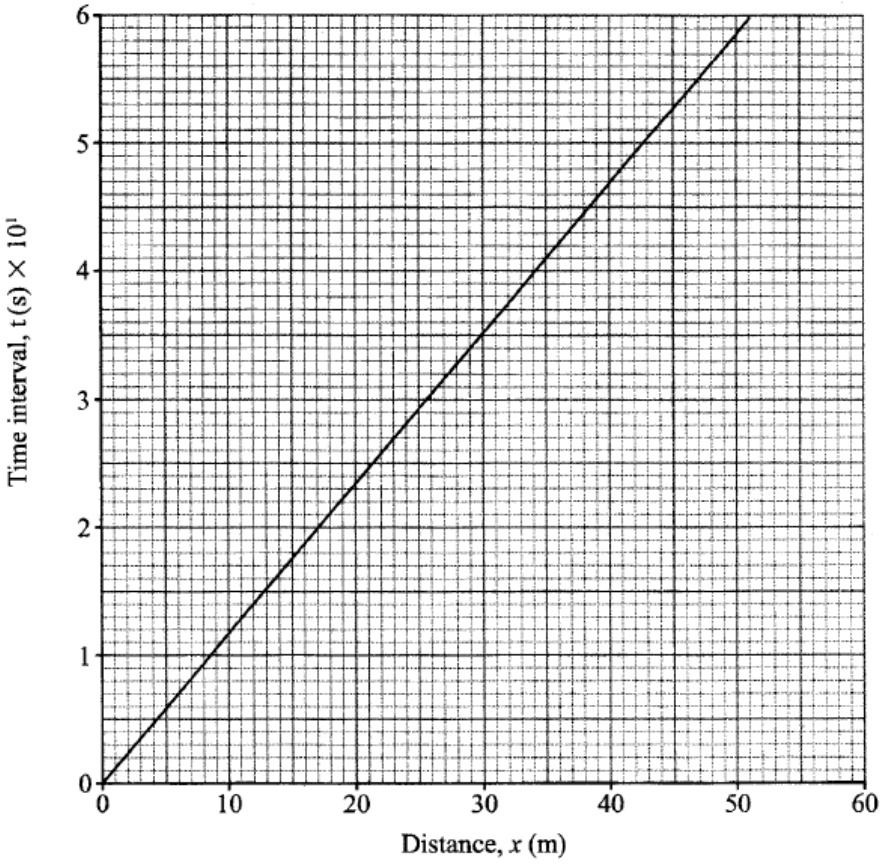
1. 2006 Q8

A soldier standing some distance from a wall, blows a whistle and hears its echo 1.8 seconds later. How far is the wall from the soldier? (speed of sound in air is $330ms^{-1}$) (3 marks)

2. 2008 Q15; 2016 Q18

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

(b) An observer stands half-way between two vertical cliffs that are L metres apart. He moves directly towards one cliff and after a distance x=10cm from the centre, 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 measure the time interval between the echoes. The process is repeated several times. The graph in **Figure 8** shows the relation between the time interval, **t** and the distance, **x** from the centre.



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

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

(iii) If the maximum time measured by the observer was t=4.7s, determine the distance L between the cliffs. (3 marks)

(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 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 from (ii) above.

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

3. 2009 Q12

A boy standing in front of a cliff blows a whistle and hears the echo after 0.5s. He then moves 17 metres further away from the cliff and blows the whistle again. He now hears the echo after 0.6s.

Determine the speed of the sound. (3 marks)

4. 2014 Q17 (b)

Figure 10 shows sound waves in air produced by a vibrating tuning fork. R is an air molecule on the path of the wave

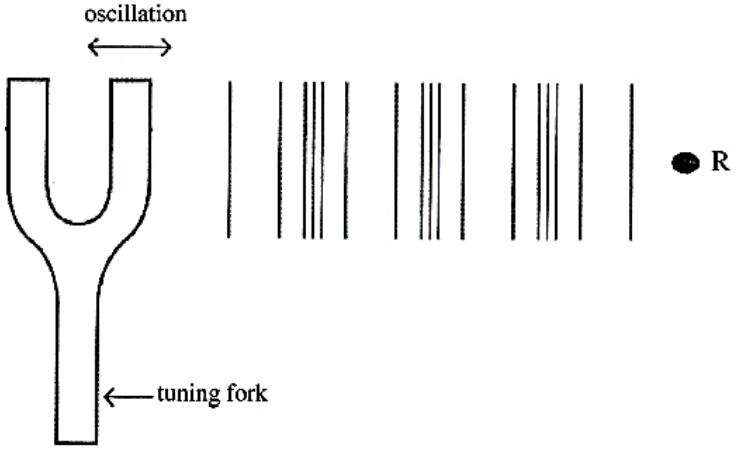


Figure 10

(i) Using a line, indicate on the diagram a distance **d** equal to one wavelength of the wave. (1 mark)

(ii) In the spaces provided, show with an arrow the direction of motion of the air molecule R as the waves pass. (1 mark)

(iii) Explain the reason for the answer in (ii) (2 marks)

5. 2015 Q9

A ship in an ocean sends out an ultra sound whose echo is received after 3 seconds. If the wavelength of the ultra sound in water is 7.5 cm, and the frequency of the transmitter is 20 kHz, determine the depth of the ocean. (3 marks)

6. 2017 Q3

State **one** use of echoes. (1 mark)

7. 2018 Q1

Explain why the walls of a studio are padded with woollen materials. (2 marks)

8. 2019 Q5

In a siren, sound is produced when a jet of air is directed perpendicular to a ring of holes on a rotating wheel. Explain the effect on the pitch of sound produced when the speed of rotation of the wheel is increased. (2 marks)

REFRACTION OF LIGHT

1. 2006 Q19

(a) Define the refractive index of a substance (1 mark)

(b) In an experiment to determine the refractive index of a liquid, the liquid was poured into a measuring cylinder. A pin was placed at the bottom of the cylinder and another pin was used to locate the apparent position of the first pin. The real depth and apparent depth were measured. The experiment was repeated with other values of real depth. The table below shows the results obtained.

Real depth (cm)	5	10	15	20	25
Apparent depth (cm)	3.3	6.7	10	13.3	16.7

(i) Plot the graph of real depth against apparent depth. (5 marks)

(ii) From the graph determine the refractive index of the liquid. (4 marks)

(c) **Figure 9** shows a ray of light incident on a glass - air interface

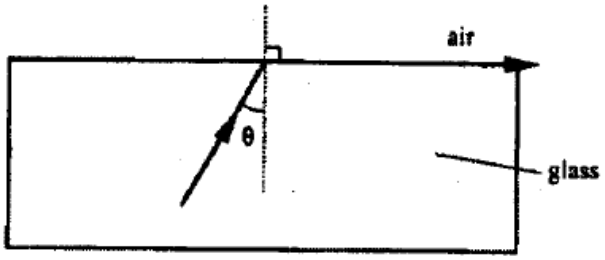


Figure 9

Given that the refractive index of the glass is 1.6, determine the angle θ. (3 marks)

2. 2007 Q7

Figure 6 shows a ray of light incident on the face of a water prism

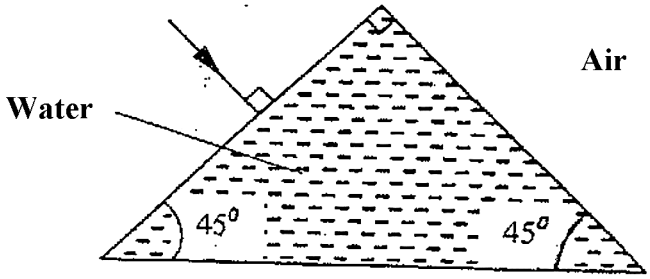


Figure 6

Sketch the path of the ray as it passes through the prism. (Critical angle for water is 49°).

(1 mark)

3. 2008 Q16

(a) State **two** conditions necessary for total internal reflection to occur (2 marks)

(b) **Figure 9** shows a ray of light incident on the boundary between two media 1 and 2 at an angle θ.

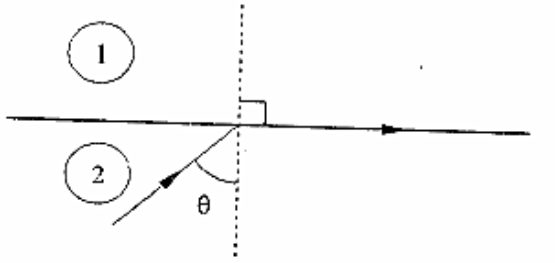


Figure 9

Show that the refractive index for a ray of light traveling from medium 1 to medium 2 is given by:

$$_1\eta_2 = \frac{1}{\sin\theta}$$ (2 marks)

(c) Figure 10 shows a ray of light incident on one face of a block of ice of refractive index 1.31 and totally reflected at the adjacent face

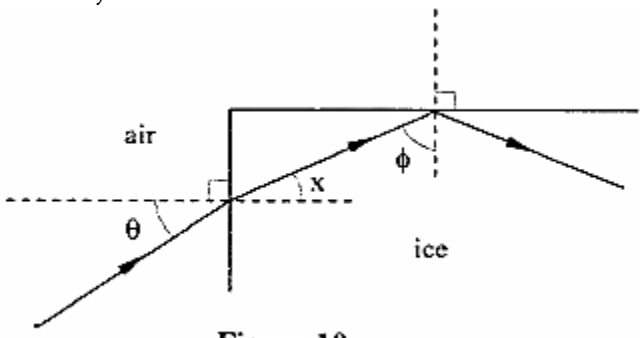


Figure 10

Determine:

(i) Angle Φ; (2 marks)

(ii) Angle x; (1 mark)

(iii) Angle θ, the greatest angle for which the total internal reflection is possible (2 marks)

4. 2009 Q7

Determine the speed of light in water given that the speed of light in air is 3.0×10^8 ms^{-1} and the refractive index of water is 1.33. (3 marks)

5. 2009 Q16

(a) **Figure 10** shows a ray of light incident on a triangular glass prism and a white screen S placed after the prism

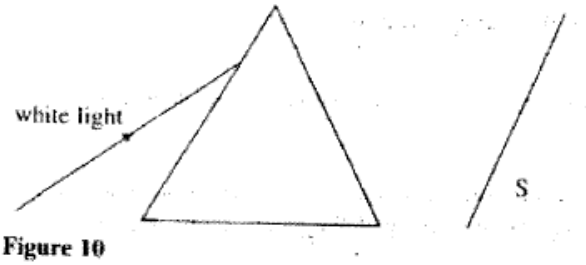


Figure 10

(i) Complete the path of the ray through the prism to show how a spectrum is formed on the screen. (3 marks)

(ii) A thermometer with a blackened bulb is placed at various parts of the spectrum. State with reason the region where the thermometer indicates the highest reading (2 marks)

(b) A pin is placed at the bottom of a beaker of depth 11.5 cm. The beaker is then filled with kerosene. By using another on the side of the beaker and observing from the top, the distance of the image of the pin in the beaker is found to be 3.5 cm from the bottom. Determine the refractive index of kerosene. (4 marks)

6. 2010 Q8

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)

7. 2011 Q10

Figure 7 shows two rays of light incident normally on face PQ of a glass prism, whose critical angle is 42°.

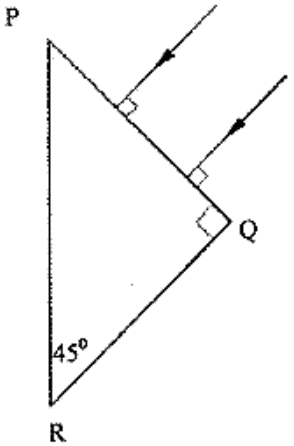


Figure 7

Complete the diagram to show the paths of the two rays as the y pass through the prism. (3 marks)

8. 2012 Q5

Figure 5 shows an object O at the bottom of a beaker full of a liquid. An observer above the beaker sees its image at point X inside the liquid.

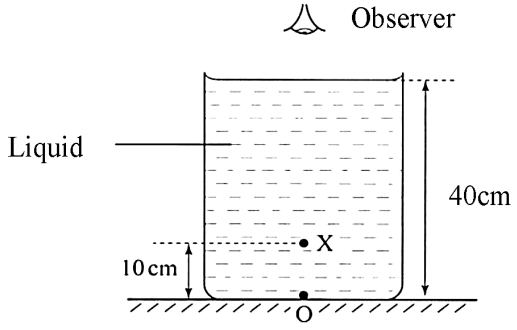


Figure 5

Determine the reflective index of the liquid (2 marks)

9. 2012 Q10

Figure 9 shows the cross section of an optical fibre made of two types of glass, A and B. The refractive index of B is lower than that of A.

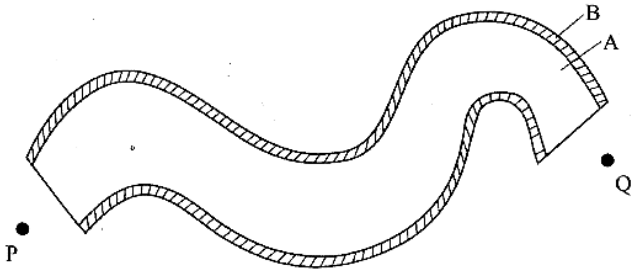


Figure 9

A ray of light enters the optical fibre at P and emerges from Q

(i) Sketch the path of the ray through the fibre. (1 mark)

(ii) State the reason why light travels through the fibre as in (i) above (1 mark)

10. 2013 Q6

Figure 3 shows a ray of light passing into a glass prism ABC

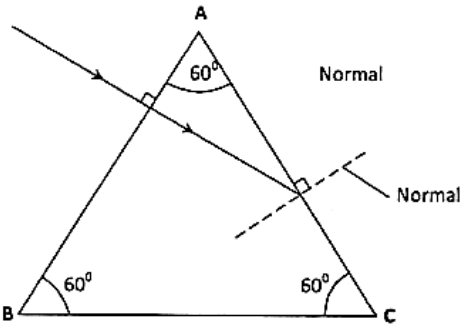


Figure 3

Sketch the path of the ray as it travels from face **AC**. (*critical angle for glass is 42⁰*) (2 marks)

11. 2014 Q12; 2016 Q9

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 42^0*)

(2 marks)

12. 2015 Q10

A nail at the bottom of a beaker containing glycerine appears to be 6.8 cm below the surface of glycerine. Determine the height of the column of glycerine in the beaker. (*take the refractive index of glycerine as 1.47*) (3 marks)

13. 2017 Q15

(a) **Figure 5** shows the interface between glass and air.



Figure 5

Draw on the figure a ray diagram to illustrate the critical angle. (3 marks)

(b) **Figure 6** shows a ray of light incident at right angles to face AB of a right-angled glass prism of refractive index 1.62.

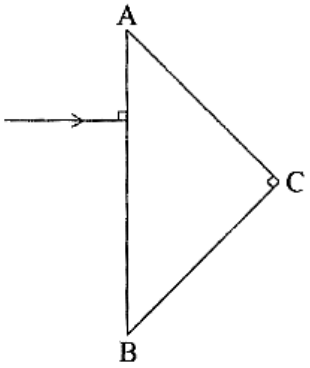


Figure 6

(i) Determine the critical angle of the material. (3 marks)

(ii) Complete the ray diagram to show the path of light until it leaves the prism. (2 marks)

(c) State any **two** applications of prisms. (2 marks)

14. 2018 Q5

The angle of incident for a ray of light moving from air to a certain liquid is 30°. Given that the refractive index of the liquid is 1.36, determine the angle of refraction. (2 marks)

15. 2019 Q17 (a-b)

(a) **Figure 10** shows a ray of light travelling from glass to air.

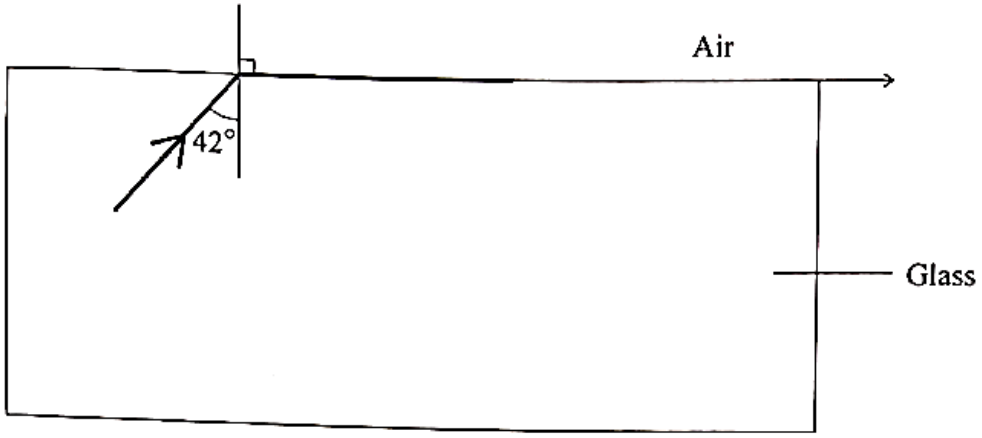


Figure 10

Determine the:

(i) critical angle of the glass - air interface (1 mark)

(ii) refractive index of glass (2 marks)

(b) A piece of metal is embedded at the centre of an ice block 15 cm from the surface of the ice. Given that the refractive index of ice is 1.32, determine how far from the surface of the ice block the metal appears to be. (3 marks)

16. 2020 Q5

The critical angle for a ray travelling from glass to air is 42°. Determine the refractive index of the glass. (3 marks)

CURRENT ELECTRICITY

1. 2006 Q9

State one condition under which Ohm's law is obeyed in a metal conductor (1 mark)

2. 2007 Q8

In the circuit diagram shown in **figure 7**, the ammeter has negligible resistance. When the switch S, is closed, the ammeter reads 0.13 A.

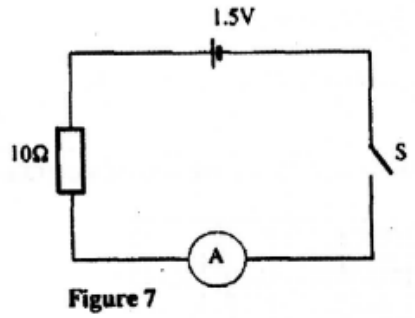


Figure 7

Determine the internal resistance of the cell. (3 marks)

3. 2007 Q15

(a) State Ohm's Law. (1 mark)

(b) The graph in figure 9 shows the current - voltage characteristics of a certain device, X

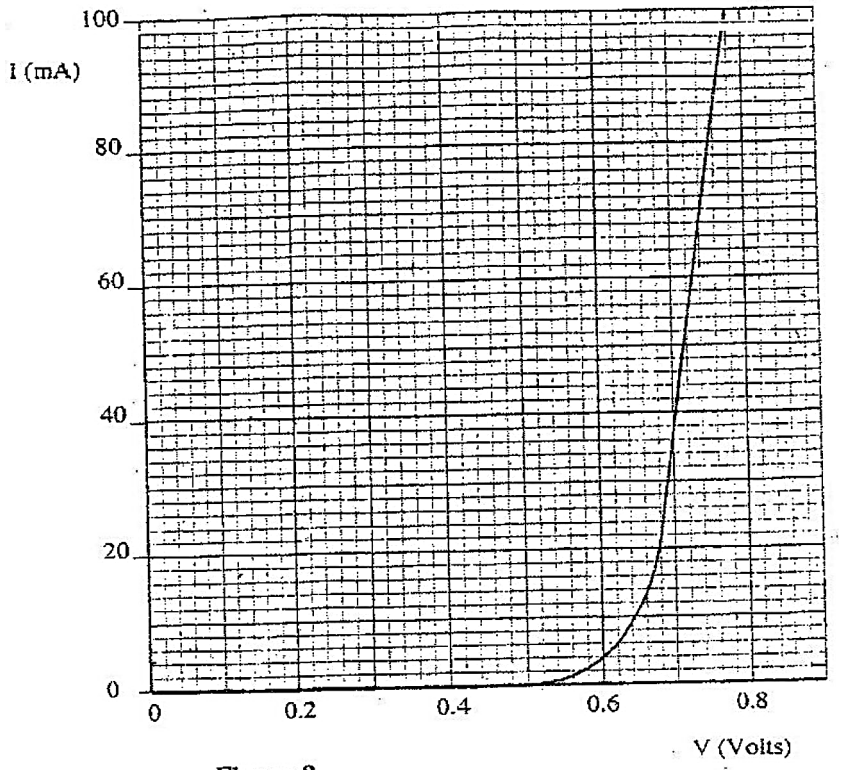
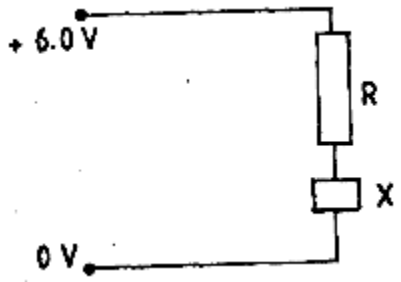


Figure 9

(i) State with a reason whether the device obeys Ohm's law (2 marks)

(ii) Determine the resistance of the device, X, when the current through it is 60 mA. (3 marks)

(iii) When the device, X is connected in the circuit below, the voltage across it is 0.70V.



Calculate the value of the resistance R.

(c) The cell in **figure 10** has an e.m.f of 2.1 V and negligible internal resistance.

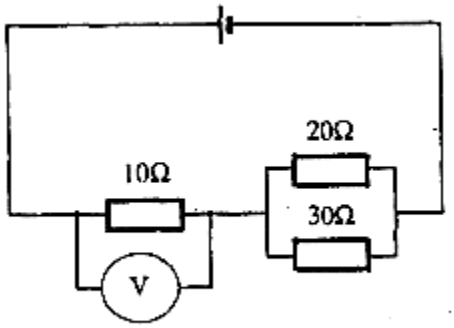


Figure 10

Determine the:

(i) Total resistance in the circuit; (2 marks)

(ii) Current in the circuit; (1 mark)

(iii) Reading of the voltmeter. (2 marks)

4. 2008 Q3

You are provided with the following;

A cell and holder, a switch, a rheostat, an ammeter, a voltmeter and connecting wires. Draw a diagram for a circuit that could be used to investigate the variation of the potential difference across the cell with the current drawn from the cell. (1 mark)

5. 2008 Q9

Figure 6 shows a circuit in which a battery of negligible internal resistance, two resistors, a capacitor, a voltmeter and a switch are connected.

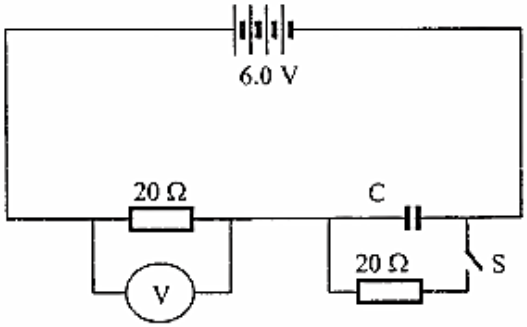


Figure 6

Giving a reason for your answer in each case, state the reading of the voltammeter, V, when the switch is

(i) Open

V = ……...

Reason……

(ii) Closed

V= …….

(iii) Velocity. (1 mark)

12. 2018 Q19

(a) **Figure 8** shows two waves of nearly equal frequency produced simultaneously.

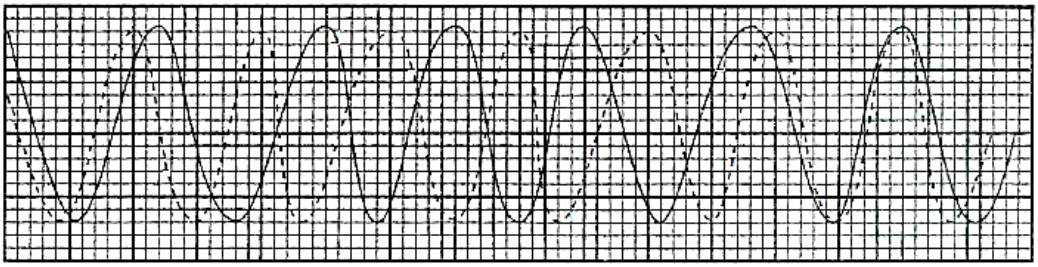


Figure 8

On the space provided, sketch the resultant of the two waves (beats). (2 marks)

(b) **Figures 9(a)** and **9(b)** shows barriers placed in the path of plane waves.

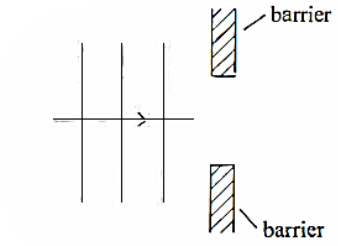


Figure 9(a)

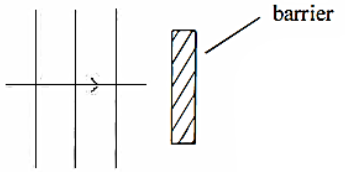


Figure 9(b)

On each figure, sketch the pattern of waves after they pass the barrier. (2 marks)

(c) **Figure 10** shows a displacement - distance graph for a certain wave motion.

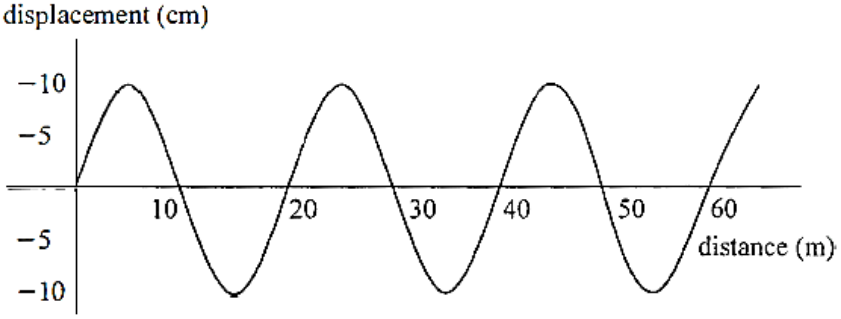


Figure 10

(iii) Indicate on the figure with letters A and B any two points that are in phase. (1 mark)

(iv) Determine the:

(III) amplitude of the wave; (1 mark)

(IV) wavelength of the wave (1 mark)

(iii) Given that the frequency of the waves is 50 Hz, determine the:

(I) period (1 mark)

(II) speed of the wave (3 mark)

13. 2019 Q16

(a) Define the following terms as used in waves:

(i) Amplitude (1 mark)

(ii) Wavelength (1 mark)

(b) **Figure 8** shows water waves approaching. a straight reflector at **a** speed **of 40 c**ms^{-1}.

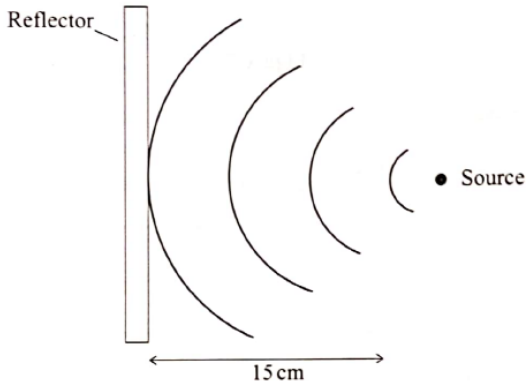


Figure 8

(i) Draw on the diagram the reflected waves. (3 marks)

(ii) Given that the distance between the source and the reflector is 15 cm, determine:

I. the wavelength of the waves (2 marks)

II. the frequency of the waves (2 marks)

(c) **Figure 9** shows light rays from two coherent sources S_1 and S_2 falling on a screen. Dark and bright fringes are observed between A and B.

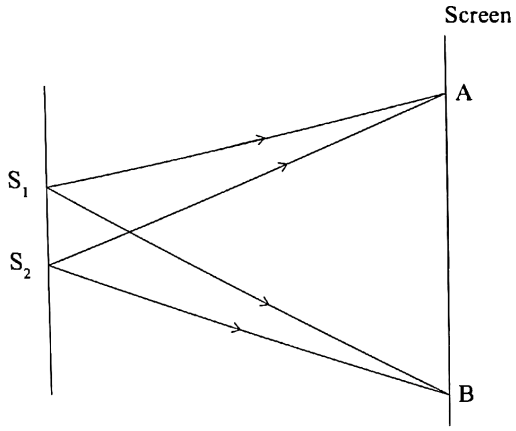


Figure 9

(i) State how:

I. bright fringes are formed (1 mark)

II. dark fringes are formed (1 mark)

(ii) State what is observed when light of a higher frequency is used. (1 mark)

14. 2020 Q4

Explain what happens to the speed of a water wave as it moves from the shallow to the deep end in a ripple tank. (2 marks)

15. 2020 Q13

Figure 4 shows circular water waves incident on a plane reflector placed at an angle to the path of the waves.

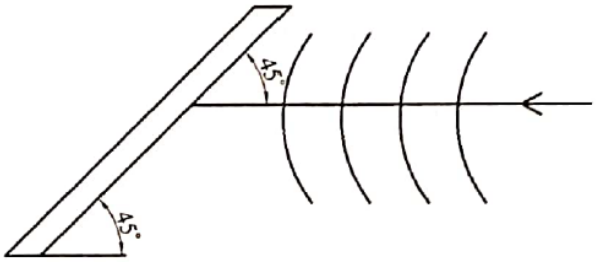


Figure 4

Complete the diagram to show the reflected waves. (2 marks)

ELECTROSTATICS II

1. 2006 Q3

A metallic body shaped as shown in figure 2 is positively charged and insulted from the ground as shown in the figure.

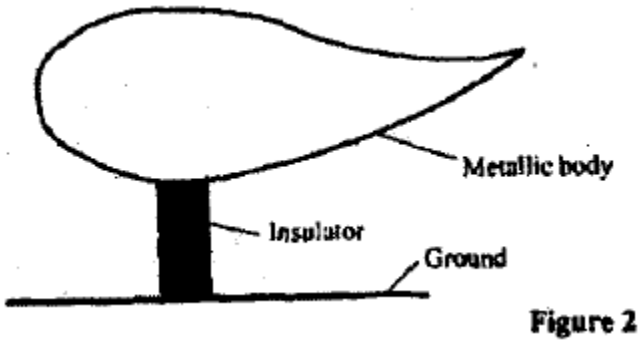


Figure 2

On the figure show the charge distribution. (1 mark)

2. 2006 Q17

Figure 7 shows a circuit where a battery of emf 4.5V, switches A and B, two capacitors C_1 = 0.3 μF

and C_2 = 0.5 μF and a voltmeter are connected

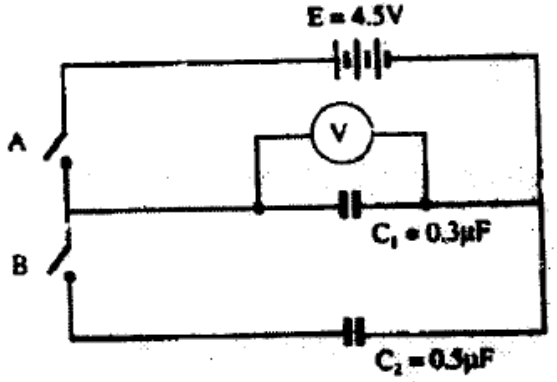


Figure 7

(a) Determine the charge on C_1 when switch A is closed and switch B is open. (3 marks)

(b) What is the effective capacitance C_T when both switches A and B are closed? (2 marks)

(c) State what is observed on the voltmeter when:

(i) switch A is closed and switch B is open; (1 mark)

(ii) Switch A is closed and opened, and then B is closed. (1 mark)

(iii) Explain the observation made in c (ii) above (1 mark)

3. 2009 Q14

(a) Figure 7 shows a pair of parallel plates of a capacitor connected to a battery. The upper plates is displaced slightly to the left.

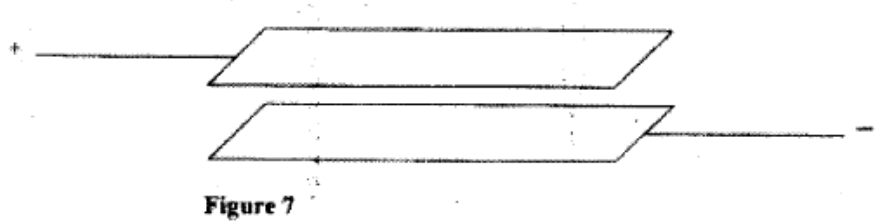


Figure 7

State with reason the effect of this movement of the capacitance. (2 marks)

(b) **Figure 8** shows an electrical circuit with three capacitors A, B and C of capacitance 4.0 μF, 5.0 μF and 3.0 μF respectively connected to a 12V battery

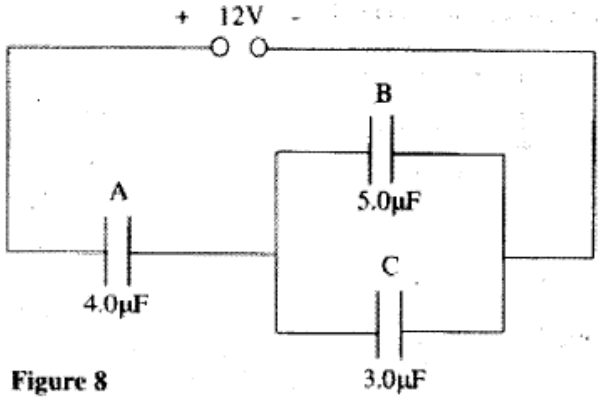


Figure 8

Determine:

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

(ii) The charge of the capacitor A; (2 marks)

(iii) The potential difference across the capacitors B. (2 marks)

4. 2010 Q15; 2016 Q16

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

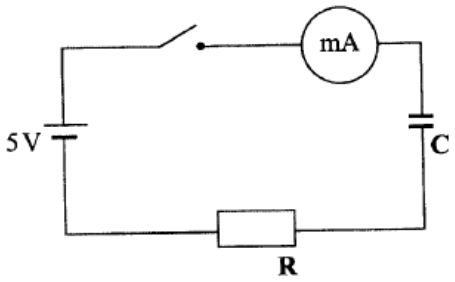


Figure 9

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

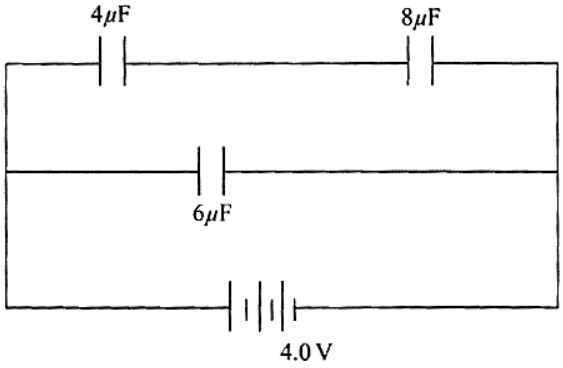


Figure 9

Determine the;

(i) total capacitance, (4 marks)

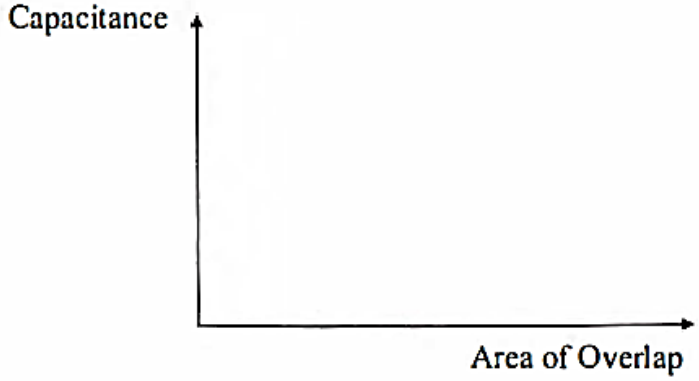
(ii) quantity of charge stored on the 8 μF capacitor. (3 marks)

11. 2018 Q10

The sharp point of a pin is brought near the cap of a positively charged electroscope. State and explain the observation made on the leaf of the electroscope. (3 marks)

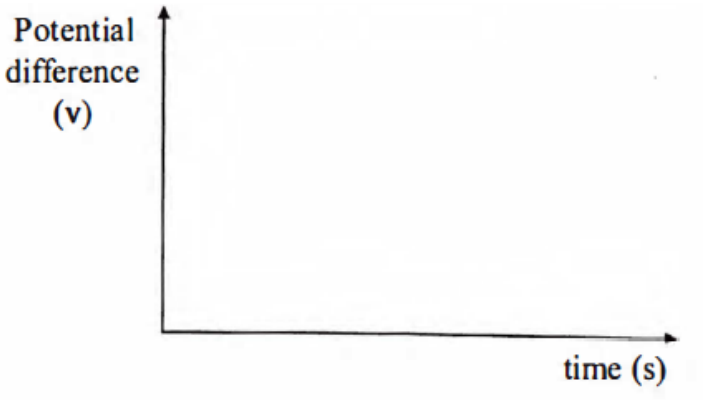
12. 2019 Q15

(a) On the axes provided, sketch a graph of capacitance plates of a parallel-plate capacitor. against the area of overlap of the plates of a parallel-plate capacitor. (1 mark)



(b) (i) Draw a circuit diagram that may be used to investigate the discharging process of a capacitor. (2 marks)

(ii) On the axes provided sketch the graph of potential different between the plates against time for the discharging process. (1 mark)



(c) **Figure** 7 shows three capacitors connected to a 6V battery.

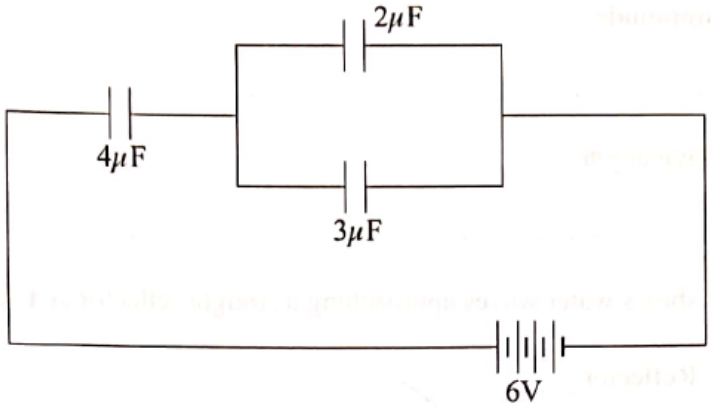


Figure 7

Determine the:

(i) effective capacitance; (3 marks)

(ii) total charge stored (2 marks)

(iii) potential difference across the 4 μF capacitor (2 marks)

13. 2020 Q7

Figure 3 shows an annular ring.

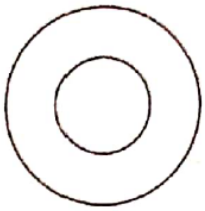


Figure 3

On the diagram, sketch the distribution of the charge on the ring, when the ring is negatively charged. (1 mark)

HEATING EFFECT OF AN ELECTRIC CURRENT

1. 2007 Q9; 2016 Q11

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 (3 marks)

2. 2008 Q10

A heating coil is rated 100W, 240V. At what rate would it dissipate energy if it is connected to a 220V supply? (3 marks)

3. 2009 Q15

Figure 9 shows the graph of the relationship between current I and potential difference V for two tungsten filament lamps X and Y. The normal working voltages for the lamp X and lamp Y are 2.5V and 3.0V respectively.

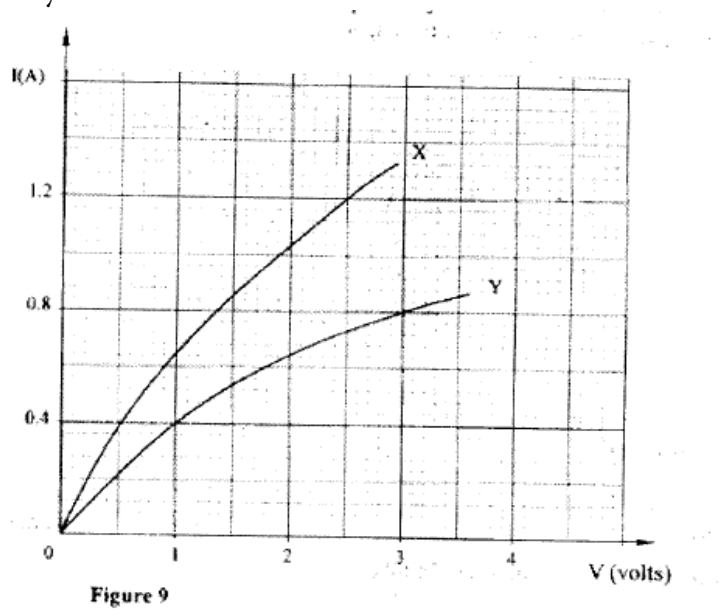


Figure 9

(a) Explain the change in the shape of the curves as the current increases. (2 marks)

(b) Determine the resistance of lamp X at the normal working voltage. (3 marks)

(c) The lamps are now connected in a series circuit in which a current of 0.4 A flows. Find the potential differences across lamp Y. (1 mark)

(d) Determine the power at which lamp Y operates under normal working voltage. (2 marks)

4. 2010 Q10

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)

5. 2014 Q14 (b); 2016 Q14 (b)

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

(i) The current that flows through it when it is connected to a 240 V supply; (3 marks)

(ii) The resistance of the bulb. (3 marks)

6. 2017 Q14

State how heating is achieved in a resistance wire. (1 mark)

THIN LENSES

1. 2006 Q18

(a) **Figure 8** shows an object placed in front of a concave mirror of focal length 10cm. C is the centre of curvature.

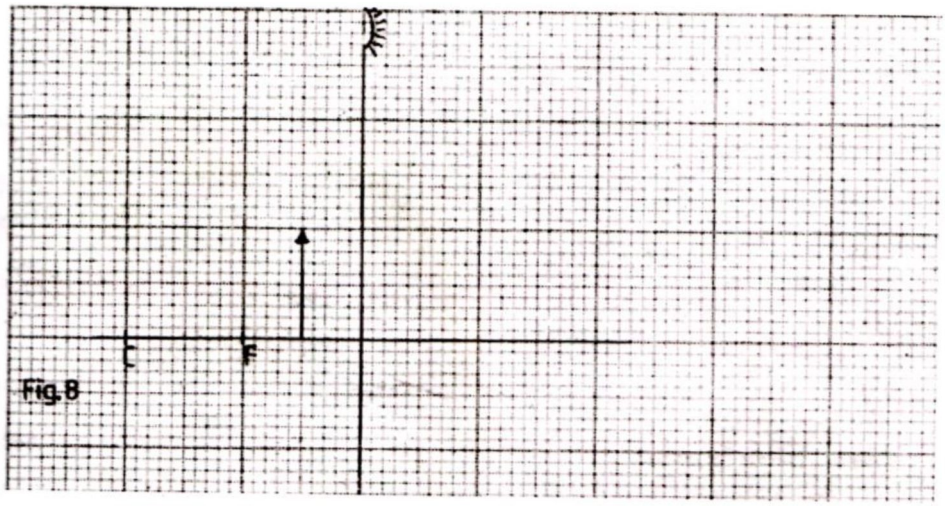


Fig. 8

(i) On the same figure draw a ray diagram showing the location of the image. (4 marks)

Use the ray diagram drawn in (i) above to determine the:

(ii) Image distance; (2 marks)

(iii) Magnification. (2 marks)

(b) A vertical object is placed 20cm in front of a convex lens of focal length 5 cm

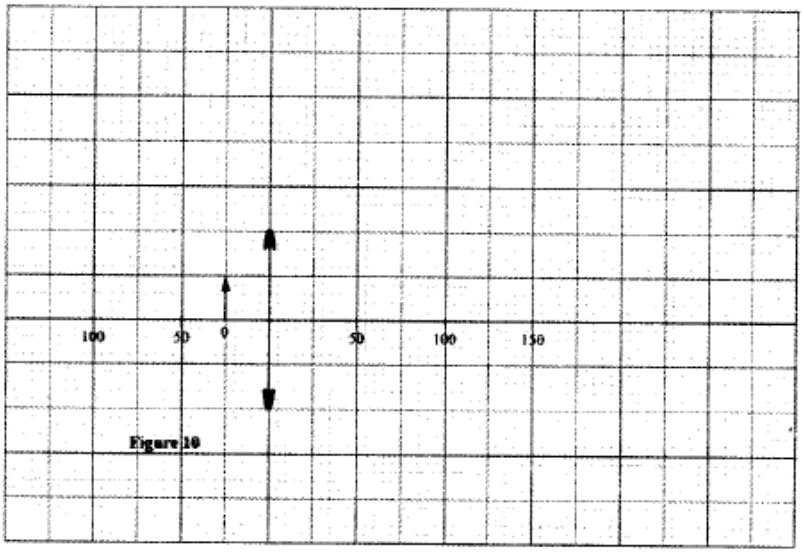


Figure 10

(i) On the same figure, draw a ray diagram showing the location of the image. (3 marks)

(ii) Use the 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 mm long placed along the principal axis of the lens used in part (a). The near end of the pin is 80 mm from the lens.

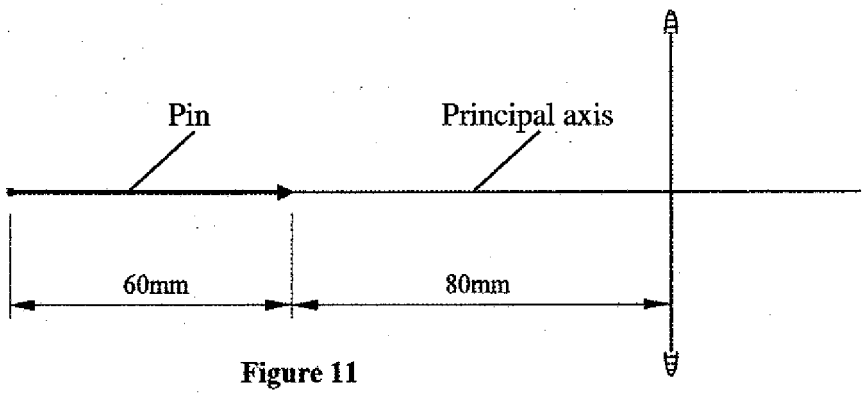


Figure 11

Determine the length of the image. (5 marks)

8. 2011 Q16

(a) State the meaning of the term "*principal focus*" as applied in lenses. (1 mark)

(b) You are provided with the following apparatus to determine the focal length of a lens:
- a biconvex lens and lens holder.

By counting the number of turns in each coil, determine the reading on the voltmeter.
(3 marks)

9. 2014 Q15

(a) One of the causes of energy loss in a transformer is heating in the coils when current flows. State;

(i) The reason why the current causes heating. (1 mark)

(ii) How the heating can be minimized. (1 mark)

(b) The input voltage of a transformer is 240 V and its output is 12 V. When an 80 W bulb is connected across the secondary coil, the current in the primary coil is 0.36A.
Determine

(i) The ratio $\frac{N_P}{N_S}$ of the transformer, *(where Np is the number of turns in the primary coil and Ns is the number of turns in the secondary coil*) (3 marks)

(ii) The power input of the transformer. (3 marks)

(iii) The power output of the transformer (1 mark)

(iv) The efficiency of the transformer (2 marks)

10. 2015 Q13

When a transformer is connected to an ac source, the output voltage is found to be 24 V. If the power input is 200 W, determine the output current. (*Assume the transformer is 100% efficient*).
(3 marks)

11. 2017 Q17

(a) **Figure** 8 shows a conductor AB connected to a galvanometer and placed between two permanent magnets.

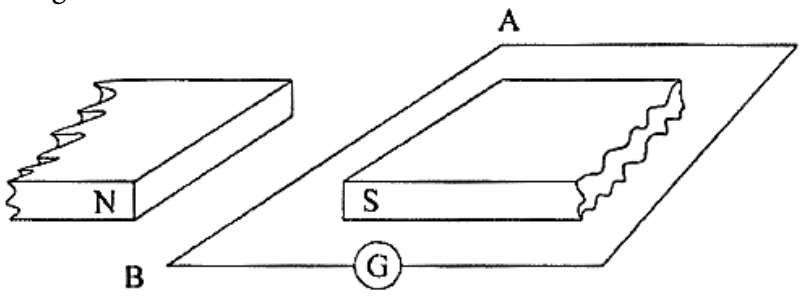


Figure 8

(i) Conductor AB is moved perpendicular to the magnetic field. State and explain the observation made on the galvanometer. (3 marks)

(ii) State the effect of moving the conductor faster. (1 mark)

(b) A transformer is used to step down 240 V to 12V for use in an electric appliance operating at 0.5 A. If the primary coil has 600 turns, determine the;

(i) number of turns in the secondary coil, (3 marks)

(ii) current in the primary coil. (3 marks)

12. 2018 Q9

A transformer has 600 turns in the primary coil and 9000 tums in the secondary coil. If the transformer is 100% efficient and the current in the secondary coil is 0.15A, determine the current in the primary coil. (3 marks)

13. 2019 Q18

(a) Describe how a magnet can be demagnetised using the electrical method. (2 marks)

(b) You are provided with two iron bars P and Q. One of the bars is magnetised while the other is not. Explain how the magnetised bar can be identified without using a magnet or magnetic material. (2 marks)

(c) **Figure 12** shows **two** identical copper coils X and Y placed close to each other. Coil X is connected to a DC power supply while coil Y is connected to a galvanometer.

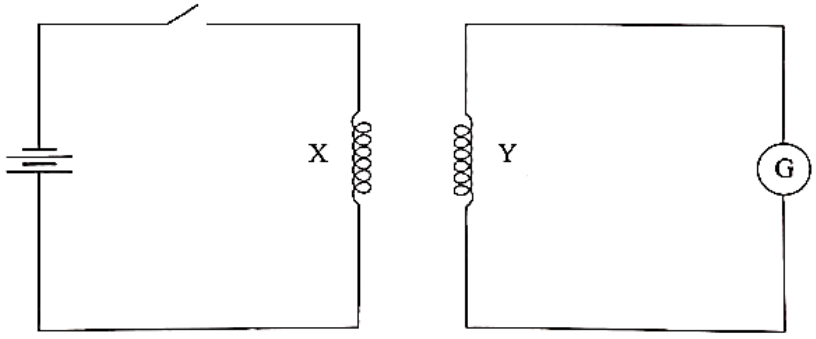


Figure 12

(i) Explain what is observed on the galvanometer when the switch is closed. (4 marks)

(ii) State what is observed on the galvanometer when the switch is opened. (1 mark)

(iii) State what would be observed if the number of turns in coil Y is doubled. (1 mark)

14. 2020 Q18

(a) **Figure** 7 shows a soft iron ring placed between the poles of two bar magnets.

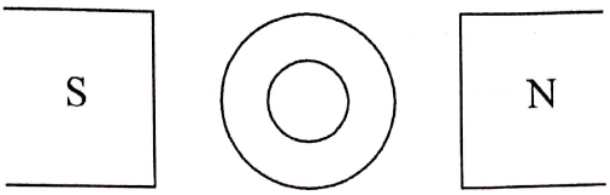


Figure 7

On the figure, draw the magnetic field lines between the poles. (2 marks)

(b) **Figure 8** shows two straight conductors P and Q connected to a battery and a variable resistor.

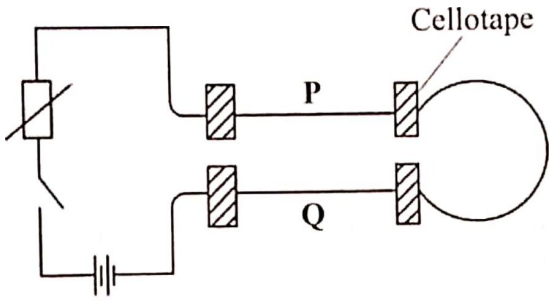


Figure 8

(i) Using arrows, indicate on the diagram the direction of current that flows through P and Q when the switch is closed. (1 mark)

(ii) State what is observed as the current flows through the conductors. (1 mark)

(iii) Explain the observation in (ii). (3 marks)

(c) (i) State how eddy currents are minimised in a transformer. (1 mark)

(ii) A step-down transformer has 600 turns in the primary coil. The input voltage is 120 V while the output voltage is 24 V. Determine the number of turns in the secondary coil. (3 marks)

MAINS ELECTRICITY

1. 2006 Q21

(a) **Figure 12** shows a section of a house wiring system.

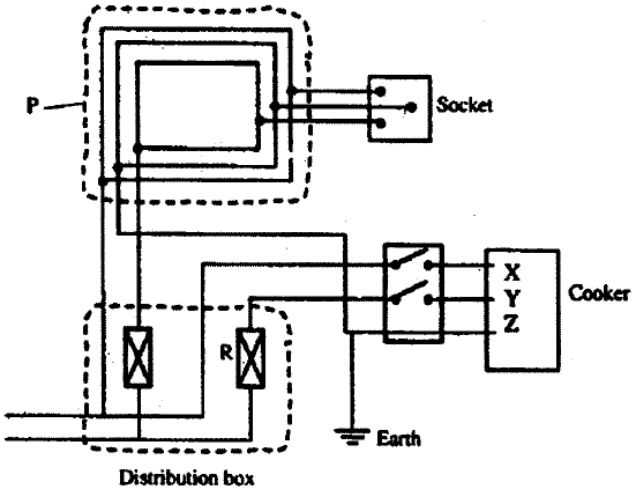


Figure 12

(i) Name:

(I) The circuit labelled P; (1 mark)

(II) The terminals labelled X and Y.

X……. Y…… (2 marks)

(ii) (I) State the purpose of R in the circuit. (1 mark)

(II) Give a reason why R is connected to Y but not to X (1 mark)

(ii) Why is the earthing necessary in such a circuit? (1 mark)

(b) Determine the cost of using an electric iron rated 1500W, for a total of 30 hours given that the cost of electricity per kWh is Ksh. 8. (2 marks)

2. 2010 Q6; 2011 Q13

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

3. 2012 Q12

State why alternating current (a.c) is NOT used for transmitting electricity over long distances. (1 mark)

4. 2012 Q15

Figure 14 shows a circuit in which a battery, a switch, a bulb, a resistor P, a variable resistor Q, a voltmeter V and two ammeters A_1 and A_2 of negligible resistance are connected.

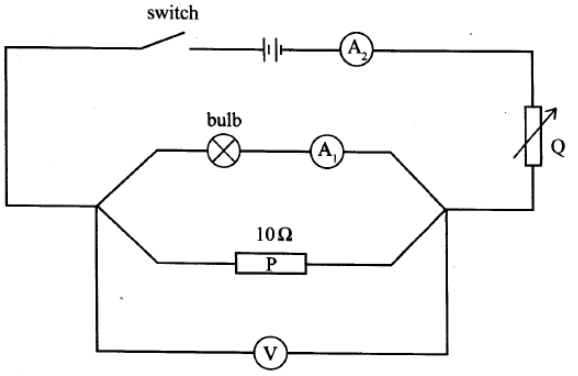


Figure 14

P has a resistance of 10 Ω. When the switch is closed A_1 reads 0.10 A and the voltmeter reads 1.5V.

(a) Determine:

(i) The current passing through P; (3 marks)

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

(b) The variable resistor Q is now adjusted so that a large current flows through A_2.

(i) State how this will affect the resistance of the bulb. (1 mark)

(ii) Explain your answer in (b) (i). (2 marks)

(c) A house has one 100 W bulb, two 60 W bulbs and one 30W bulb. Determine the cost of having all the bulbs switched on for 70 hours, given that the cost of electricity is 40 cents per kilowatt hour. (3 marks)

5. 2013 Q9

In domestic wiring systems, lamps in the lighting circuit are required to be in parallel and not in series. State two reasons for this requirement. (2 marks)

6. 2013 Q16

(a) Two points **A** and b have a potential difference of **V** volts. **Q** coulombs of charge flow between **A** and **B** for t seconds.

Determine:

(i) The electrical energy transformed between the two points in terms of **Q**. (1 mark)

(ii) The power transformed in terms of **Q** and **t**. (1 mark)

(iii) Show the power transformed is given by P = IV (2 marks)

(b) The lighting circuit in a house has 20 lamps each rated 60W, 240V. Determine whether a fuse rated 4 A can be used in the circuit when all the lamps are put on. (4 marks)

7. 2015 Q15

(a) State two factors that determine the resistance of a metallic conductor. (2 marks)

(b) Explain how a fuse safeguards electrical appliances against excessive currents. (2 marks)

(c) A hair dryer is rated 2.5 kW, 240V.

(i) Determine whether a 10 A fuse may be suitable for the hair dryer. (3 marks)

(ii) Determine the cost of using the hair dryer for 3 hours if the cost of electricity is Ksh 0.80 per kilowatt hour. (2 marks)

8. 2018 Q6

An electric kettle is rated 1.8 kW, 240 V. Determine the rating of the fuse that may be used in the kettle. (3 marks)

9. 2018 Q15

(a) Electrical energy is transmitted at very high voltages and low current.

(i) Describe how the high voltages are attained. (1 mark)

(ii) State two reasons why thick aluminium wires are preferred to copper wires for transmission over long distances. (2 marks)

(b) **Figure 4** shows an electric cooker connected to the mains supply. X, Y and Z are the mains wires.

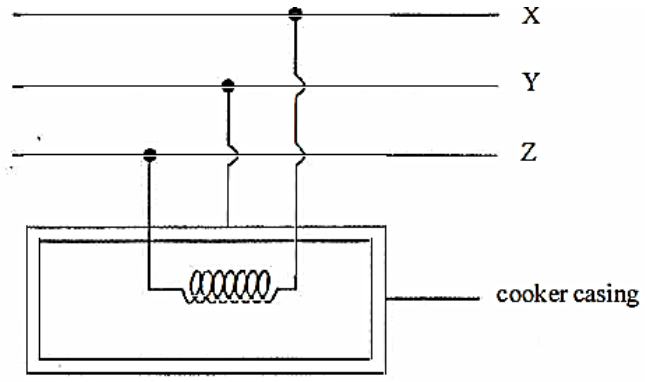


Figure 4

State with a reason the name of wire Y. (2 marks)

(c) A student has some coloured bulbs rated 60 W, 240 V to be connected for decorations.

(i) State the number of such bulbs that can be connected normally to a 240V supply through a 5A fuse. (2 marks)

(ii) If the cost of electric energy is Ksh 3.00 per kWh, determine the cost of running the bulbs in (c) (i) for 5 hours daily for 20 days. (3 marks)

10. 2019 Q11

Figure 5 shows part of the lighting circuit in a house.

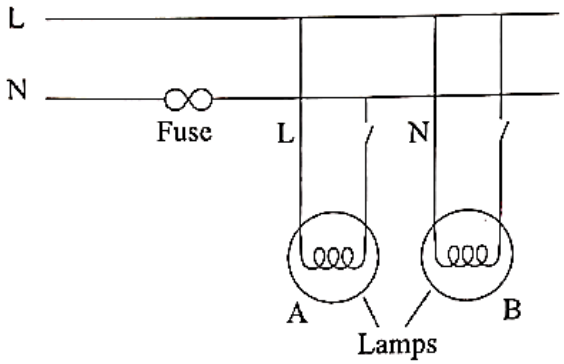


Figure 5

State **two** errors in the wiring circuit. (2 marks)

11. 2020 Q12

State the purpose of a fuse in an electrical circuit. (1 mark)

12. 2020 Q14

(a) State two ways of minimising power losses during the transmission of electric power. (1 mark)

(b) An electric cooker is rated 2.5 kW, 250 V. State the meaning of these values. (1 mark)

(c) A consumer has the following appliances in the house:

- *An electric iron rated 1500 W*
- *A water heater rated 500 W*
- *An electric cooker rated 2500 W*
- *Three bulbs each rated 60 W.*

The house is fitted with a 12 A fuse. Determine:

(i) Whether the consumer can connect all the appliances to the 240 V power supply at the same time; (4 marks)

(ii) The resistance of the heating element used in the electric cooker. (3 marks)

CATHODE RAYS AND CATHODE RAY TUBE

1. 2006 Q12, 13

Figure 6 shows a tube for investing the properties of a beam of electrons.

Use the *information in the figure to answer questions 12 and 13*

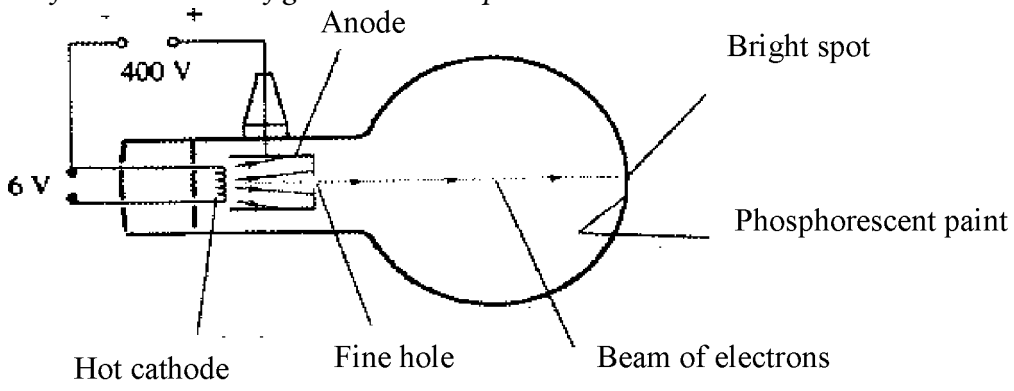


Figure 6

12. What property of the beam of electrons show that the electrons are traveling at a very high speed? (1 mark)

13. The beam of electrons is subjected to a strong magnetic field which is perpendicular to the path and into the paper. Sketch on the same figure, the new path of electrons. (1 mark)

2. 2007 Q18

(a) **Figure 14** shows the features of a cathode ray tube

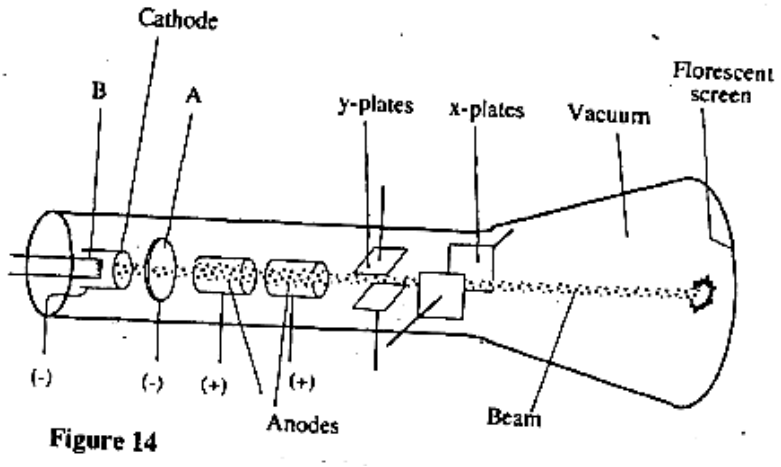


Figure 14

(i) Name the parts labelled A and B (2 marks)

A…… B ……..

(ii) Explain how the electrons are produced in the tube (2 marks)

(iii) State two functions of the anodes (2 marks)

(b) State how the resulting x-rays are affected by increasing the potential difference between the anode and the cathode. (1 mark)

(c) Light of frequency 7.5×10^{14} Hz strikes a metal surface whose work function is 4.0×10^{-19}J. Determine the kinetic energy of the emitted photoelectrons.
(*take planks constant $h=6.63 \times 10^{-34}$ Js*) (4 marks)

7. 2013 Q10; 2016 Q10
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 milliammeter.

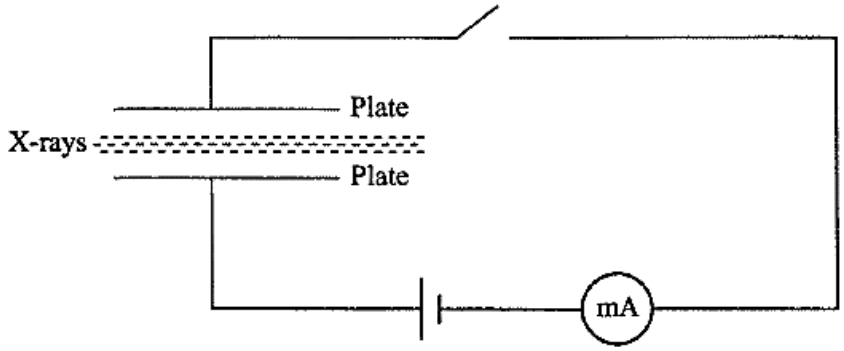


Figure 6

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

8. 2014 Q11
The anode of an x-ray tube becomes hot when the tube is in use. State the reason for this.
(1 mark)

9. 2018 Q2
State **one** characteristic of soft X-rays that distinguish them from hard X-rays. (1 marks)

10. 2019 Q10
State how the intensity of X-rays in an X-ray tube can be increased. (1 mark)

11. 2020 Q11
Explain how x-rays are produced in the x-ray tube. (2 marks)

PHOTOELECTRIC EFFECT

1. 2006 Q10, 11

Use the information given below to answer questions 10 and 11

The Kinetic energy (K.E) of an electron, ejected from the surface of a metal illuminated by radiation of frequency f is given by

$$K.E = hf - \emptyset$$

Where h is Planck's constant and Ø is the work function of the surface

10. What is meant by the term work function? (1 mark)
11. If the frequency of the illuminating radiation is just equal to the threshold frequency of the surface, explain why no photoelectric effect is observed. (2 marks)

2. 2007 Q11, 12

The graph in **figure 8** shows the variation of photoelectric current with applied voltage when a surface was illuminated with light of a certain frequency. Use the information in the figure to answer questions **11** and **12**.

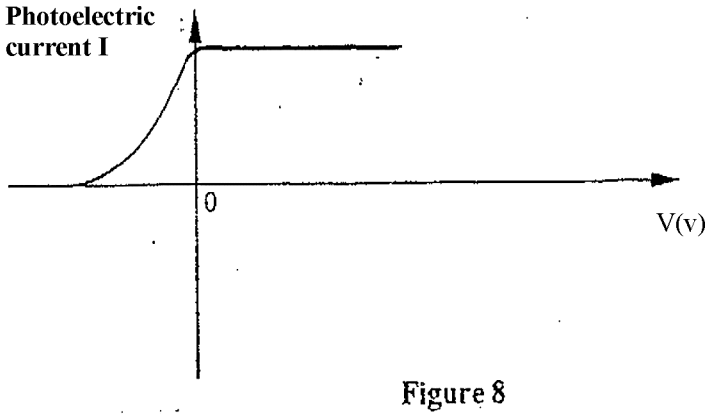


Figure 8

11. On the same axes, sketch the graph when light of higher intensity but same frequency is used to illuminate the surface. (1 mark)

12. Explain your answer in **11** above (1 mark)

3. 2009 Q18

(a) It is observed that when ultra- violet radiation is directed onto a clean zinc plate connected to the cap of a negatively charged leaf electroscope, the leaf falls

(i) Explain this observation (2 marks)

(ii) State why this observation does not occur if the electroscope is positively charged (1 mark)

(iii) Explain why the leaf of the electroscope does not fall when infra- red radiation is directed onto the zinc plate (1 mark)

(b) State the effect on the electrons emitted by the photoelectric effect when:

(i) The intensity of incident radiation is increased (1 mark)

(ii) The frequency of the incident radiation is increased (1 mark)

(c) The maximum wavelength required to cause photoelectric emission on a metal surface is 8.0×10^{-7}m. The metal surface is irradiated with light of frequency 8.5×10^{14} Hz. Determine:

(i) The threshold frequency; (2 marks)

(ii) The work function of the metal in electron volts; (3 marks)

(iii) The maximum kinetic energy of the electrons. (2 marks)

Take: 1 eV= 1.6 x 10^{-19} J.

Speed of light = 3.0 x 10^{8} ms^{-1}

Plank's constant, h = 6.63 x 10^{-34} Js

4. 2010 Q19

(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.

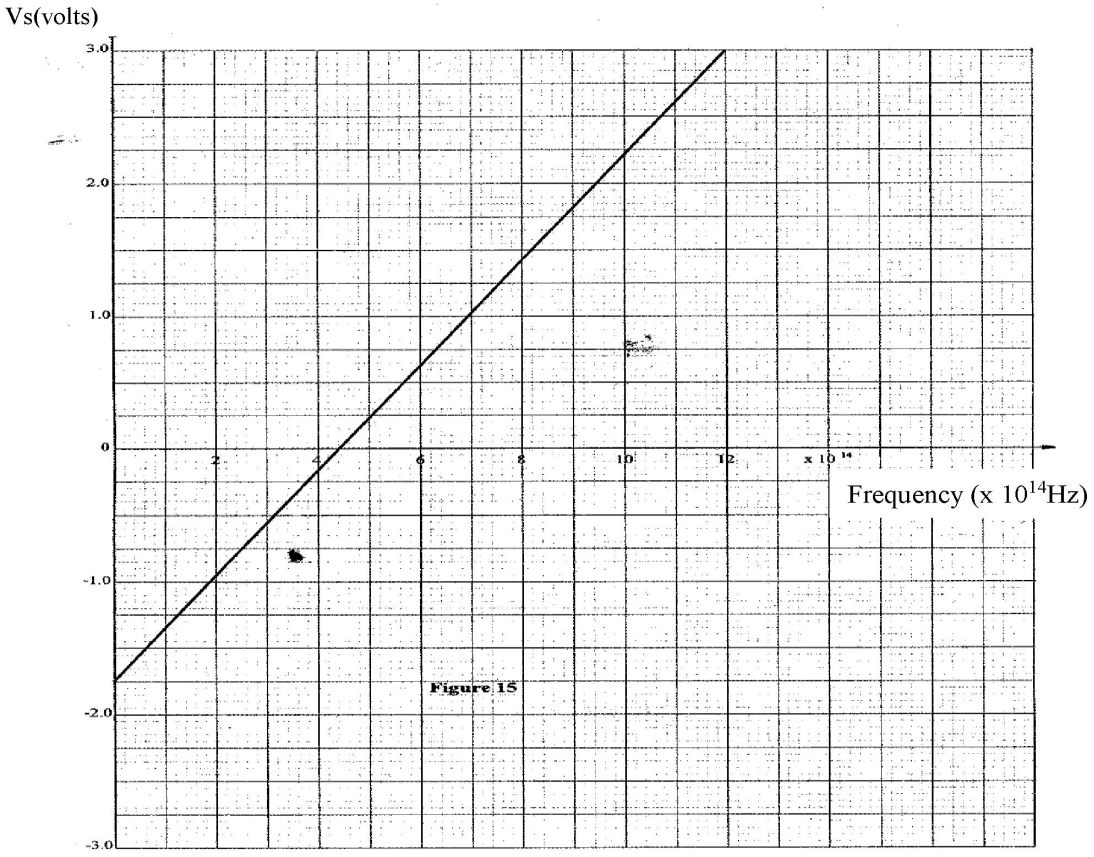


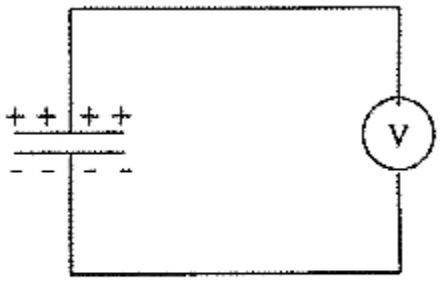
Figure 15

(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. $V_s = \frac{h}{e} f - \frac{\omega_0}{e}$, Where e is the charge of an electron, (e = 1 .6 x 10^{-19} C)
Determine from the graph:
(I) plank's constant, h; (4 marks)

(II) the work function ω_o for the metal in electron volts (eV). (3 marks)

5. 2011 Q3
Figure 3 shows a voltmeter connected across two charged parallel plates.



Parallel plates

Figure 3

When a thin sheet of mica is inserted between the plates, the voltmeter reading is observed to reduce. Explain this observation. (3 marks)

6. 2011 Q14
State the meaning of the term "threshold frequency" as used in photoelectric emission.
(1 mark)

7. 2012 Q8
Light from a lamp falls on the cap of a negatively charged electroscope. It is observed that the divergence of the leaf decreases. Explain the observation (2 marks)

8. 2013 Q12
A photon of ultraviolet light having energy **E** falls on a photoemissive surface whose work function is **T**. Write an expression for the maximum kinetic energy of the resulting photoelectron in terms of **E** and **T**. (1 mark)

9. 2014 Q6
It is observed that when the cap of an uncharged electroscope is irradiated with light of high frequency, the leaf of the electroscope rises. Explain this observation. (3 marks)

10. 2015 Q14

(a) State **two** factors that affect photoelectric emission. (2 marks)

(b) Light of wavelength 4.3×10^{-7} m is incident on two different metal surfaces, nickel and potassium. (*Take speed of light as 3.0×10^{8} ms^{-1} and planks constant h as 6.63 x $l0^{-34}$Js*).

(i) Determine the energy of the incident radiation. (3 marks)

(ii) If the work function of nickel is 8.0 x 10^{-19}J and that of potassium is 3.68 x 10^{-19}J, state with a reason from which of the two metals the given light will eject electrons. (2 marks)

(iii) Determine the velocity of the emitted electrons from the metal surface in b(ii). *(Take the mass of an electron as 9.1×10^{-31} kg).* (2 marks)

11. 2017 Q16

(a) **Figure** 7 shows a set up that may be used to observe photoelectric effect. A radiation is incident on the cathode. It is observed that the microammeter registers a current.

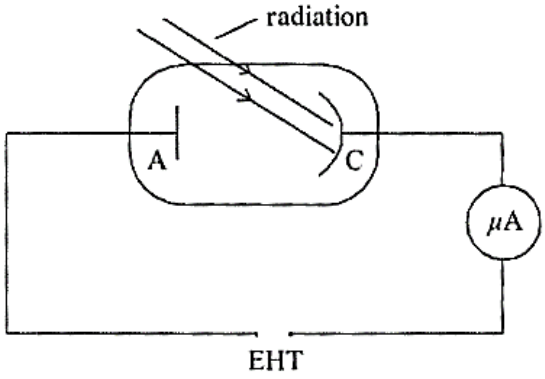


Figure 7

(i) Explain how the current is produced. (2 marks)

(ii) State with a reason what must be done for a higher current to be registered. (2 marks)

(iii) It was observed that for a certain incident radiation, no current was registered. Explain this observation. (2 marks)

(b) A monochromatic light of wavelength 4.50 X 10^{-7} m is incident on a metal surface of threshold frequency 5.5×10^{14} Hz. *(Speed of light c is 3.0×10^{8} ms^{-1} and planks constant his 6.63* X *10^{-34}Js).*

Determine:

(i) the work function of the metal surface; (3 marks)

(ii) average kinetic energy of the emitted photoelectrons. (4 marks)

12. 2018 Q16

(a) State the meaning of the following terms:

(i) *Photoelectric effect* (1 mark)

(ii) *Threshold frequency* (1 mark)

(b) **Figure 5** shows some light incident on the cathode of a photocell. The photocell is connected in series with a battery, a variable resistor and a microammeter.

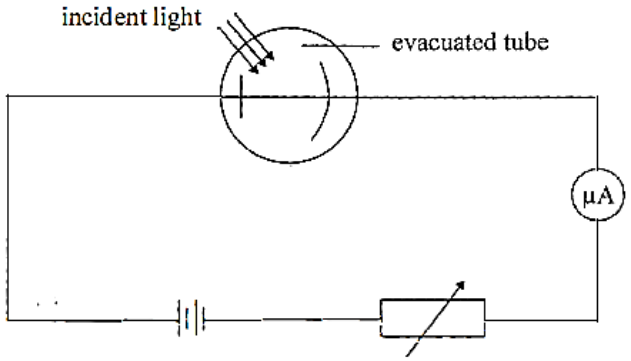


Figure 5

(i) Explain how the microammeter reading is affected when the intensity of the incident light is increased. (2 marks)

(ii) State the reason why the tube is evacuated. (1 mark)

(c) **Figure 6** shows a graph of maximum kinetic energy (KE_{max}) of photoelectrons against the frequency of the incident radiation.

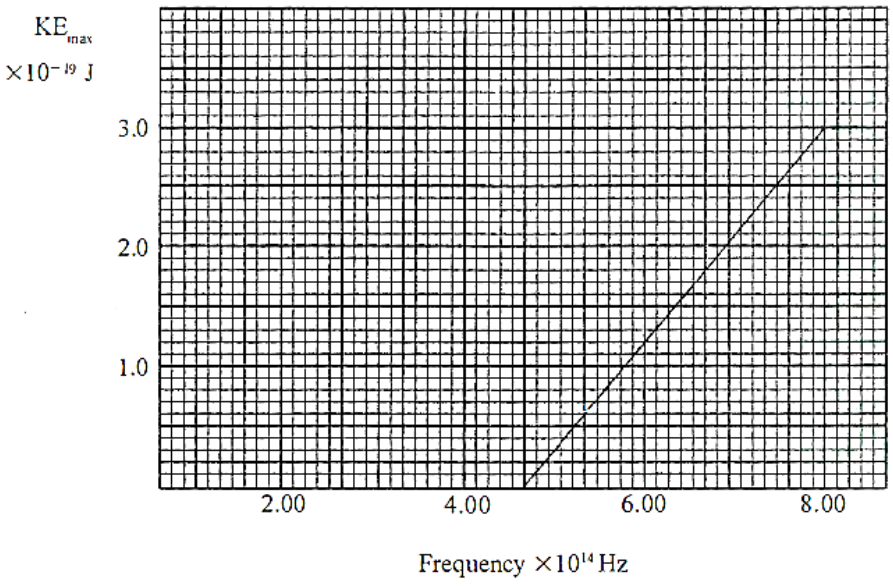


Figure 6

From the graph, determine:

(i) Plank's constant h, (3 marks)

(ii) the threshold wave length λ_0, given that the speed of light C is 3.0×10^8 ms^{-1}. (3 marks)

13. 2019 Q19 (c)

(i) State two factors that determine the speed or the photoelectrons emitted from a metal surface. (2 marks)

(ii) The energy of a photon of light is 2.21 eV. *(electronic charge is 1.6 v 10^{-19} C and planks constant h is 6.63 × 10^{-34}* Js).

I. Express this energy in joules. (1 mark)

II. Determine the frequency of the light that produces the photon. (2 marks)

14. 2020 Q17

(a) (i) Name the **three** components of the electron gun in a cathode ray tube. (3 marks)

(ii) State **one** difference between the deflection systems of a cathode ray tube and the television tube. (1 mark)

(b) Figure **6** shows a graph of stopping potential against the frequency for a certain photo emissive surface, drawn by a student from the data collected when carrying out an experiment on photoelectric effect.

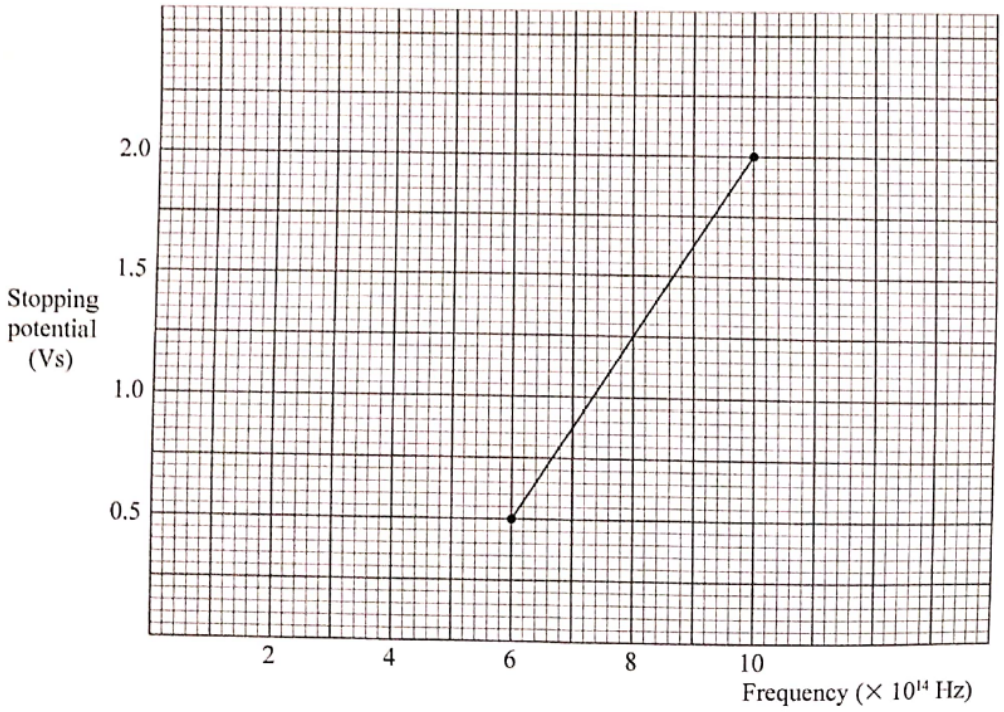


Figure 6

From the graph, determine the:

(i) threshold frequency of the surface; (3 marks)

(ii) plank's constant h, given that the energy of the incident photon is 1.6×10^{-19}J; (3 marks)

(iii) work function of the surface. (3 marks)

RADIOACTIVITY

1. 2006 Q15

A nuclear reaction is represented by the following equation

$$_{92}^{a}X \rightarrow {}^{234}_{b}Y + \text{Alpha particle}$$

Determine the values of a and b (2 marks)

2. 2007 Q13; 2016 Q8

The following is part of radioactive decay series

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

Determine the values of a and b (2 marks)

a = …….. b= ……

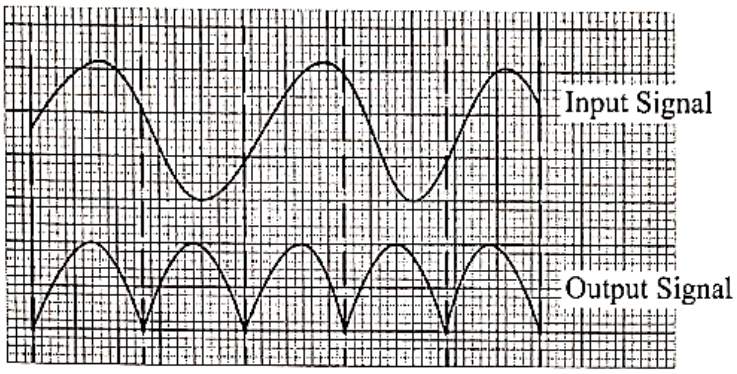


Figure 4

Explain how the two diodes rectify the input signal. (3 marks)

14. 2020 Q9

Draw a diagram to show a *p-n junction* connected in the reverse bias mode. (2 marks)

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SUGGESTED SOLUTIONS

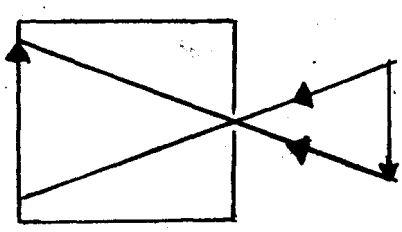
RECTILINEAR PROPAGATION OF LIGHT AND REFLECTION AT PLANE SURFACES

1. Magnification $= \frac{image\ distance}{object\ distance} = \frac{height\ of\ image}{height\ of\ object}$

$\frac{10}{600} = \frac{16}{h}$

h = 9.6m (3 marks)

2.



Rays, Image and object must be labelled; Image must be enlarged (2 marks)

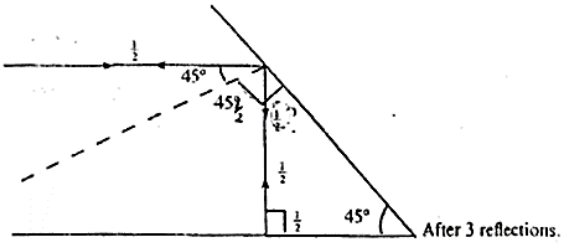
3. BC - Total absence of light; umbra, completely dark

- Total darkness

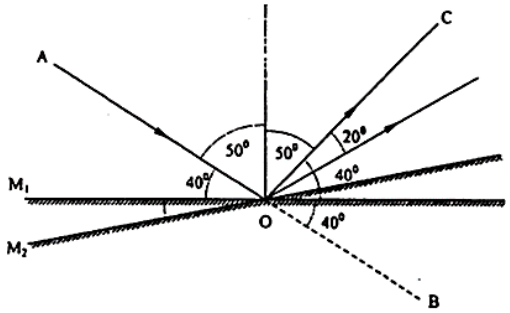
Rays are completed blocked from this region by the object (2 marks)

4. Infinite (very many, uncountable, several (1 mark)

5.



6.



Initial deviation = 90°

Reflected ray rotates $2 \times 20 = 20°$.
Final deviation = $(80° + 20°) = 100°$ (2 marks)

7.

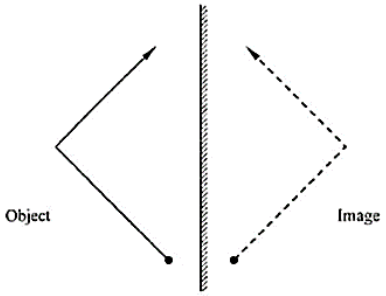
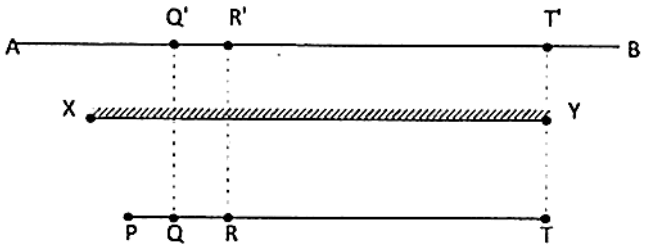


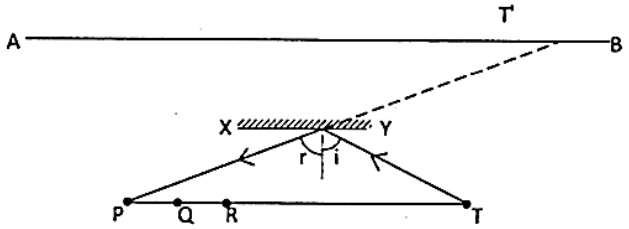
Image (lateral inversion); (accept full line) (1 mark)

8. (a)



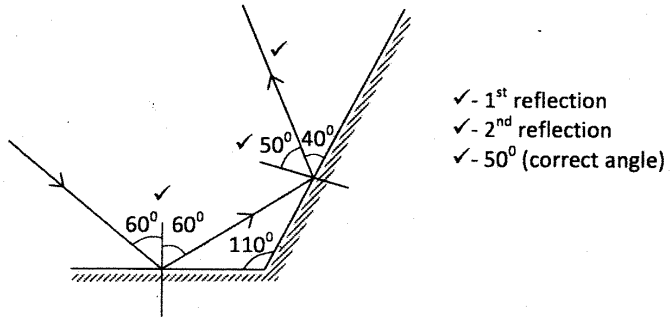
(b) T and R (1 mark)

(c)



- Reflected ray from T and R moves towards P (1 mark)

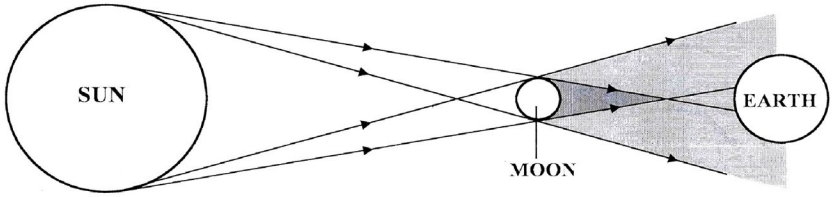
9.



10. angle of incidence = angle of reflection = θ (1 mark)

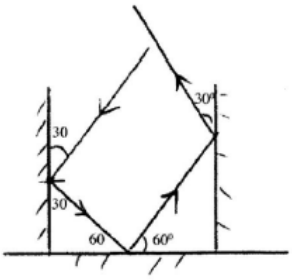
11. larger hole acts as many small holes (1 mark)
∴many overlapping images of same object (1 mark)

12.



Outer pair of rays ✓ (1)
Inner pair of rays ✓ (1)
proper labelling of umbra and penumbra ✓ (1)

13.

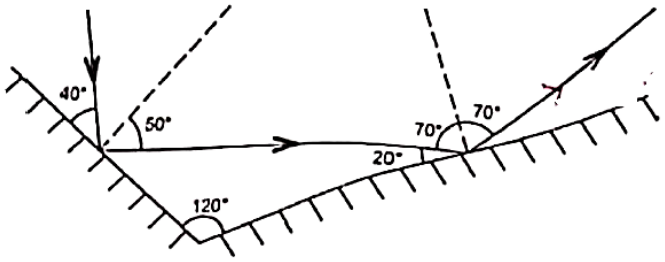


- Correct angle at every surface

Arrow on rays

14. The image is blurred. (1 mark)

15.



Correct reflections al the two minors. ✓
Angle of reflection = 70° ✓ (2 marks)

ELECTROSTATICS I

1. Leaf in A falls a bit while leaf in B rises a bit
The two leaf electroscopes share the charge (2 marks)

2. Negative change (1 mark)

3. Initially attracted because of opposite charge. (+ve or -ve)
Then neutralised and charged positive and hence repeal.
Charging by contact and law of electrostatics. (2 marks)

4.

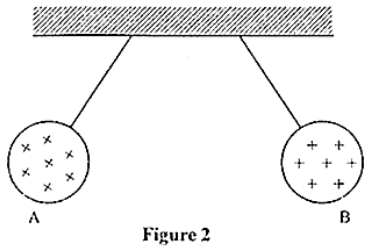


Figure 2

Pith balls repelling (1 mark)

5. - Negative charges flow from earth to cap. (1 mark)
- Negative charge neutralizes the positive. (1 mark)

6.
- estimate the quantity of charge ✓ (1)
- test for insulating properties ✓ (1)
- test for the sign of charge ✓ (1)
- test for presence of charge ✓ (1) (any two correct)

7. Positive charge ✓ (1) (1 mark)

8.
- The leaf falls
- Charge is induced on the sphere causing repulsion of electrons to the leaf hence leaf falls.

(3 marks)

9. An uncharged conductor will also cause a decrease on the divergence of the leaf. (1 mark)
OR
Both positively charged body and an uncharged conductor cause a decrease in divergence.

CELLS AND SIMPLE CIRCUITS

1. To allow escape of gases (H_2 and O_2) from battery (1 mark)

2.
- Alkaline cell lasts longer than lead acid cell/ remain unchanged longer
- Alkaline cell is more rugged than lead acid cell/ robust/ can withstand rough handling
- Alkaline cell is lighter than lead - acid cell

(any one) (1 mark)

3. (a) A - Carbon rod (+); (1 mark)
B - Manganese (VI) oxide (1 mark)
(b) Manganese (IV) oxide is a depolarizer/oxidising agent; (1 mark)

4. Each lamp on full voltage (1 mark)
Failure of one lamp does not affect the others (1 mark)

5. (i) dilute sulphuric acid (1 mark)
(ii) (I) Zinc ions go into acid leaving electrons on the plate (1 mark)
(II) Give up electrons to discharge hydrogen Ions. (1 mark)

(iii) Electrons flow from zinc plate to the copper plate. (1 mark)

6. To maintain the relative density of the electrolyte. ✓ (1) (1 mark)

7. Polarization is the formation of hydrogen gas at the positive terminal of the cell. (1 mark)

8. It acts as a depolarizer. ✓ (1 mark)

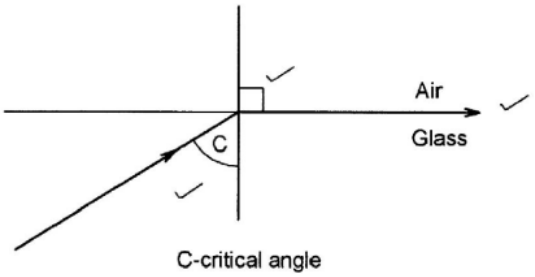
9. A battery is a group of cells connected in series or parallel. ✓ (1 mark)

10. Polarization occurs. ✓ (1 mark)

$1.47 = \frac{\text{real depth}}{6.8}$ ✓ (1)

$= 9.996 \approx 10$ cm ✓ (1) (3 marks)

13. (a)

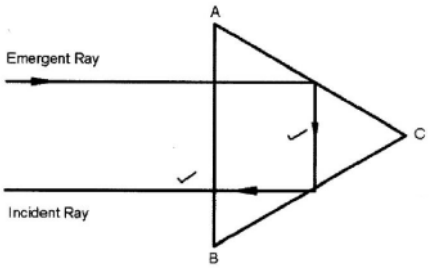


(b) (i) $\eta = \frac{1}{\sin c}$

$\sin c = \frac{1}{\eta} = \frac{1}{1.62}$

$= 38.1°$ (3 marks)

(ii)



(c) - Dispersion of white light
- In periscopes
- In Binoculars
- In telescopes (Any 2) (2 marks)

14. $\frac{Sin\ i}{Sin\ r} = \eta$ ✓

$\frac{Sin\ 30}{Sin\ x} = 1.36;$ $\frac{Sin\ 30}{1.36} = Sin\ x$

$x=21.6^0$ ✓ (2 marks)

15. (a) (i) critical angle = 42° ✓since the angle of refraction is 90° (1 mark)

(ii) $\sin C = \frac{1}{\eta}$

$\boldsymbol{\eta} = \frac{1}{\sin 42°}$ ✓

$= 1.49$ ✓

OR $\eta = \frac{\sin 90°}{\sin 42°}$ $= 1.49$ (2 marks)

(b) Refractive index $= \frac{real\ depth}{apparent\ depth}$ ✓

$\therefore$ apparent depth $= \frac{15}{1.32}$ ✓

$= 11.36$ cm ✓ (3 marks)

CURRENT ELECTRICITY

1.
- Constant temperature
- No mechanical strain (1 mark)

2. $I = \frac{1.5}{R+r}$

$0.13 = \frac{1.5}{10 + r}$

$r = 1.5\ \Omega$ (3 marks)

3. (a) The ratio of the pd across the ends of a metal conductor to the current passing through it is a constant (conditions must be given) (1 mark)

(b) (i) It does not obey Ohm's law; because the current - voltage graph is not linear through line origin / directly proportionate (2 marks)

(ii) Resistance $= \frac{V}{I}$ = inverse of slope;

$= \frac{(0.74 - 0.70)\ V}{(80 - 50)\ mA}$

$= \frac{0.4V}{30 \times 10^{-3}\ A}$

$= 1.33\ \Omega$

1.20 - 1.45 Ω (range) (3 marks)

(iii) From the graph, current flowing when pd is 0.70 is 36 MA

Pd across R $= 6.0 - 0.7 = 5.3v$

R $= \frac{5.3\ V}{60\ mA}$

$= 139.5 - 151.4\ \Omega$ (3 marks)

(c) (i) Parallel circuit $\frac{1}{30} + \frac{1}{20} = \frac{5}{60}$

R $= 12\ \Omega$

Total resistance $= 10 + 12 = 22\ \Omega$ (2 marks)

WAVES II

1.

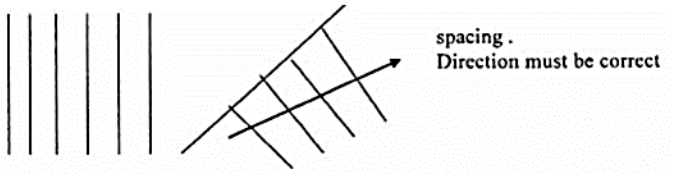


Reflected waves are curved. Either converging circular reflected waves. Converging to F; OR two perpendicular lines from the surface of one of the curves meeting at F. (2 marks)

2.



3.

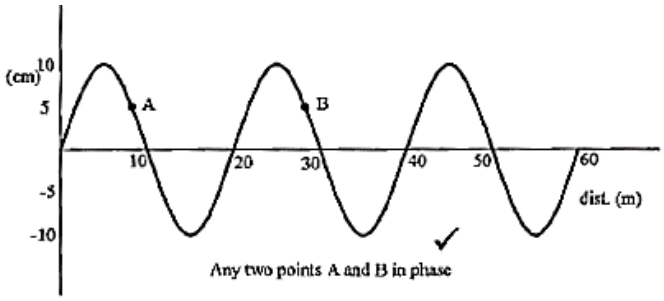


4. (a) (i) Attach two identical dippers to the same vibrator, switch on and the circular waves produced are coherent OR
Use one straight vibrator with two identical slits to produce coherent waves. (2 marks)

(ii) Constructive interference - Bright
Destructive interference – Dark (1 mark)

(b) Constructive interference -when two waves arrive at a point in phase ie crest and crest meet or trough and trough meet
Destructive interference- occurs when a crest meets a trough and gives zero intensity (2 marks)

(c)



(ii) (I) Amplitude = 10cm ✓
(II) Wavelength = 20 m ✓ (2 marks)

(iii) (I) $T = \frac{1}{f} = \frac{1}{50} = 0.2$ s ✓ (1 mark)

(II) $v = f\lambda$ ✓
$= 20 \times 50$ ✓
$= 1000\ ms^{-1}$ ✓ (3 marks)

13. (a) (i) Amplitude is the maximum displacement of a particle ✓ from the mean position (1 mark)

(iii) Wavelength is the distance between two successive points in a wave ✓ which are in phase.
OR
Distance between two successive crests or troughs in a transverse wave/between rarefaction or compressions in a longitudinal wave. (1 mark)

(b) (i)

(ii) **(I)** Wavelength $= \frac{distance}{number\ of\ waves}$
$= \frac{15}{3}$ ✓
$= 5$ cm ✓ (2 marks)

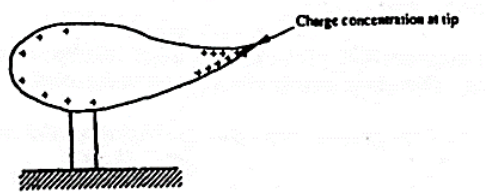
(II) $f = \frac{v}{\lambda}$ $= \frac{4.0}{5}$ ✓
$= 8$ Hz (2 marks)

(c) (i) (I) - due to destructive interference ✓ (1 mark)
(II) - due to constructive interference ✓ (1 mark)

(ii) The fringes get closer ✓
OR
When die frequency is higher the wavelength reduces hence the fringe separation decreases. ✓
OR more fringes are formed. ✓ (1 mark)

ELECTROSTATICS II

1.



2. (a) Charge Q, on C_1 is given by

Charge Q_1 $= C_1 V$;

$= 0.3\ \mu F \times 4.5$;

$= 1.35\ \mu C$; (3 marks)

(b) $C_T = C_1 + C_2$;

$= (0.3 + 0.5)$ p F $= 0.8\ \mu F$ (2 marks)

(c) (i) 4.5 V (1 mark)

(ii) Observed on voltmeter: p.d drops to less than 4.5 (1 mark)

(iii) The drop of p.d in C (ii) is because the charge on C_1 is distributed to C_2. Since values of C_1 and C_2 remain constant, when Q on C_1 reduces, then $Q = C_1V$ implies V must reduce also, hence voltmeter reading reduced. (2 marks)

3. (a) Capacitances decreases;

Because the area of overlap decreases (2 marks)

(b) (i) For Parallel arrangement; Cp = 5 + 3 = 8 μF

For the Whole circuit; $\frac{1}{C} = \frac{1}{4} + \frac{1}{8} = \frac{12}{32}$

$\therefore C = \frac{32}{12} = \frac{8}{3}\ \mu F = 2.67\ \mu F$ (3 marks)

(ii) $Q = CV = \frac{8}{3} \times 12\ \mu C$

$= 32\ \mu C$ (2 marks)

(iii) if p.d across A is V_1;

$V_1 = \frac{Q}{C} = \frac{32 \times 10^{-6}}{4 \times 10^{-6}} = 8$ V (1 mark)

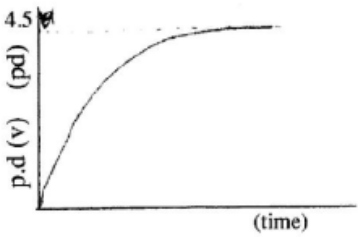
4. (a) (i) Current falls off to zero /falling to zero/ deflects to max. then zero (1 mark)

(ii) current flows when the capacitor is charging. When fully charged, current stops flowing (no current) and p.d is equal to charging voltage. (2 marks)

the plates, opposing further flow of electrons when fully charged✓ (1)
(3 marks)

(iii) Resistor - to slow down the charging process so that current and voltage are is observed. ✓ (1) (1 mark)

(iv)



Parallel arrangement✓ (1)
Circuit symbols✓ (1)

10. (a) - Area of overlap of the plates
- Distance between the plates.
- Type of dielectric. **(Any 2)** (2 marks)

(b) (i) $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$

$= \frac{1}{4} + \frac{1}{8} = \frac{2+1}{8} = \frac{3}{8}$

$\frac{C_T}{1} = \frac{8}{3}$ $= 2.67$ Mf

C $= 6 + 2.67$ $= 8.67$ μF (4 marks)

(ii) Q in series section

Q $= CV$

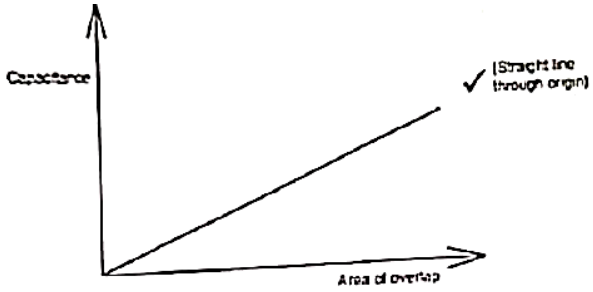
$= 2.67 \times 4.0$

$= 10.68$ C

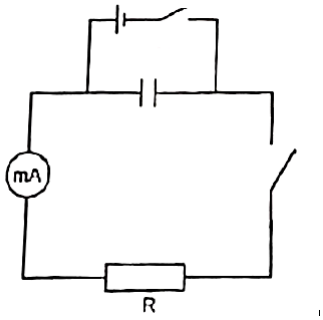
$Q(4\ \mu F) = 10.68$ (3 marks)

11. The leaf collapses ✓
- Negative charge is induced on the tip of the pin. Pin repels negatively charged ✓air ions which discharges the electroscope ✓. (3 marks)

12. (a)

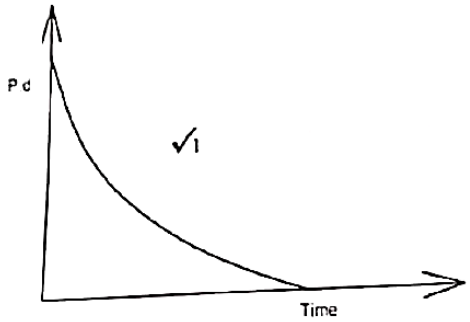


(b) (i)



Milliammeter and resistor ✓
Cell and switch ✓ (2 marks)

(ii)



(c) (i) $C_{parallel} = 2 + 3 = 5\ \mu F$ ✓

$\frac{1}{C_T} = \frac{1}{5} + \frac{1}{4}$ ✓

$C_T = \frac{20}{9} = 2.22\ \mu F$ ✓ (3 marks)

(ii) $Q = CV$

$= 2.22 \times 10^{-6} \times 6$ ✓

$= 1.332 \times 10^{-3}\ C$ ✓ (2 marks)

(iii) $V = \frac{Q}{C}$

$= \frac{1.33 \times 10^{-5}}{4 \times 10^{-6}}$ ✓

$= 3.33\ V$ ✓ (2 marks)

HEATING EFFECT OF AN ELECTRIC CURRENT

1. $R_1 = \frac{V^2}{P}$; $R_2 = \frac{V^2}{8P}$

$$\frac{R_1}{R_2} = \frac{V^2}{P} \times \frac{8P}{V^2}$$

$= 8$ (3 marks)

2. $P = \frac{V^2}{R}$; $P = \frac{240^2}{100}$

$= 84$ J/S (3 marks)

3. (a) Increase in current causes rise in temperature;
Rise in temperature causes rise in Resistance (2 marks)

(b) lamp X resistance, $R = \frac{V}{I} = \frac{2.5}{12} = 2.1\ \Omega$ (3 marks)

(c) Read off P d across Y = 1.0 V from graph (1 mark)

(d) Power on lamp Y; P = IV $= 0.8 \times 3$
$= 2.4$ watts (2 marks)

4. I_o = Initial current $I_2 = 7I_0$ ✓
$P = I^2R = I_o^2 R$ ✓
$P = (7I_o)^2R = 49I_o^2R$
∴ Power is 49 times the initial valued ✓
Apply the power formula. (3 marks)

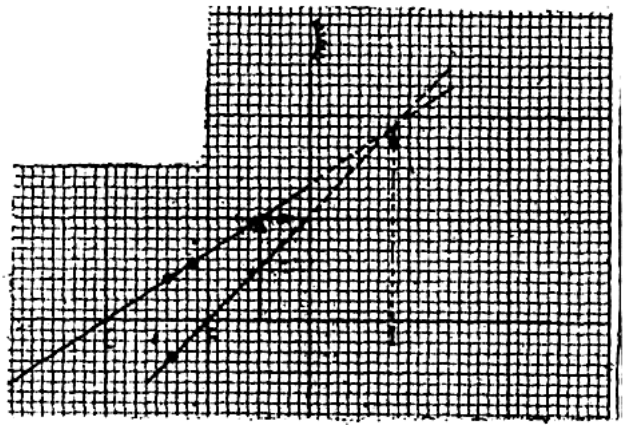
5. (i) $I = \frac{P}{V}$ ✓ (1)
$= \frac{60}{240}$ ✓ (1)
$= 0.25\ A$ ✓ (1)

(ii) $R = \frac{V}{I}$ ✓ (1)
$R = \frac{240 \times 240}{60}$ ✓ (1) OR $\frac{240}{0.25}$
$R = 960\ \Omega$ ✓ (1)

6. Conversion of the Kinetic energy of the electrons into heat energy/
Conversion of electrical energy to heat (1 mark)

THIN LENSES

1. (a) (i)



(ii) Image at 10 cm from mirror (using scale) (2 marks)

(iii) Magnification $= \frac{\text{Size of image}}{\text{Size of object}} = \frac{4.0\text{ cm}}{2.0\text{ cm}} = 2$

OR magnification $= \frac{\text{Image distance}}{\text{Object distance}} = \frac{2.0\text{ cm}}{1.0\text{ cm}} = 2$ (2 marks)

(b) (i) (I) Image distance; $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{v} = \frac{1}{5} - \frac{1}{20} = \frac{3}{20}$

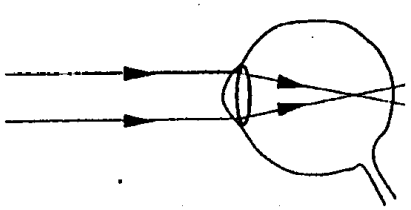
v = $\frac{20}{3}$ = 6.67 cm (3 marks)

(II) Magnification $= \frac{v}{u}$ $= \frac{6.67}{20} = 0.33$; (2 marks)

(ii) real, inverted, diminished, less bright/blurred (2 marks)

2. The process of the eye lens being adjusted to focus objects at various distances. (1 mark)

3. (a) (i)



(ii)

alternating current through the solenoid. ✓ (2 marks)

(b) - Suspend each of the bars through its centre of gravity and set it swinging in a horizontal plane about a vertical axis through its centre. ✓
- The magnetized bar will always come to rest in a north-south direction. ✓
(2 marks)

(c) (i) The galvanometer pointer first deflects then moves back ✓
When the switch is closed, a current builds up in coil X and due to change in flux linkage an emf is induced ✓ in coil Y making an induced current flow through the galvanometer during the time current in coil X is rising.
When current through coil X is steady no induced current flows through the galvanometer since there is no change in flux linkage ✓ and therefore the pointer deflects back✓ (4 marks)

(ii) Pointer deflects in the opposite direction ✓ and back to zero (1 mark)

(iii) Magnitude of deflection increases. ✓ (1 mark)

MAINS ELECTRICITY

1. (a) (i) P = Ring circuit (1 mark)
X = Neutral (point or terminal)
Y = Live (point or terminal) (2 marks)

(ii) (I) Purpose of R - or fuse; is a safety element in a circuit against excess current (1 mark)

(II) R is connected to Y but not to X ensure that when it breaks a circuit any gadget/ appliance connected does not remain live. (1 mark)

(iii) Earthing is necessary in such a circuit to guard against electric shocks. (1 mark)

(b) Cost of electricity = 1.5 kw × 30h × 8 Kshs = Kshs 360/= (2 marks)

2. Implies low currents ✓ so reduces heat losses/ power loss. ✓ (2 marks)
Or l^2R loss reduced.
$P = l^2R$ should be accompanied by power loss
NB: Heat losses/ Power Loss ✓

(ii) $T_o = \frac{c}{f_o}$ ✓

$= \frac{3 \times 10^8}{4.6 \times 10^{14}}$ ✓

$= 6.52 \times 10^{-7}$ m ✓ (3 marks)

13. (i) - The work function of the metal ✓

- Energy of incident radiation / frequency /wavelength ✓ (2 marks)

(ii) Energy = ev $= 1.6 \times 10^{-19} \times 2.21$

$= 3.54 \times 10^{-19}$ J ✓ (1 mark)

(iii) E = *hf*; $f = \frac{E}{h}$

$= \frac{3.54 \times 10^{-19}}{6.63 \times 10^{-34}}$ ✓

$= 5.33 \times 10^{14}$ Hz ✓ (2 marks)

RADIOACTIVITY

1. a = 234 + 4 = 238

b = 02 – 2 =90 (2 marks)

2. a = 234; b= 82 (2 marks)

3. Beta particle

Gain of an electron OR

Mass number has not changed but atomic number has increased by 1

Atomic number has increased by one

Nature will not affect the speed (2 marks)

4. (a) β = particle (1 mark)

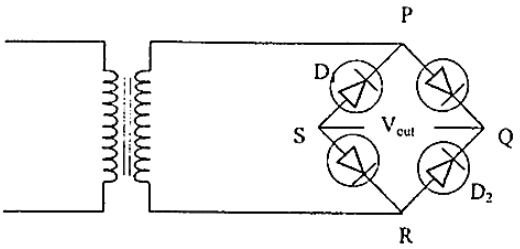
(b) (i) Ionises the gas (1 mark)

(ii) Ions are attracted towards electrodes;

Collisions with other molecules cause avalanche of ions which on attraction to the

(1 mark)

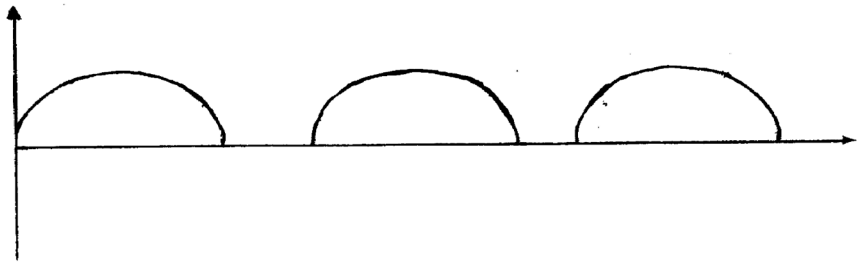
(d) By connecting it in forward biased mode (i.e. P to + and n to -) (1 mark)



(i) Correct diode direction; (2 marks)

(ii) Across QS; (1 mark)

6.



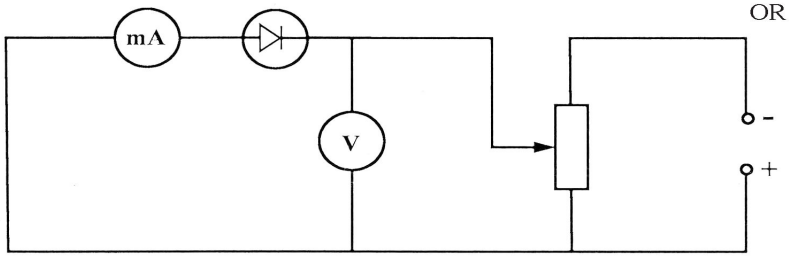
Minimum of 2 arcs should be shown
(above / below x – axis)

Curves should be symmetrical. (1 mark)

7. Arsenic shares 4 of its 5 electrons with germanium; (1 mark)
the extra electron is free for conduction. (1 mark)

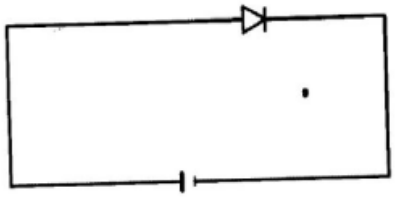
8.

OR equivalent

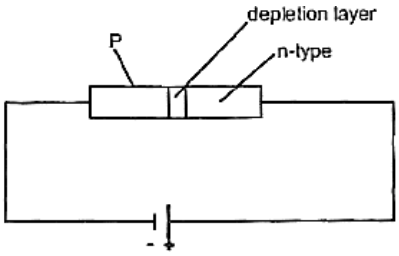


1 mark for correct bias
1 mark for both ammeter and voltmeter
1 mark for means of varying the p.d. across the diode.

9.



10. (i)



1 mark for polarity ✓
1 mark for showing depletion layer ✓

(ii) The holes and the electrons in their respective regions are attracted away from the junction by the external voltage. (1 mark)

(iii) The voltage at which the diode begins to conduct in the reverse bias mode. (1 mark)

(iv) - In rectification circuits for changing a.c. to d.c
- In control of voltages of Zener diode.
(Any one correct) (1 mark)

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