F4 TOPICAL REVISION

PHYSICS

A SERIES OF KCSE TOPICAL REVISION QUESTIONS IN PHYSICS.

A Comprehensive Detailed Analysis of Past KCSE Questions. Candidates are Hereby Advised to Pay Key Attention to this Crucial Quick Revision Kit.

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THIN LENSES

1. In a short-sighted eye, rays from distant objects are not focused on the retina.
Where are these rays focused and what type of lens is needed to correct the problem?

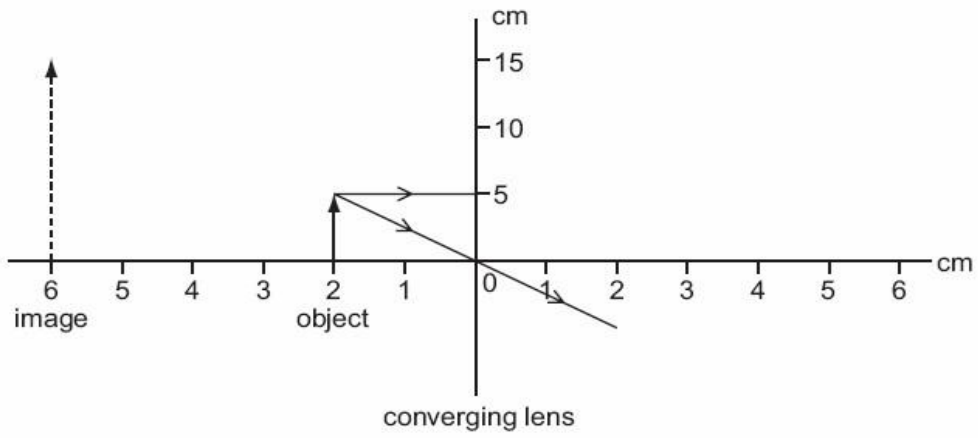
	where focused	lens needed
A	behind the retina	converging lens
B	behind the retina	diverging lens
C	in front of the retina	converging lens
D	in front of the retina	diverging lens

2. When an object is placed at the focus of a concave mirror, the image will be formed at _____.

A. infinity
B. focus
C. centre of curvature
D. pole

3. An object of size 2.0 cm is placed perpendicular to the principal axis of a concave mirror. The distance of the object from the mirror equals to the radius of curvature. The size of the image will be _____.

4. An object 5.0 cm high is placed 2.0 cm from a converging (convex) lens which is being used as a magnifying glass.
The image produced is 6.0 cm from the lens and is 15 cm high.

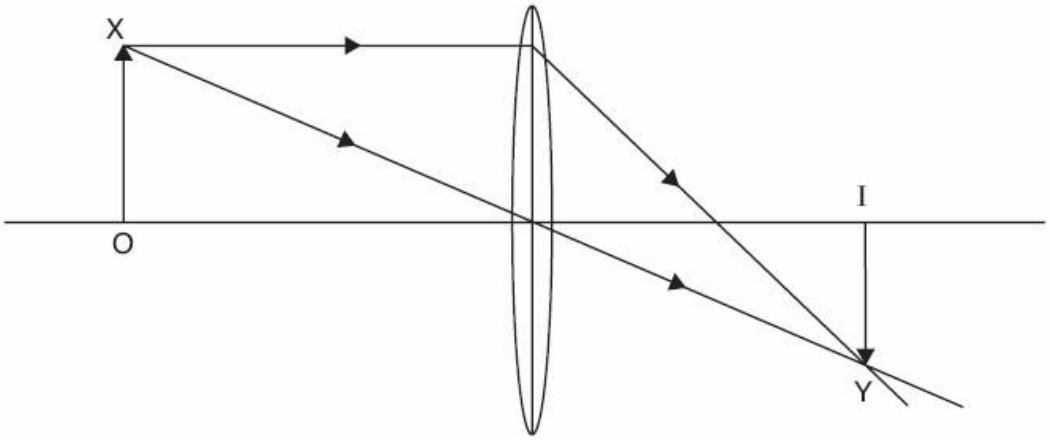


What is the focal length of the lens?

5. A real object is placed before a convex lens. The image formed by it is virtual, erect and magnified. The object is placed between

A 2f an

6. An object OX is placed in front of a converging lens. The lens forms an image IY. The figure below shows two rays from the object to the image.



(a) On the figure above ,

(i) Clearly mark and label the principal focus and the focal length of the lens, [3] **(ii)** Draw a third ray from X to Y. [1]

(b) The following list contains descriptions that can be applied to images. Tick any which apply to the image shown in Figure.

real	☐
virtual	☐
enlarged	☐
diminished	☐
inverted	☐
upright	☐
image distance less than object distance	☐
image distance more than object distance	☐

[4]

(c) State two things that happen to the image in Fig. 8.1 when the object is moved further away from the lens.

1. .....

.....

2. .....

.....[2]

[Total: 10]

7. Fig. 5.2 shows a normal eye viewing an object close to it. Fig. 5.3 is a long-sighted eye viewing an object at the same distance.

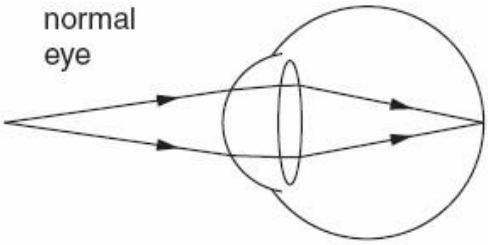


Fig 5.2

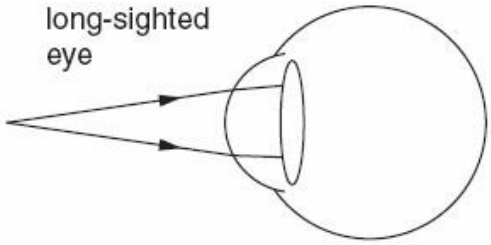


Fig 5.3

Complete Fig. 5.3 to show the rays travelling through the eye. [1]

8. Fig. 2.1 shows the lens of a simple camera being used to photograph an object.

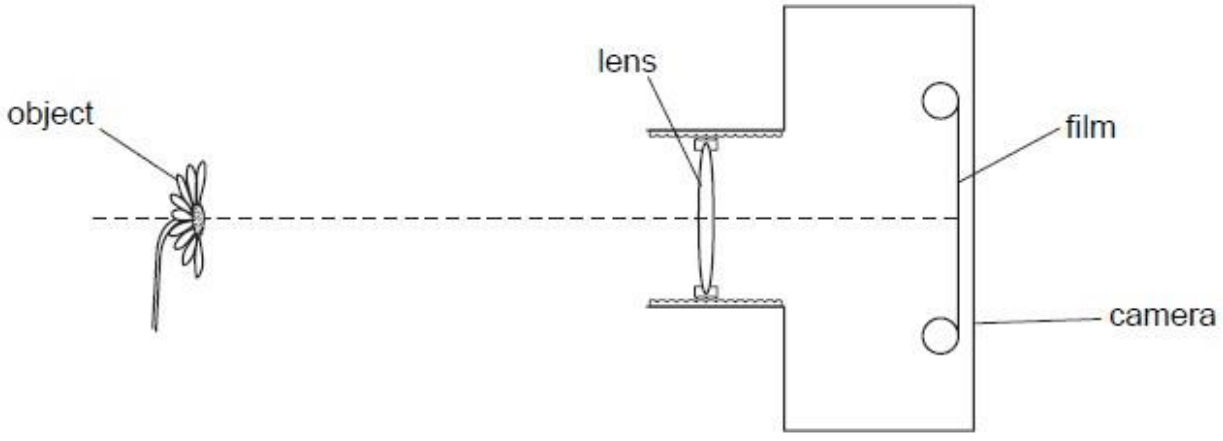


Fig. 2.1

The lens forms a focused image of the object on the film.

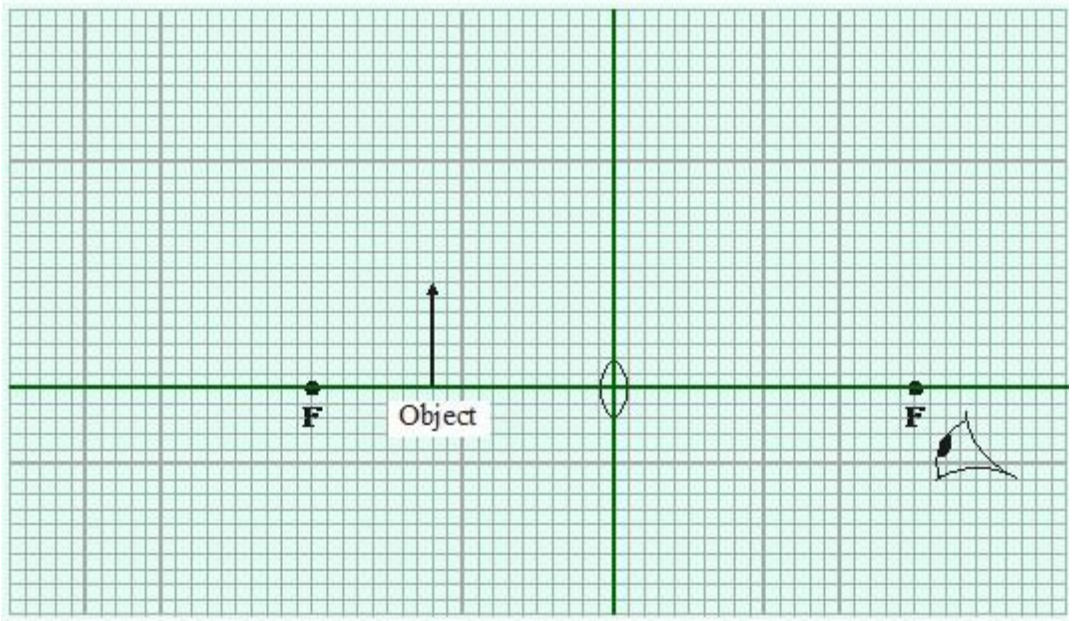
(a) Draw two rays from the top of the object to show how the lens forms the image. [2]

(b) The object moves closer to the camera. State how the lens is adjusted to keep the image in focus.

[1]

[Total 3m]

9. The diagram shows a converging lens of focal length 4 cm being used as a magnifying glass. An object 1.6 cm tall is placed 2.4 cm from the lens.



(a) On the diagram, use a ruler to construct accurately the position and size of the image. You should show how you construct your ray diagram and how light appears to come from the image to the eye.

(4 marks)

(b) The image is virtual. What is a virtual image?

(1 mark)

(c) Calculate the magnification produced by the lens. Show clearly how you work out your answer.

(2 marks)

(Total 7 marks)

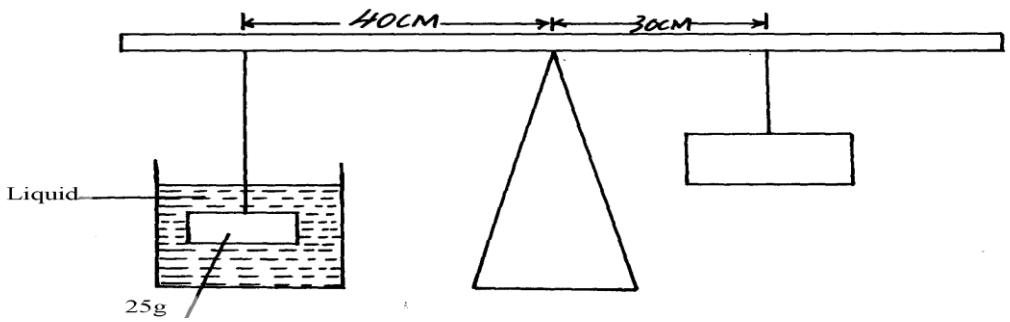
FLOATING AND SINKING

1. (a). State Archimedes's Principle .
   b). A during bell of weight 60,000N and volume $2m^3$ is to be raised from the bottom of the sea. If the density of sea water is $1024kg/m^3$, calculate:
   (i) the mass of sea-water displaced by the bell.
   (ii) The force a crane must first exert to just lift the bell from the sea-bed.
   (c). The figure below shows a bock of wood of dimension 16cm x 8cm 2cm floating with ¾ of its size submerged in a liquid.

   During the experiment with the following set-up above, the following results were obtained.
   -Initial reading of the Toppan balance with empty beaker = 22g.
   -Final reading of the top pan balance = 176g.
   Use the above results to determine:
   (i). the density of the block
   (ii). The density of the liquid.
2. (a) A piece of sealing wax weighs 3N in air and 0.22N when immersed in water. Calculate:
   (i) Its relative density.
   (ii) Its apparent weight ,in a liquid of density 800 kgm^{-3}.
   (b) The figure below shows a uniform beam one metre long and weighing 2N kept in horizontal position by a body of weight 10N immersed in a liquid.
   Determine the upthrust on the load.

3. A bubble of air has a diameter of 2.0 mm when it is 0.5m below the water surface of a boiler. Calculate the diameter of the bubble as it reaches the surface, assuming that the temperature remains constant.
   (Take g = $10Nkg^{-1}$ density of water = 10^3kgm^{-3} and atmospheric pressure = 10^5Mn^{-2}

4. (a) State the Archimedes principle
   (b) The figure below shows a block of mass 25g and density $200kg/m^3$ submerged beam by means of a thread. A mass of 2g if suspended form the beam as shown in the figure below



   (i) Determine the up thrust force acting on the block
   (ii) Calculate the density of the liquid
   (c) A rectangular block of dimensions 4m x 3m x 2m is tethered to the sea bed by a wire. If the

density of the material making the block is 0.67g/cm^3 and density of water is 1.1g/cm^3, calculate: (i) Up thrust force on the block
(ii) Tension on the wire

5. Explain why a needle can be carefully made to float in pure water but sinks if a detergent is added.

6. (i) State the law of floatation.
(ii) The fig. below shows a floating object of volume 40,000 cm^3 and mass 10g. It is held as shown in water of density 1.25g/cm^3 by a light cable at the bottom so that ¾ of the volume of the object is below the water surface. (Assume that up thrust due to air is negligible)

Figure 11

(iii) (I) Calculate the volume of the object under water.
(II) State the volume of water displaced by the object.
(III) Calculate the weight of water displaced.
(iv) Determine the tension in the cable
(v) Calculate the density of the object.

7. (a) A trolley is being pulled horizontally from a ticker-tape timer. The figure below shows part of the ticker-tape.

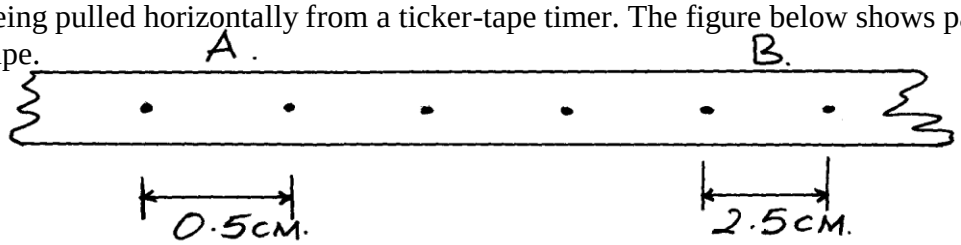


Figure 12

(i) Find the average velocity, **u**, at the section marked **A**.
(ii) Find the average velocity, **V** at the section marked **B**.
(iii) Find the acceleration of the trolley between **A** and **B**.
(b) If the mass of the trolley is 500g, determine the resultant force which acted on the trolley that caused the acceleration.

8. (a) State Archimedes' principle
(b) (i) Draw a clearly labelled diagram of common hydrometer which is suitable for measuring the densities of liquids varying between 1.0 and 1.2 g/cm^3. Show clearly the marks indicating 1.0, 1.1 and 1.2 g/cm^3.
(ii) State the principle upon which the instrument's use depends
(c) A concrete block of volume **V** is totally immersed in sea water of density ϑ. Write an expression for the upthrust on the block

9. (a) Define the term relative density
(b) The diagram below shows a wooden log 12m long, density 800kg/m^3 and cross-sectional area 0.06m^2 floating upright in sea water of density 1.03g/cm^3, such that a third of it is covered by water.

(i) Determine the weight of the block
(ii) The up-thrust on the block
(iii) The minimum weight that can be placed on the block to just make it fully submerged

(c) The following set-up was then used by a student to determine the relative density of a cork

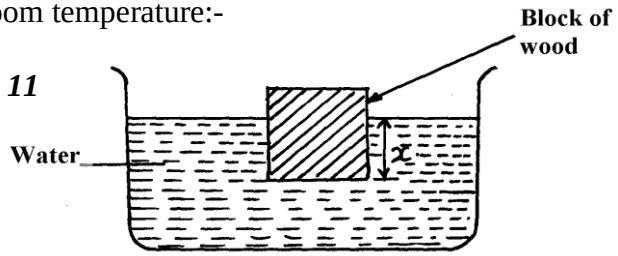
During the experiment, the following measurements were taken:-
- Weight of sinker in water = W_1
- Weight of sinker in water and cork in air = W_2
- Weight of sinker and cork in water = W_3

(i) Write an expression for the up thrust on cork
(ii) Write an expression for the relative density of the cork

10. (a) State the law of floatation

(b) The diagram ***figure 11*** below shows a block of wood floating on water in a beaker. The set-up is at room temperature:-

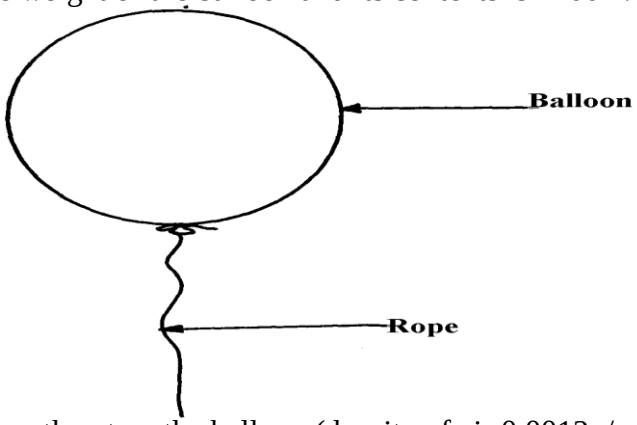
fig. 11



The water in the beaker is warmed with the block still floating on it. State and explain the changes that are likely to occur in depth **x**

(c) The diagram ***figure 12*** below shows a balloon which is filled with hot air to a volume of $200m^3$. The weight of the balloon and its contents is 2200N.

fig. 12



(i) Determine the upthrust on the balloon (density of air $0.0012g/cm^3$)

(ii) The balloon is to be balanced by hanging small rats each of mass 200g on the lower end of the rope. Determine the least number of rats that will just make the lower end of the rope touch the ground.

11. (a) State Archimedes's principle

(b) A rectangular brick of mass 10kg is suspended from the lower end of a spring balance and gradually lowered into water until its upper end is some distance below the surface
(i) State and explain the changes observed in the spring balance during the process
(ii) If the spring reads 80N when the brick is totally immersed, determine the volume of the brick. (Take density of water = $1000kgm^{-3}$)

(c) The figure below shows a hydrometer

Explain:

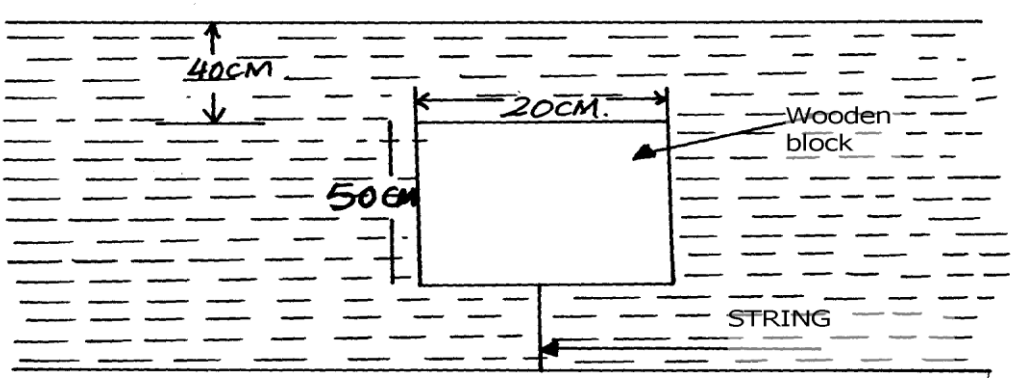
(i) Why the stem is made narrow

(ii) Why the bulb is made wide

(iii) Why the lead-shots are placed at the bottom

12. (a) State the law of floatation

(b) The diagram below shows a wooden block of dimensions 50cm by 40cm by 20 cm held in position by a string attached to the bottom of a swimming pool. The density of the block is $600kgm^{-3}$



(i) Calculate the pressure in the bottom surface of the block

(ii) State the **three** forces acting on the block and write an equation linking them when the block is stationary

(iii) Calculate the tension on the string

13. A block of glass of mass 250g floats in mercury. What volume of glass lies under the surface of Mercury? Density of mercury is $13.6 \times 10^3 Kg/m^3$

14. a) State the law of floatation

b) A balloon of negligible weight and capacity $80m^3$ is filled with helium of density $0.18Kgm^{-3}$. Calculate the lifting force of the balloon given that the density of air = $1.2Kgm^{-3}$

c) A piece of glass has a mass of 52g in air, 32g when completely immersed in water and 18g when completely immersed in an acid. (Take: density of water = $1g/cm^3$)

Calculate:

i) Density of glass

ii) Density of the acid

PHOTO ELECTRIC EFFECT

1. (a) Define the following:

(i) Photoelectric effect

(ii) threshold wavelength

(b) The variation of frequency f with the maximum kinetic energy E_k of the emitted electrons is shown on the graph below:

Using the graph above, determine

(i) the threshold frequency f_o of the radiation *RCH*

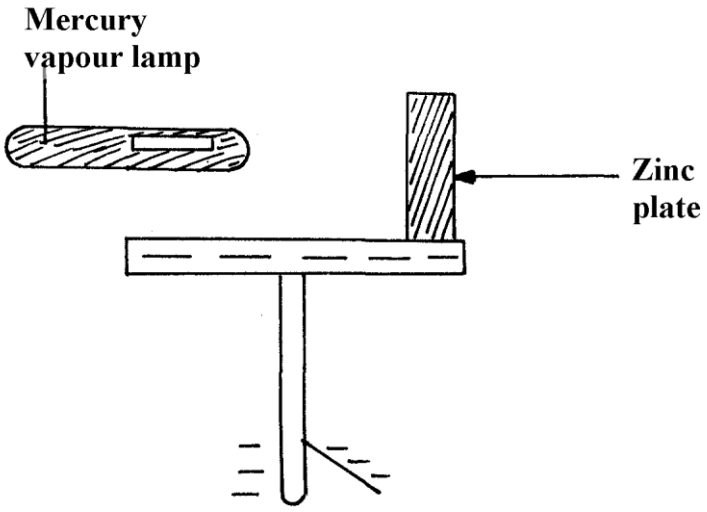
(ii) the value of the Planck's constant h

(iii) the work function, W_o

(c) On the same graph in **(b)** above, draw a line to show the variation of frequency, f, with the maximum kinetic energy, E_k, of the emitted electrons from a second metal which has a lower work function that used in **(b)**

2. ***Figure 8*** below shows a mercury vapour lamp, which emits ultraviolet light held over a negatively charged electroscope:

figure 8



(i) What happens to the leaf after the lamp is switched on?

(ii) Explain why it happens

(iii) If the experiment is repeated with equally bright red light held the same distance from the plate in place of the mercury vapour lamp, what effect would this have on the leaf? Give a reason

(iv) What does photoelectric effect suggest about the nature of light?

3. Calculate the wavelength of Green light whose energy is 3.37×10^{-19} J .
($h = 6.63 \times 10^{-34}$JS, $C = 3.0 \times 10^{8}$m/s)

4. a) Define the term *work function*

b) Name **one** factor that determines the velocity of photoelectrons produced on a metal surface when light shine on it

c) In a photoelectric effect experiment, a certain surface was illuminated with radiations of different wavelengths and stopping potential determined for each wavelength. The table below shows the results obtained.

Stopping potential , Vs	1.35	1.15	0.93	0.62	0.36
Wave length, ($x10^{-7}m$)	3.77	4.04	4.36	4.92	5.46

i) On the grid provided plot a graph of stopping potential (Y –axis) against frequency

ii) From your graph determine:

a) The threshold frequency

b) The plank's constant, h

($e = 1.6 \times 10^{-19}$ Coulomb, $C = 3.0 \times 10^{8}$ m/s)

5. a) State the role of the Grid in a cathode ray tube
   b) Explain why a magnetic field is used in the TV deflection system instead of an electric field
   c) The time base of a CRO is 25ms/div while its gain is 2.5V/div. Use this information to answer the questions that follow:
   i) Calculate the frequency of the signal
   ii) What is the peak voltage of the signal

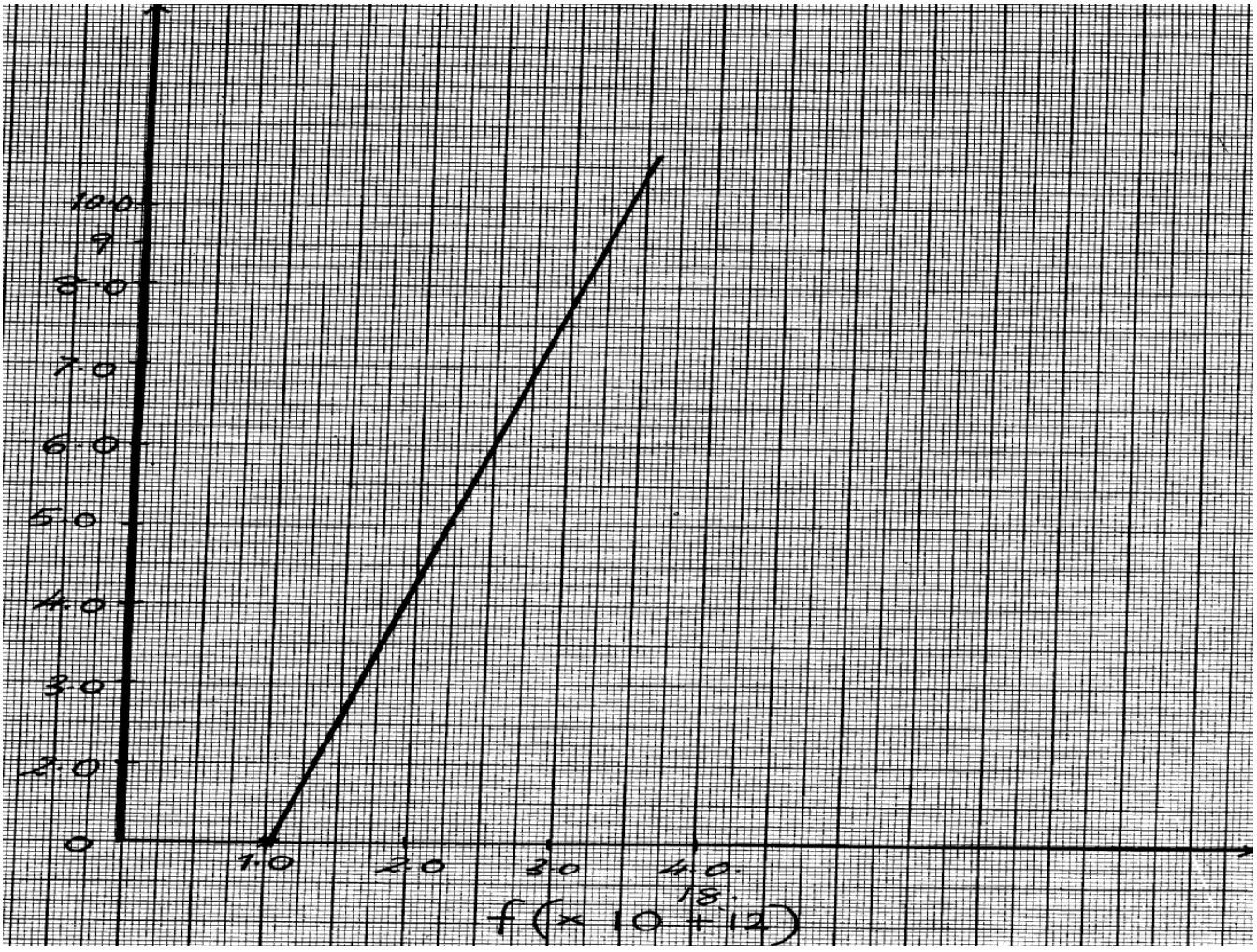
6. The graph below shows the relation between the stopping potential, Vs and the frequency of radiation when a certain surface is illuminated with light of different frequencies
   From the graph determine:-
   (i) The threshold frequency
   (ii) The value of plank's constant ($e = 1.6 \times 10^{-19}C$)
   (III) The work function of the material

7. a) State **one** reason why a C.R.O is a more accurate voltmeter than a moving coil voltmeter
   (b)The diagram below represents a cathode ray oscilloscope (CRO)

K.E max (X 10^{-19}kJ)

   i) Name the parts labeled **A** and **B**
   ii) What are the functions of **C** and **D**?
   iii) State how electrons are produced

8. a) What is meant by the term photo electric effect
   b) In an experiment using a photo cell, ultra violet light of varying frequency strikes a metal surface. The maximum Kinetic energy (KE max) of the frequency **F** is measured. The graph below shows how the maximum kinetic energy varies with frequency **F**

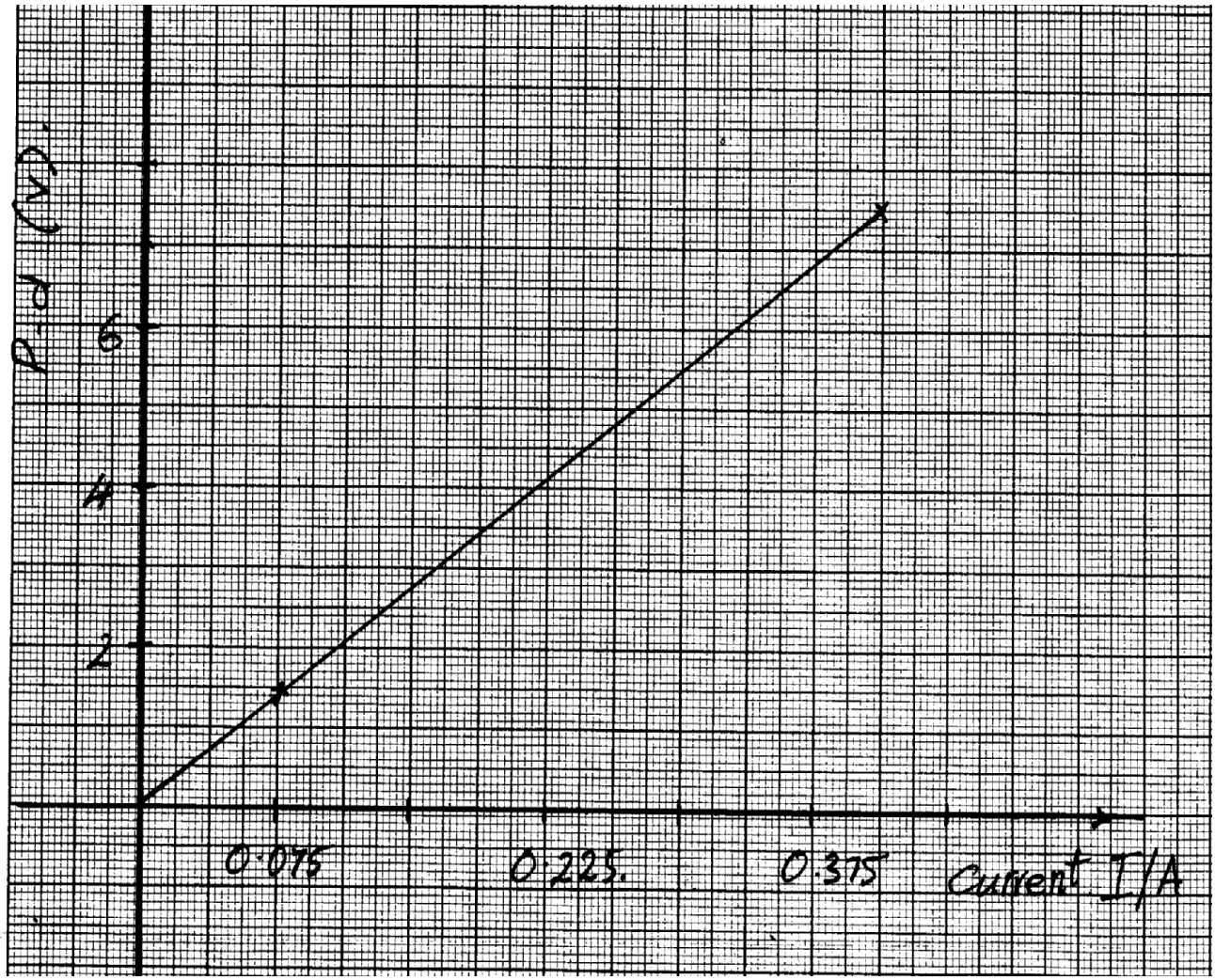


Use the graph to determine:-
i) Threshold frequency **F**
ii) The plank's constant, **h**
iii) Work function of the metal

9. (a) The diagram fig 9 below shows a photo cell; connected in a circuit:-
fig. 9

(i) Complete the diagram by indicating the correct polarities in the gap for current to flow in the circuit
(ii) State and explain the effect of using light of different wave lengths on the amount of current flowing in the circuit given that the distance of the source of light remains the same

(b) Two fixed resistors one of 100Ω and the other of unknown resistance are connected in parallel. The combination is placed in a circuit and current passing through the combination was measured for various p.d. The graph in figure 10 below drawn to scale shows the results:-



(i) From the graph, calculate the total resistance of the combination

(ii) Determine the value of the unknown resistance

(c) (i) Explain the cause of eddy currents and how they are minimized in a transformer

(ii) A transformer with 4200 turns in the primary coil operates a 240V mains supply and gives an output of 8.0V. Determine the number of turns in the secondary coil (assuming it is 10% efficient)

10. State **one** factor that affects photoelectric effect

11. a) i) What is photoelectric effect?

ii) You are provided with the following; a photo cell; a source of UV light, a rheostat, a source of e.m.f, a millimeter, a voltmeter and connecting wires. Draw a circuit diagram to show how photoelectric effect may be demonstrated in the laboratory

b) In a photoelectric effect experiment, a certain surface was illuminated with radiation of different frequencies and stopping potential determined for each frequency. The following results were obtained:

Frequency (f) (x 10^{14} H_z)	7.95	7.41	6.88	6.10	5.49
Stopping potential, (V_s), (V)	1.35	1.15	0.93	0.62	0.36

i) Plot a graph of stopping potential (Y-axis) against frequency

ii) Determine plank's constant, h and the work function of the surface given that

$EV_s = hf - hf_o$, where $hf_o = Q_e = 1.6 \times 10^{-19}$ C

c) A surface whose work function Q = 6.4 x 10^{-19} J is illuminated with light of frequency 3.0 x10^{15} H_z. Find the minimum K.E of the emitted photo electrons

(use value of h obtained in **b(ii)** above)

ELECTRICITY & ELECTRONICS

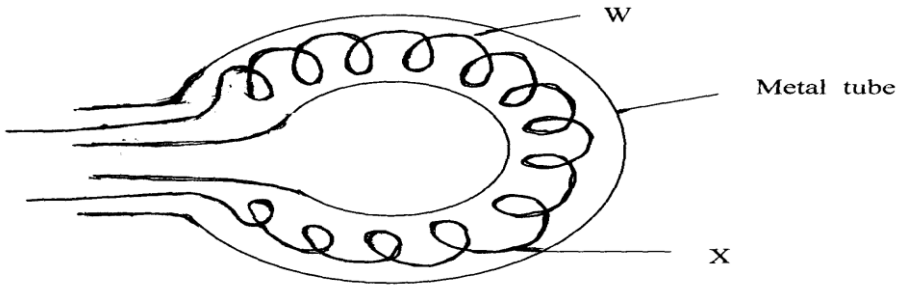
1. State **one** advantage of a lead-acid accumulator over a dry cell
2. State **one** defect of a simple cell and explain how it can be corrected.
3. Study the circuit below:

   Determine the current flowing in the circuit
4. When the time base of a cathode ray oscilloscope is turned on, there is a horizontal trace across the screen as shown in the figure:-

   (i) An alternating potential difference of constant frequency and constant amplitude is then connected to the **Y**-input of the oscilloscope. Sketch on the same diagram above the trace which might be obtained

   (ii) The time base is switched off but the alternating potential difference is left connected. Describe what would be observed on the screen
5. The figure below shows the wiring in a modern mains appliance

   Identify the wires **Y** and **Z**
6. State **two** ways of decreasing capacitance
7. (a) The figure below represents part of an electric cooker coil.



   (i) State why the part labeled **W** is coiled

   (ii) State the property of material **X** that makes it suitable for its use

   (b) State the advantage of transmitting power at:-

   (i) Very high voltage

   (ii) Alternating voltage

   (c) Aluminium wires are commonly used in power transmission than copper wires. Give **two** advantages of aluminum as transmission lines

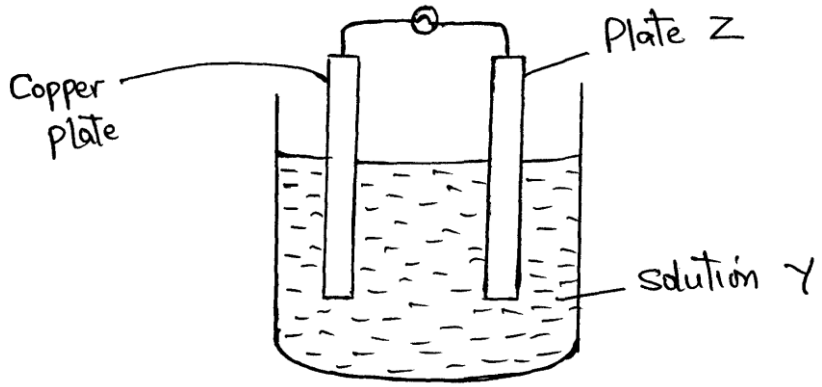
   (d) The diagram below shows a wrongly wired three pin plug.

   (i) Indicate in the diagram above the correct colors for the wiring

   (ii) State the use of device marked **X**

   (e) A household uses a 1.5Kw water heater for 2 hours a day for 30 days. If the cost of electricity is shs.6.70 per Kwh, how much will they pay for this consumption?

8. The diagram below shows a simple cell:-



(a) (i) Name **z** and solution **y**

(ii) Name and explain the defect that occurs at plate **z**

(iii) Give **one** method of preventing the defect that occurs at the copper plate

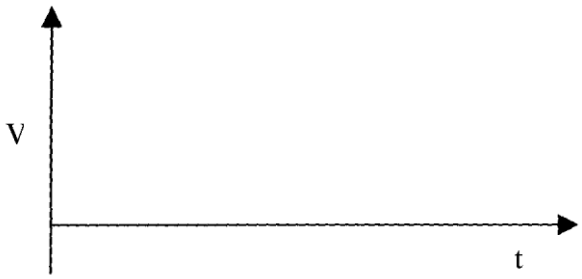
(b) (i) Explain how P-type semi-conductor is formed

(ii) The figure below shows a circuit diagram for full wave rectification

(I) Draw the diodes D_3 and D_4 on the diagram to complete the circuit

(II) On the axes below sketch a voltage –time graph observed when a C.R.O is connected at points

(a)PQ (b) ST



(iii) On the circuit diagram **(b) (ii)** above, draw a capacitor which can be used to smoothen the output voltage

9. Explain how conductivity of a semi conductor changes with increase in temperature

10. With the time base switched on; the following trace was obtained on the screen of a CRO as shown in the figure below:

Draw a circuit diagram that can be used to produce the wave above

11. ***Figure 4*** below shows a circle with two diodes **P** and **Q** and a cell:-

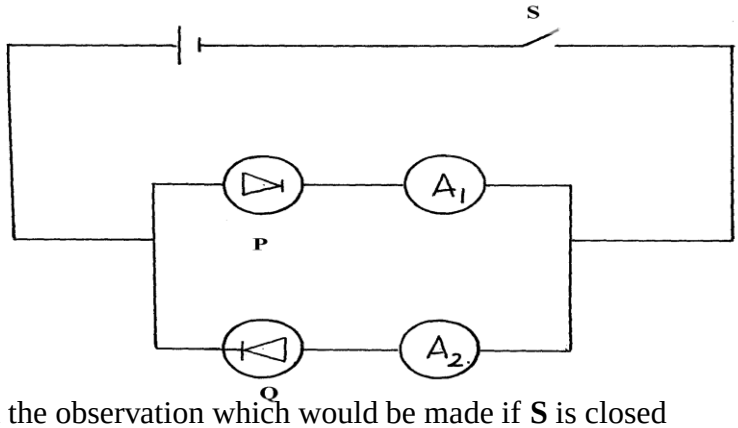


Figure 4

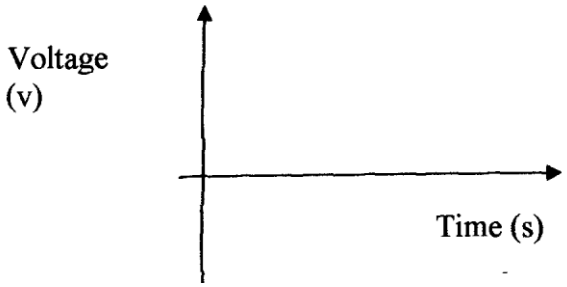
Explain the observation which would be made if **S** is closed

12. Explain why eight 1.5V cells arranged in series to give a total of 12V cannot be used to start a car. But car battery of 12V starts a car

13. a) i) Distinguish between a **p- type** and an **n- type** extrinsic semi conductors

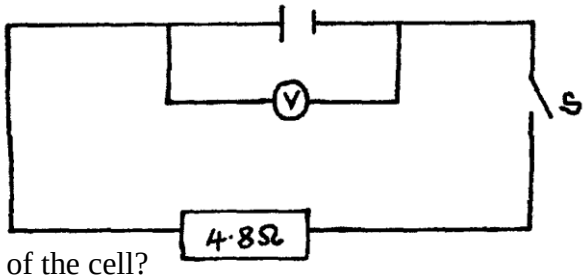
ii) The figure below shows a bridge rectifier

A capacitor has been connected across the resistors as shown. Sketch on the axes below the wave form when a C-R-O is connected across the resistor; R



Sketch on the same axes above the wave form when a C-R-O is connected across the resistor R and capacitor **c** removed

iii) Figure shows a voltmeter connected across the cell. The voltmeter reads 1.5V when the switch S, is open and 1.25V when the switch is closed.



i) What is the e.m.f of the cell?

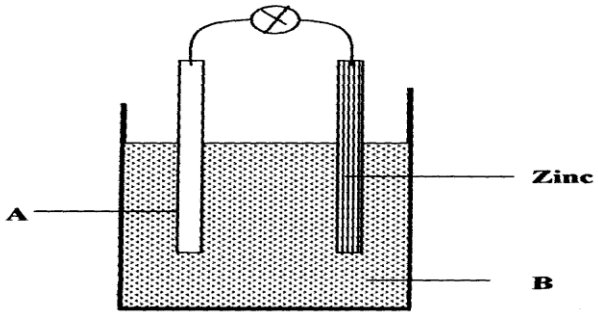
ii) What is the terminal voltage of the cell?

iii) Calculate the internal resistance of the cell

14. What is the use of a fuse in an electric circuit?

15. Distinguish between **Topping** and **Dopping**

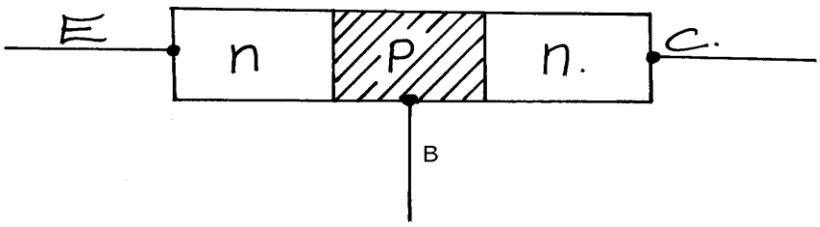
16. The figure below shows the set up for a simple cell.



a) Name the Electrode **A** and the solution **B**
b) State **two** reasons why the bulb goes off after a short time

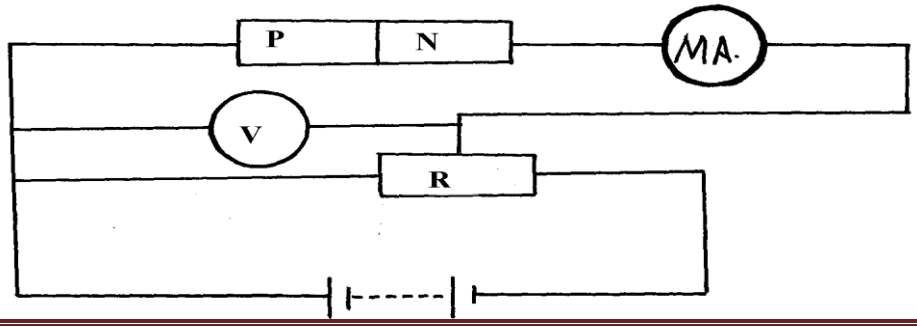
17. The figure 2 shows a simple cell made of copper and zinc electrodes dipped in dilute sulphuric acid
a) Identify the cathode
b) If a voltmeter is connected across the rods the reading is observed to reduce with time. State **two** causes of this observation
18. State **one** reason why colour televisions have a higher power rating than black and white televisions
19. Explain **two** factors that affect the capacitance of a parallel-plate capacitor
20. a) A girl opened up a used up dry cell and found the following:
i) The zinc casing was 'eaten away'
ii) The cell was watery
Name the cell defect
b) Three identical bulbs are connected in series with a battery of dry cells. At first the bulbs shine brightly but gradually become dimmer. Using the same cells, explain how you would increase the brilliance of the bulbs
21. Figure 9 below shows a diagram of an n – p – n transistor.
(a) Complete the diagram by showing the connections of two batteries **suitable for biasing** the transistor in the common- emitter mode.

Figure 9



22. State the **purpose** of introducing an impurity in a semi conductor.
23. In an attempt to establish the relationship between current through a junction diode and the p.d across it, a student connected a diode to an e.m.f source as in ***figure 3*** below:-

fig. 3



(a) State whether the diode is forward biased or reverse biased
(b) Briefly describe how she obtained her readings
(c) Sketch a graph to represent the relationship between current (y-axis) and the p.d across the diode

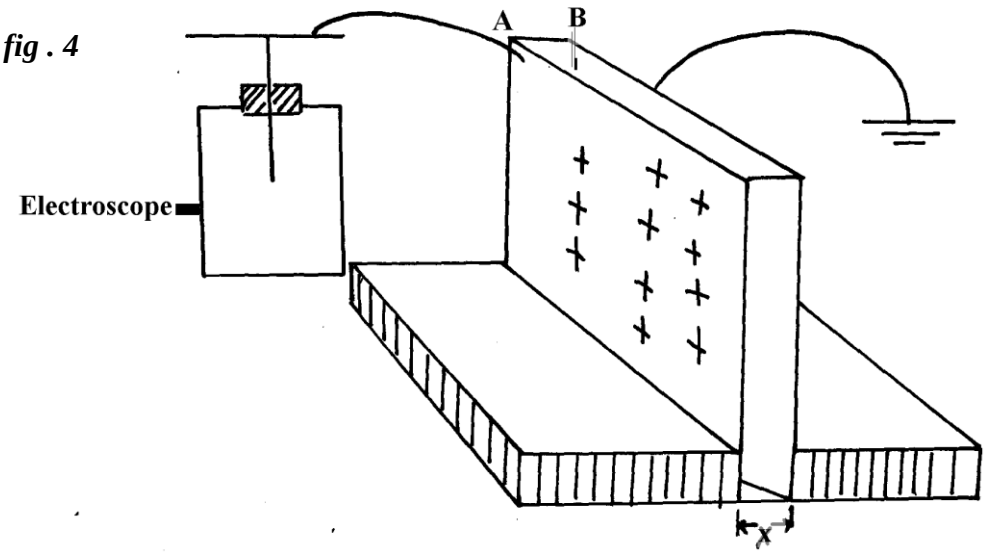
24. Figure 8 shows a circuit where a battery of emf 4.5V, switches A and B, two capacitors . C_1= 0.3 µF and C_2 = 0.5 µF and a voltmeter are connected

a) Determine the charge on C1 when switch A is closed and switch B is open
b) What is the effective capacitance C_T when both switches A and B are closed?

c) State what is observed on the voltmeter when;
i) Switch A is closed and switch B is open
ii) Switch A is closed and opened and then B is closed
iii) Explain the observation made in **c(ii)** above

25. (a) Define capacitance
(b) Two aluminium plates **A** and **B** of same dimensions are each mounted on an insulating stand. Plate **A** is charged to high voltage and connected to uncharged electroscope while plate **B** is earthed. The two plates are placed side by side as in the diagram ***figure 4*** below:-

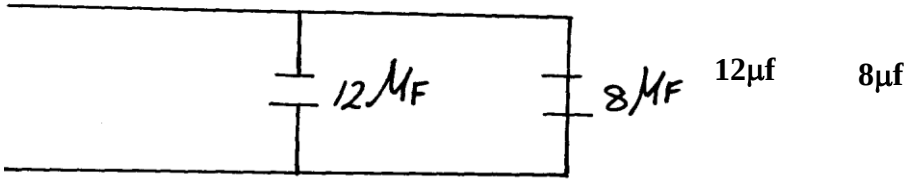
fig . 4



(i) Indicate on the diagram the position of the leaf and charge distribution on the electroscope
(ii) State and explain the observation on the electroscope when the distance (**x**) of separation between the plates is increased while keeping the area of overlap the same

(c) A 12µf capacitor is charged with a 200V source then placed in parallel with uncharged 8.0µf capacitor as shown in fig 5 below:-

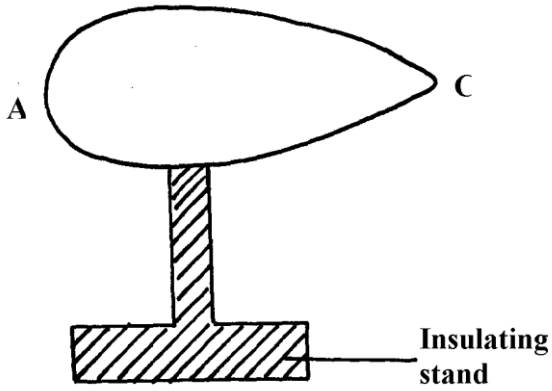
fig. 5



Determine:
(i) The initial charge on the 12µf capacitor
(ii) The final charge on each capacitor

(d) The diagram ***figure 6*** below shows a pear shaped charged conductor on an insulating stand (charges not shown on the diagram)

fig. 6



Part **A** is touched using a proof-plane and then the proof-plane is brought next but not touching the cap of a leaf electroscope (not shown on the diagram). The same experiment is repeated for part **C** of the conductor.

(i) State the expected observation in the above experiments

(ii) Explain the observations made in **(d) (i)** above

(iii) Name any **one** application of the above phenomenon

26. a) State **two** factors that affect the capacitance of a parallel plate capacitor

b) The diagram below shows an arrangement of capacitors in a circuit

i) Determine the total charge in the circuit

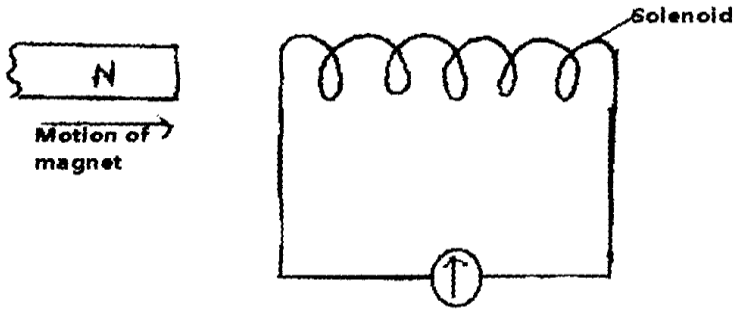
27. a) What is doping as used in electronics

b) Distinguish between intrinsic and extrinsic semi-conductors.

c) What would be observed in the diagram below when switch S is closed, B_1 and B_2 are identical torch bulbs

28. a) Define Eddy currents

b) The diagram below shows the north pole of a magnet approaching a solenoid



i) Using Lenz's law, indicate the direction of current through the galvanometer

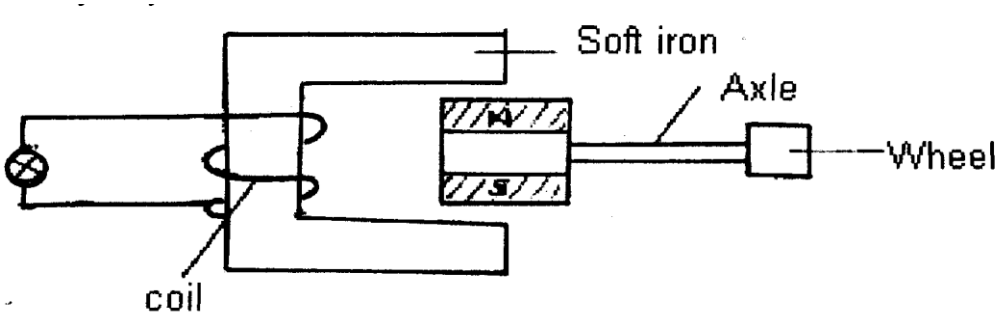
ii) Explain the observation made when:

I The magnet is moved away from the solenoid

II The magnet is placed stationary in the solenoid

c) A transformer is designed as shown in the figure below. If the primary coil has 2400 turns and the secondary has 200 turns calculate the p.d across BC assuming there are no energy losses in the transformer

d) The figure shows a cross- section of a bicycle dynamo. The wheel is connected by an axle to a permanent cylindrical magnet and is rotated by the bicycle tyre



i) Explain why the bulb lights

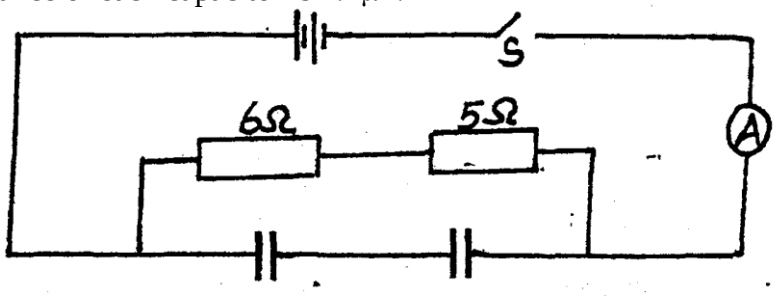
ii) How can the bulb be made brighter

29. A car battery requires topping up with distilled water occasionally. Explain why this is necessary and why distilled water is used

30. Draw appropriate symbol of a circuit diagram of a junction diode in reverse bias

31. a) In the circuit diagram shown in Fig.5 each cell has an e.m.f of 1,5v and internal resistance of 0.5Ω. The capacitance of each capacitor is 1.4μF.

Fig.5

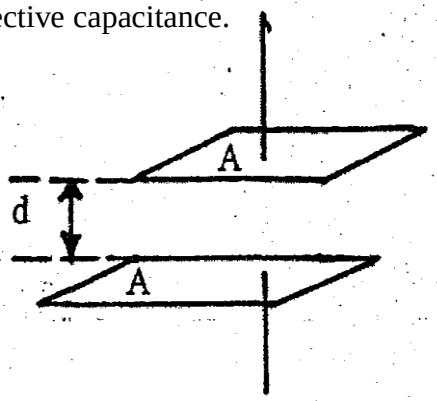


i) When the switch **S** is closed determine the ammeter reading.

ii) When the switch **S** is closed determine the charge on each capacitor.

b) The diagram in Fig. 6 represents two parallel plates of a capacitor separated by a distance **d**. Each plate has an area of a square unit. Suggest **two** adjustments that can be made so as to increase the effective capacitance.

Fig.6



c) Complete the table to describe the function of the parts of a lighting conductor.

Port	**Function**
Spike	
Thick copper rod	
Earthed metal plate	

32. The circuits in Fig. 7 shown are close to each other.

Fig. 7

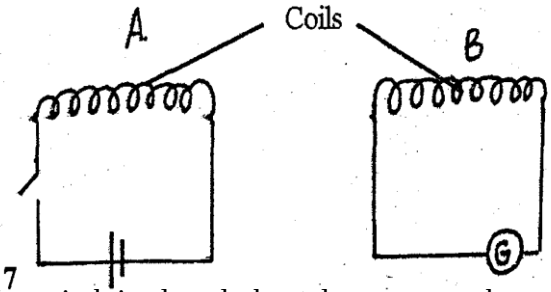
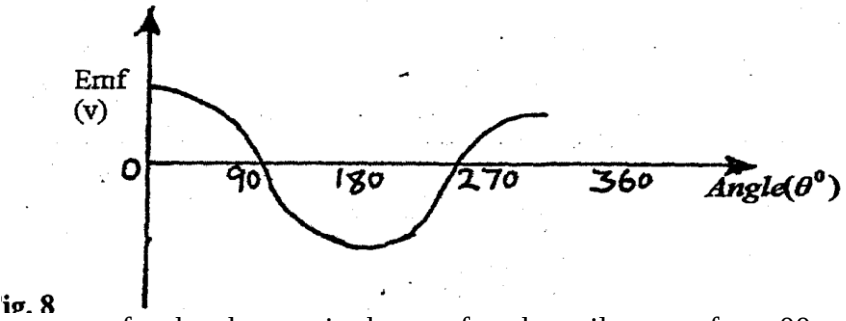


Fig. 7

a) When the switch is closed, the galvanometer shows a reading and then returns to zero. When the switch is then opened, the galvanometer shows a reading in the opposite direction and then returns to zero. Explain these observations.

b) Energy losses in a transformer are reduced by having a laminated soft iron core. State and explain **two** other ways of reducing energy loses in a transformer.

c) The e.m.f generated as the soil of an alternating generator rotates is represented in the graph in *Fig. 8.*

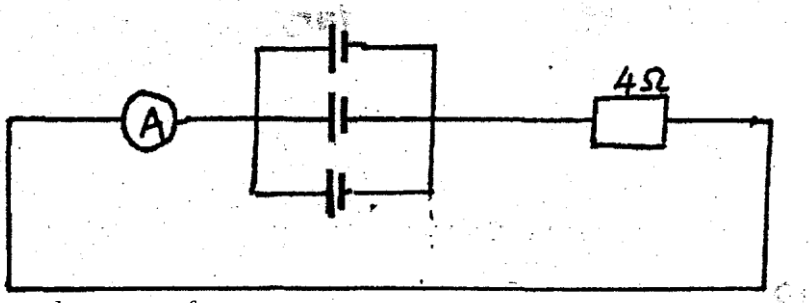


ig. 8

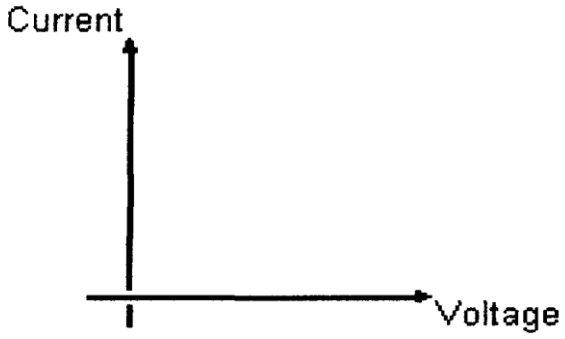
i) Give reasons for the changes in the e.m.f as the coil rotates from 00 to 900 and 900 to1800.
ii) Sketch on the same diagram a similar graph if the generator was a direct current one.

33. State **one** advantage of:
i) A lead-acid accumulative over a dry cell
ii) A dry cell over lead-acid accumulator

34. Three identical cells of e.m.f. 2.0v and of negligible internal resistance are connected as shown in figure below. Determine the ammeter reading.



35. State **one** advantage of:
i) A lead-acid accumulative over a dry cell
ii) A dry cell over lead-acid accumulator
36. Compare the property of material used to make a fuse wire to one used to make the filament of a torch bulb.
37. State **two** reasons why the CRO is a more accurate voltmeter than a moving coil voltmeter.
38. The strip below represents part of the electromagnetic spectrum. **C** is the visible part of the spectrum. **A** is the region of the shortest wave length and **F** the highest
Name the sections which represent:
(i) X-rays (ii) Infra-red (iii) T.V waves
39. Sketch a forward bias characteristics of a **P – N** junction diode in the axis below



X-RAYS

1. Give **one** use of X –rays in medicine
2. State the factor that affects:-
   (i) The intensity of X-rays
   (ii) The strength of X-rays
3. An x-ray tube must be highly evaluated. Give a reason for this
4. a) In the production of X- rays, electrons are directed at a tungsten target. State a reason why the target is made of tungsten
   b) How can the intensity of the X-rays tube be increased?
5. a) Arrange the following waves in order of increasing frequencies: microwaves, x-rays, Infra-red, ultra-violet
   b) The table below shows the electromagnetic spectrum;

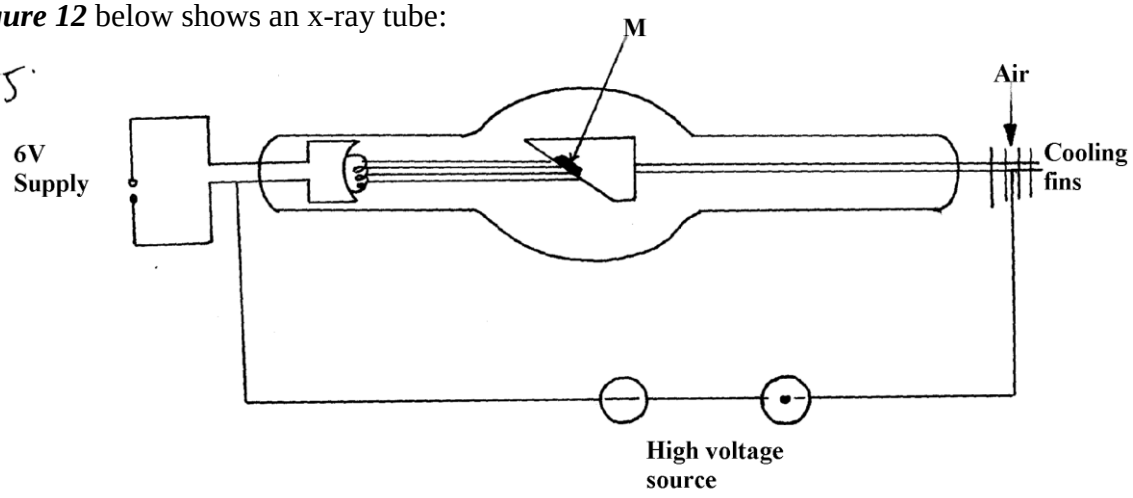
Gamma rays	A	Ultra violet	B	Infra red	Radio waves

   i) Identify **A** and **B**
   ii) State **one** use for each

6. ***Figure 12*** below shows an x-ray tube:

figure 12

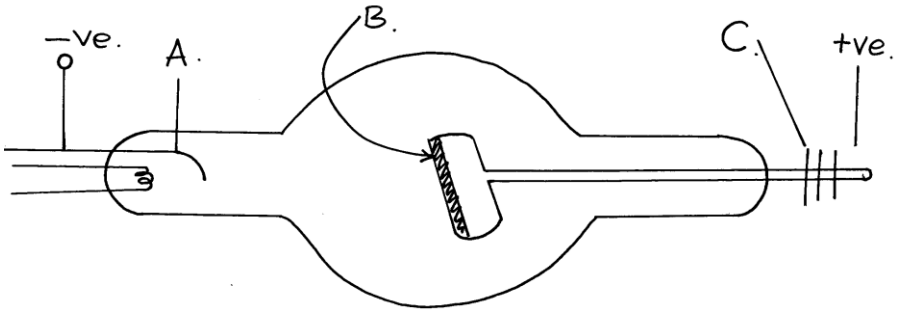
15



(a) Indicate on the diagram the path of x-ray beam supplied by the tube
(b) Why is **M** set at angle of 45^{o} relative to the electron beam?
(c) Name a suitable metal that can be used for part **M** and give a reason for your choice
(d) State how the following can be controlled:-
   (i) Intensity
   (ii) Penetrating power
   (iii) The exposure to patients
(e) An x-ray tube is operating with an anode potential of 12Kv and a current of 10.0m.A:
(i) Calculate the number of electrons hitting the anode per second
(ii) Determine the velocity with which the electrons strike the target
(iii) State **one** industrial use of x-rays

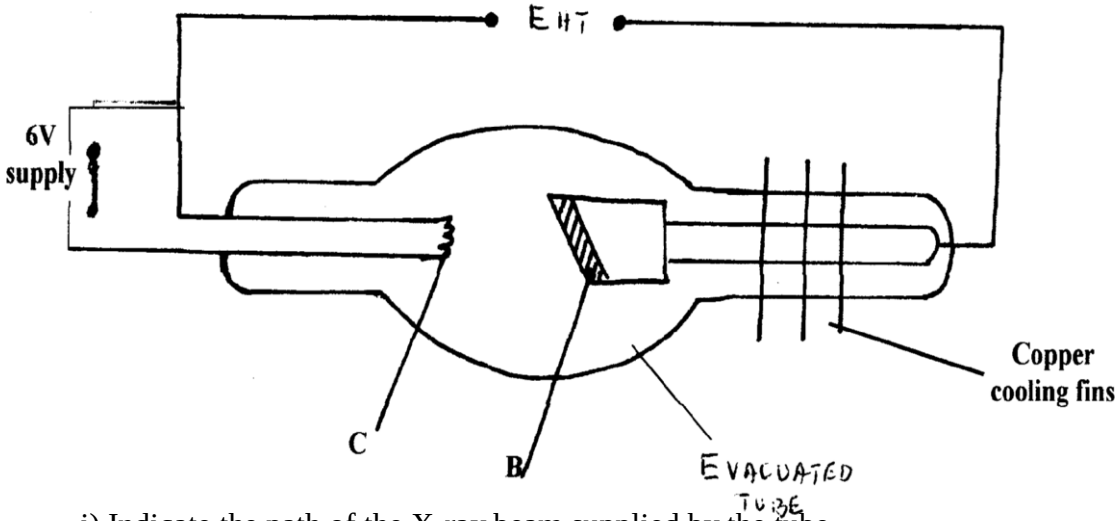
7. (i) The diagram below shows simplified diagram of an x-ray tube,

Figure 8



(a) Name the parts **A, B,** and **C**.
(b) What adjustments would be made to:
(i) Increase the penetrating power of the x-rays produced.
(ii) Increase the intensity of the rays produced.
(c) Name a suitable material for the part marked **B** and give a reason for your choice.
(d) Name a suitable material for the part marked **C** and sate its purpose.
(e) Why is it necessary to maintain a vacuum inside the tube?
(f) State **one** use of x-rays in the following areas; -
(i) In medicine
(ii) In Industry.

8. a) The figure shows the circuit of a modern X-ray tube



EHT

Evacuated tube

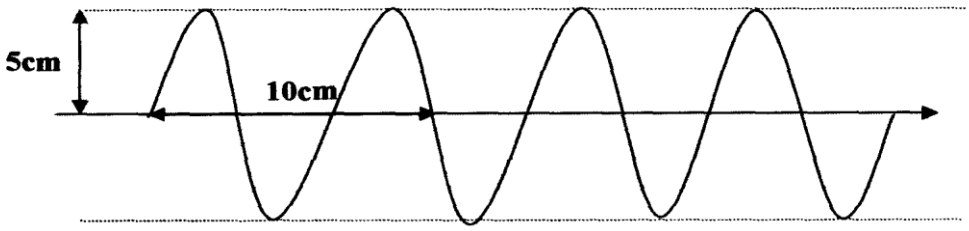
i) Indicate the path of the X-ray beam supplied by the tube
ii) Name the part labeled **C** and state its function (2 mks)
iii) If the tube above is operated at an accelerating potential of 100kV and only 0.05% of the energy of the electrons is converted to X – rays, calculate the wave length of the generated X-rays. (Take electric charge e = 1.602 x10^{-19}C, planks constant h = 6.63 x 10^{-34} Js, and speed of light c = 3.0 x 10^{8}m/s)
iv) State **two** properties of X-rays
v) State **one** industrial application of X-rays

9. Below is a nuclear reaction

A **B** **C**

i) Identify radiation **K**
ii) Determine the value of **X** and **Y**

10. a) State the energy changes that take place in an X - ray tube
b) Electrons in an X-ray tube are accelerated by a potential difference of 40 kV. If 20% of the electrons are converted into X- rays, determine the maximum wavelength of the emitted electrons.
c) i) Draw a simple circuit consisting of a photocell to show the direction of flow of current
ii) The diagram below shows a wave form displayed on a CR0 screen.



If the Y — gain reads 0.5V cm^{-1} while the time base is set at 0.1 ms cm^{-1}, determine the amplitude and frequency of the wave.

11. The table below shows results obtained in an experiment to determine the internal resistance of a cell

V(V)	0.4	0.5	0.6	0.7	08	1.3
R(Ω)	0.45	0.65	0.80	1.05	1.40	2.4
$^1/_V$ (V^{-1})						
$^1/_R$($Ω^{-1}$)						

i. Complete the table for values of $^1/_V$ and $^1/_R$ giving your answers to 3 d.p
ii. Plot a graph of $^1/_V$ against $^1/_R$
iii. Use the graph to determine the e.m.f **E** and the internal resistance **r** of the cell given that

$$\frac{E}{V} = \frac{r}{R} + 1$$

RADIOACTIVITY

1. (a) Define radioactive decay
(b) A radioactive element decays to **$^1/_{128}$** of its original activity after 49 days. Determine its half –life
2. (a) You are provided with the following:-
- One diode
-A load resistor
- An a.c. source
- One transformer
(i) Using the above apparatus draw a circuit arrangement for half wave rectification
(ii) Explain how the circuit drawn in **(a)(i)** above achieves half wave rectification
(b) (i) Determine the value of **x** and **y** in the nuclear equation below:-

(ii) The half life of a radioactive element is 20minutes. The mass of the element after 120 minutes is 0.03125g. Determine the original mass of the element

(iii) What evidence supports the fact that gamma rays are not charged

(iv) Alpha particles have low penetrating power as opposed to beta particles. Give a reason for this

v) A manufacturer wishes to check the thickness of steel sheets he produces. Explain how this can be done using a radioactive source and a counter

3. a) What is meant by radio active decay?

b) Uranium 235 was bombarded with a neutron and fission took place in the following manner:

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{90}_{38}Rn + {}^{a}_{b}X + 10({}^{1}_{0}n)$$

Determine the values of **a** and **b**

c) When carrying out experiments with radio active substance one is instructed that the source should never held with bare hands but with forceps. Give a reason for the instruction

d) The diagram below shows the paths taken by three radiations **A, B** and **C** from a radio active isotope through an electric field

i) State the charge on plate **Y**

ii) Identify the radiation **A** and **C**

iii) Give a reason why **C** deviates move **A**

e) $_{90}$Th disintergrates into radium (Ra) by emission of two alpha and two beta particles as in equation $^{233}_{90}Th \rightarrow {}^{A}_{Z}Ra + 2({}^{4}_{2}H) + 2({}^{0}_{-1}e)$

State:

i) The atomic number of the daughter nuclide

ii) The mass number of the daughter nuclide

f) One of the application of Beta emission (B) is controlling thickness gauge. Explain how they are used for this purpose?

4. The following is a nuclear reaction for a fusion process resulting from the reaction of polonium with loss of beta particles

(i) Determine the values of **S** and **T**

(ii) State the source of the energy released ✓ 1

5. The expression below is an equation for radioactive element **A.** Element **B** and **C** are the daughter nuclides. **A, B** and **C** are not the actual symbols of any of the elements

238 234 X

A	B	+ C
92	90	Y

(a) State what type of radioactive decay this is.

(b) What is the value of:

X…… Y……

6. Arrange the following in order of increasing frequency: Red light, Infrared radiation, X-rays, UV radiation, Short –radio waves, TV and Fm radio waves, Am radio waves and Long radio waves.

7. Radium -222 is a radioactive element with a half-life period of 38 sec. What fraction of the mass of a sample of this element remain after 380 sec.

8. (a) Define the term half-life of a radioactive material

(b) (i) Use the table below to plot a graph of activity against time

Activity (Disintegration/seconds)	680	567	474	395	276	160	112	64
Time **t** (days)	0	1	2	3	5	8	10	14

(ii) Find the half-life of the material in days

(c) The half-life of a radio-active substance is 138 days. A sample of the substance has 8×10^{10} un-decayed nuclei at time t = 0. How many un-decayed nuclei will be left after 690 days?

(d) An element x (uranium) decays by emitting two alpha particles and a beta particle to yield element Y

(i) State the atomic number and mass number of Y

(ii) Write down the decay equation

9. a) What is meant by radioactive decay?

b) A radioactive source placed 12cm from the detector produced a constant count rate of 5 counts per minute. When the source is moved close to 3cm, the count rate varies as follows;

Time	0	20	40	60	80
Count rate	101	65	43	29	21

i) State the type of radiation emitted.

ii) Explain the constant count rate when the source is 12cm away.

iii) Plot a graph of count rate against time (Use graph paper)

iv) Use the graph to estimate the half life of the element

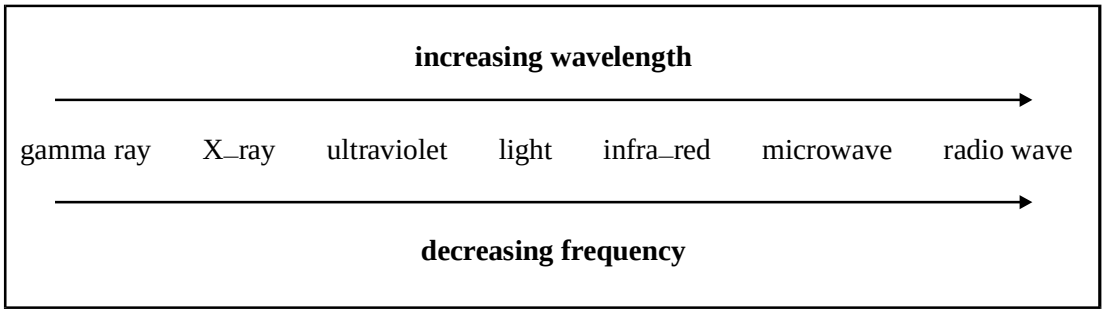
10. State **one** advantage of:

i) A lead-acid accumulative over a dry cell

ii) A dry cell over lead-acid accumulator

ELECTROMAGNETIC WAVES

1. The diagram shows the waves that make up the electromagnetic spectrum.



(a) In going from light to radio waves, describe how:

(i) the wavelength changes;.....

.....

(ii) the frequency changes. .....

.....

(2)

(b) Which TWO waves in the spectrum are most harmful to humans?

1.....

2.....

(2)

(c) Choose ONE of the waves shown in the diagram.
Name ONE use for the wave that you choose and describe how it is used.
Wave.....
Use.....
Description of use.....
.....
.....

(3)
(Total 7 marks)

2. The diagram shows the electromagnetic spectrum.

gamma rays	X-rays	ultra-violet	visible		micro-waves	radio waves

(a) Write the name of the missing radiation on the diagram.

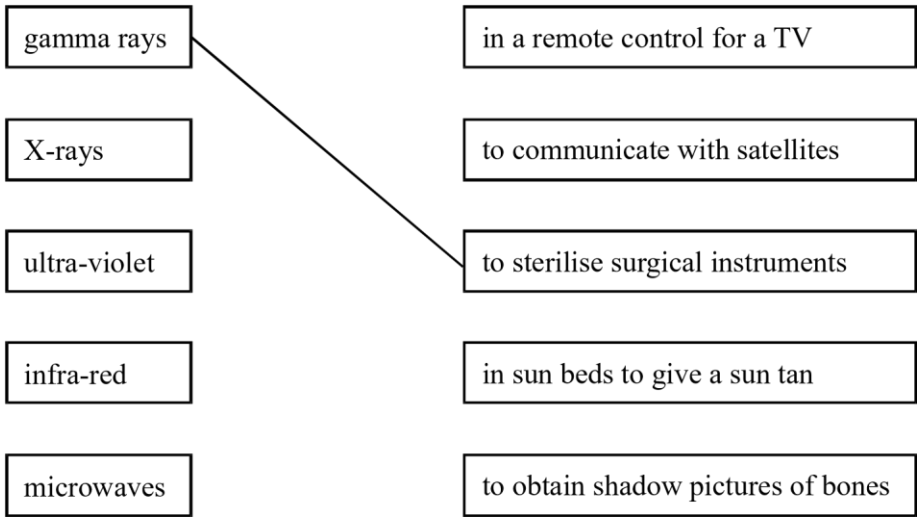
(1)

(b) Name **one** use for this radiation.

.....

(1)
(Total 2 marks)

3. The boxes on the left show types of electromagnetic radiation.
The boxes on the right show some uses of electromagnetic radiation.
Draw **one** line from each type of radiation to its use.
The first has been done for you.



(3)
(Total 3 marks)

4. The table shows some information about the electromagnetic spectrum

Low frequency ... High frequency

radio waves	micro-waves	infra-red	light **A** **B**	ultraviolet	X-rays	gamma rays

(a) State **two** characteristics of all electromagnetic waves.

1 .....

2 .....

(2)

(b) (i) What is the colour of the light at **A**?

.....

(1) (ii) What is the colour of the light at **B**?

.....

(1) (c) (i) State **one** use of ultraviolet radiation.

.....

(1) (ii) State **one** use of gamma radiation.

.....

(1)

(d) Ultraviolet radiation and gamma radiation can damage the human body.
State **one** damaging effect for each.
ultraviolet .....
gamma .....

(2)
(Total 8 marks)

5. (a) The table shows some information about the electromagnetic spectrum.

low frequency ⟶ high frequency

radio waves	**A**	infra-red	visible light	**B**	X-rays	gamma rays

(i) Name the radiation at **A**.

.....

(1) (ii) Name the radiation at **B**.

.....

(1) (iii) State **one** use of X-rays.

.....

(1) (iv) State **one** harmful effect of X-rays.

.....

(1) (v) State **two** properties that all electromagnetic waves have in common.

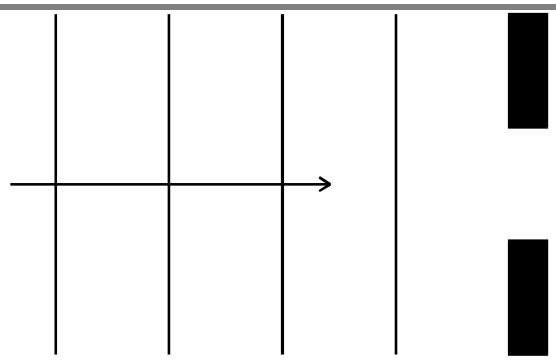
1 .....

2 .....

(2)

(b) The diagram shows water waves approaching a gap.

The wavelength of the waves is 1.5 cm. The gap is also 1.5 cm wide.



Complete the diagram to show the diffracted waves produced by the gap.

(3)

(c) In the 17th and !8th centuries, scientists debated whether light behaved as waves or particles.

Diffraction is a wave property.
When light is shone onto a 1.5 cm gap, no diffraction is observed.
Suggest **two** conclusions that could be drawn from this observation.

.....
.....
.....
.....

(3)
(Total 12 marks)

6. The boxes show the names of some of the waves in the electromagnetic spectrum and their uses.

Draw **one** straight line from each electromagnetic wave to its use.

infra-red ●	● prolonging the shelf life of food
ultraviolet ●	● electric toaster
gamma rays ●	● mobile phones
microwaves ●	● detecting forged five pound notes
	● measuring the depth of the sea

(Total 4 marks)

7. (a) The diagram shows the various parts of the electromagnetic spectrum.

radio	microwave	infra-red	visible	ultraviolet	X-ray	gamma ray

long wavelength	←	short wavelength
low frequency	→	high frequency
low energy	→	high energy

(i) Describe the relationship shown between the energy carried by an electromagnetic wave and its frequency.

.....
.....

(1)

(ii) Explain why waves with high energy are more dangerous to humans than those with low energy.

.....
.....
.....

(2)

(iii) Describe the relationship shown between the wavelength and frequency of the waves.

.....
.....

(1)

(b) Ultrasounds are also waves.
State **two** differences between ultrasound waves and radio waves.

1 .....

.....

2 .....

.....

(2)

(Total 6 marks)

8. Part of the electromagnetic spectrum is shown below.

gamma rays	**X-rays**	**A**	**visible light**	**infra-red waves**	**micro-waves**	**radio waves**

(a) Name part **A** of the electromagnetic spectrum.

.....

(1) (b) Which part of the electromagnetic spectrum has the shortest wavelength?

.....

(1)

(c) All electromagnetic waves travel at the same speed in a vacuum.
If the frequency decreases, what happens to the wavelength?

.....

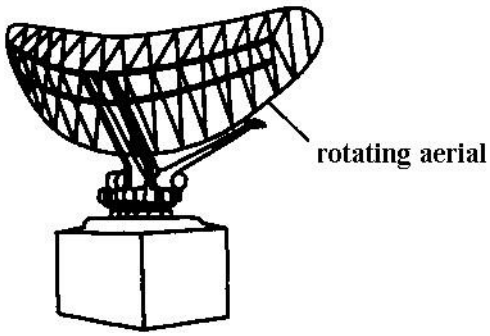
(1)

(d) Microwaves can be used to cook food.
Which other part of the electromagnetic spectrum can be used to cook food?

.....

(1) (e) Radar uses pulses of microwaves to detect aeroplanes.



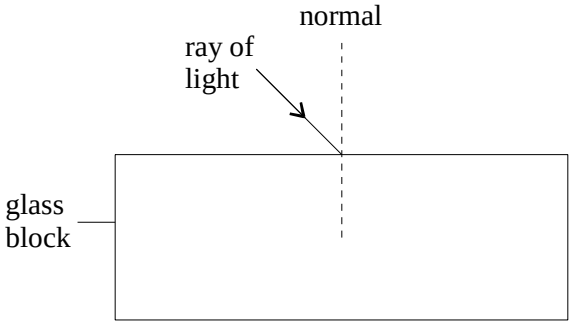


Explain how microwaves can be used to find the position of an aeroplane in the sky.

.....
.....
.....
.....
.....
.....
.....
.....

(3)
(Total 7 marks)

9. (a) A light ray travels through air and strikes a glass block.



Use a ruler to draw the paths of the refracted ray as it passes through and out of the block.

(2)

(b) This is part of a newspaper article

Ditch those glasses - in 15 minutes

Using computer technology and a thin invisible beam of ultraviolet radiation, microscopic amounts of eye tissue can be removed to correct visual impairment.

(i) Suggest another use for ultraviolet radiation.

.....

.....

(1)

(ii) Visible light and ultraviolet light are parts of the electromagnetic spectrum. Two features of an electromagnetic wave are its wavelength and frequency. Use these features to compare ultraviolet radiation and visible radiation.

.....

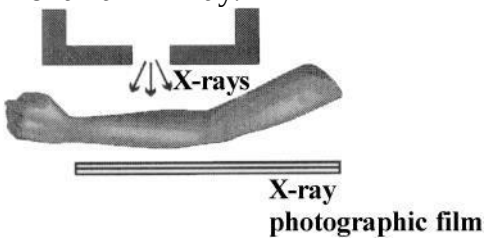
.....

.....

.....

(2)

(c) Nicola has a suspected broken arm.
She is taken to hospital for an arm X-ray.



(i) Explain how the properties of X-rays make them suitable for making an X-ray photograph of the suspected broken arm.

.....

.....

.....

.....

.....

.....

(3)

(ii) Why can exposure to X-rays be harmful to the body?

.....

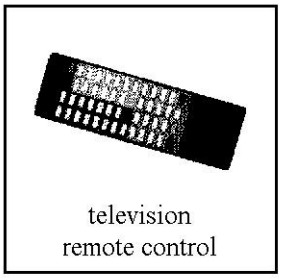
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(1)

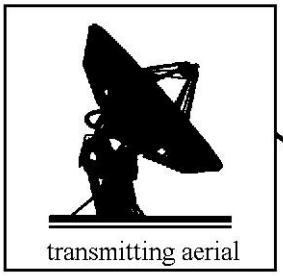
(Total 9 marks)

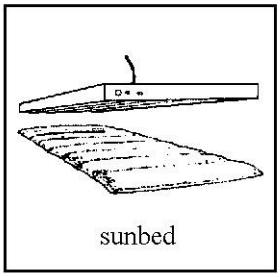
10. The diagrams show some everyday objects that produce waves.

(a) Draw a line from each diagram to the type of wave that the object produces.


television remote control


loudspeaker


transmitting aerial


sunbed

sound

infra-red

ultraviolet

radio

(b) Which **one** of the waves is **not** in the electromagnetic spectrum?

.....

(1)

(c) Which **one** of the waves has a wavelength shorter than light?

.....

(1)
(Total 5 marks)

11. The diagram shows the different waves in the electromagnetic spectrum.

increasing wavelength

X-rays and gamma rays	ultraviolet	light	infra-red	microwaves	radio waves

increasing frequency

(a) Complete the sentence.

As the wavelength of the waves increases, their frequency .....

(1)

(b) Give one use of:

(i) microwaves

.....

(1)

(ii) ultraviolet waves

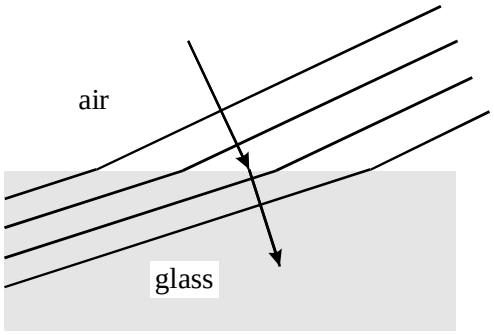
.....

(1)

(iii) gamma rays

.....

(1) (c) The diagram shows light waves passing from air into glass.



Describe **two** changes that take place to the waves as they pass into the glass.

.....

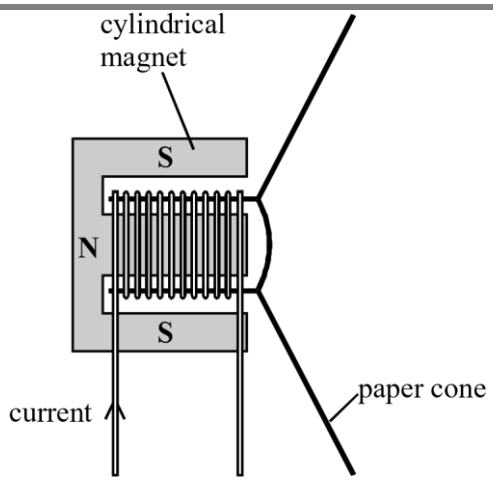
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(2)

(Total 6 marks)

ELECTROMAGNETIC INDUCTION

1. The diagram shows a moving coil loudspeaker.



(a) (i) When the current is in the direction shown in the diagram, the paper cone moves to the right.

Describe the movement of the paper cone when the direction of the current is reversed.

.....

.....

(1) (ii) Explain why the paper cone moves when a current passes in the coil.

.....

.....

.....

.....

(2)

(b) An alternating current passes in the coil.
Describe the movement of the paper cone.

.....

.....

(1) (c) The loudspeaker is used to produce a sound that has a frequency of 800 Hz. The wavelength of the sound as it leaves the loudspeaker is 0.40 m.
Calculate the speed of the sound in air.

.....

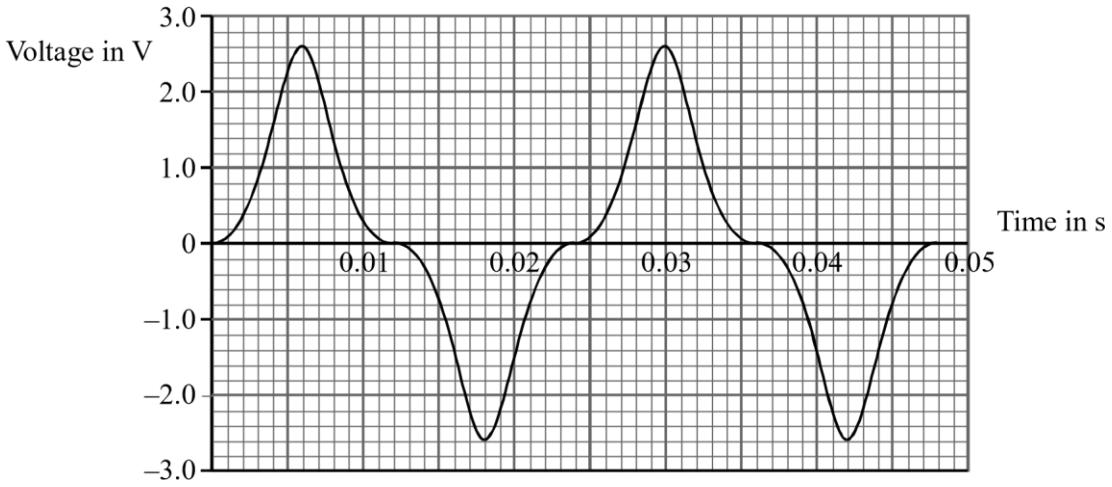
.....

.....

.....

(3)
(Total 7 marks)

2. (a) The graph shows how the output voltage of a bicycle dynamo changes with time.



(i) How can you tell that the dynamo produces an alternating voltage?

.....

(1)

(ii) Use the graph to write down the values of

the amplitude of the voltage.....
the period of the voltage.....

(2) (iii) Calculate the frequency of the alternating voltage.

.....
.....

(2)

(b) A dynamo consists of a magnet that rotates inside a coil of wire.

(i) Explain why a voltage is generated in the coil when the magnet rotates.

.....
.....

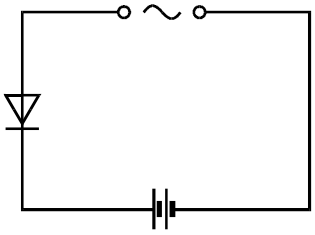
(2)

(ii) A dynamo is used as the energy source for the lights on a bicycle. The bicycle speeds up.
State and explain the effect this has on the brightness of the lights.

.....
.....

(2)

(c) The dynamo can also be used to recharge a battery. The diagram shows the circuit that is used.

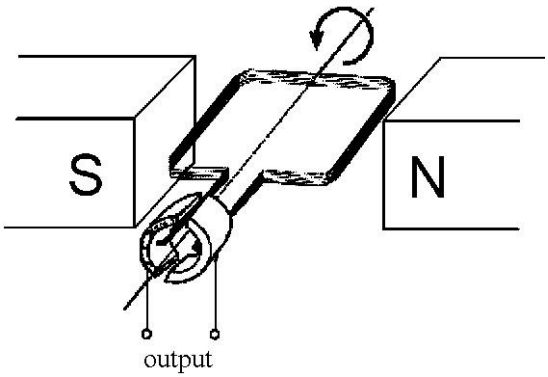


Suggest why the diode is included in the circuit.

.....
.....

(2)
(Total 11 marks)

3. (a) The diagram shows the construction of a simple electrical generator. When the coil is rotated, an alternating voltage is produced at the output.



(i) Explain what is meant by an alternating voltage.

.....
.....

(1) (ii) State **two** ways in which the voltage output could be increased.

1 .....

2 .....

(2)

(b) The generators at a power plant produce a voltage of 25 000 V. For long distance transmission, on overhead power lines, this is stepped up to 400 000 V. It is later stepped down to 240 V for domestic use.

(i) Explain why the voltage is stepped up to 400 000 V.

.....
.....
.....
.....

(2)

(ii) A transformer is used to step up the voltage. Calculate the ratio of primary turns to secondary turns needed for this transformer.

.....
.....
.....

(3)

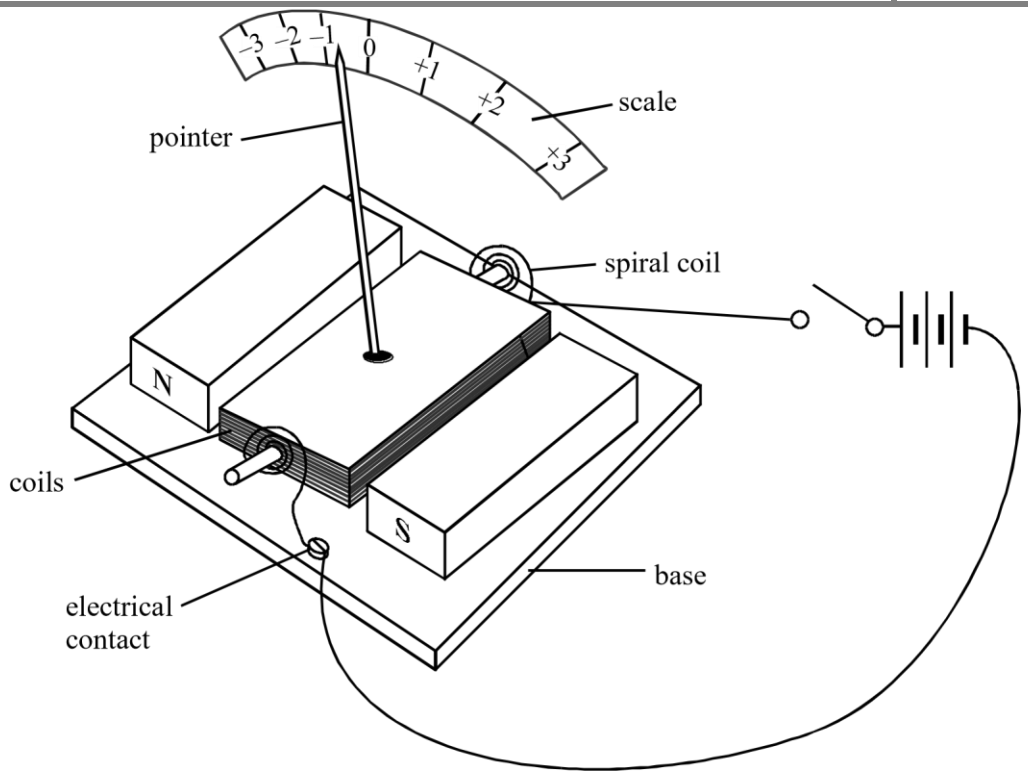
(c) Give **one** advantage and **one** disadvantage of increasing the thickness of overhead power lines.

Advantage .....
.....
Disadvantage .....
.....

(2)

(Total 10 marks)

4. (a) The diagram shows a model ammeter built by a pupil.



When the switch is closed, the needle moves to the point +3 on the scale.

(i) Why does the needle move when the switch is closed?

.....

.....

(2) (ii)

What will happen to the movement of the needle if the battery is reversed?

.....

(1)

(iii) What change would make the needle move further?

.....

(1) (b) State why you think the wire is formed into spirals at each end.

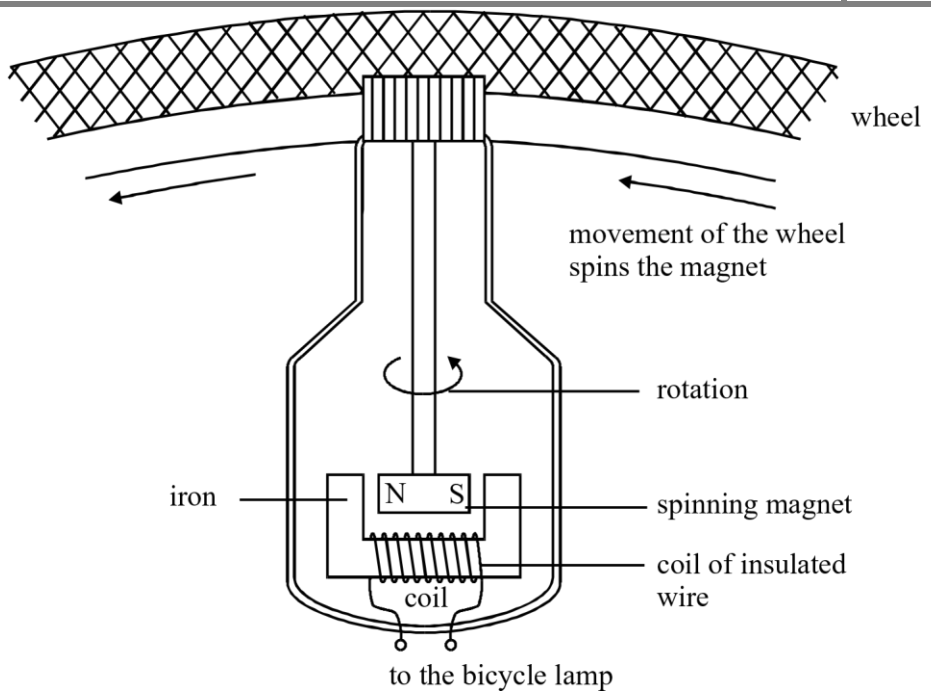
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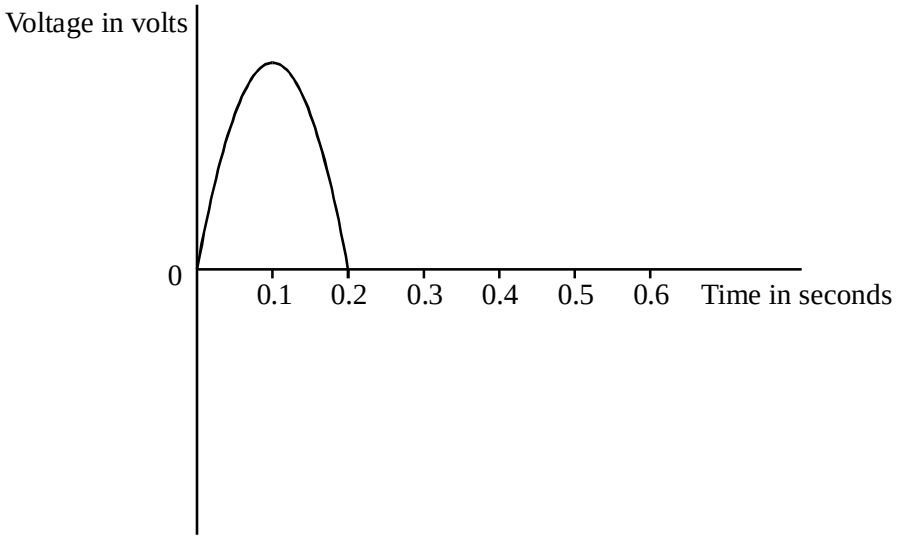
(2)

(Total 6 marks)

5. (a) The diagram shows a bicycle dynamo used to power the bicycle lamps.



An alternating voltage is induced in the coil when the magnet rotates. The graph shows how the induced voltage changes with time for half a revolution of the magnet.



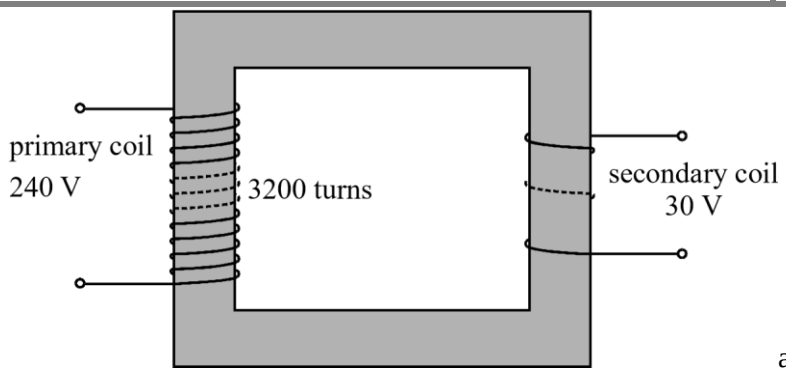
(i) Continue the graph to show the voltage as the magnet turns through a further half revolution.

(3)

(ii) On the same grid, sketch the voltage graph produced when the bicycle wheel is turning more slowly.

(2)

(b) A computer printer operates at 30 V. The diagram shows the transformer used to step down the mains voltage from 240 V to the 30 V needed by the printer.
There are 3200 turns on the primary coil.



(i) Calculate the number of turns on the secondary coil.

.....
.....
.....
.....

(3)

(ii) The current in the printer is 0.4 A.
Calculate the energy supplied to the printer in one second.

.....
.....
.....

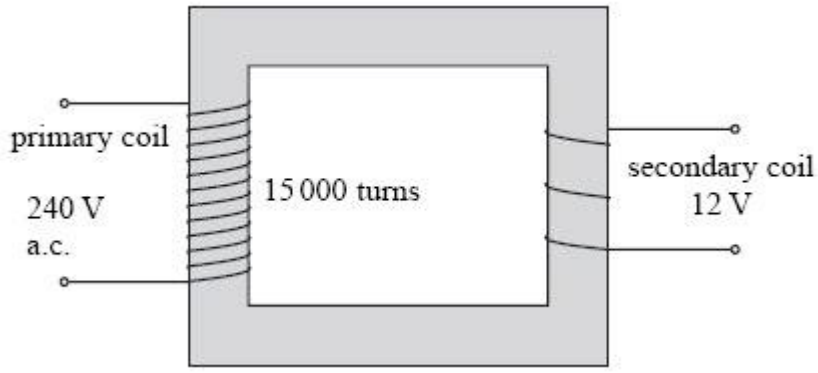
(2)

(iii) The energy supplied to the transformer by the mains in one second is 15 J.
Calculate the efficiency of the transformer.

.....
.....
.....

(3)
(Total 13 marks)

6. The diagram shows a transformer which is used to step down the 240 V mains voltage to light a 12 V lamp. The number of turns in the primary coil is 15 000.



(a) (i) Write down an equation which could be used to calculate the number of turns in the secondary coil.

.....
.....

(1)

(ii) Calculate the number of turns in the secondary coil.

.....
.....
.....
.....
.....

(2)

(b) 250 J of electrical energy is supplied to the primary coil in 10 s.

Calculate the current in the primary coil.

.....
.....
.....
.....

(3)

(c) (i) The energy output from the secondary coil is 225 J in 10 s.
Calculate the efficiency of the transformer.

.....
.....
.....
.....

(2) (ii) Explain why the efficiency is less than 100%.

.....
.....
.....
.....

(2)
(Total 10 marks)

MAINS ELECTRICITY

1. The metal case of an electric heater is earthed. The plug to the heater contains a 5 A fuse. There is a current of 4 A when the heater works normally. The cable to the heater becomes so worn that the live wire makes electrical contact with the case.

What happens? Give a reason for your answer

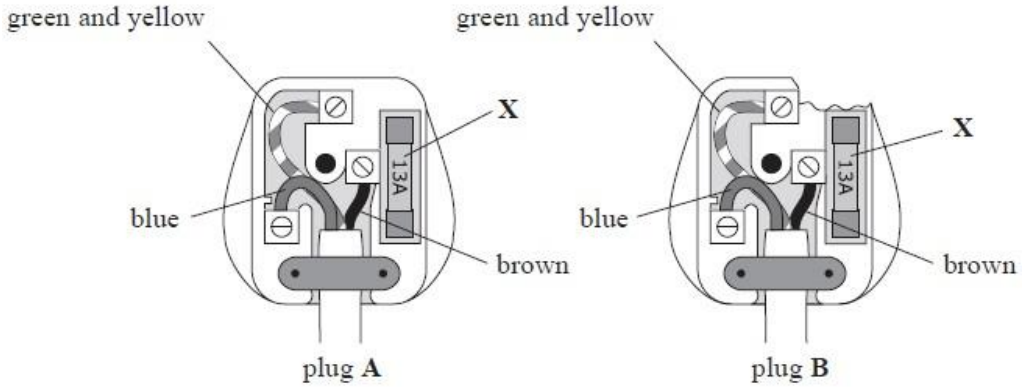
[2m]

2. A lamp with a resistance of 576Ω is connected to a 120-V source.
   a. What is the current through the lamp?

   b. What is the power rating of the lamp?

[2m]

3. (a) The covers are removed from two plugs, **A** and **B**. The diagram shows the inside of the plugs.



(i) Identify a problem with plug **B**.

.....

.....

(1) (ii) Suggest why this makes plug **B** unsafe.

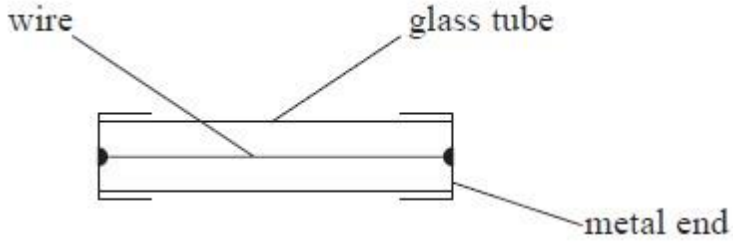
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.....

(1) (iii) Name part **X**.

.....

(1) (iv) The diagram below shows the structure of part **X**.

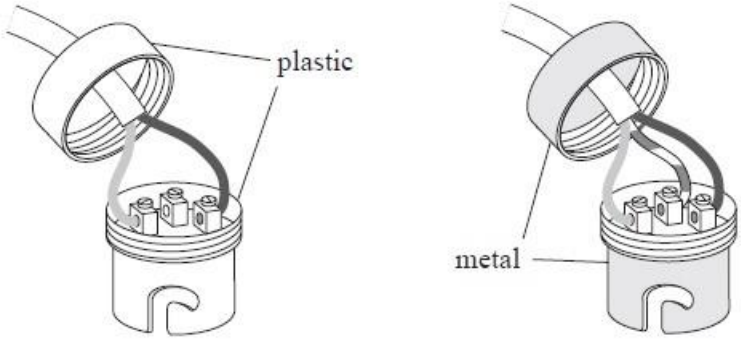


State **one** change which occurs in part **X** when the current is too large.

.....

.....

(1) (b) The diagram shows two light fittings, **Y** and **Z**.



Y Z

When the tops are screwed on, each fitting is safe to use. (i) State why light fitting **Y** is safe to use.

.....

.....

(1) (ii)

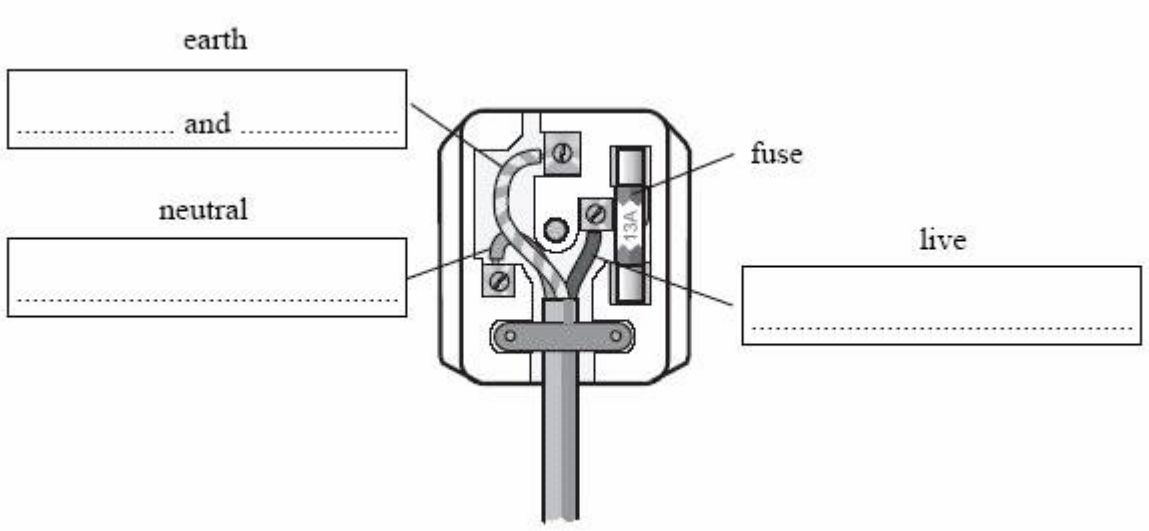
Why is light fitting **Z** safe to use?

.....

..... (1)

4. (a) The diagram shows a correctly wired 3-pin plug.

Label the wires with the correct colours.



(3)

(b) The table shows information about some household electrical appliances.

appliance	power	current
table lamp	100 W	0.40 A
clothes iron	2.2 kW	8.8 A
television set	80 W	0.32 A

(i) The mains cable for the iron is thicker than the mains cables for the other two appliances.

Suggest **two** reasons for this.

1 .....

.....

2 .....

.....

(2)

(ii) The three appliances are switched on for 30 minutes.

Which costs the least to run?

Explain your answer.

.....

.....

.....

(2)

(iii) The iron is switched on for 30 minutes.

Calculate the electrical energy used in kW h.

.....

.....

.....

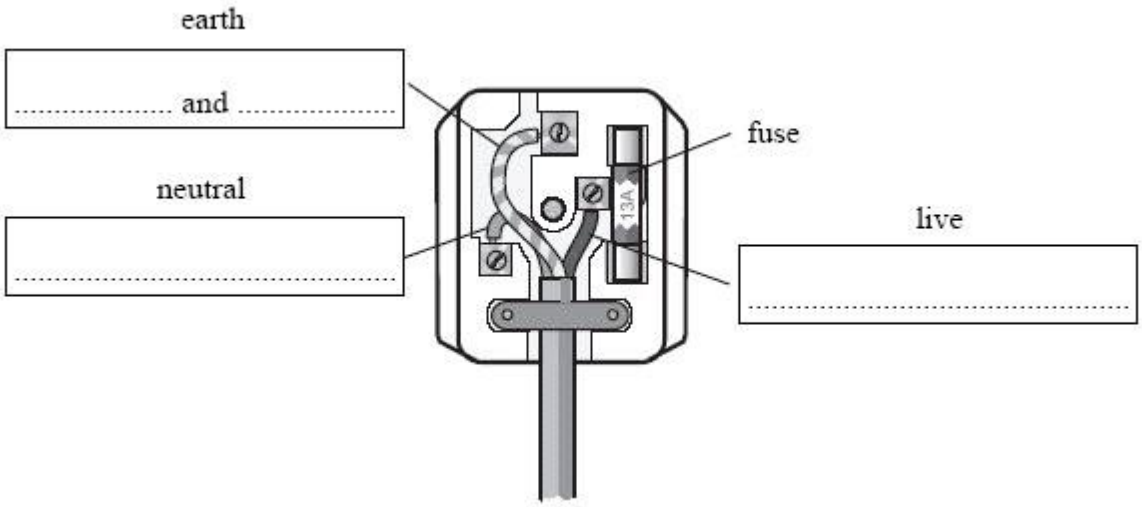
.....kW h

(3)

(Total 10 marks)

5. The diagram shows a correctly wired 3-pin plug.

Label the wires with the correct colours.



(3)

6. The table lamp shown in Fig. 10.2 is made from plastic. It has only two wires in the cable to connect it to the plug.

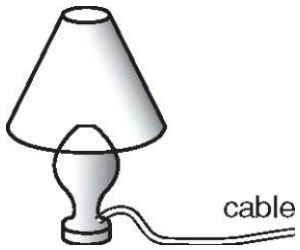


Fig. 10.2

The lamp has a power rating of 100 W and is used with a 230 V supply.

(i) Which wire, earth, live or neutral, is **not** needed in the cable for the lamp?

……
……

[1]

(ii) Explain why the lamp is safe to use even though it has only two wires in the cable.

……
……

……
……

[2]

(iii) Explain what is meant by a *power rating of 100 W*.

……
……

……
……

[2]

(iv). Calculate the value of the fuse that should be used in the plug for this lamp.

……
……

……
……

[3]

(v) Calculate the electrical energy supplied to the lamp in 30 minutes.

……
……

……
……

……
……[3]

Page

CATHODE RAYS

1. State one way of producing a beam of electrons and define the phenomenon.

[2m]

2. (ii) What are Cathode rays?

[1m]

(ii) Give three properties of these rays.

(a)
……
…….

(b)
……
……

(c)
……
……[3m]

[Total 4m]

3. A thin metal filament J and a metal plate K are sealed inside an evacuated glass vessel. The electrical connections pass through the glass to external components as shown in Fig. 11.1.

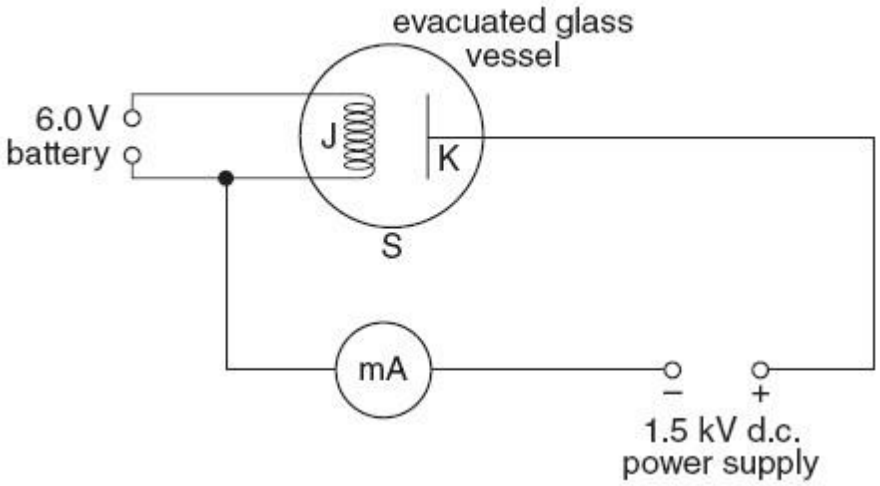


Fig. 11.1

(a) A 6.0 V battery is connected to J and the filament becomes white hot. The current from the battery is 1.6 A. Calculate the power supplied by the battery.

[2] (b) A milliammeter and a 1.5 kV d.c. power supply are connected in series between K and J. The positive terminal of the power supply is connected to K. (i) The milliammeter registers a small current. Explain the presence of a current in this circuit despite the gap between J and K.

[3] (ii) State why the glass vessel must be evacuated.

[1] (

iii) One pole of a bar magnet is brought close to the side S of the glass vessel and the current registered by the milliammeter decreases. Explain why this happens.

[2] (

iv) The terminals of the 1.5 kV d.c. power supply are reversed. Explain how this affects the current in the milliammeter.

[2]

(c) Fig. 11.2 shows two terminals M and N of a potential divider (potentiometer) connected to a 6.0 V battery. N is also connected to one of the two Y-input terminals of a cathode-ray oscilloscope. The other Y-input terminal is connected to the sliding contact of the potential divider (potentiometer).

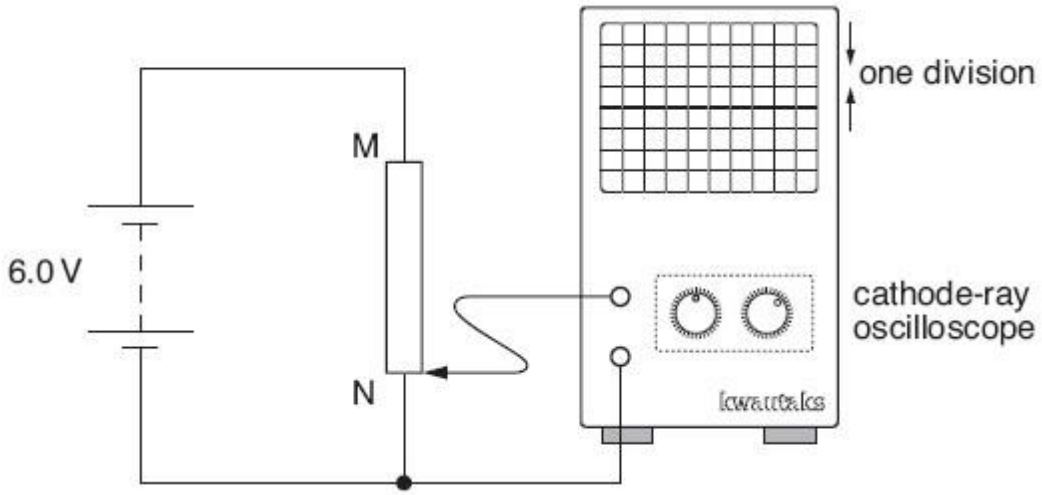


Fig. 11.2 The sliding contact is at N and the trace on the oscilloscope is a horizontal line passing through the centre of the screen.

(i) The timebase setting is 1.0 ms / div. Explain why the trace is a horizontal line.

[1] (ii) The Y-gain setting is 2.0 V / div. The sliding contact is moved at a slow, uniform rate from N to M. Describe in detail what happens to the trace on the screen.

[3] (iii) The Y-gain setting is now changed to 1.0 V / div and the trace disappears from the screen. State why this happens.

[1]

4. Fig. 7.1 shows a simple version of an electron-beam tube.

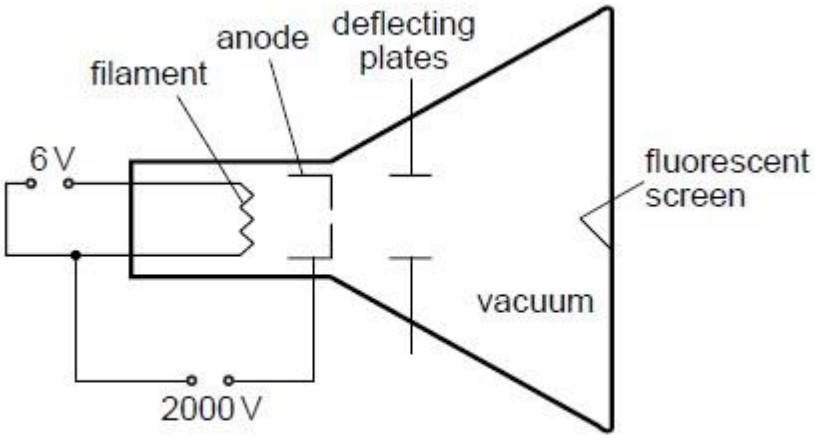


Fig. 7.1

The filament is connected to a 6 V power supply and there is a potential difference of 2000 V between the filament and the anode. As the electron beam hits the fluorescent screen, a spot of light appears on the screen.
(a) Explain why

(i) Electrons are emitted from the filament,

(ii) Electrons accelerate after they leave the filament,

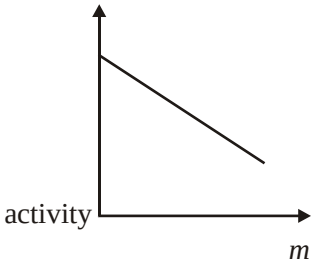
(iii) A vacuum is needed in the tube.

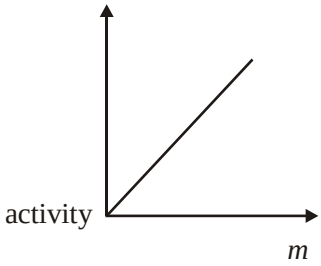
[3]

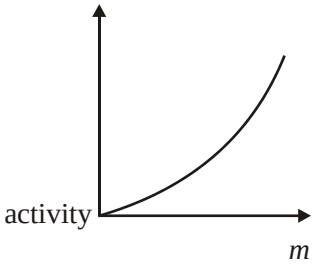
(b) An alternating potential difference of very low frequency is applied across the deflecting plates in Fig. 7.1. The spot of light on the screen is seen to move.
Describe and explain the movement of the spot.

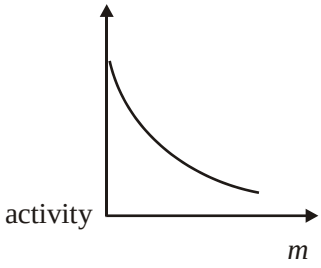
RADIOACTIVITY

1. Which of the following graphs shows the variation with mass m of the activity of a sample of a radioactive material?

A. 

B. 

C. 

D. 

(1)

2. When the isotope aluminium-27 is bombarded with alpha particles, the following nuclear reaction can take place

$$_4^2\text{He} + {}_{27}^{13}\text{Al} \rightarrow X + \text{neutron}.$$

Which **one** of the following correctly gives the atomic (proton) number and mass (nucleon) number of the nucleus X?

	Proton number	Nucleon number
A. B.	15	30
C.	16	31
D.	30	15
(1)	31	16

3. The following is a nuclear reaction equation.

$$_1^1\text{H} + {}_3^7\text{Li} \rightarrow 2X.$$

X is

A. an alpha particle.

B. a neutron.

C. a proton.

D. an electron.

(1)

4. A sample of a radioactive isotope of half-life $T_{1/2}$ initially contains N atoms. Which **one** of the following gives the number of atoms of this isotope that have **decayed** after a time 3 $T_{1/2}$?

A. $\frac{1}{8}\ N$

B. $\frac{1}{3}\ N$

C. $\frac{2}{3}N$

D. $\frac{7}{8}N$

(1)

5. Thorium-234 is a radioactive substance. It decays into protactinium by emitting beta particles (â) and gamma rays (g).

(a) Complete the equation for this decay.

234 ....

$$_{90}Th \longrightarrow \ldots\ldots\ldots\ \square + \ldots\ldots\ldots Pa$$

(2)

(b) When a gamma ray (g) is emitted from a nucleus, the mass number and atomic number do not change. Explain why.

.....

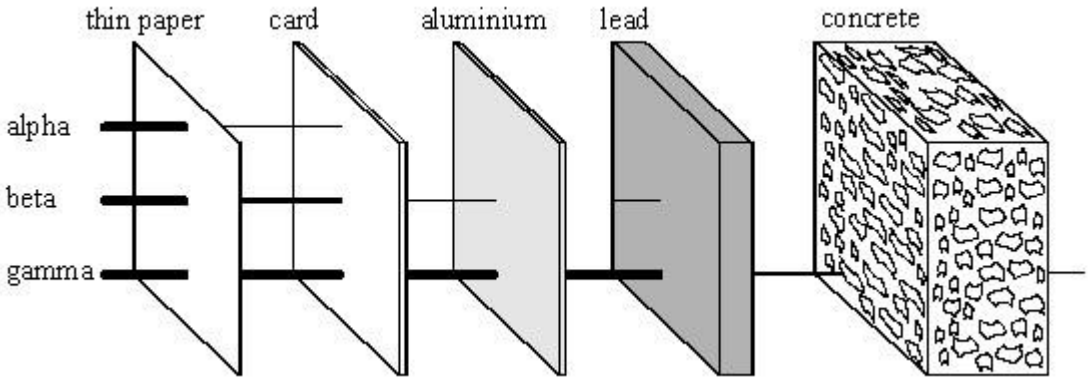
.....

.....

(2)

(Total 4 marks)

6. The three main types of radioactive emission are called alpha, beta and gamma. The diagram shows the penetrations of alpha, beta and gamma radiation.

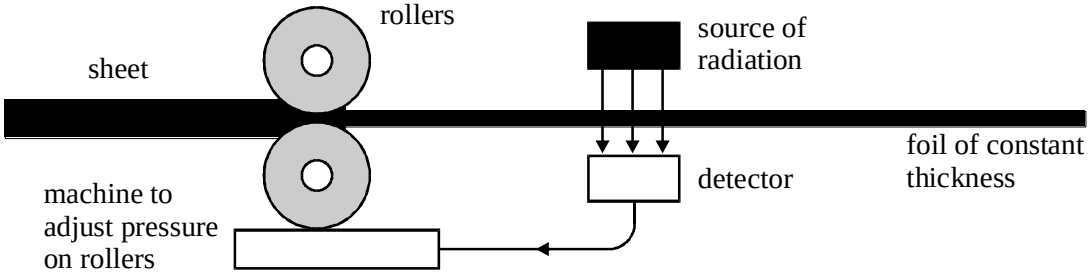


(a) Which type of radiation has the greatest penetration?

.....

(1)

(b) The diagram shows how aluminium sheet is rolled to form foil of constant thickness.



(i) Which type of radiation should be used to check the thickness of the foil?

.....

(1)

(ii) Explain why the other TWO types of radiation are **not** suitable.

.....

.....

.....

.....

(2)

(Total 4 marks)

7. The apparatus for investigating the absorption of the emissions from a radioactive source is shown in Fig. 11.1.

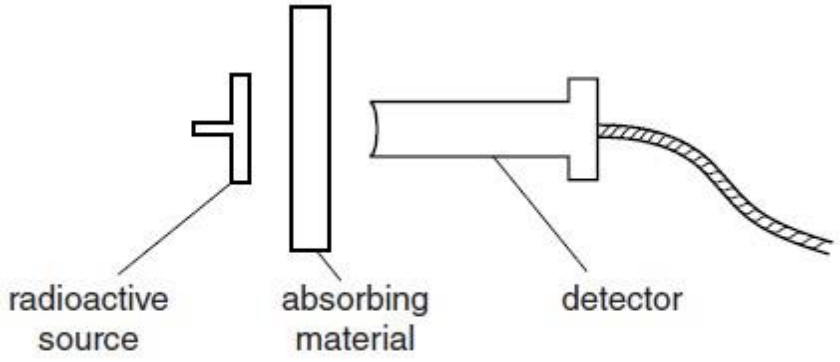


Fig. 11.1

The source and detector are about 2 cm apart. The detector is connected to a scaler, which measures the count rate.
Different absorbing materials are placed between the source and the detector. The table below shows the count rate obtained with each of five absorbers.

absorbing material	count rate / counts/s
air	523
sheet of paper	523
0.5 mm of aluminium	391
10 mm of aluminium	214
10 mm of lead	122

(a) How can you tell that the source is not emitting any α-particles?
[2]

(b) What is the evidence that β-particles are being emitted?

[2]

(c) What is the evidence that □-rays are being emitted?

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