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## SECTION A (25 marks)

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

1. **Figure 1** shows the image formed by a plane mirror when an object is placed in front of the mirror.

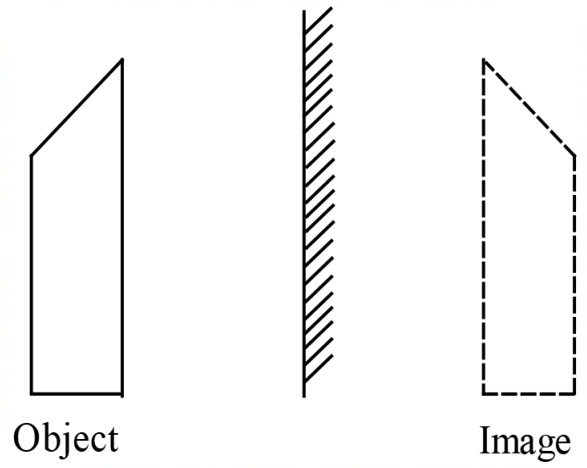


**Figure 1**

Apart from the image being virtual and of the same size as the object, state **one** other characteristic displayed in the figure. (1 mark)

- Image distance is equal to object distance.
- The image is laterally inverted.

2. A student observed that when removing a polyester sweater, a cracking sound was produced. Explain this observation. (2 marks)

Static charges accumulate on the cloth due to friction. Upon removal, there is discharge of the static charges thereby producing the crackling sound.

3. Explain what happens to the potential difference of a charged parallel plate capacitor when the distance of separation between the plates is reduced. (3 marks)

When separation distance is reduced, capacitance increases and the potential difference between the plates reduce since capacitance is inversely proportional to the potential difference.



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**4.** State **one** advantage of using a circuit breaker instead of a fuse in a domestic wiring system. (1 mark)

- A circuit breaker responds instantaneously unlike a fuse which takes time.
- A circuit breaker can be reset while a fuse once it melts, it has to be replaced.

**5.** A student is provided with a steel needle and a copper coin. Describe how the student can use a bar magnet to identify which of the two materials is magnetic. (2 marks)

Bring the rod and the copper coin in turn close to the magnet, the one attracted is magnetic.

**6.** **Figure 2** shows an object 'O' and its image 'I' as formed by a concave mirror.

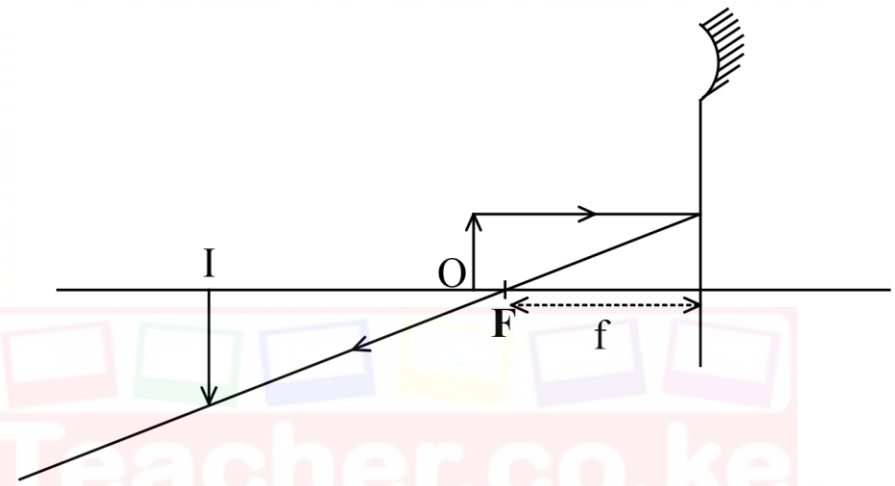


**Figure 2**

Complete the ray diagram and indicate the focal length of the mirror. (2 marks)

**7.** Using domain theory, explain how electric current produces a magnetic effect in an electromagnet. (3 marks)

A magnetic material is placed in a solenoid and a direct current passed. Dipoles in domains of the material are made to face one direction.

**8.** State the meaning of the term *periodic time* of a wave. (1 marks)

Time for one complete oscillation/cycle.

**9.** Explain why sound energy travels faster in a metal block than in water. (2 marks)

Sound travels through longitudinal vibration of particles, in solids particles are closer to each other.



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**10.** State the meaning the term *refractive index* of water. (1 mark)

The ratio of the angle of incidence to that of the angle of refraction when a ray passes from air to water.

**11. Figure 3** shows a cell connected to a bulb and a switch.

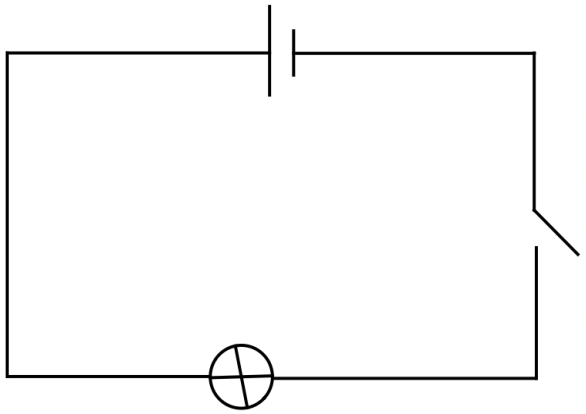

**Figure 3**

When the switch is closed, the bulb lights. Explain how the cell drives the electrons in the circuit. (2 marks)

Potential difference between terminals of the cell drive current in the circuit.

**12.** An electric bulb is marked 60 W, 240 V. Determine the energy the bulb consumes in one minute. (2 marks)

$$E = Pt$$
$$= 60\ W \times 60\ s$$
$$= 3\,600\ J$$

**13.** (a) State what is meant by *long sightedness* as an eye defect. (1 mark)

This is where the image of near object is formed behind the retina.

(b) Explain how long sightedness can be corrected using a lens. (2 marks)

By placing a convex lens in front of the eye lens.



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## SECTION B (55 marks)

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

**14.** (a) **Figure 4** shows an electromagnet set-up.

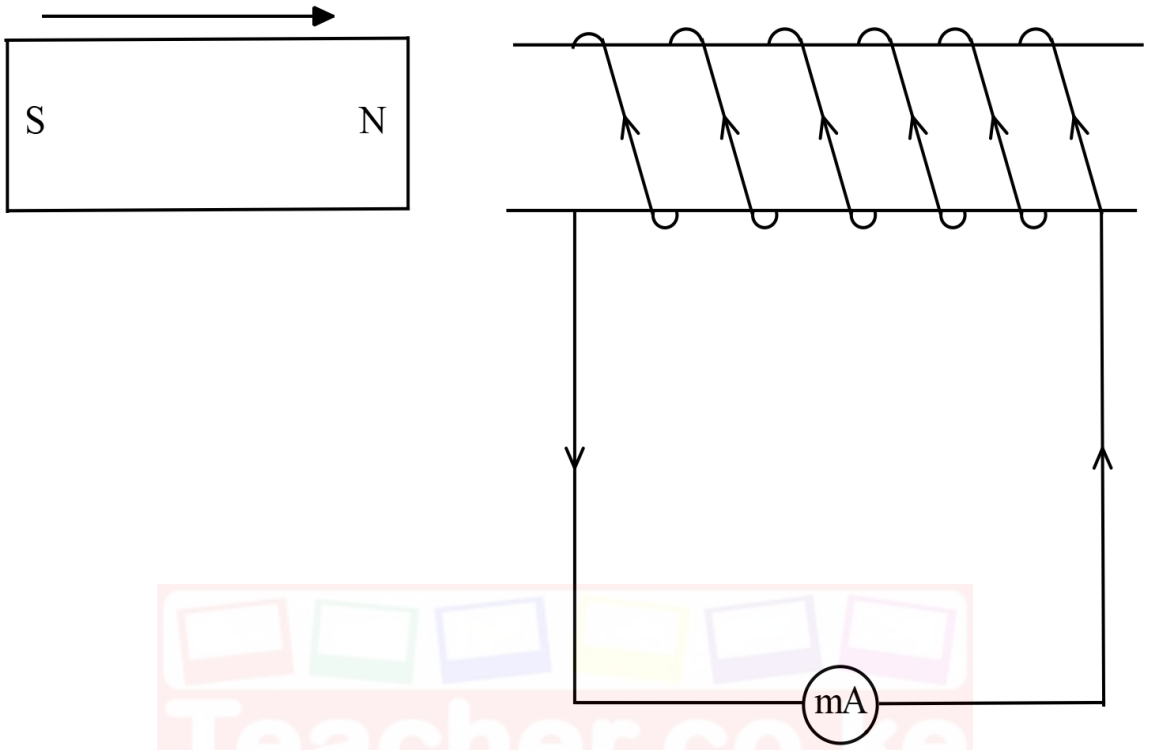


**Figure 4**

When the magnet is moved towards the coil as shown by the arrow, the milliammeter reads a maximum current of 0.1 mA.

(i.) Explain how the current is generated in the circuit. (3 marks)

Magnetic flux cutting the coil changes causing current induced.

(ii.) Using the same set-up, state how the current observed in the milliammeter can be increased. (1 mark)

By moving the magnet faster towards the coil.

(iii.) On the figure, indicate with an arrow the direction of the induced current in the coil. (1 mark)



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(iv.) Explain why the current flows in the direction shown in part (iii.). (3 marks)

Induced current opposes the change in flux producing it, a North pole is induced at the end of the coil facing the approaching magnet.

(b) A family observed that after purchasing a refrigerator, the monthly electricity bill increased by Ksh 2000 in a 30 day month. Given that the cost of electricity per KWh is Ksh 400 and the fridge was sed for 24 hours per day, determine the power rating of the fridge. (3 marks)

$$E = \frac{2\,000}{400}$$

$$= 5 \text{ kWh/day}$$

$$Power = \frac{5 \times 1\,000}{24}$$

$$= 208.3\ W$$

**15.** (a) (i.) State **three** uses of the electron gun in the cathode ray oscilloscope. (3 marks)

- Produce beam of electrons.
- Accelerate electrons.
- Focus electrons.

(ii.) State the reason why the inner wall of a cathode ray oscilloscope tube is coated with graphite. (1 mark)

To conduct away and earth electrons.

(iii.) Describe how a cathode ray oscilloscope can be used to measure the voltage of a cell. (3 marks)

Signal is connected to Y – plates, displacement of the spot on the screen is multiplied by the sensitivity to get voltage.


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(b) **Figure 5** shows an x-ray tube.

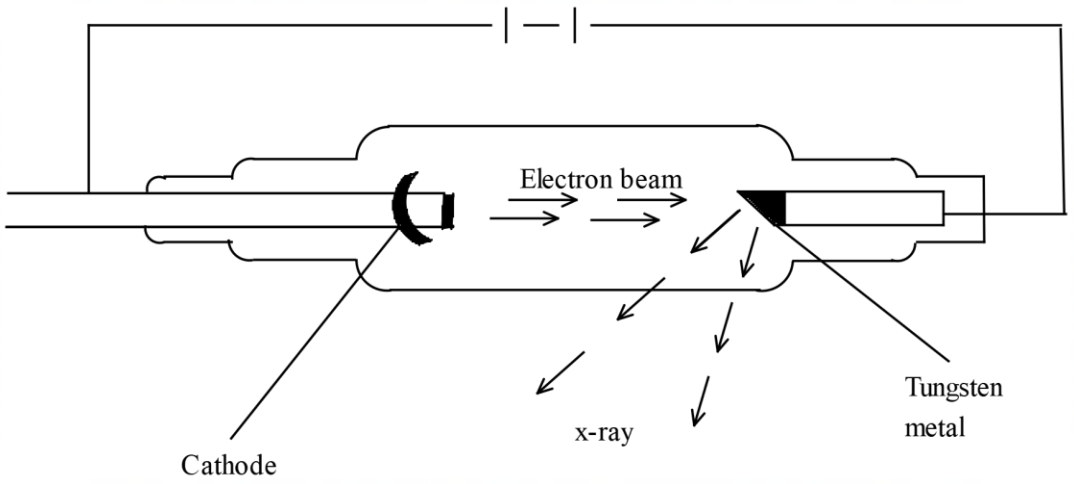


**Figure 5**

(i) On the figure, show with an arrow:

I. the direction of the electron beam in the tube; (1 mark)

II. the direction of the x-rays produced. (1 mark)

(ii) State **two** ways by which focusing of the electron beam is achieved in the tube. (2 marks)

- Achieved using the cathode.
- By using high potential difference.

**16.** (a) (i) State the meaning of the term *photoelectric emission*. (1 mark)

Photoelectric emission occurs when light of sufficient energy dislodges electrons from a metal surface.

(ii) Explain how the energy of a photon is used by the electrons during photoelectric emission. (2 marks)

Used to overcome the metal's work function and the rest is used to provide the electrons with kinetic energy.



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(b) Explain the meaning of the term *stopping voltage* as used in photoelectric effect.

(2 marks)

Potential required to stop electrons completely from reaching the anode in a photocell.

(c) When a certain metal surface is illuminated with a light of wavelength $4.0 \times 10^{-7}\ m$, it emits photoelectrons whose kinetic energy is $6.6 \times 10^{-20}\ J$. (Planck's constant is *h* is $6.6 \times 10^{-34}$ Js and speed of light *c* is $3.0 \times 10^{10}$ m/s.)

Determine the:

(i) energy of a photon of the incident light. (3 marks)

$$E = \frac{hc}{\lambda}$$

$$= \frac{6.6 \times 10^{-34} \times 3.0 \times 10^{8}}{4.0 \times 10^{-7}}$$

$$= 4.95 \times 10^{-19}\ J$$

(ii) work function of the metal surface. (3 marks)

$$E = KE + \Phi$$

$$\Phi = (4.95 \times 10^{-19}) - (6.6 \times 10^{-20})$$

$$\Phi = 4.29 \times 10^{-19}\ J$$

**17.** (a) Explain how visible tracks of radiations are formed in the expansion cloud chamber when the moist air in the chamber expands. (3 marks)

The expansion causes cooling, vapour condenses on ions formed by radiations forming tracks.



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(b) The following equation shows a radioactive decay series.

$$^{234}_{92}U \rightarrow {}^{230}_{90}Th + Radiation$$

(i) State the name of the radiation emitted. (1 mark)

Alpha.

(ii) State what would be observed on the leaf of a positively charged electroscope when the radiation identified in (i) passes close to the cap of the electroscope. (3 marks)

Leave divergence decreases. Alpha particle ionizes air and opposite ions are attracted towards the cap neutralizing the charge thus discharging.

(c) A certain radioactive substance has a half – life of 8 hours. 10 g of the sample has an activity of 90 counts per minute. Determine the:

(i) quantity of the sample that is active after 24 hours; (1 mark)

$$\frac{1}{8} \times 10 = 1.25\ g$$

(ii) activity of the remaining sample after 24 hours. (1 mark)

$$\frac{1}{8} \times 90 = 11.25 \text{ counts per minute}$$

**18.** (a) Use the energy band theory to explain why intrinsic semiconductors do not conduct at absolute zero temperature. (2 marks)

At absolute zero, the valence band of intrinsic semiconductor is full while the conduction band is empty. Therefore, the intrinsic semiconductor does not have electrons for conduction.


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(b) **Figure 6** shows a p – n junction diode connected to a source of e.m.f.

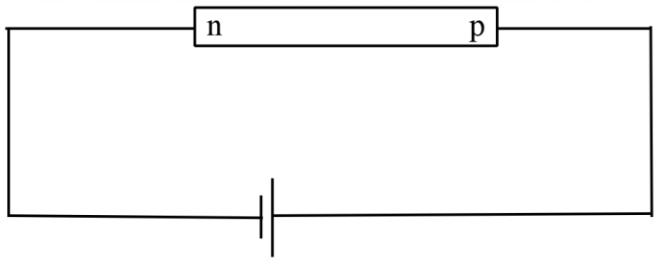



**Figure 6**

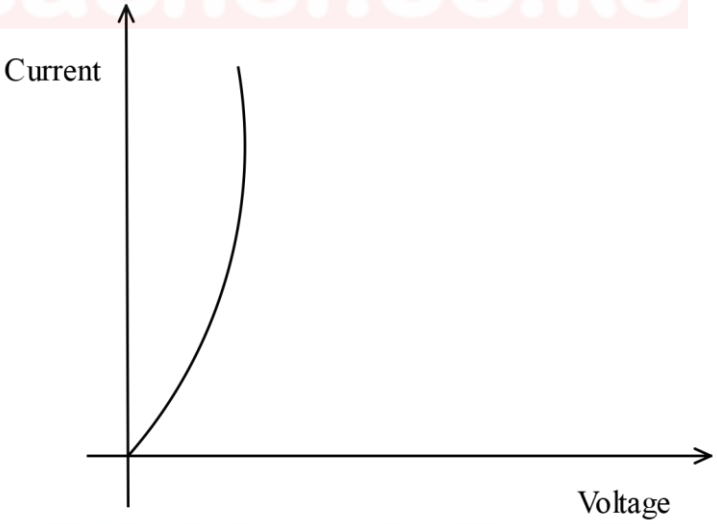
(i) State the type of biasing shown in the figure. (1 mark)

Forward biasing.

(ii) Explain what happens to the charge carriers at the junction. (3 marks)

The applied voltage overcomes the potential barrier, enabling fixed ions in the depletion layer to be mobile. Thus holes from the p – type move across the junction, and electrons from the n – type also move across the junction.

(iii) In the space provided, sketch the current – voltage graph for the diode in the figure. (1 mark)





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(c) **Figure 7** shows a waveform generated by an alternating current source.

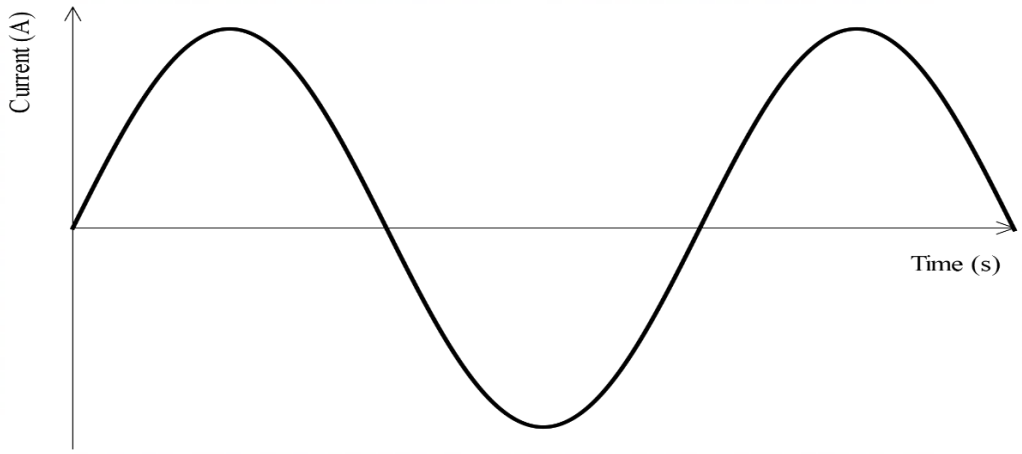
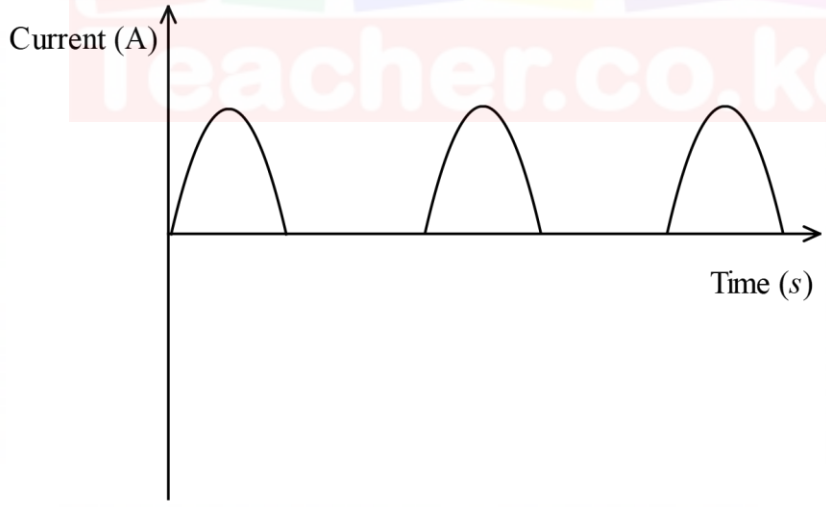



**Figure 7**

(i) On the axis provided, sketch the waveform obtained when a p – n junction diode is connected in series with the source.




(ii) Explain the shape of the waveform drawn in part (c)(i). (2 marks)

P – n junction allows current flow in one direction only.

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