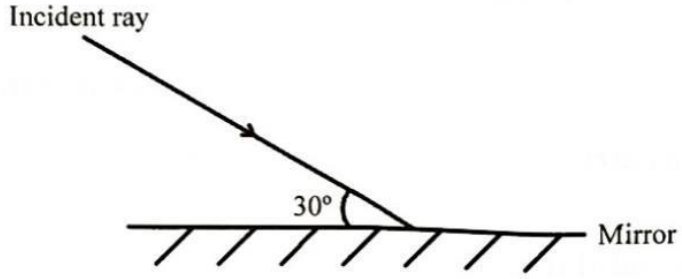
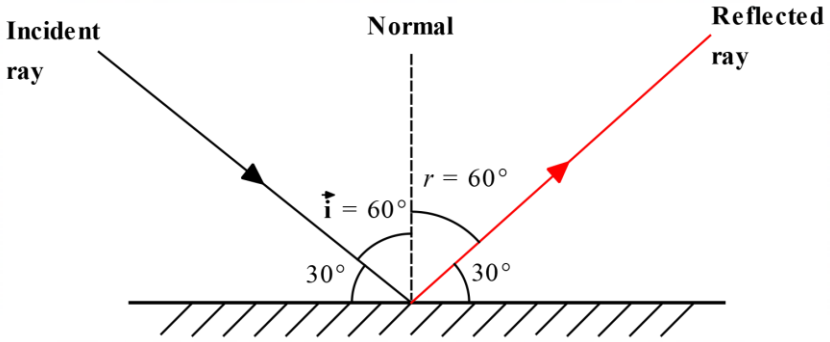
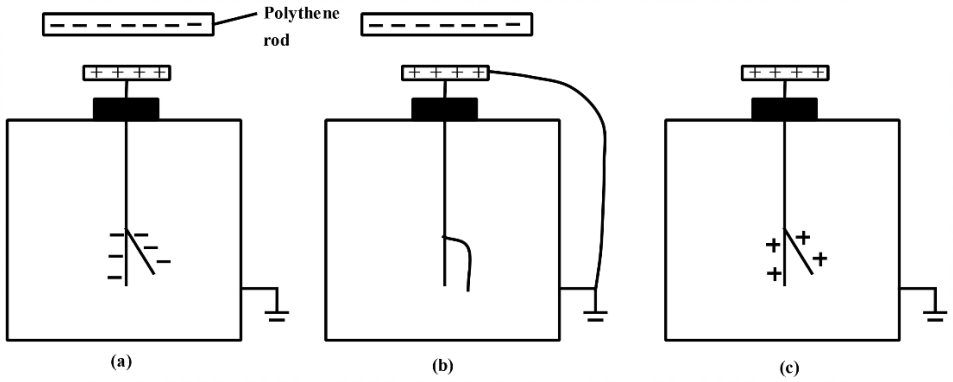
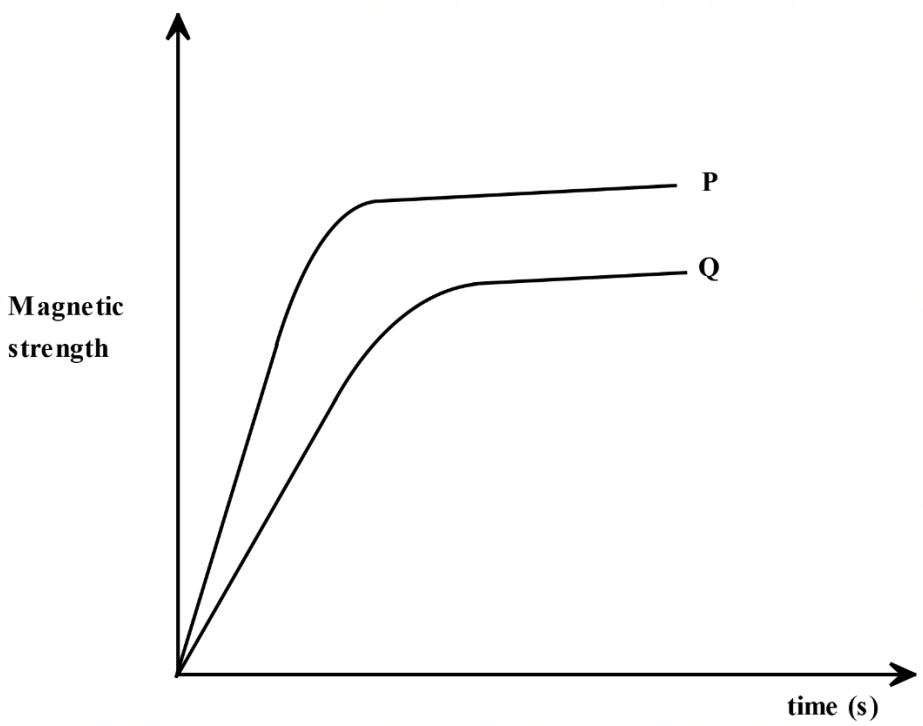
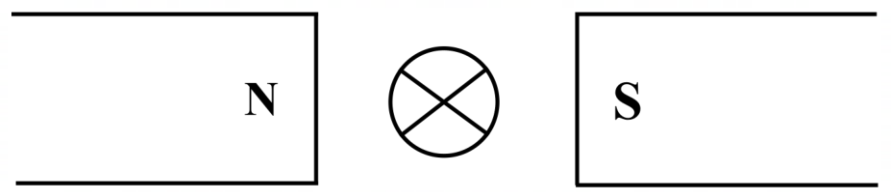
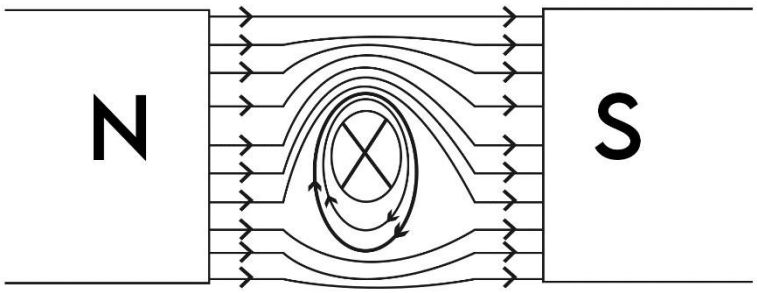
 SECTION A (25 MARKS)

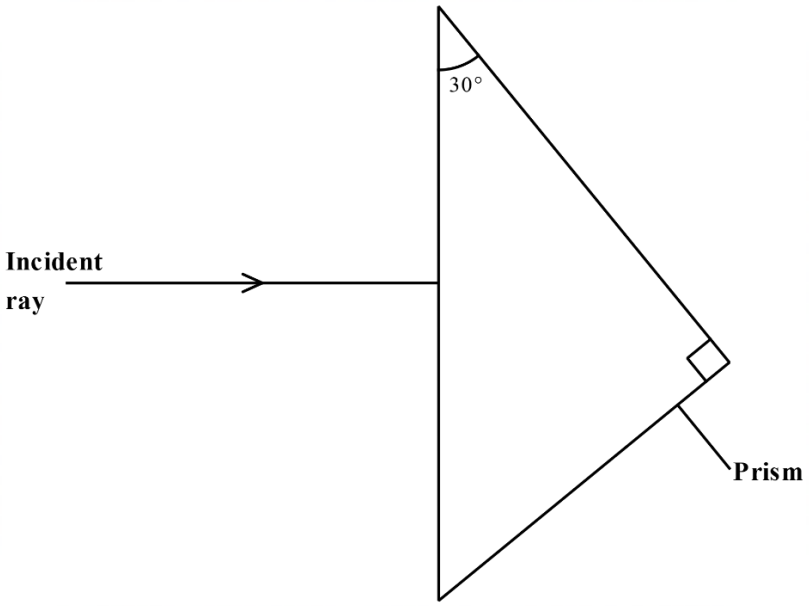
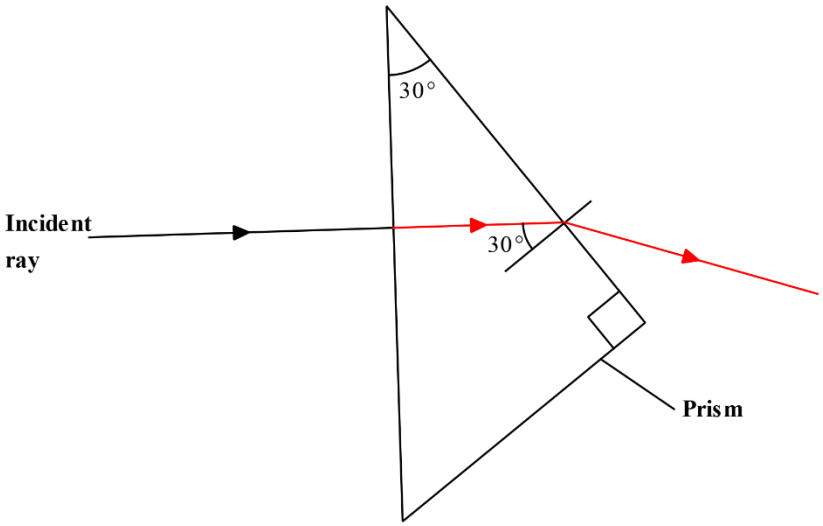
No.	CONTENT	NOTES

1	**Figure 1** shows a ray of light incident on a plane mirror.  **Figure 1** Complete the diagram to show the path of the reflected ray. **(1 mark)** ***Expected response***  	
2	**Figure 2a, 2b** and **2c** show the process of charging an electroscope by induction.  **Figure 2**	

	It is observed that the leaf rises in (a), collapses in (b) and then rises in (c). Explain why the leaf collapses in (b). **(3 marks)** ***Expected response*** ○ **Due to earthing. Electrons flow to the earth leading to reduced charges on the leaf and plate. Hence leaf divergence decreases.**	
3	State **one** use of capacitors. **(1 mark)** ***Expected response*** ○ **Used in smoothing circuits *(rectification)*** ○ **Used in tuning circuits *(circuits of radio receivers)*** ○ **Used in delay circuits *(car indicators)***	
4	**Figure 3** shows a graph of magnetic strength against time for two nails P and Q when magnetized in a solenoid. P and Q are of the same size but are made of different materials.  **Figure 3** **(a)** Identify the material that is magnetized faster. **(1 mark)** ***Expected response*** ○ **P** **(b)** Use the domain theory to explain the answer in 4(a). **(2 marks)** ***Expected response*** ○ **P is a soft magnetic material as compared to Q. Hence, less time is taken for the magnetic dipoles to align themselves in**	

	the north-south direction until the material reaches its magnetic saturation.	
5	State the meaning of the term *principal focus* of a convex mirror. **(1 mark)** ***Expected response*** **o It is the point at which all rays parallel and close to the principal axis appear to diverge from after reflection by the mirror.**	
6	**Figure 4** shows a current carrying conductor placed between the poles of two magnets. *(The direction of the current is into the paper)*  **Figure 4** Sketch the magnetic field produced between the conductor and the poles of the magnets. **(2 marks)** ***Expected response*** 	

7	**Figure 5** shows two coherent sources of sound A and B in phase. O is a point equidistant from A and B.  **Figure 5** An observer moves from M to N through Q. Explain what is observed at point Q. **(3 marks)** ***Expected response*** • **As the observer moves from M to Q, he/she will experience alternate loud (constructive interference) and soft (destructive interference) sound.** • **At Q, the observer will experience a loud sound (constructive interference)** **his is the locus of points equidistant from the two sources, hence the path difference is zero.** **because t**	
8	State **one** factor that affects the speed of sound in water. **(1 mark)** ***Expected response*** • **Temperature** • **Salinity** • **Pressure**	

9	**Figure 6** shows a ray of light incident on a prism with a critical angle of 42°.  Complete the diagram to show the path of the ray through the prism. **(2 marks)** ***Expected response***  	

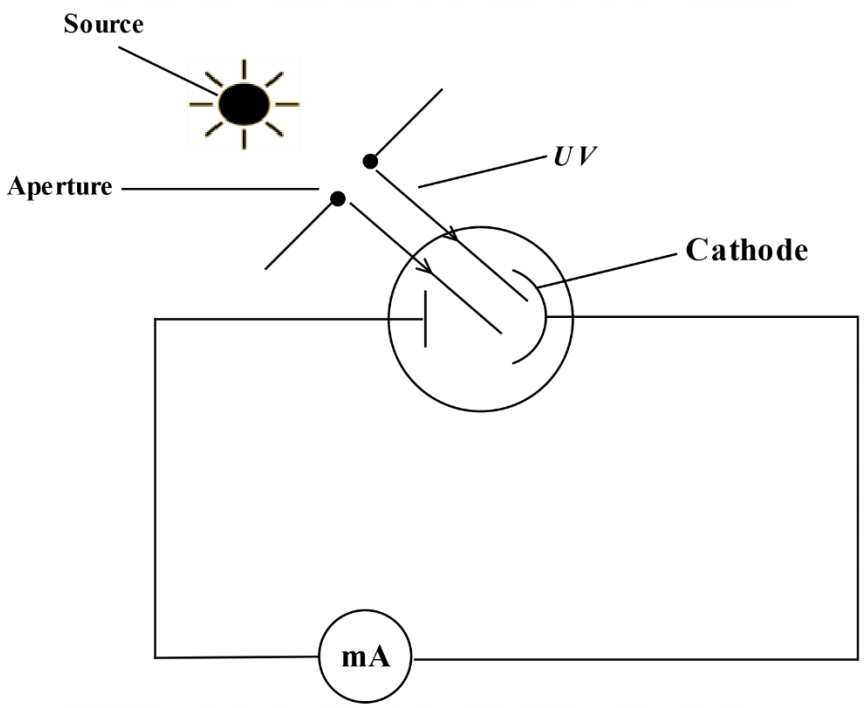
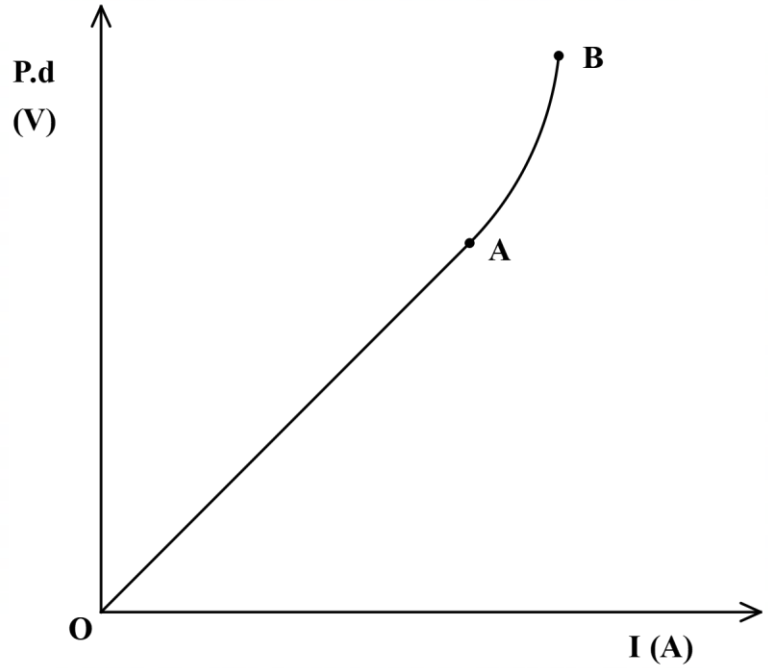
10	It is observed that when the heat current of the cathode ray tube is increased, the intensity of the cathode rays increases. Explain this observation. **(2 mark)** ***Expected response*** **Increase in heat current increases the energy of electrons to break loose from the force of attraction of the nuclei. Consequently, more electrons are emitted through thermionic emission increasing the intensity of the cathode rays.**	
11	A current of 2A flows through a bulb for 2.5 minutes. Determine the quantity of charge that flows through the bulb. **(3 marks)** ***Expected response*** $$Q = It$$ $$t = 2.5 \times 60$$ $$= 150sec$$ $$\therefore Q = 2 \times 150$$ $$= 300\ coulombs$$	
12	**Figure 7** shows UV light passing through an aperture and incident on the cathode of a photocell.  	

	Figure 7 **(a)** State what is observed on the milliammeter when the size of the aperture is increased. **(1 mark)** ***Expected response*** **O More deflection / Pointer deflects more / Higher deflection** **(b)** State the reason for the answer in 12(a). **(1 mark)** ***Expected response*** **O Increasing the size of the aperture increases the intensity of the UV on the cathode. As a result, more photoelectrons are emitted at the cathode.**	
13	State the property of radio waves that makes them suitable for use in communication. **(1 mark)** ***Expected response*** **O They have longest wavelength in the electromagnetic spectrum.**	

SECTION B (55 MARKS)

No.	CONTENT	NOTES
14	**a)** State and explain how increase in temperature affects conductivity of a semi-conductor. **(2 marks)** ***Expected response*** **O An increase in temperature will reduce the electrical resistance of a semi-conductor. Consequently, this increases chances of an electron moving from the valence band to the conduction band.** **b)** **Figure 8** shows a graph of potential difference (V) across a bulb against the current (I) through the bulb obtained from an experiment.  **Figure 8** Explain why parts: **(i) AO** is straight. **(1 mark)** ***Expected response*** **O Current flowing is directly proportional to the potential difference across the bulb/** **(ii) AB** is curved. **(2 marks)** ***Expected response*** **O Current flowing is not directly proportional to the p.d across the bulb as the bulb is non ohmic.**	

c) A circuit consists of 20 identical lamps connected in series to 240 V mains supply. Determine the potential difference across each lamp. **(2 marks)**

Expected response

$$\textbf{Sum of voltage drop across each lamp} = \textbf{Supply voltage}$$

$$20x = 240V$$

$$x = \frac{240}{20}$$

$$= 12V$$

Alternatively;

$$V = IR$$

$$But, I = \frac{V}{R}$$

$$= \frac{240V}{20R}$$

$$= 12V/R$$

$$\therefore V = \frac{12V}{R} \times R$$

$$= 12V$$

d) Figure 9 shows a circuit consisting of two identical lamps and three ammeters A_1, A_2 and A_3 connected to a cell.

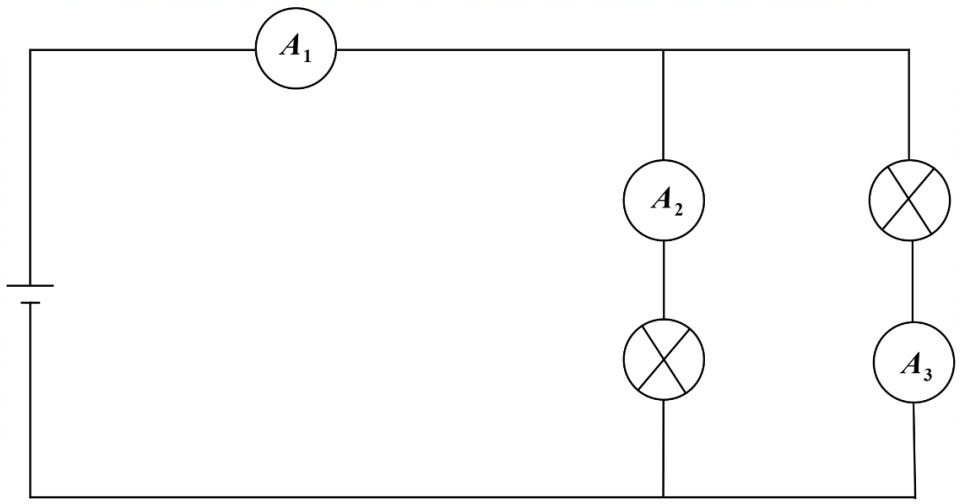


Figure 9

Given that Ammeter A_1 reads 0.5A:

(i) state the reading on Ammeter A_3. **(1 mark)**

Expected response

- **0.25A**

(ii) explain the answer 14(d)(i). **(2 marks)**

Expected response

- **Since the bulbs are identical, they have similar resistance, hence current is split equally.**

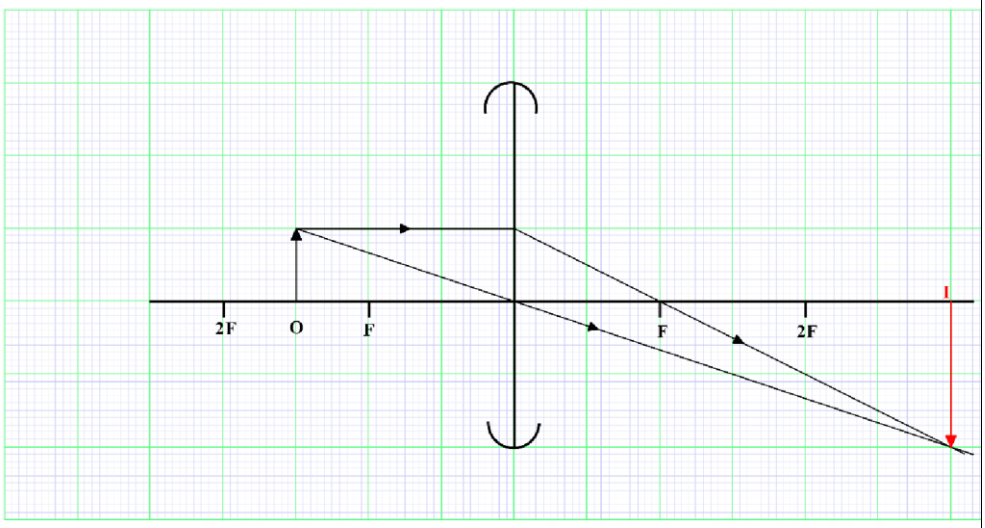
15 **a)** State the use of the eye piece lens in a compound microscope. **(1 mark)**

Expected response

- **Acts as a magnifying glass.**
- **Produces a magnified virtual image of the real image formed by the objective lens.**

b) On the grid provided, draw a ray diagram to show how a convex lens forms a magnified real image. **(3 marks)**

Expected response



c) Figure 10 shows a defect of vision in a human eye.

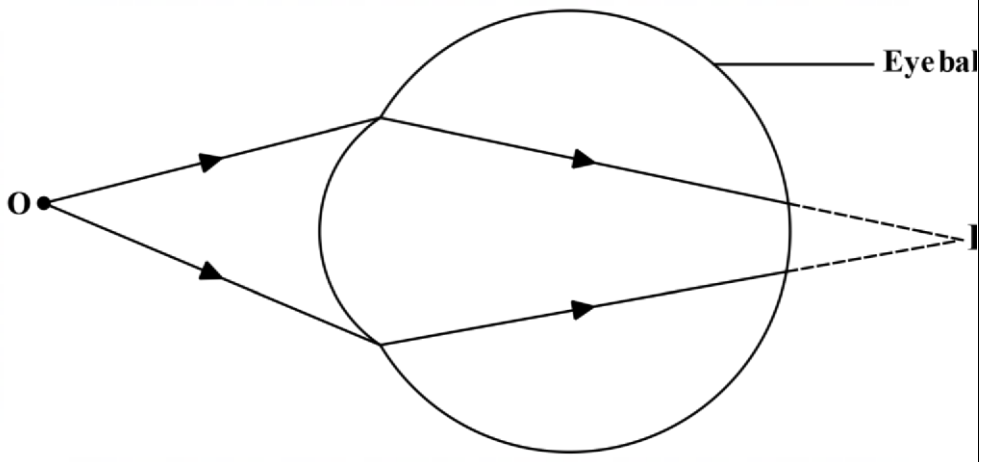


Figure 10

(i) State the type of defect shown. **(1 mark)**

Expected response

- **Long sightedness (Hypermetropia)**

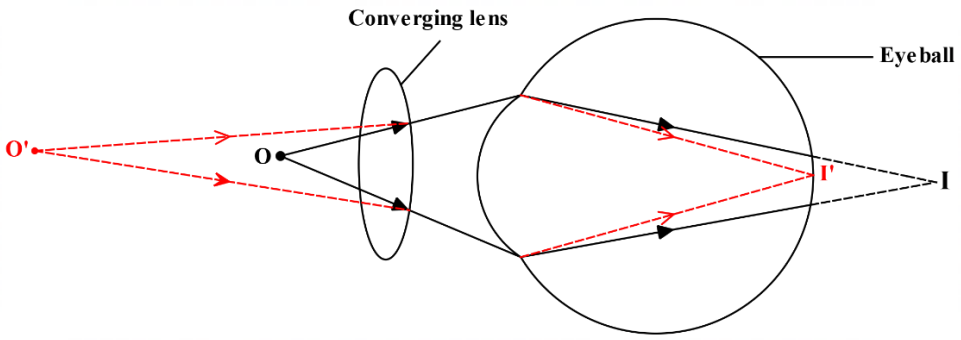
(ii) State the type of lens that can be used to correct this defect. **(1 mark)**

Expected response

- **Converging lens**

(iii) On the same figure, draw rays to show how the lens in 15(c)(ii) corrects the defect. **(2 marks)**

Expected response



d) Figure 11 shows a graph of image distance V against the object distance U obtained in an experiment to determine the focal length of a concave mirror.

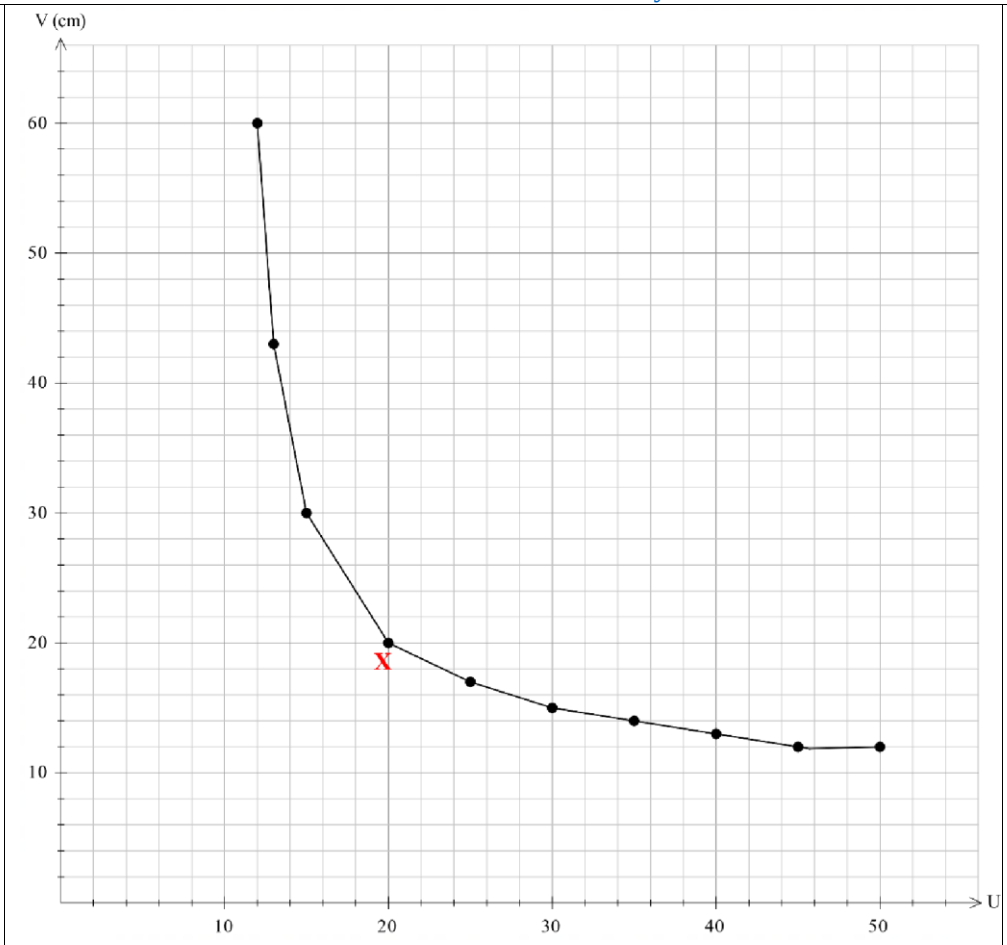


Figure 11

(i) Identify and mark a point X on the graph where V=U. **(1 mark)**

(ii) Use point X to determine:

I. the radius of curvature r. **(2 marks)**

Expected response

$$\boldsymbol{Object\ at\ C\ forms\ an\ image\ I,\ at\ C\ hence\ U = V = r}$$
$$\boldsymbol{r = 20cm}$$

II. the focal length of the mirror. **(1 mark)**

Expected response

$$\boldsymbol{f = \frac{r}{2}}$$
$$\boldsymbol{= \frac{20}{2}cm}$$
$$\boldsymbol{= 10cm}$$

16 **a)** State Faraday's law of magnetic induction. **(1 mark)**

Expected response

- **It states that the magnitude of the induced e.m.f is directly proportional to the rate of change of magnetic flux linkage.**

b) **Figure 12** shows a bar magnet being moved towards a solenoid. The solenoid is being connected to a galvanometer.

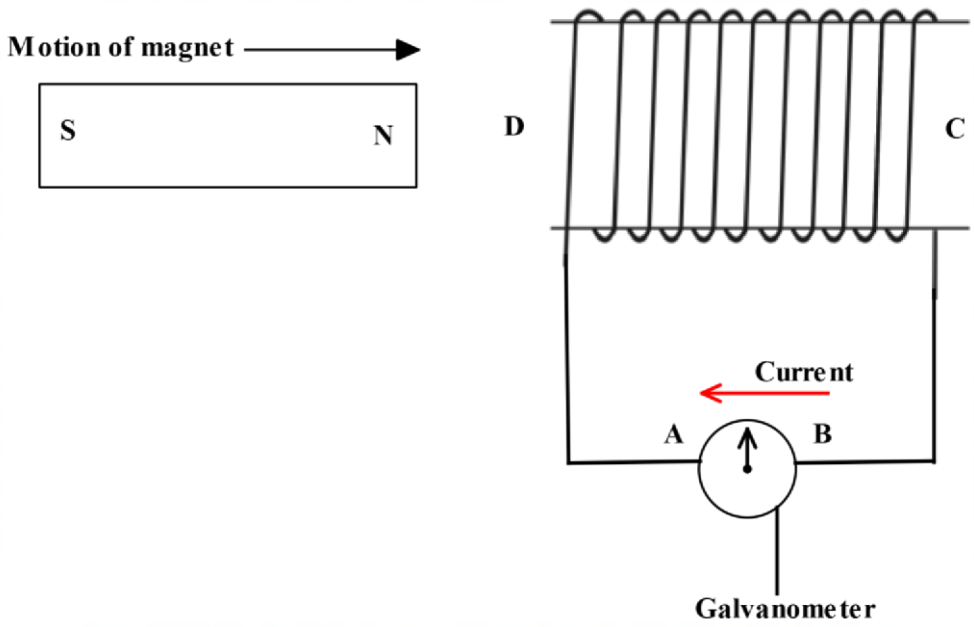


Figure 12

(i) Indicate on the diagram the direction of the induced current in the solenoid. **(1 mark)**

(ii) Identify the pole induced at D. **(1 mark)**

Expected response

- **North pole**

(iii) Explain the answer in 16(b)(ii). **(2 marks)**

Expected response

- **As the north pole of the magnet is moved towards the coil, the induced current flows in the coil, forming an electromagnet with a north pole at the end of the nearest incoming magnet. This opposes the movement of the magnet.**

(iv) Apart from the number of turns in the solenoid, state **two** factors affecting the magnitude of the induced current. **(2 marks)**

Expected response

- **Rate of change of magnetic flux.**
- **The angle of deflection between the wire and the magnetic field.**

c) Explain how laminating the core of a transformer increases its efficiency. **(2 marks)**

Expected response

- **Laminating the core of a transformer reduces eddy currents thus minimizing the heating effect. Hence increases its efficiency.**

17 **a)** Explain how a fuse protects electrical devices from damage. **(2 mark)**

Expected response

- **Fuses are made of short thin wire of low melting point. When current exceeds the fuse rating, the fuse wire gets very hot and melts, hence breaking the circuit. /**
- **Excess current is converted to heat energy which melts the fuse which has a low melting point, hence breaking the circuit.**

b) State and explain why the voltage in the mains electricity is stepped up before long distance transmission. **(3 marks)**

Expected response

- **To minimize power loss in transmission cables. For any given resistance in a circuit, when the current is high, the power loss is large and when the current is low, power loss is also low, thus stepping up voltage reduces current in a circuit. Therefore, power loss $P = I^2R$ is minimized by stepping up voltage.**

c) **Figure 13** shows how power can be transmitted from the generating station through transformers P, Q and R to the consumers.

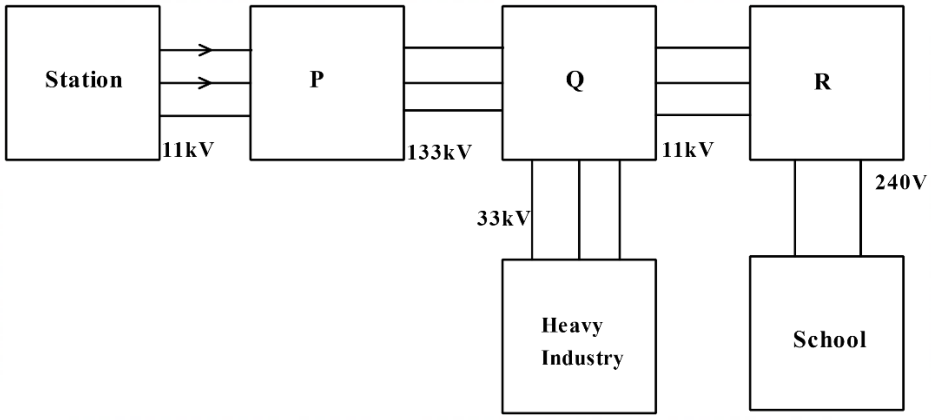


Figure 13

(i) Identify the type of transformer labelled P. **(1 mark)**

Expected response

- **Step up transformer**

(ii) Explain how the number of turns in the primary and secondary coils of transformer P affects its output voltage. **(3 marks)**

Expected response

- **Constantly changing current in primary produces a changing magnetic flux per turn which is linked to each turn in the secondary coil (magnetic flux linkage) inducing an e.m.f in each turn.**

(iii) State the reason why one of the wires from R to the school should be earthed. **(1 mark)**

Expected response

- **To produce a neutral wire which is at zero potential.**

d) A power station generates 11kV at a current of 1A. The voltage is stepped up to 160kV before being transmitted through electric cables. Assuming the transformer is 100% efficient, determine the secondary current. **(3 marks)**

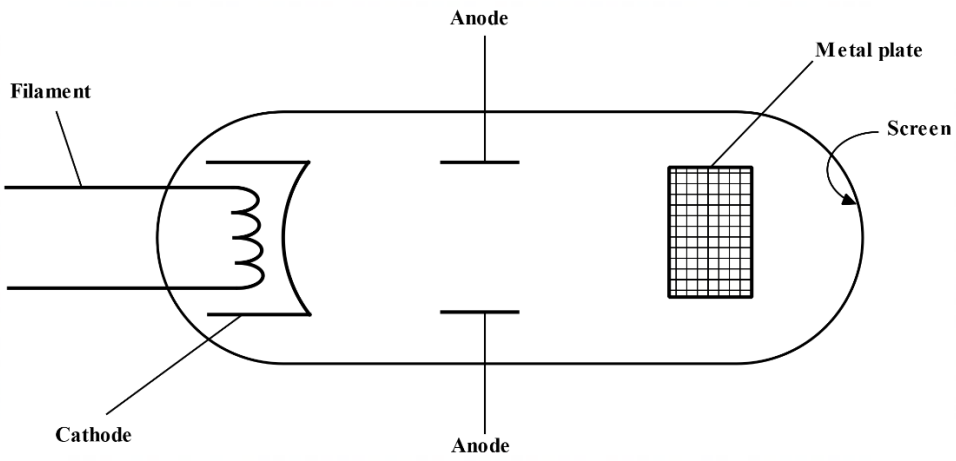
Expected response

$$\frac{V_p}{V_s} = \frac{I_s}{I_p}$$

$$\frac{11kV}{160kV} = \frac{I_s}{1A}$$

$$I_s = 0.6875A$$

18 **a) Figure 14** shows a cathode ray tube. A metal plate is placed between the



anode and the screen.

Figure 14

(i) State with a reason what would be observed on the screen when the cathode rays are produced. **(2 marks)**

Expected response

- **A rectangular shadow of the metal plate. Cathode rays travel in a straight line, hence they will be blocked by the metal plate casting a shadow on the screen.**

(ii) State the effect on the cathode rays produced when the anode potential is increased. **(1 mark)**

Expected response

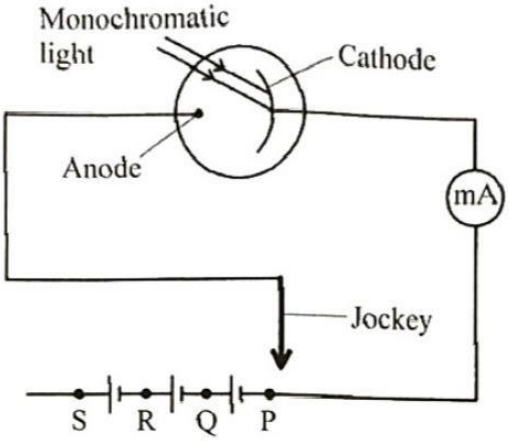
- **Their quality is increased / Their kinetic energy is increased.**

b) Explain how X-rays produce photographs of fractures in bones. **(2 marks)**

Expected response

- **X-rays penetrate matter but are stopped by the bones which form images on a photographic paper which they affect.**

c) **Figure 15** shows monochromatic light incident on the cathode of a photocell connected to points P, Q, R and S through a jockey.



State what will be observed when the jockey is:

(i) connected to point P. **(1 mark)**

Expected response

- **Since there is no external cell, current produced will be minimal, hence milliammeter records slight reading.**

(ii) connected to point P to Q to R and then to S. **(1 mark)**

Expected response

- **The milliammeter reading will keep increasing.**

	d) Explain the answer in (c)(ii). **(2 marks)** • **The cells are connected in a way that they attract the electrons emitted from the cathode of the photocell. So as the jockey is moved to Q, R to S, the milliammeter readings keep increasing.** **e)** State how radioactivity may be used to detect oil leakage in and underground pipeline. **(2 marks)** ***Expected response*** • **The oil is mixed with radioactive element such as Uranium and pumped into the pipeline. A radioactive detector is then moved along the pipeline. In case it detects the radiations emitted, that is the point of leakage.**	

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