SECTION A (25 marks)

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

1 State the reason why when a ray of light strikes a mirror at 90^0, the reflected ray travels along the same path as the incident ray. (1 mark)

2 Explain why the image formed in a pin hole camera gets blurred when the hole is enlarged. (2 marks)

3 State the reason why the magnetic field strength of a magnet is greatest at the poles. (1 mark)

4 **Figure 1** shows a 2 V cell connected in series with a resistor R and a switch S. Voltmeters V_2 and V_1 are connected across the cell and the resistor respectively.

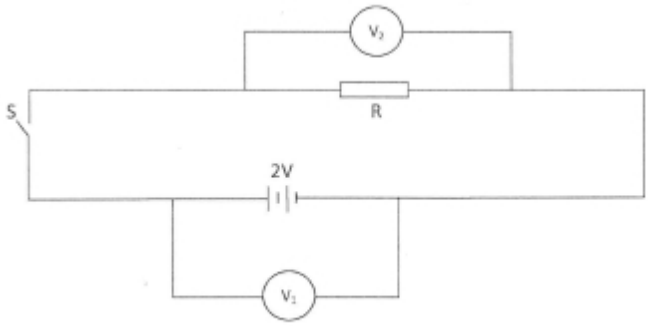

Figure 1

(a) State the reading of V_1 with S open. (1 mark)

(b) With S closed, V_1 reads 1.6 V. State the reading of V_2. (1 mark)

5 **Figure 2** shows the image of an object formed by reflection in a converging mirror. C is the centre of curvature of the mirror.

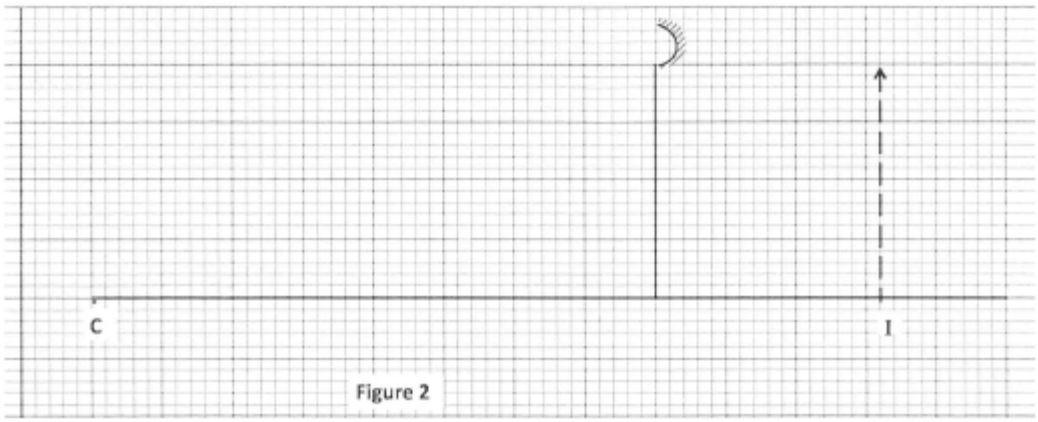

Figure 2

Complete the diagram to show:

(a) how incident rays are reflected to form the image; (2 marks)

(b) the object position. (1 mark)

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

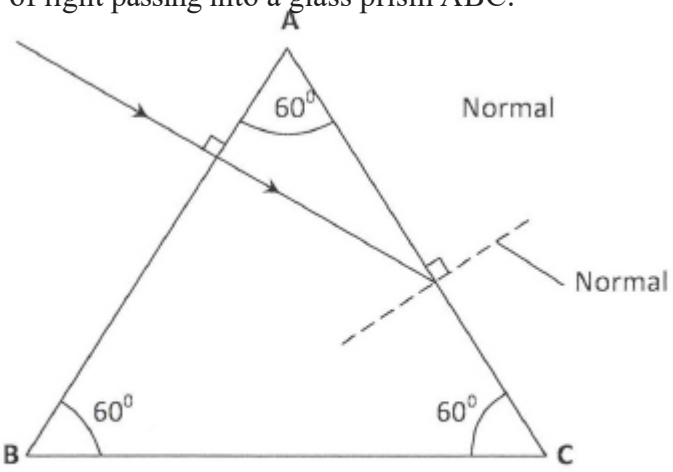

Figure 3

Sketch the path of the ray as it travels from face **AC**. *(critical angle for glass is 42°)*

(2 marks)

7 The equation below represents a nuclear reaction in which two deuterium nuclei fuse to form Helium and X.

$$^{2}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{2}He + ^{a}_{b}X.$$

(a) Determine the values of a and b. (1 mark)

(b) Identify X. (1 mark)

8 **Figure 4** shows a simple transformer connected to a 12 V a.c. source and an a.c. voltmeter.

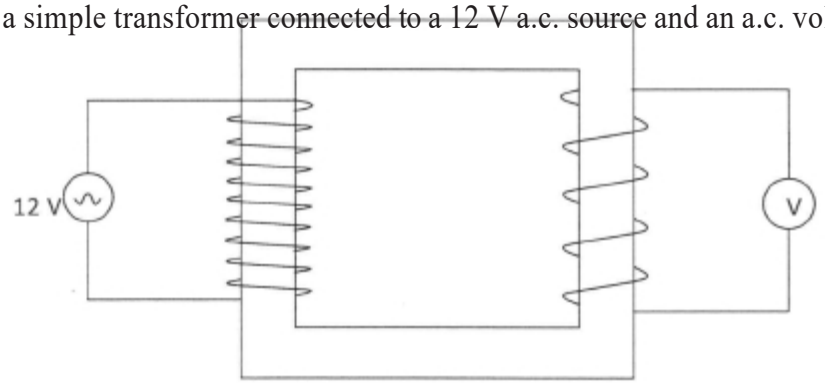

Figure 4

By counting the number of turns in each coil, determine the reading on the voltmeter.

(3 marks)

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

10 **Figure 5** shows a narrow beam of x-rays passing between two metal plates in air. The plates are connected in series with a switch, a cell and a milliameter.

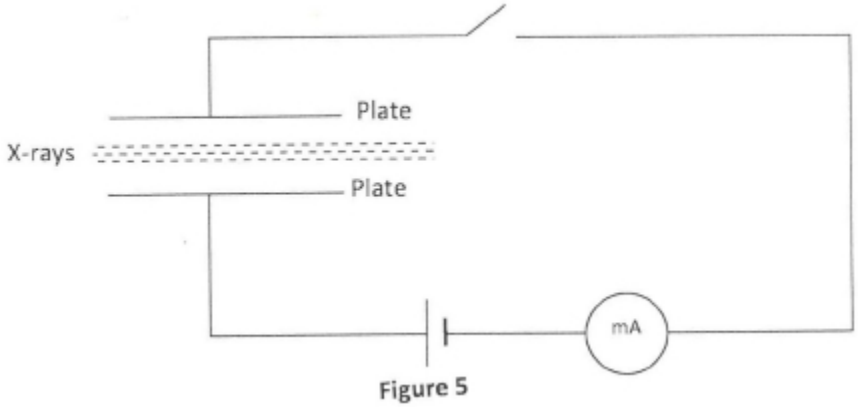

Figure 5

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

11 Explain the fact that radiant heat from the sun penetrates a glass sheet while radiant heat from burning wood is cut off by the glass sheet. (2 marks)

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

13 When a germanium crystal is doped with arsenic, it becomes an N-type semiconductor. Explain how this change occurs. (2 marks)
(Number of electrons in the outermost shell for germanium = 4, Arsenic = 5)

SECTION B (55 marks)

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

14 **Figure 6** shows two convex lenses A and B used to produce a magnified virtual image of an object.

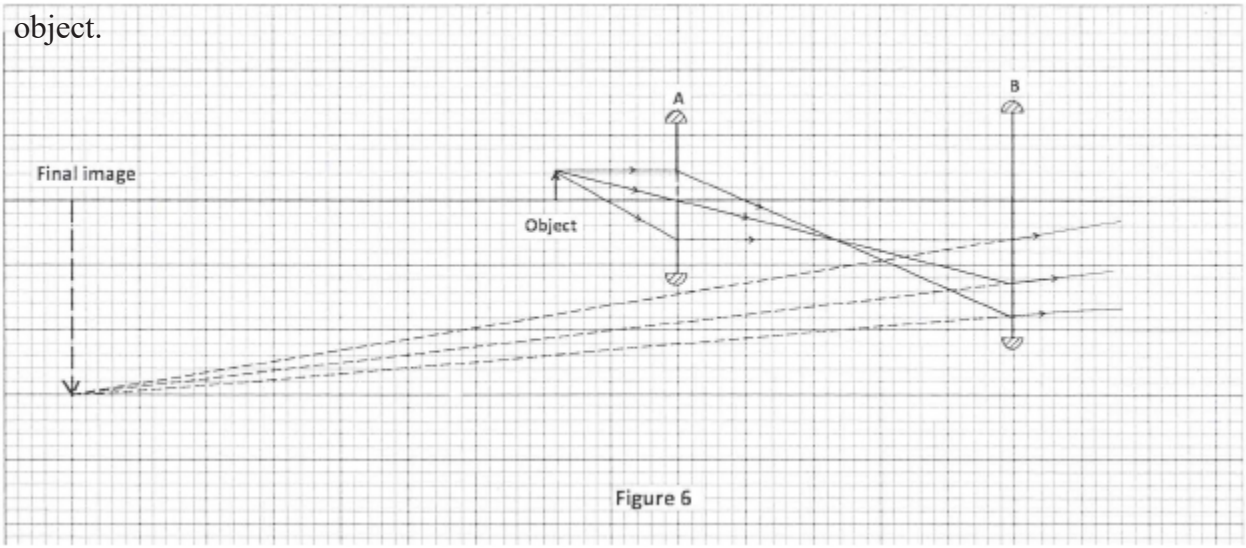

Figure 6

(a) Determine the focal length of lens A. *(Take 1unit to represent 10cm).* (1 mark)

(b) State the function of:

(i) lens A (1 mark)

(ii) lens B (1 mark)

(c) State how the functions in (b) are achieved by:

(i) lens A (1 mark)

(ii) lens B (1 mark)

(d) Determine the magnification produced by:

(i) lens A; (2 marks)

(ii) the whole system. (2 marks)

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

(b) **Figure 7** shows capacitors **A** and **B** connected in series with a battery of e.m.f 4 V.

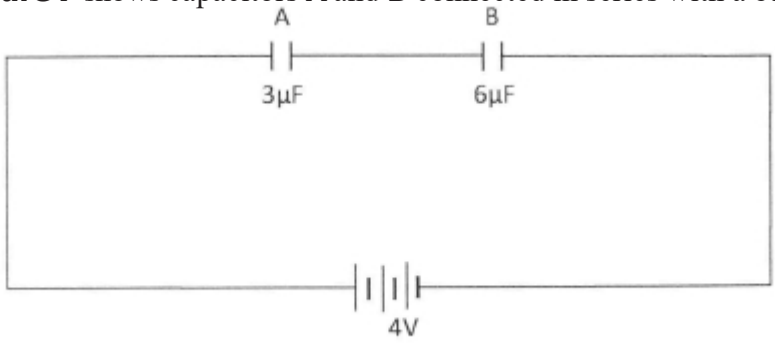

Figure 7

Determine:

(i) the effective capacitance of the circuit. (3 marks)

(ii) the quantity of charge in capacitor **A**. (3 marks)

(iii) the quantity of charge in capacitor **B**. (1 mark)

(c) **Figure 8** shows an isolated negative point charge **Q**.

Figure 8

On the figure, sketch the electric field pattern around the charge. (2 marks)

16 (a) Two points **A** and **B** have a potential difference of **V** volts. **Q** coulombs of charge flow between **A** and **B** in **t** seconds. Determine:

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

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

(iii) show that the power transformed is given by P = IV. (2 marks)

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

17 (a) **Figure 9** shows a cathode ray tube in which a beam of electrons is cast on the screen.

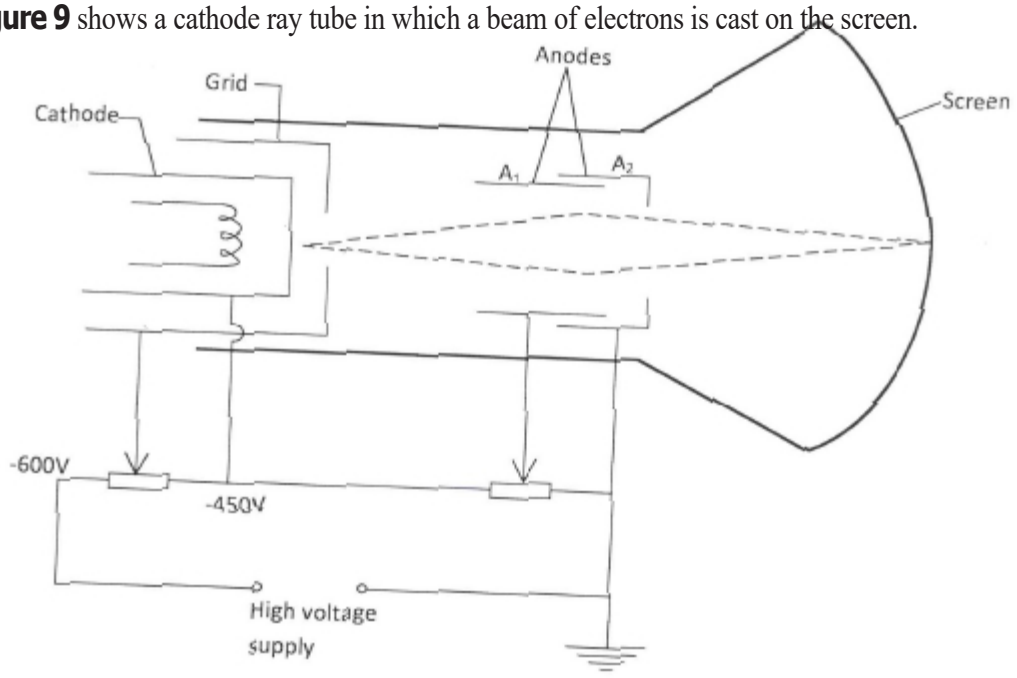

Figure 9

(i) state how the electrons are produced in the tube. (1 mark)

(ii) state how the electron beam is detected. (1 mark)

(iii) State the reason for having a variable potential difference (p.d.) at the:

(I) grid; (1 mark)

(II) anodes. (1 mark)

(b) **Figure 10** shows the waveform of a signal applied at the y-plates of an oscilloscope whose time-base is switched to the scale of 2 milliseconds per centimeter.

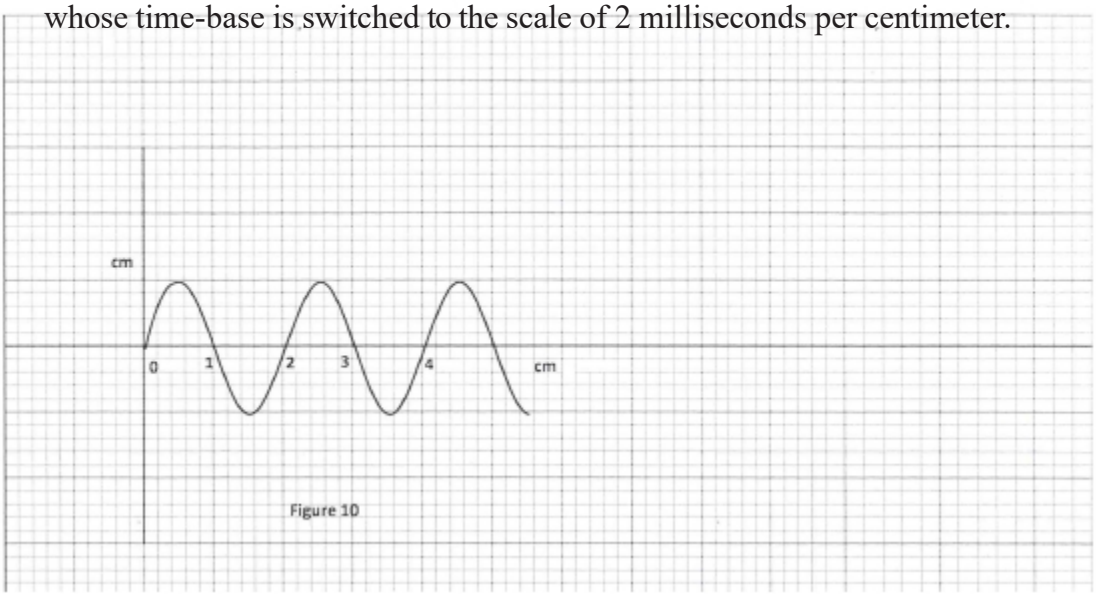

Figure 10

Determine:

(i) the period of the signal; (2 marks)

(ii) the frequency of the signal. (3 marks)

18 (a) **Figure 11** shows plane light waves in air incident on a convex lens whose principal focus is **F**, the waves move past point **G**.

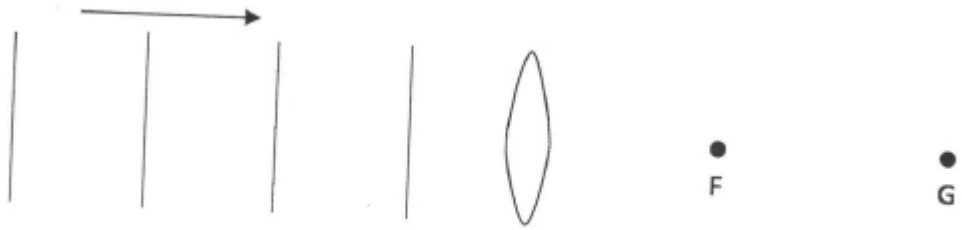

Figure 11

Complete the diagram to show the pattern of the emergent waves between the lens and point **G**. (2 marks)

(b) **Figure 12** shows crests of circular water waves spreading from two points **A** and **B** due to a vibrator. **C** and **D** are points on the surface of the water.

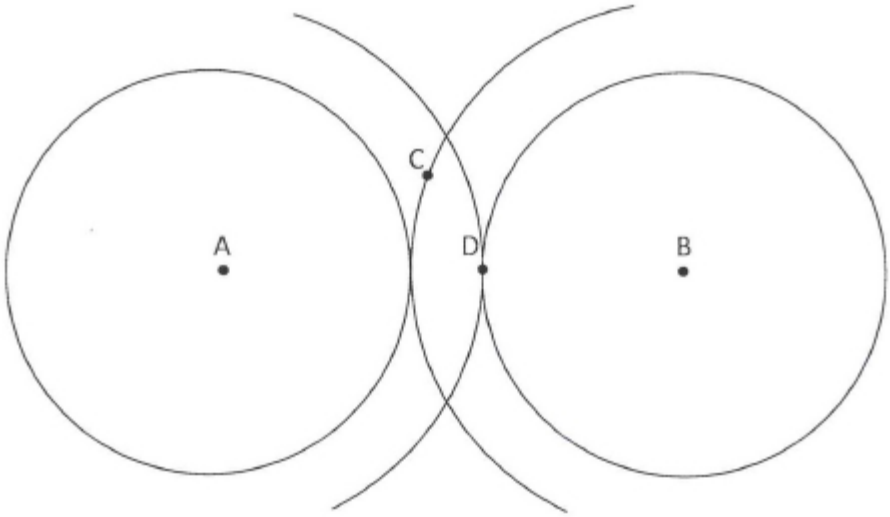

Figure 12

Given that the amplitude of each wave is 5 cm, state with a reason the amplitudes of the waves at point:

(i) **C**; (2 marks)

(ii) **D**. (2 marks)

(c) **Figure 13** shows a standing wave formed when a string of length 1.5 m stretched between two supports is plucked in the middle.

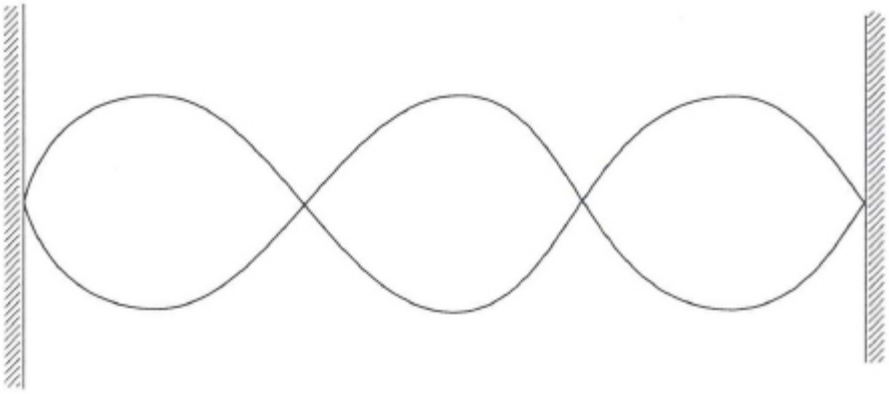

Figure 13

(i) Explain how the standing wave is formed. (3 marks)

(ii) Determine the wavelength of the standing wave. (1 mark)

19 (a) **Figure 14** shows an E shaped steel block being magnetised by a current through two coils in series.

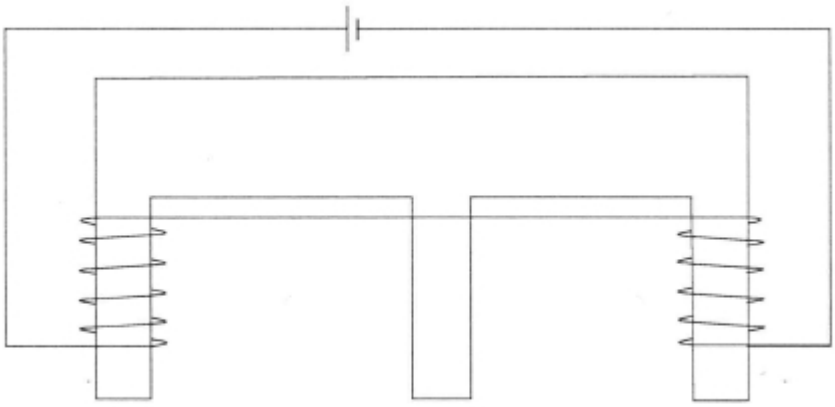

Figure 14

On the figure, indicate

(i) the north and south poles of the resulting magnet (1 mark)

(ii) the complete magnetic field pattern between the poles. (1 mark)

(b) **Figure 15** shows the permanent magnet made in part (a) above.

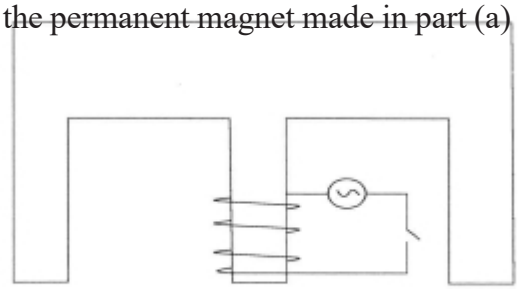

Figure 15

A coil wound loosely on the middle limb is connected in series with a low voltage a.c. and a switch. State and explain the observation made on the coil when the switch is closed. (2 marks)

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

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

(ii) Explain how:

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

(II) Copper gets positively charged (1 mark)

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