SECTION A

Answer ALL the questions in this section.

1. **Figure 1.** represents a pinhole camera


Pin hole camera

Figure 1.
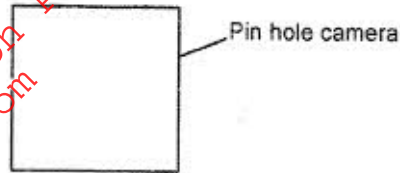
Sketch rays to show the formation of an enlarged image in the camera. Label both the object and the image. (2 marks)

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

3. **Figure 2.** shows a horse-shoe magnet whose poles are labelled and two other magnets near it. Iron nails are attracted to the lower ends of the magnets as shown.

Horse-shoe magnet

Figure 2.

Nail — Nail

Nails
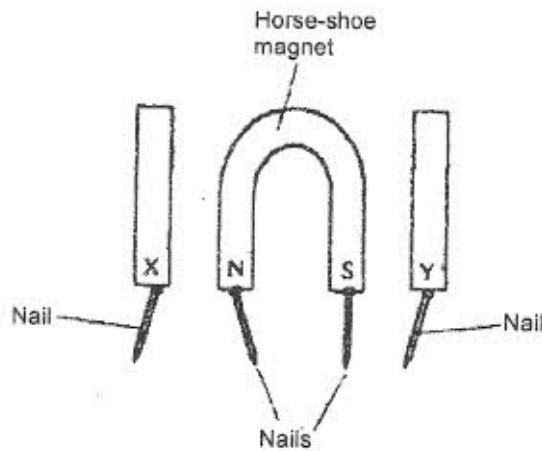
Identify the poles marked X and Y (1 mark)

X_____   Y_____

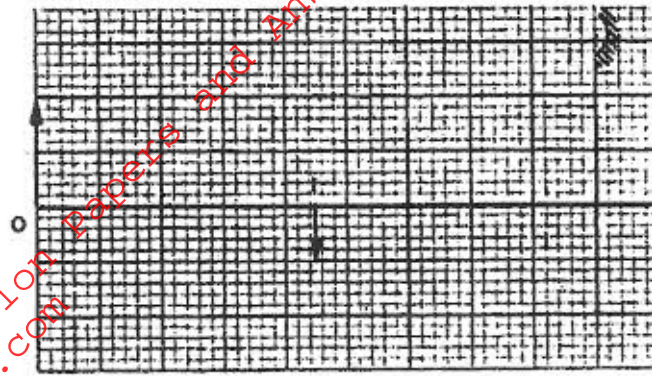4. Figure 3. shows an object, O, in front of a concave mirror and its image, 1, formed after reflection

Figure 3

(a) On the same diagram draw appropriate ray(s) to locate the principal focus, F, of the mirror. (2 marks)

(b) Determine the focal length of the mirror (scale 1:5) (1 mark)

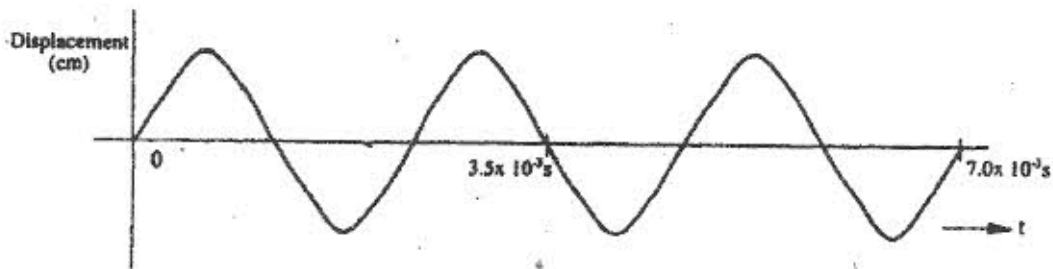5. **Figure 4.** shows the displacement-time graph for a certain wave

Figure 4

Determine the frequency of the wave. (3 marks)

6. **Figure 5. (a) and (b)**, show wave fronts incident on barriers blocking part of the path.

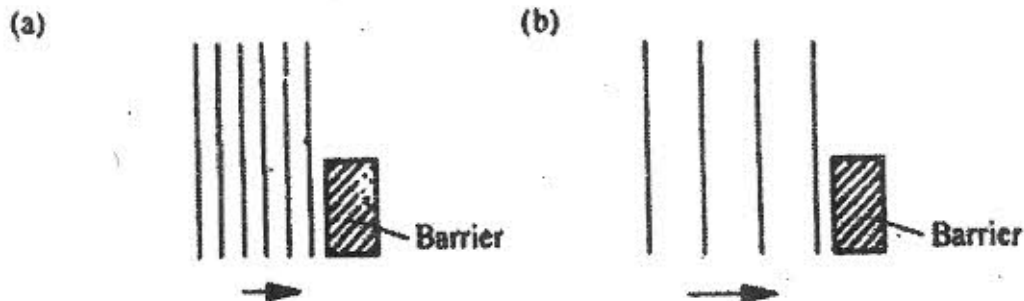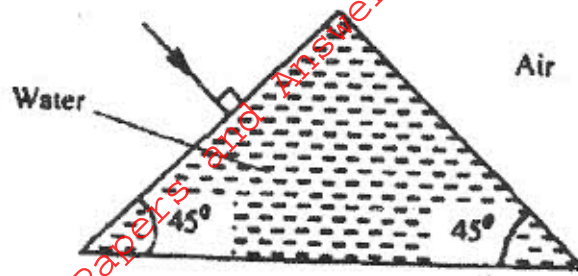(a)   (b)

Figure 5

On the same figures sketch the wavefronts to show the behaviour of the waves as they pass each barrier and after passing the barrier (1 mark)

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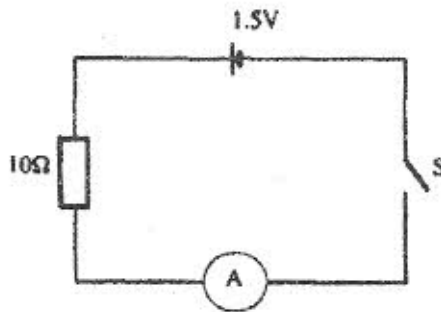

Figure 6

Sketch the path of the ray as it passes through the prism
Critical angle for water is 49° (1 mark)

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

Figure 7

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

9. A heater of resistance R_1 is rated P watts, V volts while another of resistance R_2 is rated 2P watts, $V/2$ volts. Determine R_1/R_2 (3 marks)

10. State what is meant by the term accommodation as applied to the human eye (1 mark)

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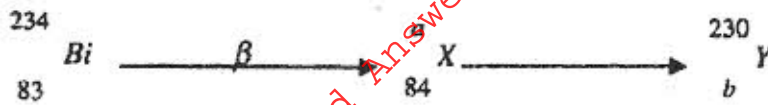

Figure 8.
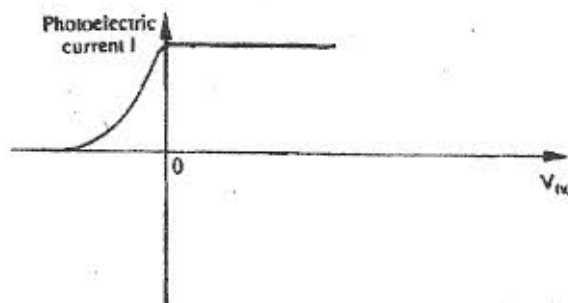
11. On the same axes, sketch the graph when light of higher intensity but same frequency is used to illuminate the surface. (1 mark)

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

13. The following is part of a radioactive decay series.

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

Determine the values of a and b (2 marks)

a = _____   b = _____

14. You are provided with a diode, a resistor R an a.c soure of low voltage and connecting wires.

In the space provided, sketch the circuit diagram for a half-wave rectifier and indicate the terminals where the output voltage Vo may be connected (2 marks)

SECTION B

Answer ALL the questions in this section.

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

(b) The graph in **Figure 9.** shows the current-voltage characteristic of a certain device, X.
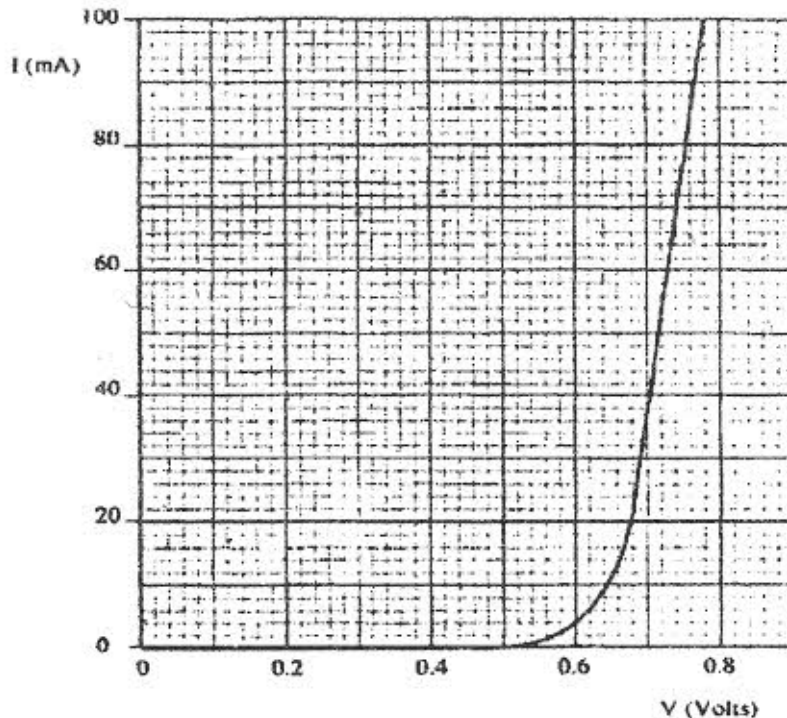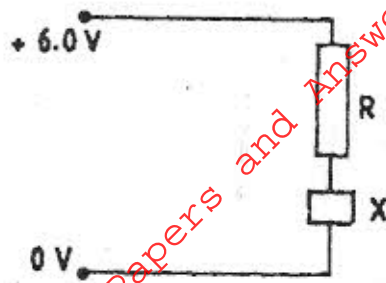

Figure 9.

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

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

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

Calculate the value of the resistance R. (3 marks)

(c) The cell in **Figure 10**. has an emf of 2. 1V and negligible internal resistance
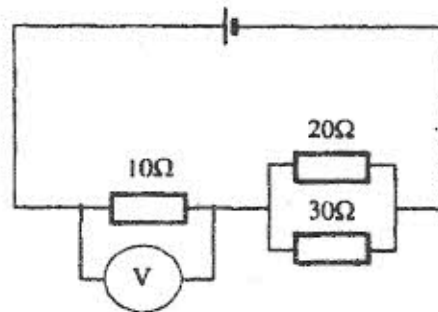

Figure 10

Determine the
(i) Total resistance in the circuit (2 marks)
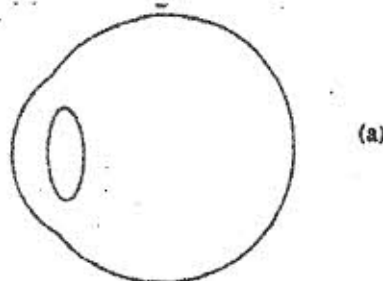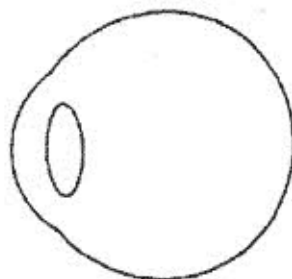
(ii) Current in the circuit (1 mark)

(iii) Reading on the volmeter (2 marks)

16. (a) **Figure 11 (a) and (b)** show diagrams of the human eye.
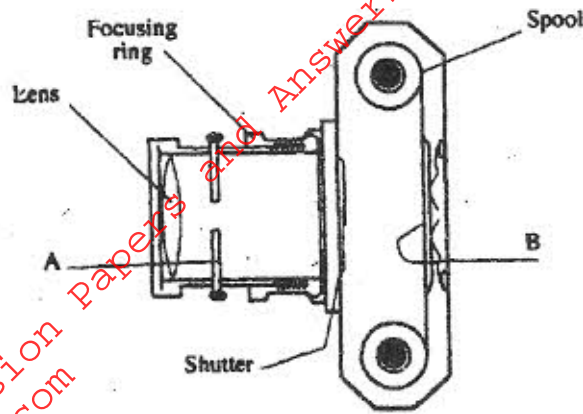

(a)

Figure 11

(b)

(i) Sketch in Figure 11 (a) a ray diagram to show shortsightedness (1 mark)

(ii) Sketch in Figure 11 (b) a ray diagram to show how a lens can be used to correct the shortsightedness. (2 marks)

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(b) **Figure 12.** shows the features of a simple camera

Figure 12

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

(ii) A still object is placed at a certain distance from the camera. Explain the adjustments necessary for a clear image of the object to be formed.   (2 marks)

(iii) State the functions of the shutter and the parts labelled A and B   (3 marks)

Shutter _____

(c) A lens forms a clear image on a screen when the distance between the screen and the object is 80cm. If the image is 3 times the height of the object, determine:

(i) The distance of the image from the lens   (3 marks)

17. (a) State Lenz's Law of electromagnetic induction   (1 mark)

(b) **Figure 13.** shows a simple microphone in which sound waves from the person talking cause the cardboard diaphragm to vibrate.
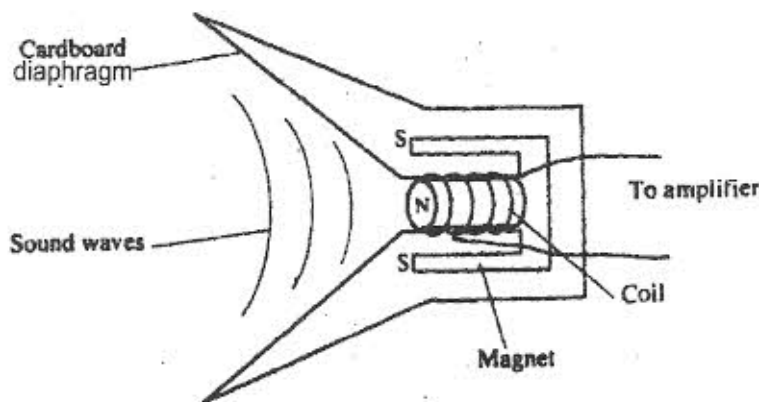
Figure 13

(i) Explain how a varying current is induced in the coil when the diaphragm vibrates   (3 marks)

(ii) State two ways in which the induced current in (i) above can be increased.   (2 marks)

(c) A transformer with 1200 turns in the primary circuit and 120 turns in the secondary circuit has its primary circuit connected to a 400V a.c source. It is found that when a heater is connected to the secondary circuit it produces heat at the rate of 600w. Assuming 100% efficiency, determine the:

    (i)   Voltage in the secondary circuit;   (2 marks)

    (ii) Current in the primary circuit;   (2 marks)

    (iii) The current in the secondary circuit;   (1 mark)
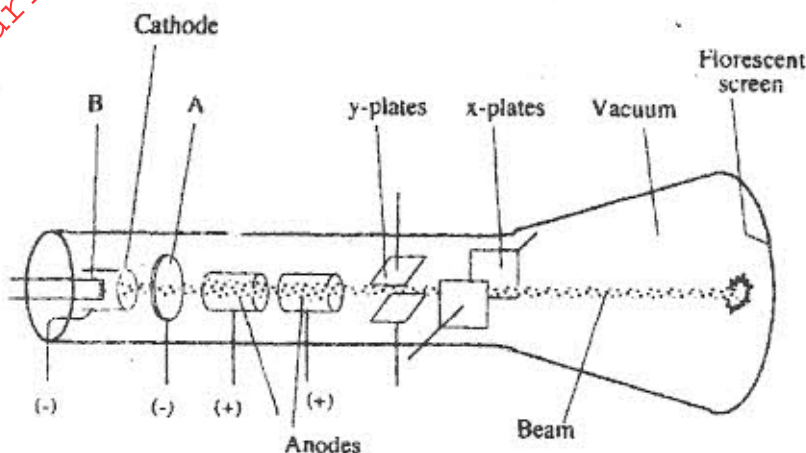
18.   (a) Figure 14 shows the features of a cathode ray tube.

Figure 14.

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

    A _____   B_____

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

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

    (iv) At what part of the cathode ray tube would the time base be connected?

                                                                                (1 mark)

    (v) Why is a vacuum created in the tube?   (1 mark)

(b) The graph in Figure 15. was obtained on a **Cathode Ray Oscilloscope** (CRO) screen when the output of an a.c generator was connected to the input of the CRO. The time-base calibration of the CRO was set at 20 milliseconds per centimetre and the y-gain at 5 volts per centimetre.
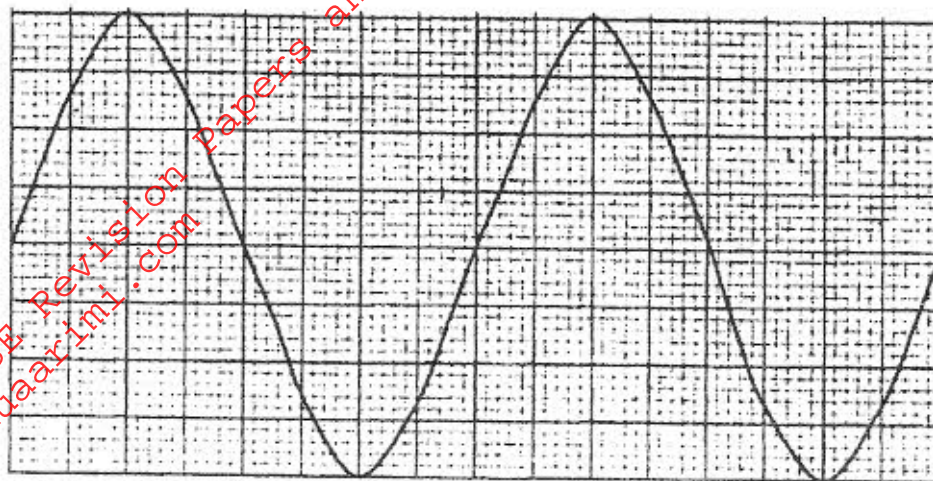
(i) Determine the pick voltage of the generator   (2 marks)

(ii) Determine the frequency of the voltage   (3 marks)

(iii) On the same grid, redraw the graph for the same voltage when the time base calibration is set at 40 milliseconds per centimetre and the y-gain at 10 volts per centimetre. (Show at least one complete cycle)   (2 marks)