

Name of the Student: \_\_\_\_\_

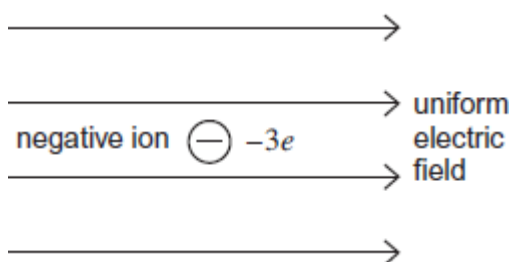
Max. Marks : 22 Marks

Time : 22 Minutes

**Q1.**

- (a) **Figure 1** shows a negative ion which has a charge of  $-3e$  and is free to move in a uniform electric field. When the ion is accelerated by the field through a distance of 63 mm parallel to the field lines its kinetic energy increases by  $4.0 \times 10^{-16}$  J.

**Figure 1**



- (i) State and explain the direction of the electrostatic force on the ion.

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\_\_\_\_\_

(2)

- (ii) Calculate the magnitude of the electrostatic force acting on the ion.

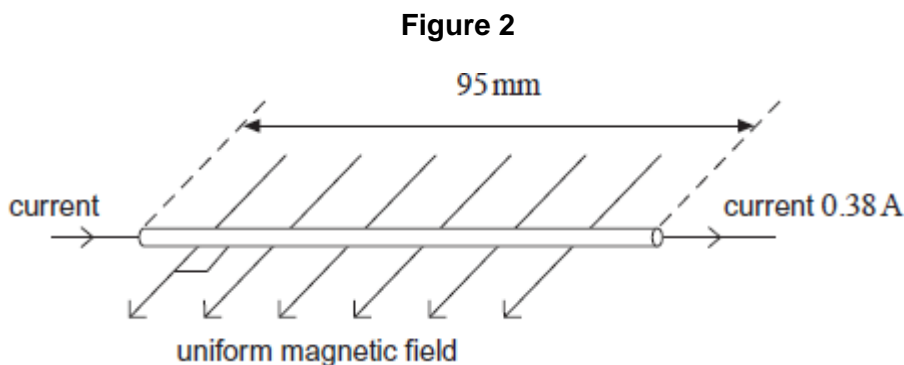
magnitude of electrostatic force \_\_\_\_\_ N

(2)

- (iii) Calculate the electric field strength.

electric field strength \_\_\_\_\_  $\text{NC}^{-1}$

- (b) **Figure 2** shows a section of a horizontal copper wire carrying a current of 0.38 A. A horizontal uniform magnetic field of flux density  $B$  is applied at right angles to the wire in the direction shown in the figure.



- (i) State the direction of the magnetic force that acts on the moving electrons in the wire as a consequence of the current and explain how you arrive at your answer.

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(2)

- (ii) Copper contains  $8.4 \times 10^{28}$  free electrons per cubic metre. The section of wire in **Figure 2** is 95 mm long and its cross-sectional area is  $5.1 \times 10^{-6} \text{ m}^2$ . Show that there are about  $4 \times 10^{22}$  free electrons in this section of wire.

(1)

- (iii) With a current of 0.38 A, the average velocity of an electron in the wire is  $5.5 \times 10^{-6} \text{ m s}^{-1}$  and the average magnetic force on one electron is  $1.4 \times 10^{-25} \text{ N}$ . Calculate the flux density  $B$  of the magnetic field.

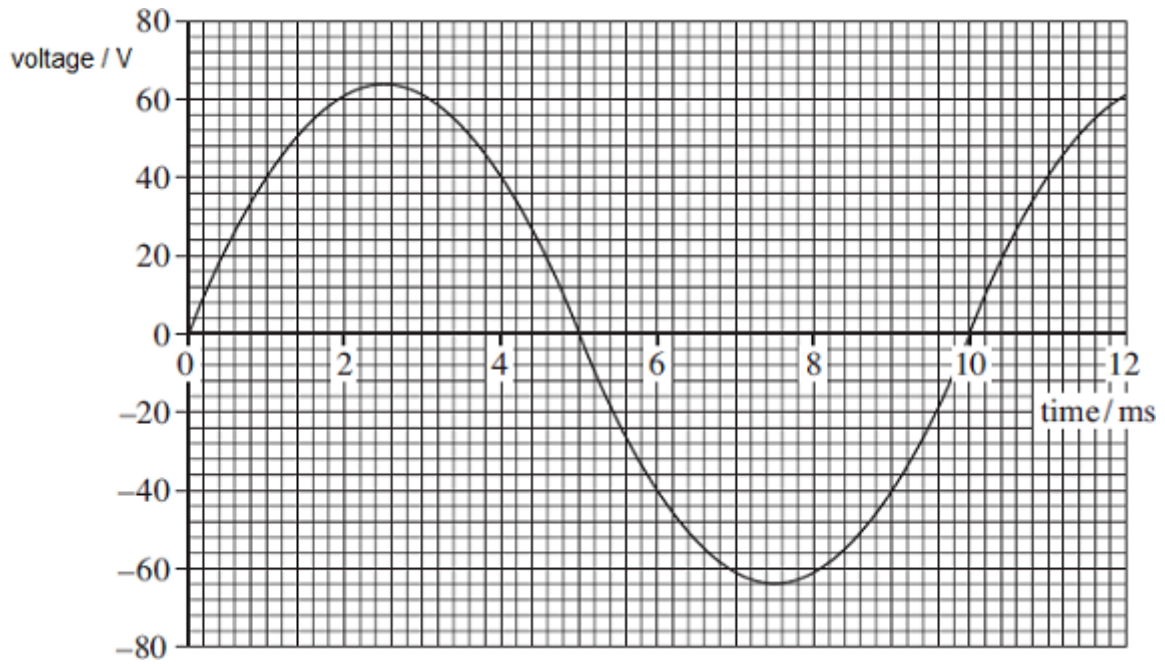
flux density \_\_\_\_\_ T

(2)

(Total 10 marks)

**Q2.**

The graph below shows how a sinusoidal alternating voltage varies with time when connected across a resistor, R.



(a) (i) State the peak-to-peak voltage.

peak-to-peak voltage \_\_\_\_\_ V (1)

(ii) State the peak voltage.

peak voltage \_\_\_\_\_ V (1)

(iii) Calculate the root mean square (rms) value of the alternating voltage.

rms voltage \_\_\_\_\_ V (2)

(iv) Calculate the frequency of the alternating voltage. State an appropriate unit.

frequency \_\_\_\_\_ unit \_\_\_\_\_ (3)

(b) On the graph above draw a line to show the dc voltage that gives the same rate of energy dissipation in R as produced by the alternating waveform.

- (c) An oscilloscope has a screen of eight vertical and ten horizontal divisions. Describe how you would use the oscilloscope to display the alternating waveform in the graph above so that two complete cycles are visible.

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(3)  
(Total 12 marks)