4 **(a)** Fig. 4.1 shows a section through a loudspeaker.

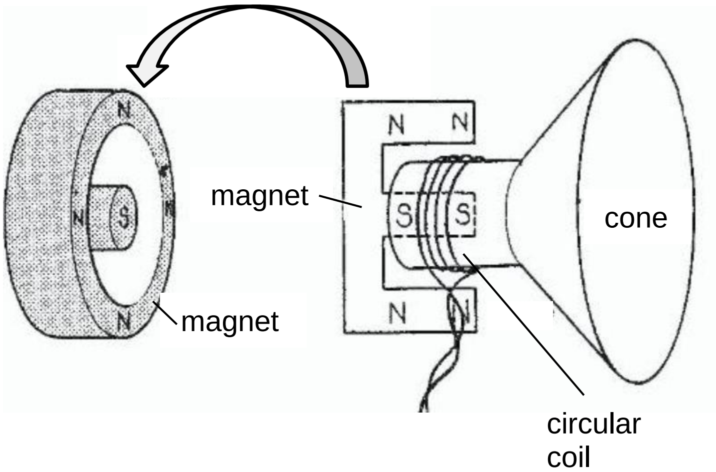

Fig. 4.1

The circular coil is free to move left and right in the space between the North and South poles of the magnet. The magnet is curved. The coil is connected to a d.c. supply of e.m.f. 1.5 V and of negligible internal resistance.

(i) The length of the wire in the coil is 24 m and its resistance is 8.0 Ω. The magnetic flux density of the magnetic field at the position of the coil is 1.2×10^{-2} T. Calculate the force experienced by the wire in the coil due to the radial magnetic field.

force = ……………… N [2]

(ii) Wire of the same length and material but half the diameter of the original wire is used to make a similar coil. State and explain the change to your answer in **(i)** when this coil is used in place of the original one.

…..

....

....

.... [2]

(b) Fig. 4.2 shows a horizontal copper wire placed between the opposite poles of a permanent magnet. The wire is in a state of tension and is clamped at each end. The length of the wire in the field of flux density 0.032 T is 6.0 cm.

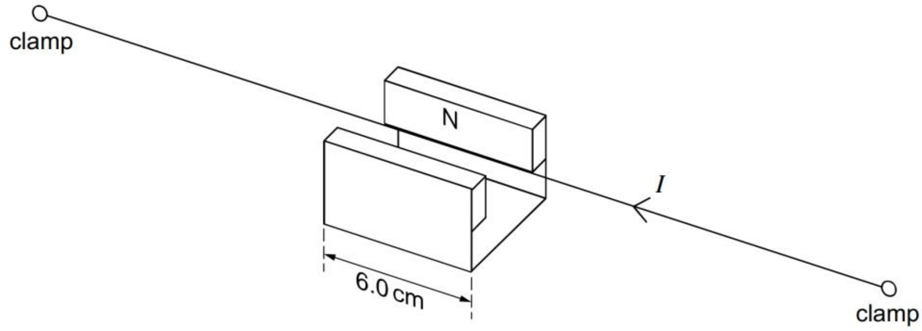

Fig. 4.2

(i) A direct current I is passed through the wire. On Fig. 4.2 draw and label an arrow **F** to indicate the direction of the force on the wire. [1]

(ii) The direct current is changed to an alternating current of constant amplitude and variable frequency, causing the wire to oscillate. Fig. 4.3 shows how the acceleration of the wire at the centre point between the poles varies with time when the frequency of the current is at the fundamental frequency of the wire.

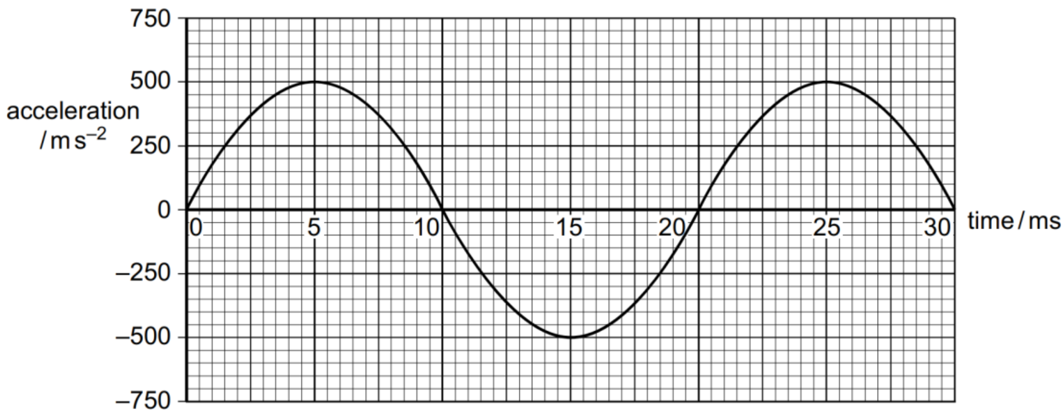

Fig. 4.3

The distance between the clamps is 75 cm. Calculate the speed of the wave in the wire.

speed = …………... m s^{-1} [2]

(iii) Explain whether the maximum acceleration of all points on the wire between the clamps is the same or not. A sketch may help your answer.

....

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.... [3]