6 **(a)** A straight conductor carrying a current I is at an angle θ to a uniform magnetic field of flux density B, as shown in Fig. 6.1.

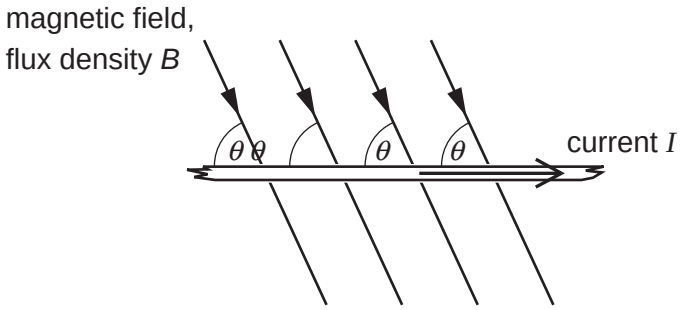

Fig. 6.1

The conductor and the magnetic field are both in the plane of the paper. State

(i) an expression for the force per unit length acting on the conductor due to the magnetic field,

force per unit length =.....[1]

(ii) the direction of the force on the conductor.

.....[1]

(b) A coil of wire consisting of two loops is suspended from a fixed point as shown in Fig. 6.2.

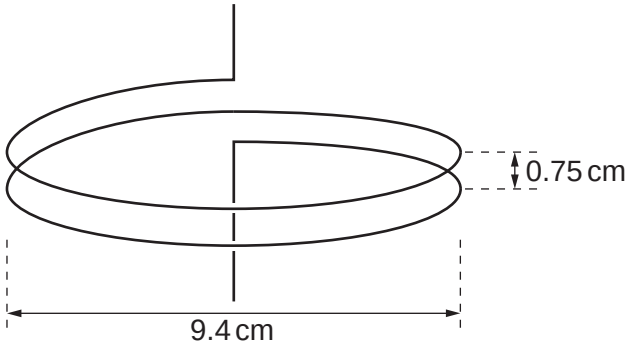

Fig. 6.2

Each loop of wire has diameter 9.4 cm and the separation of the loops is 0.75 cm.
The coil is connected into a circuit such that the lower end of the coil is free to move.

(i) Explain why, when a current is switched on in the coil, the separation of the loops of the coil decreases.

.....

.....

.....

.....

.....[4]

(ii) Each loop of the coil may be considered as being a long straight wire.
In SI units, the magnetic flux density B at a distance x from a long straight wire carrying a current I is given by the expression

$$B = 2.0 \times 10^{-7} \frac{I}{x}.$$

When the current in the coil is switched on, a mass of 0.26 g is hung from the free end of the coil in order to return the loops of the coil to their original separation.
Calculate the current in the coil.

current = ...A [4]