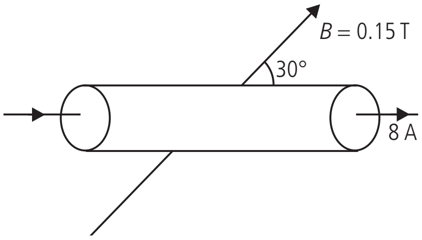
CHAPTER 4

Moving Charges and Magnetism

NCERT FOCUS ANSWERS

Topic 1

1.



Let l be length of wire, carrying a current of 8 A at an angle 30° with the magnetic field.

Force on the wire, $F = iBl\sin\theta$

Force per unit length $F/l = iB\sin\theta$

$F/l = 8 \times 0.15 \times \sin 30° = 0.6\ \text{N m}^{-1}$.

2. The magnetic force $f = qvB$ act normal to the direction of motion, thus provide the necessary centripetal force to follow the circular path.

$$qvB = \frac{mv^2}{r}$$

$$r = \frac{mv}{qB} = \frac{9.1\times10^{-31}\times4.8\times10^{6}}{1.5\times10^{-19}\times6.5\times10^{-4}}$$

or $\quad r = 4.48 \times 10^{-2} = 45$ mm

3. Time period can be calculated.

$$T = \frac{2\pi r}{v} = \frac{2\pi m}{Bq}$$

So, frequency

$$f = \frac{1}{T} = \frac{Bq}{2\pi m} \text{ or } f = \frac{6.5\times10^{-4}\times1.6\times10^{-19}}{2\pi\times9.1\times10^{-31}}$$

$f = 18.2 \times 10^6$ Hz = 18.2 MHz.

The frequency of revolution of electron is independent of speed of electron.

4. The magnetic field inside the solenoid is along its axis. Here the current in the wire flows perpendicular to the axis.

$F = iBl\sin 90°$

or $\quad F = 10 \times 0.27 \times 3 \times 10^{-2} \times 1 = 0.081$ N

Topic 2

1. The magnetic field at the centre of a circular coil having 100 turns.

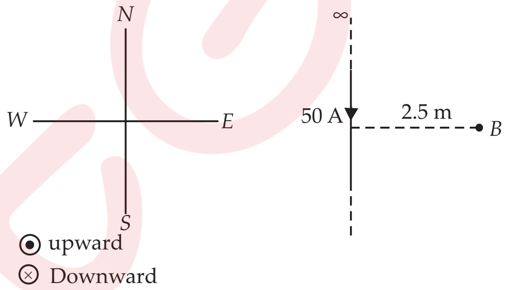
$$B = \left(\frac{\mu_0 I}{2r}\right)N \text{ or } B = \left[\frac{4\pi\times10^{-7}\times0.4}{2\times8\times10^{-2}}\right]\times100$$

$B = 3.14 \times 10^{-4}$ T

2. Magnetic field due to a long straight wire

$$B = \frac{\mu_0}{4\pi}\frac{2I}{r} \quad\text{or}\quad B = 10^{-7}\times\frac{2\times35}{20\times10^{-2}} = 3.5\times10^{-5}\ \text{T}$$

3. Let us first decide the standard directions on the plane of paper.



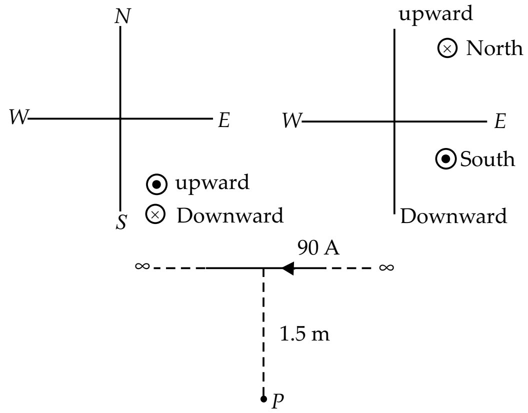
Magnitude of magnetic field

$$|\vec{B}| = \frac{\mu_0}{4\pi}\frac{2I}{r} = 10^{-7}\times\frac{2\times50}{2.5} = 40\times10^{-7}\ \text{T}$$

By right hand palm rule, the direction of magnetic field can be seen as upward.

$$\vec{B} = 40\times10^{-7}\hat{k}\ \text{T}$$

4. The standard directions on the plane of paper can be different according to requirements.



The magnitude of magnetic field,

$$B = \frac{\mu_0}{4\pi}\frac{2I}{r} = 10^{-7}\times\frac{2\times90}{1.5} = 120\times10^{-7}\ \text{T}$$

Direction of magnetic field can be observed by right hand palm rule and it is southward.

Topic 3

1. Total number of turns in 80 cm length of solenoid can be calculated

$N = 5 \times 400 = 2000$ turns.

$$n = \frac{\text{number of turns}}{\text{length}}$$

$$\frac{2000}{80 \times 10^{-2}} = 2500 \text{ turns/ m}$$

Magnetic field near centre of long solenoid, $B = \mu_0 nI$

$B = 4\pi \times 10–7 \times 2500 \times 8$ or $B = 8\pi \times 10–3$ T

2. Force of attraction per unit length on two parallel wires carrying current in same direction.

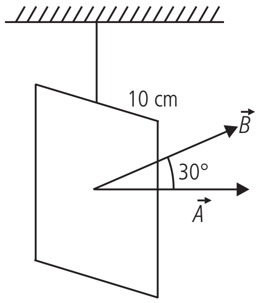
$$F/l = \frac{\mu_0}{4\pi}\frac{2I_1I_2}{r} = 10^{-7} \times \frac{2 \times 8 \times 5}{4 \times 10^{-2}} = 20 \times 10^{-5} \text{ N m}^{-1}$$

Attractive force on 10 cm section of wire A

$F = [20 \times 10^{-5}][10 \times 10^{-2}] = 2 \times 10^{-5}$ N

Topic 4

1.



Torque experienced by the coil carrying current in the given magnetic field.

$\tau = NIAB \sin\theta$

$\tau = 20 \times 12 \times [100 \times 10^{-4}] \times 0.8 \sin 30°$ or $\tau = 0.96$ N m.

2. Current sensitivity of a moving coil galvanometer is defined as

$$C.S. = \frac{\phi}{I} = \frac{NAB}{k} \text{ and voltage sensitivity, } V.S. = \frac{NAB}{k}$$

(i) Ratio of current sensitivity

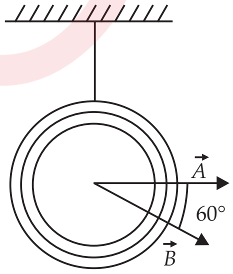
$$\frac{C \cdot S_2}{C \cdot S_1} = \frac{N_2B_2A_2k}{N_1B_1A_1k}$$

$$= \frac{42 \times 1.8 \times 0.5 \times 10^{-3} \times k}{30 \times 0.25 \times 03.6 \times 10^{-3} \times k} = 1.4$$

(ii) Ratio of voltage sensitivity

$$\frac{V \cdot S_2}{V \cdot S_1} = \frac{C \cdot S_2 \times R_1}{C \cdot S_1 \times R_2} = \frac{7}{5} \times \frac{10}{14} = 1$$

3. (a) The given coil is circular and is suspended such that field lines makes angle 60° with normal of the coil.



Torque on the coil, $\tau = NIBA \sin\theta$

$\tau = 30 \times 6 \times 1 \times \pi \times (8 \times 10^{-2})^2 \times \sin 60° = 3.13$ N m

A similar torque is required to prevent the coil from turning.

(b) As long as the area of the planar coil remains same, the torque on the coil is also same, irrespective of the shape.