NCERT CHAPTER - 5

Exercise

Q3 $\theta = 30°$ (Angle the axis of the magnet makes with the ext field ?

$B = 0.25T$ (Uniform external field)

$M = ??$

$\tau = 4.5 \times 10^{-2} J$

$\tau = BM \sin\theta$

$= 0.25 \times x \times \sin 30°$

$4.5 \times 10^{-2} = 0.25 \times \frac{1}{2} \times x$

$x = \frac{4.5 \times 10^{-2} \times 2}{0.25}$

$\underline{M = 0.36 J T^{-1}}$ (Am²)

4) $M = 0.32 J T^{-1}$

$B = 0.15T$

(a) stable → $\theta = 0°$ (Angle betn magnetic moment & magnetic field)

unstable → $\theta = 180°$) (Angle betn $\vec{M}$ & $\vec{B}$)

b) P.E. : In stable → $-MB\cos\theta$ $(\theta = 0°)$

$\underline{= -MB} = -0.32 \times 0.15 = -4.8 \times 10^{-2} J$

: Unstable → $-MB\cos\theta$ $(\theta = 180°) = +4.8 \times 10^{-2} J$

$= \underline{+MB}$

Q5 A current-carrying solenoid behaves as a bar magnet because a
ans magnetic field develops along its axis, i.e., along its length.

~~ans~~ $N = 800$ turns

$I = 3.0A$

$A = 2.5 \times 10^{-4} m^2$

$M = NIA$

$= 800 \times 3 \times 2.5 \times 10^{-4}$

$= 0.6JT^{-1}$

Q7 $M = 1.5JT^{-1}$

$B = 0.22T$

Initial Angle $(\theta_1) = 0^\circ$

} given in the Q

a) Work req ~~to rot~~ to turn the magnet so as to align its magnetic moment:

i) normal to the field direction

ans) $\theta_2 = 90^\circ$

Work: $-MB[\cos\theta_2 - \cos\theta_1]$

$= -MB[\cos 90^\circ - \cos 0]$

$= +MB$

$= 1.5 \times 0.22$

$= \underline{0.33J}$

ii) opposite to the electric field

$\theta_2 = 180^\circ$

Work : $-MB[\cos\theta_2 - \cos\theta_1]$

$= -MB[\cos 180° - \cos 0]$

$= +2MB$

$= 2 \times 0.33$

$= 0.66\,J$

(b) For case (i):

$\tau = MB\sin\theta$

$= MB\sin 90°$

$= 1.5 \times 0.22$

$= \underline{0.33\,J}$

For case (ii):

$\tau = MB\sin\theta$

$= 1.5 \times 0.22 \times \sin 180°$

$= \underline{0\,J}$

Q8 $N = 2000$ turns

$A = 1.6 \times 10^{-4}\,m^2$

$I = 4\,A$

a) Magnetic moment $(M) = NIA$

$= 2000 \times 1.6 \times 10^{-4} \times 4$

$128 \times 10^{2} \times 10^{-4}$

$= 128 \times 10^{-2}$

$= \underline{1.28\,Am^2}$

b) Uniform magnetic field:

Net force $= 0$

Net Torque = $m \times B \sin\theta$

$= 1.28 \times 7.5 \times 10^{-2} \times \sin 30$

$= 9.984 \times \frac{1}{2} \times 10^{-2}$

$= 4.8 \times 10^{-2}$ NM

9) $N = 16$

$R = 10 \times 10^{-2}$ M $\qquad A = \pi R^2 = \pi \times (0.1)^2$ M^2

$I = 0.75$ A

$B = 5.0 \times 10^{-2}$ T

frequency $(\nu) = 2.0 s^{-1}$

Magnetic moment $= NIA$

$= 16 \times 0.75 \times \pi \times (0.1)^2$

$= 0.3775T^{-1}$

Frequency:

$$\nu = \frac{1}{2\pi}\sqrt{\frac{MB}{I}}$$

$$I = \frac{MB}{4\pi^2 \nu^2}$$

$$= \frac{0.377 \times 5 \times 10^{-2}}{4\pi^2 \times (2)^2}$$

$= 1.19 \times 10^{-4}$ kg M^2

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11) B_H = ~~0.35 G~~ 0.16 G

Angle of dip = δ = 60°

Angle of declination, θ = 12°

$$B_H = B\cos\delta$$

$$B = \frac{B_H}{\cos\delta}$$

$$= \frac{0.16}{\cos 60^\circ} = \underline{0.32\,G}$$

The earth's Magnetic field lies in the vertical plane 12° west of the geographic meridian making an angle of 60° (upwards) with the horizontal direction.

13) $M = 0.36\,G$

$$B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2M}{d^3} = M$$

B_2 at the normal bisector = $\frac{B_1}{2} = \frac{\mu_0}{4\pi}\frac{M}{d^3} = \frac{M}{2}$

Total magnetic field = $B_1 + B_2$

$$= M + \frac{M}{2}$$

$$= 0.36 + 0.18$$

$$= \underline{0.54\,G}$$

18) $I = 2.5\,A$

$\delta = 0^\circ$

$B_H = B\cos\delta$

$= 0.33 \times 10^{-4} \times \cos 0^\circ$

$= 0.33 \times 10^{-4}\,T$

$B_H = \frac{\mu_0 I}{2\pi R}$ (Magnetic field at a distance R from a straight wire)

$R = \frac{\mu_0 I}{2\pi B_H}$

$= \frac{4\pi \times 10^{-7} \times 2.5}{2\pi \times 0.33 \times 10^{-4}} = 15.15 \times 10^{-3}\,m = \underline{1.51\,cm}$

Ans) Parallel to & above the cable at a distance of 1.5 cm.