L-5

Magnetism and Matter
Ncert Solution

5.3

$B = 0.25\,T$

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

$\theta = 30^\circ$

$T = MB\sin\theta$

$$M = \frac{T}{B\sin\theta}$$

$$= \frac{4.5 \times 10^{-2}}{0.25 \times \sin 30} = 0.36\,JT^{-1}$$

5.4

Moment of bar Magnet,

$M = 0.32\,JT^{-1}$

$B = 0.15\,T$

a) The bar magnet is aligned along the magnetic field. This system is considered as being in stable Equilibrium. Hence the angle θ between the bar magnet and magnetic field is 0°

P.E $= -MB\cos\theta$

$= -0.32 \times 0.15 \cos 180^\circ$

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

5.5

$n = 800$

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

$I = 3.0 A$

A current carrying solenoid behaves like a bar magnet because a magnetic field develops along its axis i.e along its length

$M = nIA$

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

$= 0.6\ J T^{-1}$

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$n = 2000$
$A = 1.6 \times 10^{-4}\ m^2$
$I = 4\ A$

a) $M = nAI$
$= 2000 \times 1.6 \times 10^{-4} \times 4$
$= 1.28\ Am^2$

b) $B = 7.5 \times 10^{-2}\ T$

$\theta = 30^\circ$

$\tau = MB\sin\theta$
$= 1.28 \times 7.5 \times 10^{-2} \sin 30$
$= 4.8 \times 10^{-2}\ Nm$

Since the magnetic field is uniform the force on the solenoid is zero. The torque on the solenoid is 4.8×10^{-2} N/m

5.9 $N = 16$

$r = 10\,cm = 0.1\,m$

$A = \pi r^2 = \pi \times (0.1)^2\,m^2$

$I = 0.75\,A$

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

$v = 2.0\,s^{-1}$

$M = NIA = NI\pi r^2$

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

$= 0.377\,J\,T^{-1}$

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

I = Moment of Inertia

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

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

5.11 Angle of declination $\theta = 12^0$
Angle of dip, $\delta = 60^0$
$B_H = 0.16 G$,

$B_H = B \cos\delta$

$B = \frac{B_H}{\cos\delta} = \frac{0.16}{\cos 60^0} = 0.32 G$

Earth's magnetic field lies in the vertical plane 12^0 west of the geographic meridian making an angle of 60^0 (upward) with the horizontal direction. Its magnitude is 0.32 G

5.18

5.13 $H = 0.36 G$

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

$B_2 = \frac{\mu_0 M}{4\pi d^3} = \frac{H}{2}$

$B = B_1 + B_2$

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

$= 0.36 + 0.18 = 0.54 G$

5.18 $I = 2.5 A$

$\delta = 0^{\circ}$

$H_H = H \cos \delta$

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

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

$\mu_0 = 4\pi \times 10^{-7}$

$R = \frac{\mu_0 I}{2\pi H_H} = \frac{4\pi \times 10^{-7} \times 2.5}{2\pi \times 0.33 \times 10^{-4}}$

$= 15.15 \times 10^{-3} m$

$= 1.51 cm$

Hence, a set of neutral points parallel to and above the cable are located at a normal distance of 1.51 cm