2019-221

Ch-5

5.3) $T = MB\sin\theta$

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

$= \frac{4.5\times10^{-2}}{0.25\times\sin30^\circ} = 0.36\ J\,T^{-1}$

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

$\therefore U = -MB\cos\theta$

$= -0.32\times0.15\cos0^\circ$

$= -4.8\times10^{-2}\ J$

b) $\theta = 180^\circ$, so it is unstable

$U = -MB\cos\theta$

$= 4.8\times10^{-2}\ J$

5.5) Magnetic field develops along the axis of the solenoid. Therefore current-carrying solenoid acts like a bar magnet.

$m = nIA = 800\times3\times2.5\times10^{-4}\ J\,T^{-1}$

$= 0.6\,T^{-1}\,J$ along the axis of the solenoid.

5.8) a) $M = nAI$

$= 2000\times1.6\times10^{-4}\times4 = 1.28\ A\,m^2$

b) $B = 7.5\times10^{-2}\ T$

$\tau = MB\sin\theta$

$= 1.28\times7.5\times10^{-2}\sin30^\circ$

$= 4.8\times10^{-2}\ Nm$

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

$= 16 \times 0.75 \times \pi \times (0.1)^2 = 0.377\ JT^{-1}$

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

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

$= \frac{0.377 \times 5 \times 10^{-2}}{4\pi^2 \times (2)^2} = 1.19 \times 10^{-4}\ kg\,m^2$

5.11) $\theta = 12^\circ$

$\delta = 60^\circ \qquad B_H = 0.16\ G$

$B_H = B\cos\delta$

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

Earth's magnetic field lies in the vertical plane 12° west of the geographic meridian, making angle 60° (upward) with horizontal

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

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

$\text{Total} = B_1 + B_2$

$= H + \frac{H}{2} \qquad = 0.36 + 0.18 = 0.54\ G$

5.18) $H_H = 0.33\ G \quad , \quad \delta = 0^\circ \quad , \quad I = 2.5\ A$

$H_H = H\cos\delta$

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

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

$R = \frac{\mu_0 I}{2\pi H_H} = \frac{4\pi \times 10^{-7} \times 2.5}{2\pi \times 0.33 \times 10^{-4}} = 15.15 \times 10^{-3}\ m = 1.5\ km$