Home assignment

Magnetism and Matter

Ncert Exercise

(3) magnetic field strength $B = 0.25\,T$

Torque on the bar magnet, $T = 4.5 \times 10^{-2}\,J$

Angle between the bar magnet and external magnetic field $\theta = 30°$

Torque is related to magnetic moment (M) as

$T = MB \sin\theta$

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

$= \frac{4.5 \times 10^{-2}}{0.25 \times \sin 30°}$

$= 0.36\,J\,T^{-1}$

magnetic moment of magnet $= 0.36\,J\,T^{-1}$

4 Moment of bar magnet $= M = 0.32\,J\,T^{-1}$

External magnetic field $= B = 0.15\,T$

a) The bar magnet is aligned along the magnetic field, this system is being is stable equilibrium there the angle θ between the bar magnet and the magnetic field ~~B = 0.15T~~ is 0.

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

$= -0.32 \times 0.15 \cos 0$

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

b) bar magnet is oriented 180° to the magnetic field, hence it is is unstable equilibrium

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

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

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

(3) No of turns in Solenoid = 800
Area of cross section = $2.5 \times 10^{-4} m^2$
current = 3.0A
A current carrying solenoid behaves as a bar magnetic field direction along its axis

$M = nIA$

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

$= 0.6 JT^{-1}$

(8) No of turns in solenoid = 2000
Area of cross section = $A = 1.6 \times 10^{-4} m^2$

Current in the solenoid = $I = 4A$

a) magnetic moment along the axes of solenoid
$M = nAI$
$= 2000 \times 1.6 \times 4$
$= 1.28 m^2$

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

Angle between magnetic field and axis of solenoid = $\theta = 30°$
Torque = $\tau = MB \sin\theta$

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

Torque = 4.8×10^{-2} Nm

(9) No of turns = N = 16
radius of coil = 10 cm = 0.1 m
Cross section of coil, $A = \pi r^2$
$= \pi \times (0.1)^2$
Current = 0.75 A
magnetic field strength = 5.0×10^{-2} T
frequency of oscillation = $v = 2.0 s^{-1}$

Magnetic moment

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

~~Magnetic moment~~ =

$= 16 \times 0.75 \times \pi (0.1)^2$
$= 0.3775 JT^{-1}$

frequency

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

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

$$= \frac{0.3775 \times 5 \times 10^{-2}}{4\pi^2 \times (2)^2}$$

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

(11) Angle of declination $\theta = 12$

Angle of dip $\delta = 60$

Horizontal component $B_H = 0.164$

Earth magnetic field at given location $= B$

$$B_H = B \cos \delta$$

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

$$= \frac{0.16}{\cos 60}$$

$$= 0.324$$

(13) Earth's magnetic field $= 0.364$

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

μ_0 = permeability of free space

M = magnetic moment

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

Total magnetic field = $B = B_1 + B_2$

$= H + H/2$

$= 0.36 + 0.18 = 0.54$ G

18 Current = 2.5 A

Angle of dip = 0°

Earth magnetic field = 0.33 G

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

Horizontal component of Earth magnetic field

$= H_H = H\cos$

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

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

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

μ_0 = Permeability of free

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

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

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

$$= 15.5 \times 10^{-3}$$

$$= 1.51 \text{ cm}$$