Chapter 5 Magnetism and Matter

3 Magnetic field strength B = 0.25 T
Torque on the bar magnet = 4.5×10^{-2} J
$\theta = 30^\circ$
$T = MB\sin\theta$
$M = \frac{T}{B\sin\theta} = \frac{4.5\times10^{-2}}{0.25\times\sin30^\circ} = 0.36\ JT^{-1}$

4
a ~~The bar magnet of magnetic moment M = 0.32 J T^{-1} is placed in a uniform magnetic field of 0.15 T~~

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

Potential energy = $-MB\cos\theta$
$-0.32 \times 0.15 \cos 180^\circ$
$= 4.8 \times 10^{-2}$ J

15 $n = 800$ $A = 2.5\times10^{-4}\ m^2$ $I = 3.0$ A

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

$M = nIA$
$= 800 \times 3 \times 2.5\times10^{-4}$
$= 0.6\ JT^{-1}$

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a $M = n A I$

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

$= 1.2 \times 10 \, Am^2$

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

$\theta = 30^\circ$

$\tau = MB \sin\theta$

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

$\Rightarrow 4.8 \times 10^{-2}$ Nm

⇒ Since the magnetic field is uniform the force of solenoid is zero.

9 $N = 16$, $r = 10 cm$, $A = \pi r^2 = \pi \times (0.1)^2 m^2$

$I = 0.75 A$ $B = 5.0 \times 10^{-2} T$ $v = 2.0 s^{-1}$

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

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

$\Rightarrow 0.377 JT^{-1}$

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

Where

I = moment of inertia of the coil

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

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

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11 $\theta = 12^0$ Angle of dip $\delta = 60^0$ $B_H = 0.16\ G$

$B_H = B\cos\delta$

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

13 $H = 0.36\ G$

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

where
μ_0 = Permeability of free space
M = magnetic field
$B_2 = \frac{\mu_0 M}{4\pi d^3} = \frac{H}{2}$
Total $B = B_1 + B_2$
$= H + \frac{H}{2}$
$= 0.36 + 0.18$
$= 0.54\ G$

18 $I = 2.5A$ $\delta = 0^0$ $H = 0.33\ G = 0.33 \times 10^{-4}\ T$
$H_H = H\cos\delta = 0.33 \times 10^{-4}\cos 0^0 = 0.33 \times 10^{-4}\ T$

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

where,
μ_0 = Permeability of free space $= 4\pi \times 10^{-7}\ TmA^{-1}$

$\therefore R = \frac{\mu_0 I}{2\pi H_x}$

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

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