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## Ch-5 Magnetism and Matter

Exercises.

**5.3** $B = 0.25\ T$

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

$\theta = 30°$

$T = MB \sin\theta$

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

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

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

**5.4** $M = 0.32\ J\ T^{-1}$

$B = 0.15\ T$

a) stable equilibrium $\theta = 0 \to 90°$

potential energy $= -MB\cos\theta$

$= -0.32 \times 0.15 \cos 0°$

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

b) Unstable equilibrium $\theta = 0 \to 180°$

potential energy $= -MB\cos\theta$

$= -0.32 \times 0.15 \cos 180°$

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

**5.5** $n = 80$

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

$I = 3.0\ A$

$M = nIA$

$= 80 \times 3 \times 2.5 \times 10^{-4}$

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

→

5.7 a) $m = 1.5\text{J T}^{-1}$

$B = 0.22\text{T}$

→ i) $\theta_1 = 0°$

$\theta_2 = 90°$

$W = -mB(\cos\theta_2 - \cos\theta_1)$

$= -1.5 \times 0.22(\cos 90° - \cos 0°)$

$= -0.33(0-1)$

$= 0.33\text{J}$

→ ii) $\theta_1 = 0°$

$\theta_2 = 180°$

$W = -mB(\cos\theta_2 - \cos\theta_1)$

$= -1.5 \times 0.22(\cos 180° - \cos 0°)$

$= -0.33(-1-1)$

$= 0.66\text{J}$

b) For if $\theta = \theta_2 = 90°$

$\tau = mB\sin\theta$

$= 1.5 \times 0.22 \sin 90°$

$= 0.33\text{J}$

ii) $\theta = \theta_2 = 180°$

$\tau = mB\sin\theta$

$= mB\sin 180°$

$= 0$

5.8 $n = 2000$

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

$\theta = 4A$

a) $M = nA\theta = 2000 \times 1.6 \times 10^{-4} \times 4$

$= 1.28\text{Am}^2$

b/p $B = 7.5 \times 10^{-2} T \quad \theta = 30^\circ$

$\tau = mB \sin\theta$

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

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

5.9 $N = 16$

$a = 10 cm = 0.1 m$

$A = \pi a^2 = \pi (0.1)^2 m^2$

$I = 0.75 A$

$B = 5 \times 10^{-2} T$

$v = 2.0 s^{-1}$

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

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

$= 0.3777 J T^{-1}$

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

$$= \frac{mB}{4\pi^2 \nu^2}$$

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

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

5.13 Earth's Magnetic field, $H = 0.36 G$

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

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

$B = B_1 + B_2$

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

$= 0.36 + 0.18 = 0.54 G$

**5.11** $\theta = 12^\circ$

$\delta = 60^\circ$

$B_m = 0.16\ G$

$B_H = B \cos\delta$

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

$= \dfrac{0.16}{\cos 60^\circ} = 0.32 G$

**5.18** $I = 2.5\ A$

$\delta = 0^\circ$

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

$H_H = H \cos\delta$

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

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

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

$\Rightarrow R = \dfrac{\mu_0 I}{2\pi H_H}$

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