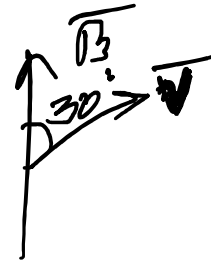




$$q = 1.6 \times 10^{-19} \text{ C}$$
$$v = 6 \times 10^7 \text{ m/s}$$
$$\theta = 30^\circ$$
$$B = 1.5 \text{ T}$$



$$F = ?$$

$$F = qBv \sin \theta \quad \text{[NOTE: } \vec{F} = q \cdot \vec{v} \times \vec{B}]$$

$$= 1.6 \times 10^{-19} \times 1.5 \times 6 \times 10^7 \times \sin 30$$

$$= 7.2 \times 10^{-12} \text{ N}$$

②

$$v = 5 \times 10^6 \text{ m/s}$$

$$q = 1.6 \times 10^{-19} \text{ C}$$

$$B = 0.4 \text{ T}$$

$$\theta = 30^\circ$$

$$a = ?$$

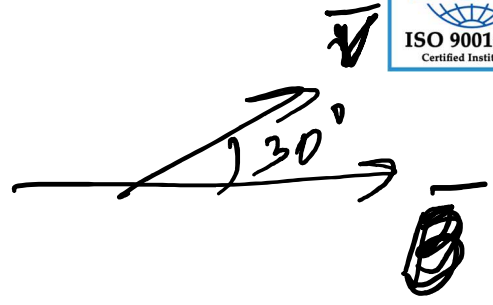
$$M = 1.6 \times 10^{-27} \text{ kg}$$

$$F = qvB \sin \theta$$

$$Ma = qvB \sin \theta$$

$$\therefore a = \frac{1.6 \times 10^{-19} \times 0.4 \times 5 \times 10^6 \sin 30}{1.6 \times 10^{-27}}$$

$$= 10^{14} \text{ m/s}^2$$



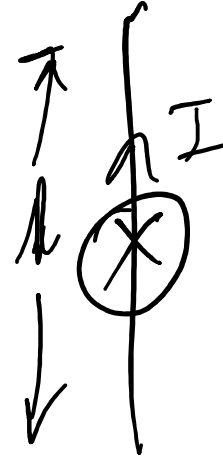
3

$$l = 1\text{m}$$

$$F = ?$$

$$I = 2.5\text{A}$$

$$B = 0.36 \times 10^{-4} \text{ T/m}^2$$



$$F = BIL$$

$$= 0.36 \times 10^{-4} \times 2.5 \times 1$$

$$= 9 \times 10^{-5} \text{ N}$$

4

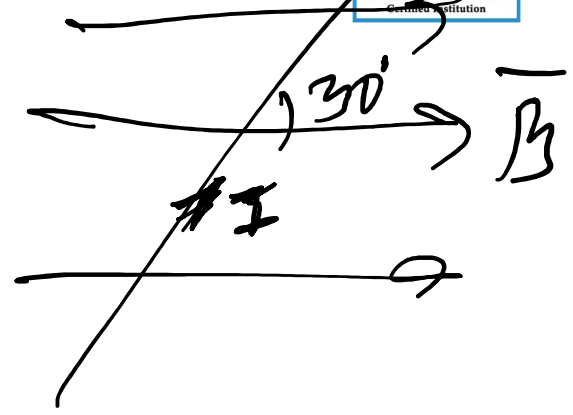
$$F = ?$$

$$L = 5\text{m}$$

$$I = 5\text{A}$$

$$B = 10^{-3}\text{T}$$

$$\theta = 30^\circ$$



$$F = BIL \sin \theta$$

$$= 10^{-3} \times 5 \times 5 \times \sin 30$$

$$= 12.5 \times 10^{-3}\text{N}$$

$$= 1.25 \times 10^{-2}\text{N}$$

5

$$I = 1A$$

$$B = 0.36 \times 10^{-4} T$$

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

$$\therefore R = \frac{4\pi \times 10^{-7} \times 1}{2\pi \times 0.36 \times 10^{-4}}$$

$$= 0.005556 m$$

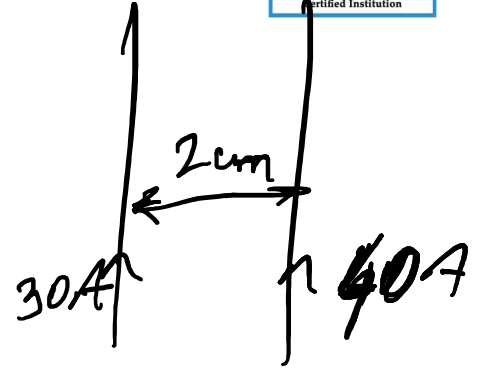
$$= 5.556 \times 10^{-3} m$$



(6) $l = 0.1 \text{ m}$

$$F = \frac{\mu_0}{2\pi} \frac{I_1 I_2}{d}$$

$$\therefore F = 0.1 \times \frac{4\pi \times 10^{-7}}{2\pi} \times \frac{30 \times 40}{0.02}$$



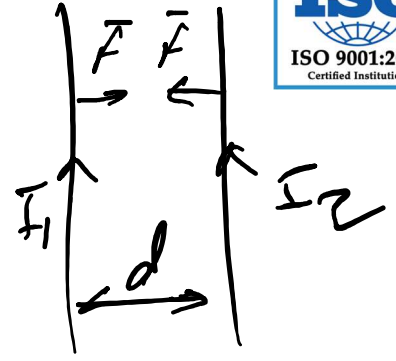
$$F = 0.0012 \text{ N}$$

7

$$L = 0.1 \text{ m}$$

$$I_1 = I_2 = 40 \text{ A}$$

$$d = 0.2 \text{ m}$$

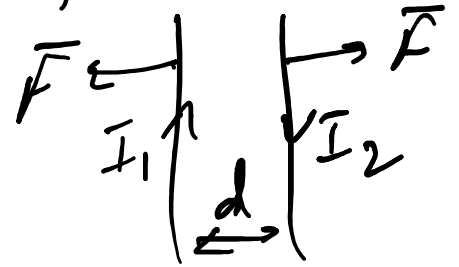


$$i) \quad \frac{F}{L} = \frac{\mu_0}{2\pi} \frac{I_1 I_2}{d}$$

$$\therefore F = 0.1 \times \frac{4\pi \times 10^{-7}}{2\pi} \times \frac{40 \times 40}{0.2}$$

$$= 1.6 \times 10^{-4} \text{ N (attraction)}$$

$$ii) \quad F = 1.6 \times 10^{-4} \text{ N (repulsion)}$$



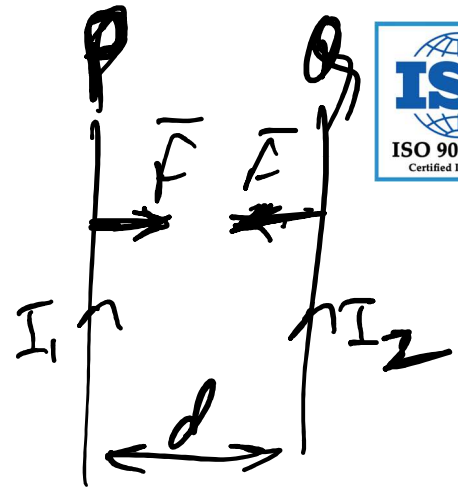
8

$$d = 0.04 \text{ m}$$

$$I_1 = 8 \text{ A}$$

$$I_2 = 5 \text{ A}$$

$$L = 0.1 \text{ m}$$



$$\frac{F}{L} = \frac{\mu_0}{2\pi} \frac{I_1 I_2}{d}$$

$$\therefore F = 0.1 \times \frac{4\pi \times 10^{-7}}{2\pi} \times \frac{8 \times 5}{0.04}$$

$$F = 2 \times 10^{-5} \text{ N} \text{ from P to Q (attraction)}$$

9

$$B = ?$$

$$N = 50$$

$$r = 6.284 \times 10^{-2} \text{ m}$$

$$I = 0.3 \text{ A}$$

$$B(2r) = \mu_0 I \cdot N$$

$$\therefore B = \frac{4\pi \times 10^{-7} \times 0.3 \times 50}{2 \times 6.284 \times 10^{-2}}$$
$$= 1.5 \times 10^{-4} \text{ Wb/m}^2$$

10

$$R = 0.1 \text{ m}$$

$$N = 50$$

$$I = 0.5 \text{ A}$$

$$B = ?$$

$$B = \frac{\mu_0 N I}{2R} = \frac{4\pi \times 10^{-7} \times 50 \times 0.5}{2 \times 0.1}$$

$$= 5\pi \times 10^{-5} \text{ Wb/m}^2$$

11



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$$I = 2A$$

$$R = 0.157m$$

$$B_{z=0} = 2 \times 10^{-4} T$$

$$N = ?$$

$$B = \frac{\mu_0 NI}{2R}$$

$$\therefore N = \frac{2 \times 10^{-4} \times 2 \times 0.157}{4\pi \times 10^{-7} \times 2}$$

$$\approx 25 \text{ turns}$$

12

$$B_{z=0} = 10^{-4} \text{ T}$$

$$N = 50$$

$$R = 0.02 \text{ m}$$

$$I = ?$$

$$B = \frac{\mu_0 N I}{2R}$$

$$\begin{aligned} \therefore I &= \frac{10^{-4} \times 2 \times 0.02}{4\pi \times 10^{-7} \times 50} \\ &= 0.06366 \text{ A} \end{aligned}$$

13

$$R = 0.05 \text{ m}$$

$$N = 10$$

$$I = 5 \text{ A}$$

$$B_z = 0.12 \text{ m} \text{ ?}$$

$$B = \frac{\mu_0 N I}{2} \frac{R^2}{(R^2 + z^2)^{3/2}}$$

$$= \frac{4\pi \times 10^{-7} \times 10 \times 5}{2} \times \frac{0.05^2}{(0.03^2 + 0.12^2)^{3/2}}$$

$$= 3.575 \times 10^{-5} \text{ T}$$

14

$$N = 1$$

$$I = 1A$$

$$B = \frac{\mu_0 N I}{2R}$$

$$N' = 4$$

$$I' = 1A$$

$$B' = ?$$

$$B' = \frac{\mu_0 N' I'}{2R'}$$

$$\frac{B'}{B} = \frac{N'}{N} \cdot \frac{I'}{I} \cdot \frac{R}{R'}$$

$$= \frac{4}{1} \cdot \frac{4R'}{R'}$$

$$\therefore B' = 16B$$

∴ Mag. field is 16 times

$$\left[\begin{array}{l} \because 2\pi R = 4 \times 2\pi R' \\ \therefore R = 4R' \end{array} \right]$$

15

$$I = IA$$

$$N' = N/2$$

$$B = \frac{\mu_0 N I}{2 R}$$

$$B' = \frac{\mu_0 N' I}{2 R}$$

$$\frac{B'}{B} = \frac{N'}{N} \cdot \frac{R}{R'}$$

$$\left. \begin{aligned} \because N 2\pi R &= N' 2\pi R' \\ \therefore NR &= N'R' \end{aligned} \right\}$$

$$= \frac{N'}{N} \cdot \frac{NR}{N'R'}$$

$$= \left(\frac{N'}{N}\right)^2 = \left(\frac{N/2}{N}\right)^2 = \frac{1}{4}$$

$$\therefore B' = \frac{1}{4} B$$

\therefore Mag. field is decreased to $\frac{1}{4}$ initial value.

16

$$I = 5A$$

$$N = 500$$

$$R = 0.05m$$

$$B_{z=0} = ?$$

$$B_{z=0.12m} = ?$$

$$B_{z=0} = \frac{\mu_0 N I}{2R} = \frac{4\pi \times 10^{-7} \times 500 \times 5}{2 \times 0.05}$$

$$\therefore 0.03142T$$

$$B_{z=0.12m} = \frac{\mu_0 N I}{2} \frac{R^2}{(R^2 + z^2)^{3/2}}$$

$$= \frac{4\pi \times 10^{-7} \times 500 \times 5}{2} \times \frac{0.05^2}{(0.05^2 + 0.12^2)^{3/2}}$$

$$= 0.001787T$$

17

$$M = 8$$

$$R = 0.08 \text{ m}$$

$$I = 5 \text{ A}$$

$$z = 6 \text{ cm} ?$$

$$B = \frac{\mu_0 N I}{z} \frac{R^2}{(R^2 + z^2)^{3/2}}$$

$$= \frac{4\pi \times 10^{-7} \times 8 \times 5}{z} \frac{0.08^2}{(0.08^2 + 0.06^2)^{3/2}}$$

$$= 80\pi \times 10^{-7} \times 64 \times 10^{-4} \frac{100^{3/2}}{(64 + 36)^{3/2}} \times 10^6$$

$$= 80\pi \times 10^{-7} \times 64 \times 10^{-2} \frac{100^{3/2}}{1000}$$

$$= 80\pi \times 10^{-7} \times 64 \times 10^{-2} \frac{1000}{1000}$$

$$= 1.608 \times 10^{-4} \text{ T}$$

18

$$I = 7A$$

$$B = 6.6 \times 10^{-4} T$$

$$N = ?$$

$$R = 0.1m$$

$$B = \frac{\mu_0 N I}{2R}$$

$$\therefore N = \frac{6.6 \times 10^{-4} \times 2 \times 0.1}{4\pi \times 10^{-7} \times 7}$$

$$\approx 15$$

19

$$R = 0.15 \text{ m}$$

$$z = ?$$

$$B_z = \frac{1}{2} B_0$$

$$\frac{\mu_0 N I \cdot R^2}{2 (R^2 + z^2)^{3/2}} = \frac{1}{2} \cdot \frac{\mu_0 N I}{2R}$$

$$\frac{R^2}{(R^2 + z^2)^{3/2}} = \frac{1}{2R}$$

$$2 \times 0.15^3 = (0.15^2 + z^2)^{3/2}$$

$$2^2 \times 0.15^6 = (0.15^2 + z^2)^3$$

$$2^{4/3} \times 0.15^2 = 0.15^2 + z^2$$

$$0.15^2 (2^{4/3} - 1) = z^2$$

$$0.15 \sqrt{2^{4/3} - 1} = z$$

$$0.15 \times 0.8 = z$$

$$\therefore z = 0.12 \text{ m}$$

$$\therefore z = 12 \text{ cm.}$$

20

$$\frac{B_z}{B_{z'}} = \frac{8}{1}$$

$$z = 5\text{cm}$$

$$z' = 20\text{cm}$$



$$\frac{\frac{\mu_0 \mu I}{2} \frac{R^2}{(R^2 + z^2)^{3/2}}}{\frac{\mu_0 \mu I}{2} \frac{R^2}{(R^2 + z'^2)^{3/2}}} = \frac{8}{1}$$

$$\frac{\mu_0 \mu I}{2} \frac{R^2}{(R^2 + z^2)^{3/2}} \approx \frac{\mu_0 \mu I}{2} \frac{R^2}{(R^2 + z'^2)^{3/2}}$$

$$\left[\frac{R^2 + z'^2}{R^2 + z^2} \right]^{3/2} = \frac{8}{1}$$

$$\left[\frac{R^2 + 20^2}{R^2 + 5^2} \right] = \left[2^3 \right]^{2/3}$$

$$\frac{R^2 + 400}{R^2 + 25} = 4$$

$$\therefore 300 = 3R^2$$

$$R = 10\text{cm}$$

$$\therefore \text{Diameter} = 2R$$

$$= \underline{\underline{20\text{cm}}}$$