

CLASS: 12

CHAPTER: Moving charges and Magnetic field.

PROBLEMS: 1 to 27

Date: 08/06/2020

Q2: $B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi \times 10^{-7} \times 50}{2 \times \pi \times 2.5} = \underline{\underline{4 \times 10^{-6} \text{ T}}}$, Upwards.

Q6: $B = \frac{\mu_0 I}{2r} = \frac{4\pi \times 10^{-7} \times 0.5}{2 \times 50 \times 10^{-2}} = \underline{\underline{5.28 \times 10^{-6} \text{ T}}}$.

Q10: $B = \frac{\mu_0 I}{2a} = \frac{\mu_0 \frac{q}{t}}{2a} = \frac{\mu_0 q}{2at} = \frac{4\pi \times 10^{-7} \times 2 \times 1.6 \times 10^{-19}}{2 \times 0.8 \times 2}$
 $= \underline{\underline{4\pi \times 10^{-26} \text{ T}}}$.

Q12: Consider two half circles. $B_1 = \frac{1}{2} \cdot \frac{\mu_0 I_1}{2a_1}$; $B_2 = \frac{1}{2} \frac{\mu_0 I_2}{2a_2}$.

$$B_{\text{Total}} = B_1 + B_2 = \frac{1}{2} \frac{\mu_0 I_1}{2a_1} + \frac{1}{2} \frac{\mu_0 I_2}{2a_2} = \frac{\mu_0}{4} \left[\frac{I_1}{a_1} + \frac{I_2}{a_2} \right]$$

$\therefore I_1 = I_2 = I$.

Q15: $B = \mu_0 n I_0 = 4\pi \times 10^{-7} \times \frac{500}{40 \times 10^{-2}} \times 1 = \underline{\underline{157 \times 10^{-5} \text{ T}}}$.

Q17: $B = \frac{\mu_0 N I_0}{L} \Rightarrow 4 \times 10^{-2} = \frac{4\pi \times 10^{-7} \times N \times 8}{50 \times 10^{-2}} \Rightarrow N = \underline{\underline{1990}}$

Q19: $F = qVB \sin \theta = 1.6 \times 10^{-19} \times 5 \times 10^7 \times \frac{1}{2} \Rightarrow \underline{\underline{4 \times 10^{-12} \text{ N}}}$

Q27: $\frac{1}{2} \mu_0 I^2 = \frac{1}{2} \times 1.65 \times 10^{-27} \times V^2 = 2 \times 10^6 \times 1.6 \times 10^{-19}$

$\therefore V = 1.9694 \times 10^7 \text{ m/s}$.

$F = qVB = 1.6 \times 10^{-19} \times 1.9694 \times 10^7 \times 2.5 = \underline{\underline{7.8776 \times 10^{-12} \text{ N}}}$

$$Q_{27}: r = \frac{m v}{q B} = \frac{9.1 \times 10^{-31} \times 4.8 \times 10^6}{1.6 \times 10^{-19} \times 6.5 \times 10^4} = 4.2 \times 10^{-2} \text{ m}$$

$$f = \frac{q B}{2 \pi m} = \frac{1.6 \times 10^{-19} \times 6.5 \times 10^4}{2 \times 3.14 \times 9.1 \times 10^{-31}} = 0.182 \times 10^8 \text{ Hz. ; No effect}$$

$$Q_{30}: \frac{1}{2} m v^2 = \frac{1}{2} \times 9.1 \times 10^{-31} \times v^2 = 40 \times 1.6 \times 10^{-19} \Rightarrow v = 3.75 \times 10^6 \text{ m/s}$$

$$r = \frac{m v}{q B} = \frac{9.1 \times 10^{-31} \times 3.75 \times 10^6}{1.6 \times 10^{-19} \times 9 \times 10^5} = \underline{\underline{23.7 \times 10^{-2} \text{ m}}}$$

$$Q_{34}: B = \frac{m v}{q r} = \frac{1.7 \times 10^{-27} \times 7 \times 10^7}{1.6 \times 10^{-19} \times 6.4 \times 10^6} = \underline{\underline{0.166 \times 10^{-7} \text{ T}}}$$

$$Q_{36}: F = I l B \sin \theta \Rightarrow \frac{F}{l} = B I \sin \theta = 0.15 \times 8 \times \frac{1}{2} = \underline{\underline{0.6 \text{ N}}}$$

$$Q_{39}: \text{At equilibrium } m g \sin \theta = I l B \cos \theta \Rightarrow I = \frac{m g \sin \theta}{l B \cos \theta}$$

$$I = \left(\frac{m}{l}\right) \cdot \frac{g}{B} \cdot \tan \theta = 0.30 \times \frac{9.8}{0.15} \times \tan 30 = \underline{\underline{11.3 \text{ A}}}$$

$$Q_{42}: \frac{F}{l} = \frac{\mu_0 I_1 I_2}{2 \pi r} = \frac{4 \pi \times 10^{-7} \times 20 \times 75}{2 \times \pi \times 1 \times 10^{-2}} = 3 \times 10^{-2} \text{ N/m; downwards}$$

$$Q_{44}: \frac{F}{l} = 0.05 = \frac{4 \pi \times 10^{-7} \times 200 \times 100}{r \times 2 \pi} \Rightarrow r = \frac{2 \times 10^{-7} \times 200 \times 100}{0.05} = 8 \times 10^{-2} \text{ m}$$

$$Q_{46}: f = \frac{q B}{2 \pi m} \Rightarrow B = \frac{2 \pi m f}{q} = \frac{2 \times 3.14 \times 1.67 \times 10^{-27} \times 8 \times 10^6}{1.6 \times 10^{-19}} = 0.524 \text{ T}$$

$$Q_{13}: B_1 = \frac{1}{4} \frac{\mu_0 I_1}{2 \pi r_1} ; B_2 = \frac{3}{4} \frac{\mu_0 I_2}{2 \pi r_2} \quad I_1 = I_2$$

$$B = B_1 + B_2 = \frac{\mu_0 I}{8 \pi} \left[\frac{1}{r_1} + \frac{3}{r_2} \right]$$

Home Work: Solve the rest of the problems in your numerical copy.