## JEE MAIN ANSWER KEY & SOLUTIONS

**SUBJECT :- PHYSICS**

**CLASS :- 12th** **PAPER CODE :- CWT-4**

**CHAPTER :- MAGNETIC EFFECT OF CURRENT**

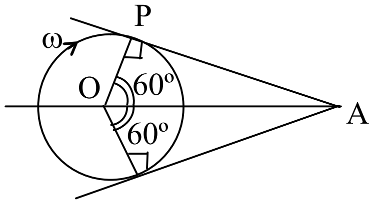
## ANSWER KEY

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** | (B) | **2.** | (A) | **3.** | (D) | **4.** | (B) | **5.** | (D) | **6.** | (B) | **7.** | (A) |
| **8.** | (A) | **9.** | (C) | **10.** | (D) | **11.** | (A) | **12.** | (C) | **13.** | (B) | **14.** | (A) |
| **15.** | (C) | **16.** | (B) | **17.** | (B) | **18.** | [C] | **19.** | (C) | **20.** | (C) | **21.** | 1 |
| **22.** | 12 | **23.** | 1 | **24.** | 0.5 | **25.** | 0.2 | **26.** | 0.2 | **27.** | 3.9 | **28.** | 141 |
| **29.** | 6 | **30.** | 8.375 | | | | | | | | | | |

## SOLUTIONS

**1.** (B)

**Sol.** Point A shall record zero magnetic field (due to $\alpha$-particle) is at position P and Q as shown in figure. The time taken by $\alpha$-particle to go from P to Q is –




$t = \frac{1}{3}\frac{2\pi}{\omega}$ or $\omega = \frac{2\pi}{3t}$

**2.** (A)

**Sol.** $M = iA$

$= (e\nu)\,\pi r^2$

**3.** (D)

**Sol.** Direction of electron velocity is along magnetic lines of flux. Hence F = O

**4.** (B)

**Sol.** $V_{surface} = \frac{9}{10}$, $Vout = \frac{9}{15}$ $\left(v = \frac{k9}{r}\right)$

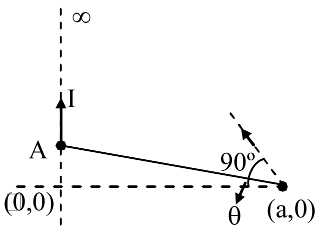
$\therefore \frac{V_{out}}{V_{surface}} = \frac{2}{3} \Rightarrow V_{out} = \frac{2}{3}V$

**5.** (D)

**Sol.** From curie law $\chi \propto \frac{1}{T}$

**6.** (B)

**Sol.**




$B = \frac{\mu_0}{4\pi}\frac{i}{a}(\sin 90^\circ + \sin(-\theta))$

$= \frac{\mu_0}{4\pi}\frac{i}{a}\left(1 - \frac{b}{\sqrt{a^2+b^2}}\right)$

**7.** (A)

**8.** (A)

**Sol.** $\frac{B_1}{B_2} = \frac{I_1}{I_2} \times \frac{r_2}{r_1}$

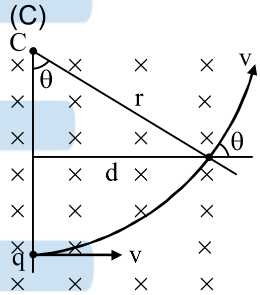
But $\frac{I_1}{I_2} = \frac{V/R_1}{V/R_2} = \frac{R_2}{R_1} = \frac{\rho\ell_2/A}{\rho\ell_1/A} = \frac{\ell_2}{\ell_1}$

$= \frac{2\pi r_2}{2\pi r_1} = \frac{r_2}{r_1}$

$\therefore \frac{B_1}{B_2} = \frac{r_2}{r_1} \times \frac{r_2}{r_1} = \left(\frac{40}{20}\right)^2 = 4$

**9.** (C)

**Sol.**

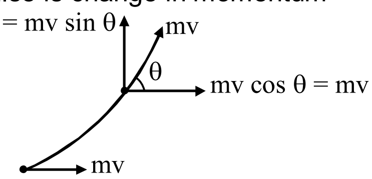



As $d <<< \frac{mv}{qB}$

$d = r\sin\theta$

Impulse is change in momentum

$mv\,\theta = mv\sin\theta$




$\sin\theta = \frac{d}{r}$

where $r = \frac{mv}{qB}$

$\therefore$ $d <<< r$

$\therefore$ $\sin\theta = \theta$

$\theta = \frac{d}{r}$

Change in momentum

$= mv\,\theta$

$= mv \times \frac{d}{r} = \frac{mv \times d \times qB}{mv}$

Impulse = qBd

**10.** (D)

**11.** (A)

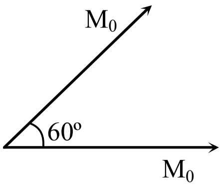
**12.** (C)

**13.** (B)

**14.** (A)

**15.** (C)

**Sol.**




$\Rightarrow M_{net} = \sqrt{3}\ M_0$

**16.** (B)

**17.** (B)

**18.** (C)

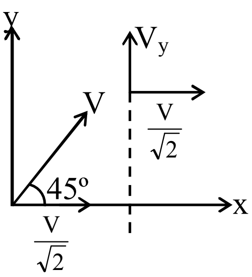
**19.** (C)

**20.** (C)

**Sol.** Since area of hysterics curve of (B) is smaller it is suitable for electromagnet and transformer.

**21.** 1

**Sol.**



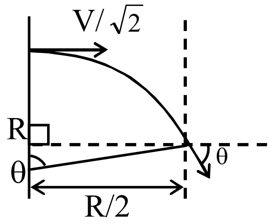

$0.5 = \frac{Vt}{\sqrt{2}}$, $t = \frac{\sqrt{2}\times 0.5}{V}$

$V_y = \frac{V}{\sqrt{2}} - \frac{qE}{m}\times t$

$V_y = \frac{V}{\sqrt{2}} - \frac{V^2}{\sqrt{2}V}$, $V_y = 0$

$R = \frac{mV}{qB} = \frac{mV}{\sqrt{2}qB}$

$\sin\theta = \frac{R}{2R} = \frac{1}{2}$, $\theta = 30°$




Deviation = 45° + 30° = 75° clockwise.

**22.** 12

**Sol.** $R = \frac{mv}{qB}$

$q \times 12 \times 10^3 = \frac{1}{2} m \times (10^6)^2$

$\frac{24\times 10^3}{10^{12}} = \frac{m}{q}$

$R = \frac{24\times 10^3\times 10^6}{10^{12}\times 0.2}$

$R = 12 \times 10^{-2}$ m

R = 12 cm

**23.** 1

**Sol.** $e = (B_v)\, V\ell = 0.2 \times 10^{-4} \times 50\ 10^{-3} v = 1mv$

**24.** 0.5

**Sol.** $r = \frac{mv}{Bq}, \therefore v = \frac{Bqr}{m}, qE = Bqv$

$\therefore E = Bv = \frac{B^2qr}{m}$

$= \frac{(0.1)^2(20\times 10^{-6})(5\times 10^{-2})}{(20\times 10^{-9})}$

= 0.5 v/m

**25.** 0.2

**Sol.** $T = 2\pi\sqrt{\frac{I}{MH}}$

$T' = 2\pi\sqrt{\frac{I14}{\frac{M}{4}H}}$

= T = 4 s

$\left\{ \begin{array}{l} I = \frac{m\ell^2}{12} \\ I' = \frac{\left(\frac{m}{4}\right)\ell^2}{12} = \frac{I}{4} \end{array} \right.$

**26.** 0.2

**Sol.** $\varepsilon = -\frac{d\phi}{dt} \Rightarrow i = \frac{\varepsilon}{R}$

**27.** 3.9

**Sol.** $B_0 = \frac{\mu_0 I}{2a}$

At axial point

$B = \frac{\mu_0 I a^2}{2(a^2+x^2)^{3/2}}$

$\frac{B}{B_0} = \frac{a^3}{(a^2+x^2)^{3/2}}$

$\Rightarrow B = B_0 \frac{a^3}{(a^2+x^2)^{3/2}}$

$= 0.5 \times 10^{-4} \times \frac{(12cm)^3}{(144cm^2+25cm^2)^{3/2}}$

$= 3.9 \times 10^{-5}$ T.

**28.** 141

**Sol.** $W(qE) = \frac{1}{2}mv_x^2 + \frac{1}{2}mv_y^2 - 0$

$\Rightarrow 4 \times 10^{-6} \times 4x = \frac{1}{2}m(4^2 + 3^2)$

$4 \times 10^{-6} \times 4 \times x = \frac{1}{2} \times 10 \times 10^{-6} \times 25$

$X = \frac{250}{32}m = \frac{125}{16}m$

$\Rightarrow 125 + 16 = 141$ Ans

**29.** 6

**Sol.** $M = 6.7 \times 10^{-2}\ A - m^2$

$I = 7.5 \times 10^{-6}\ kgm^2$

$T = 2\pi\sqrt{\frac{I}{MB}}$

$= 2\pi\sqrt{\frac{7.5 \times 10^{-6}}{6.7 \times 10^{-2} \times 10^{-2}}}$

$= 2\pi\sqrt{\frac{7.5}{6.7} \times 10^{-2}}$

$= 2\pi \times 10^{-1}\sqrt{\frac{75}{67}}$

$t = 10T$

$= 2\pi\sqrt{\frac{75}{67}} = 6.65$ sec.

**30.** 8.375

$r = \frac{mV}{qB}, V = \sqrt{\frac{2k}{m}}$

$\Rightarrow r = \frac{\sqrt{2km}}{qB}$

$= \frac{\sqrt{2 \times 6.7 \times 10^3 \times 2 \times 1.6 \times 10^{-19} \times 6.7 \times 10^{-27}}}{2 \times 1.6 \times 10^{-19} \times 0.2}$

$= \frac{6.7}{8} \times 10^{-1} = 0.08375\ m = 8.375\ cm$