345. C

The magnetic induction produced due to a current carrying arc at its centre of curvatureis-

$B = \frac{\mu_0 i\alpha}{4\pi r}$ .... (A)

$\therefore \alpha = \frac{\pi}{4}$ ....(B)

From eqs. (A) and (B)

$B = \frac{\mu_0 i\pi}{4 \times 4 \times \pi r} = \frac{\mu_0 i}{16 r}$

346. A

$B_0 = B_{PSR} + B_{PQR}$ .... (A)

$B_{PSR} = \frac{\mu_0 i}{2\pi}\left[\frac{2\pi - 2\phi}{r}\right] = \frac{\mu_0 i}{2\pi r}[\pi - \phi]$ .... (B)

$B_{PQR} = \frac{\mu_0 i}{4\pi} \cdot \frac{2\sin\theta}{OQ}$

From the figure OQ = r cos θ

$$B_{PQR} = \frac{\mu_0 i}{4\pi}\frac{2\tan\phi}{r} \quad .... (C)$$

From eqs. (A) and (C)

$$B = \frac{\mu_0 i}{2\pi r}[\pi - \phi] + \frac{\mu_0 i}{2\pi r}\tan\phi$$

$$= \frac{\mu_0 i}{2\pi r}[\pi - \phi + \tan\phi]$$

347. A

$\ell = (2\pi r)n$ or $n = \frac{\ell}{2\pi r}$

$$B = \frac{\mu_0 n i}{2r} = \frac{\mu_0 i\ell}{4\pi r^2} \text{ or}$$

$$B = \frac{4\pi\times10^{-7}\times6.28\times1}{2\times2\times\pi\times(0.10)2} = 6.28 \times 10^{-5} \text{ Tesla.}$$

348. B

$E_{kp} = eV$, $\therefore E_k = qV$,
$\therefore E_k \propto q$, $\therefore V$ = constant
$E_{kp} : E_{kd} : E_{ka} :: 1 : 1 : 2$.

349. A

The electron will pass undeviated if the electric force and magnetic force are equal and opposite. Thus
E.e. = Bev or B = E/v
but E = V/d

$$\text{Therefore, } B = \frac{V}{v.d.} = \frac{600}{3\times10^{-3}\times2\times10^{6}}$$

$\therefore B = 0.1\ wb/m^2$.
The direction of field is perpendicular to the plane of paper vertically downward.

350. A

Kinetic energy of the proton = $\frac{1}{2}mv^2$
= 5 MeV

$$\text{or } v^2 = \frac{2\times5\text{MeV}}{m} = \frac{2\times5\times10^{6}\times1.6\times10^{-19}}{1.6\times10^{-27}}$$

= 3.1×10^7 m/s.
The magnetic field is horizontal from south to north and velocity $\vec{v}$ is vertically downward, i.e. angle between $\vec{v}$ and is $\vec{B}$ is 90º therefore force on proton
F = qvB sin 90 = qvB = evB
= $1.6\times10^{-19}\times3.1 \times 10^7 \times 1.5$
= 7.44×10^{-12} N.
According to Fleming left had rule, the direction of force is horizontal from west to east.

351. C

We have $F = qvB = \frac{mv^2}{r}$ or $v = \frac{qBr}{m}$

$$= \frac{3.2\times10^{-19}\times1.2\times0.45}{6.8\times10^{-27}} = 2.6 \times 10^7 \text{ m/s.}$$

The frequency of rotation $n = \frac{v}{2\pi r}$

$$= \frac{2.6\times10^{7}}{2\times3.14\times0.45} = 9.2 \times 10^6\ sec^{-1}.$$

Kinetic energy of α-particle,

$$E_K = \frac{1}{2}\times 6.8 \times 10^{-27} \times (2.6 \times 10^7)^2$$
$$= 2.3 \times 10^{-12} \text{ joule.}$$
$$= \frac{2.3\times10^{-12}}{1.6\times10^{-19}} \text{ eVolt} = 14 \times 10^6 \text{ eV}$$

= 14 MeVolt.
If V is accelerating potential of α-particle, then Kinetic energy = qV
14×10^6 eVolt = 2eV (since charge on α-particle = 2e)

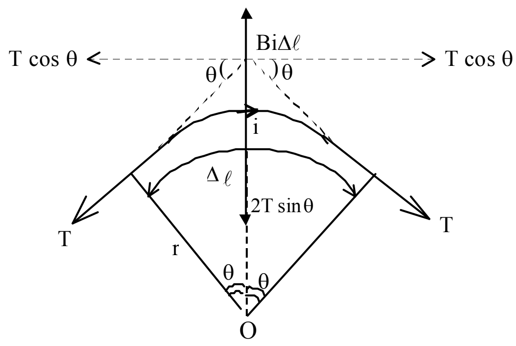
$$\therefore V = \frac{14\times10^{6}}{2} = 7 \times 10^6 \text{ Volt.}$$

352. A

$F = Bi\ell\sin\theta = 0.25 \times 5 \times 0.25 \sin 65º$
= 0.3125 sin 65º

353. C

When the current is passed in the loop, magnetic force 'Bil' acts at every point of the loop. This force is at right angles to the current but lies in the plane of the loop. So the loop stretches out into a circle. Figure shows a part of this circle. The tension in the loop is T. Then according to the geometry of the figure.



$2T\sin\theta = Bi\,\Delta\ell$
where $\Delta\ell$ is the length of the element.
Since, θ is small, $\sin\theta \cong \theta$, therefore
$2\theta.T = Bi\,\Delta\ell$
or $(\Delta\ell/r)$. $T = Bi\,\Delta\ell$ or T = B. ri
but $2\pi r = \ell$ length of wire

$$\therefore T = \frac{Bi.\ell}{2\pi} = \frac{1\times157\times0.5}{3\times3.14} = 0.125 \text{ N.}$$

354. A

Let ab be a metal wire sliding on rails PQ and RS, in a region of uniform field of induction, $\vec{B}$ pointing vertically upward. The magnetic field $\vec{B}$ is normal to length of wire ab ($\theta = 90^o$); therefore magnetic force on the wire of length (ab = d) is given by F = Bid sin 90º = Bid

By Fleming left hand rule, this force is directed away from battery as shown in fig. If m is mass of wire and a the acceleration,

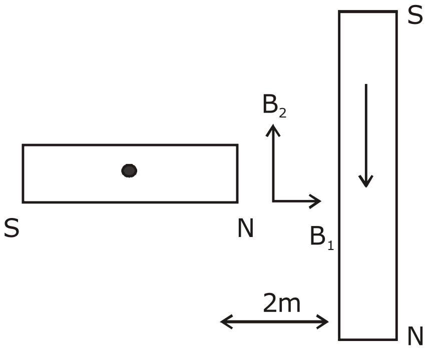
then F = ma = Bid. or $a = \frac{Bid}{m}$ = const.

$\therefore$ From relation v = u + at, we have velocity after time t

(initial velocity u = 0)

$v = 0 + \frac{Bid}{m}t$ or $v = \frac{Bid}{m}t$

355. A



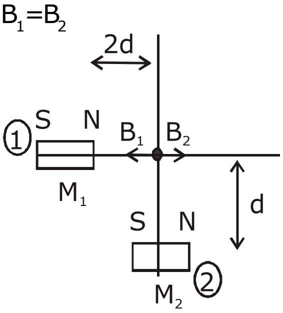
$$B_1 = \frac{2\mu_o}{4\pi}\frac{M}{r^3} = \frac{2\mu_o}{4\pi}$$

$$B_2 = \frac{\mu_o}{4\pi}\frac{M}{r^3} = \frac{\mu_o}{4\pi}$$

$$B_{net} = \sqrt{B_1^2 + B_2^2} = \frac{\mu_o}{4\pi}\sqrt{5}$$

356. B

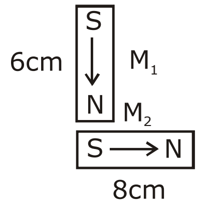
$B_1 = B_2$



$$\frac{2\mu_o}{4\pi}\cdot\frac{M_1}{(2d)^3} = \frac{\mu_o}{4\pi}\cdot\frac{M_2}{d^3}$$

$$\frac{M_1}{M_2} = \frac{4}{1}$$

357. A



$$M = \sqrt{M_1^2 + M_2^2}$$

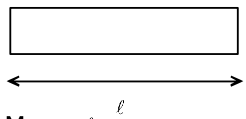
$$M_1 = \frac{3\mu}{7},\quad M_2 = \frac{4\mu}{7}$$

$$M = \frac{\mu}{1.4}$$

358. A

$$\frac{B_1}{B_2} = \frac{\tau_1}{\tau_2} \quad [\tau = MB]$$

359. D



$M = m\ell$

$$M_1 = m.\frac{3\ell}{\pi}$$

$$M_1 = \frac{3M}{\pi}$$

360. C
By theory

361. A
By Theory

362. A
By theory

363. C
By Theory

364. C
By Theroy

365. A
By Theory

366. C
By Theroy

367. D
By Theory

368. D
By Theroy

369. D
By Theroy

370. B
Anticlockwise