PHYSICS

61. (1)

Total flux out of all six faces as per Gauss's theorem should be $\frac{Q\times10^{-6}}{\varepsilon_0}$

Therefore, flux coming out of each face

$$=\frac{Q}{6\varepsilon_0}\times10^{-6}\ C$$

62. (2)

Current in the loop $I=\frac{V}{R}$ equal for both loops. Magnetic moment of equilateral triangle of side a

$$M_T=\left(\frac{12a}{3a}\right)I\frac{\sqrt{3}}{4}a^2=\sqrt{3}Ia^2\quad[\because M=NIA]$$

Similarly magnetic moment of square of side a $=\left(\frac{12a}{4a}\right)Ia^2\quad[\because M=NIA]$

$M_S=3Ia^2$

63. (3)

When a charged particle enters a transverse magnetic field it traverse a circular path. Its kinetic energy remains constant.

64. (2)

$$B=\frac{\mu_0 NI}{2\pi R}\quad\therefore\frac{B_1}{B_2}=\frac{N_1R_2}{N_2R_1}=\frac{200}{100}=\frac{20}{40}=1$$

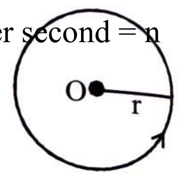
So, $\frac{B_1}{B_2}=1$

65. (3)

Radius of circular orbit = r

Number of rotations per second = n

i.e., $T=\frac{1}{n}$



Magnetic field at its centre, B_c = ?

As we know, current

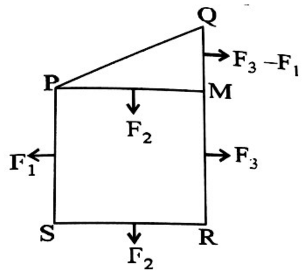
$$i=\frac{e}{T}=\frac{e}{\left(\frac{1}{n}\right)}=en=\text{equivalent current}$$

Magnetic field at the centre of circular orbit.

$$B_c=\frac{\mu_0 i}{2r}=\frac{\mu_0 ne}{2r}$$

66. (2)

According to the figure the magnitude of force on the segment QM is F_3-F_1 and PM is F_2.



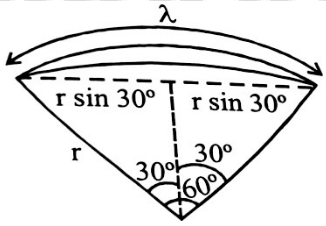
Therefore, the magnitude of the force on segment PQ is $\sqrt{(F_3-F_1)^2+F_2^2}$

67. (1)

Magnetic dipole moment

$M = m\times l$ and $M' = m\times r$

From figure



$$l=\frac{\pi r}{3}\text{ or }r=\frac{3l}{\pi}$$

$$\text{So, }M'=m\times r=\frac{m\times3l}{\pi}=\frac{3}{\pi}M$$

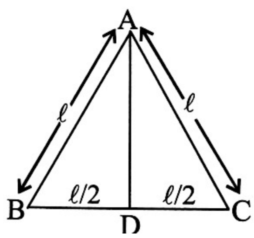
68. (2)

$\tau = MB\sin\theta$ and $\tau = iAB\sin 90°$

$\therefore A=\frac{\tau}{iB}$

Also, $A=\frac{1}{2}(BC)(AD)$

But $\frac{1}{2}(BC)(AD)$



$$=\frac{1}{2}(l)\sqrt{l^2-\left(\frac{l}{2}\right)^2}=\frac{\sqrt{3}}{4}i^2$$

$$\Rightarrow\frac{\sqrt{3}}{4}(l)^2=\frac{\tau}{Bi}\quad\therefore l=2\left(\frac{\tau}{\sqrt{3}Bi}\right)^{\frac{1}{2}}$$

69. (4)

If θ_1 and θ_2 are apparent angles of clip.

Let α be the angle which one of the plane make with the magnetic meridian.

$$\tan\theta_1 = \frac{v}{H\cos\alpha}$$

i.e., $\cos\alpha = \dfrac{v}{H\tan\theta_1}$ … (i)

$$\tan\theta_2 = \frac{v}{H\sin\alpha}$$

i.e., $\sin\alpha = \dfrac{v}{H\tan\theta_2}$ … (ii)

Squaring and adding (i) and (ii), we get

$$\cos^2\alpha + \sin^2\alpha = \left(\frac{V}{H}\right)^2\left(\frac{1}{\tan^2\theta_1 + \tan^2\theta_2}\right)$$

i.e., $1 = \dfrac{V^2}{H^2}\left[\cot^2\theta_1 + \cot^2\theta_2\right]$

or $\dfrac{H^2}{V^2} = \cot^2\theta_1 + \cot^2\theta_1$

i.e., $\cot^2\theta = \cot^2\theta + \cot^2\theta$

70. (4)

Charge Q = n × charge on an electron

$Q = ne$

$$\therefore n = \frac{Q}{e} = \frac{1}{1.6\times10^{-19}} = 6.25\times10^{18}$$