PHYSICS

161. (4)
162. (1)
163. (2)

According to the question, the situation can be drawn as

Let the current I is flowing in anti-clockwise direction, then the magnetic moment of the coil is m = NIA

where, N = number of turns in coil

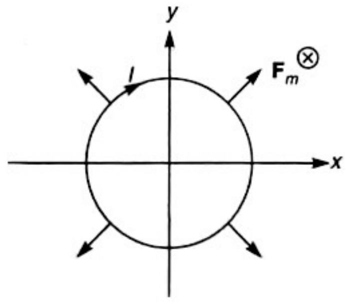
and A = area of each coil = πr^2.

Its direction is perpendicular to the area of coil and is along Y-axis.

Then, torque on the current coil is

$\tau = m \times B = mB \sin 90°$

$= NIAB = N\pi r^2 B$(N-m)



164. (1)

$r = L\sin\theta$

F = Magnetic force (repulsion) per unit length $= \frac{\mu_0}{2\pi}\frac{I^2}{2r} = \frac{\mu_0}{4\pi}\frac{I^2}{L\sin\theta}$

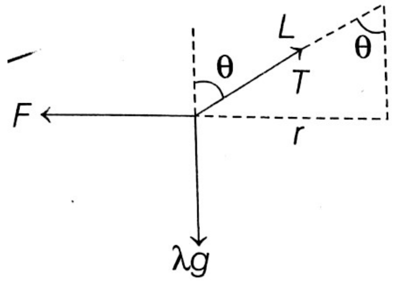
λg = weight per unit length

Each wire is in equilibrium under three concurrent forces as shown in figure. Therefore applying Lami's theorem.

$$\frac{F}{\sin(180° - \theta)} = \frac{\lambda g}{\sin(90° + \theta)}$$

$$\text{or } \frac{\frac{\mu_0}{4\pi}\frac{I^2}{L\sin\theta}}{\sin\theta} = \frac{\lambda g}{\cos\theta}$$

$$\therefore\ I = 2\sin\theta\sqrt{\frac{\pi\lambda g L}{\mu_0\cos\theta}}$$



165. (1)

In each row all the 5000 electroplaques are connected in series.

Therefore, equivalent emf = 0.15 × 5000 = 750 V

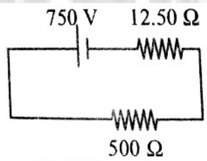
Equivalent resistance = 0.25 × 5000 = 1250 Ω

All 100 rows are connected in parallel.

Therefore voltage = 750 V.

Equivalent resistance = $\frac{1250}{100} = 12.50\ \Omega$

Thus resultant circuit of eel becomes



Current across 500 Ω

$= \frac{V}{R} = \frac{750}{500 + 12.50} = 1.46$ A

$I \approx 1.5$ A

166. (3)

Straight wire will produce a non-uniform field to the right of it. F_{bc} and F_{da} will be calculated by integration but these two forces will cancel each other. Further force on wire ab will be towards the long wire and on wire cd will be away from the long wire. But since the wire ab is nearer to the long wire, force of attraction towards the long wire will be more. Hence, the loop will move towards the wire.

167. (3)

168. (2)

169. (2)

Area of the given loop is A = (area of two circles of radius $\frac{a}{2}$ and area of a square of side a)

$$= 2\pi\left(\frac{a}{2}\right)^2 + a^2 = \left(\frac{\pi}{2}+1\right)a^2$$

$$|M| = IA = \left(\frac{\pi}{2}+1\right)a^2 I$$

170. (3)

$U = -MB = -MB\cos\theta$

Here, M = magnetic moment of the loop

θ = angle between M and B

U is maximum when $\theta = 180°$ and minimum when $\theta = 0°$. So, as θ decreases from 180° to 0°, its PE also decreases.