DPP – 03

SOLUTION

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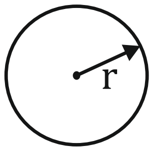
1. magnetic moment $\Rightarrow i\vec{A} = \vec{\mu}$

i.e. $\vec{\mu} \propto \bar{A}$

i.e. which loop has maximum are will show highest magnetic moment (couple).

for circle area will be highest.

2. Magnetic moment $\vec{\mu} = i\vec{A}$.



circumference $= 2\pi r = L$

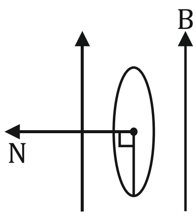
$$r = \frac{L}{2\pi}$$

$$\text{Area} = \pi r^2 = \pi\left(\frac{L}{2\pi}\right)^2$$

$$\text{Area} = \frac{L^2}{4\pi}$$

$$\vec{\mu} = \frac{iL^2}{4\pi}$$

3. $\tau = \bar{M} \times \bar{B}$



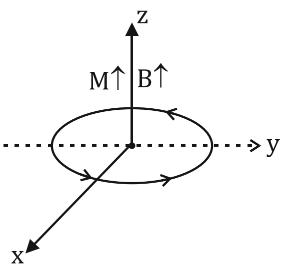
$= MB\sin\ \theta$

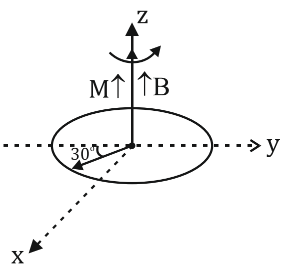
$= i\pi r^2 \cdot B\sin\ 90°$

$\tau = i\pi r^2 B$

$\tau = \pi r^2 iB$

4. The rotation of the loop by 30° about an axis perpendicular to its plane make no change in the angle made by axis of the loop with the direction of magnetic field, therefore, the work done to rotate the loop is zero.





5. $\because w = MB[\cos\ \theta_1 - \cos\ \theta_2] \rightarrow$ for 1 coil

$\theta_1 = 0,\ \theta_1 = 180$

$w = 2MB = 2i\pi r^2 \times 0.1$

$w = 0.2 \times 2 \times \pi(0.04)^2$ $\qquad\because r = 4$ cm

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$= 0.4 \times 3.14 \times 0.0016$ $r = 0.04\ m$

$w = 0.002$

for 50 coil $\Rightarrow w^1 = 50 \times 0.002 = 5 \times 0.02$

$= 0.1$ Joule

$w^1 = 0.1$ Joule

6. $\vec{M} = (A\hat{i} + B\hat{j})$

$\bar{B} = (Cx^2\hat{i} + Dy^2\hat{j})$

$u = -\bar{M} \cdot \bar{B}$

$u = -(ACx^2 + BDy^2)$

Force on magnetic dipole.

$F = \left(-\frac{\partial u}{\partial x}\right)\hat{i} + \left(-\frac{\partial u}{\partial x}\right)\hat{j}$

$F = 2ACx\hat{i} + 2BDy\hat{j}$

$F/_r = (E\hat{i} + Fj)$

$= 2AC(E/i + 2BD(F)\hat{j}$

$F = 2ACE\hat{i} + 2BDF\hat{j}$

7. Current $I = 6.6 \times 10^{15} \times 1.6 \times 10^{-19}$

$I = 10.5 \times 10^{-4}\ A$

area $A = \pi r^2 = 3.14(0.528 \times 10^{-10})^2$

$A = 3.14 \times (0.53)^2 \times 10^{-20}$

M(magnetic moment) $= 10.5 \times 10^{-4} \times 3.14 \times (0.53)^2 \times 10^{-20}$

$= 9.6 \times 10^{-24} \approx 10 \times 10^{-24}$

$M \simeq 1 \times 10^{-23}$

i.e. $x = 1$

8. $\tau = M \times B = MB\sin\ \theta$

$= \dot{I}AB\sin\ \theta$

$= \dot{I}AB \cdot 1$ $\because \theta = 90°$

$\tau = \dot{I}\pi r^2 B$

i.e. $\alpha = 8$

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9. magnetic moment due to loop ABCOA.

$M_1 = Iab\hat{j}$

Magnetic moment due to loop AOEFA

$M_2 = Iabi$

$M = M_1 + M_2 = Iab(\hat{i} + \hat{j})$

Magnitude $|M| = \sqrt{2}Iab.$

direction $= \left(\frac{i + j}{\sqrt{2}}\right) = \left(\frac{i}{\sqrt{2}} + \frac{j}{\sqrt{2}}\right)$

10. Magnetic moment $= iA$

$M = \left(\frac{q}{T}\right) \cdot \pi r^2$

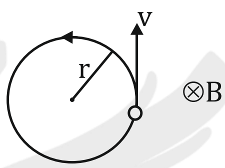
$M = \frac{2\pi r^2}{\left(\frac{2\pi r}{v}\right)}$

$M = \frac{qvr}{2}$

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

$M = \frac{qv}{2} \cdot \frac{mv}{qB}$

$M = \frac{mv^2}{2B}$



$\because$ direction of $\bar{M}$ or $\bar{A}$ is opposite to $\bar{B}$

$\therefore \bar{M} = \frac{-mv^2}{2B}\hat{B} = \frac{-mv^2\bar{B}}{2B^2}$

$\vec{M} = -\frac{mv^2\bar{B}}{2B^2}$

11. $\tau = M \times B$

$\because M = NIA$

$M = NI\pi r^2(\hat{j})$

$\because B = B\hat{i}$

i.e. angle between $\bar{M}$ and $\bar{B}$ is $90°$

$\therefore \ \tau = MB\sin\theta$

$\tau = NI\pi r^2 \cdot B\sin\ 90°$

$\tau = B\pi r^2 IN$

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12. $\because M = NIA$

$\because dq = \lambda dx$ and $A = \pi x^2$

$$M = \frac{n\rho_0\pi}{l}\int_0^l x^3 dx$$

$$M = \frac{n\rho_0\pi}{l}\left[\frac{x^4}{4}\right]_0^l$$

$$M = \frac{n\rho_0\pi}{4}l^3$$

$$M = \frac{\pi}{4}n\rho_0 l^3$$

13. Angle between Magnetic moment $(\bar{M})$ and $\bar{B}$ is zero so torque (τ) will be zero

i.e. it will not show any rotation tendency.

(option A and D are correct)