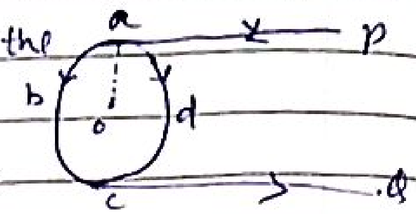
Home Assignment



(1) The current in the part abc of the coil is equal to adc of the coil, which is equal to 2.5A.

Here, $r = OA = Od = Ob = OC = 5\ cm = 0.05\ m.$

Magnetic field induction at O due to current through circular coil abcd will be zero because the magnetic field induction at O due to current through segment abc of the coil is equal and opposite to that adc.

Magnetic field induction at O due to current through long straight conductor ap

$$B_1 = \frac{\mu_0}{4\pi}\frac{I}{r}(\sin 90^\circ + \sin 0^\circ)$$

$$= 10^{-7} \times \frac{5}{5 \times 10^{-2}} = 10^{-5}\ T$$

outward normally to the plane of paper.

through cQ.

$$B_2 = \frac{\mu_0}{4\pi}\frac{I}{r}(\sin 90^\circ + \sin 0^\circ)$$

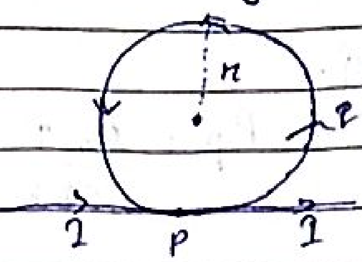
$$= 10^{-7} \times \frac{5}{5 \times 10^{-2}} = 10^{-5}\ T.$$

Total magnetic field induction at O

$B = B_1 + B_2 = 10^{-5} + 10^{-5} = 2 \times 10^{-5}$ normal outwardly to the plane of paper

(2)

Magnetic field induction at straight line current



$$B_{st\ line\ current} = \frac{\mu_0 I}{2\pi r}$$

Magnetic field induction at circular current

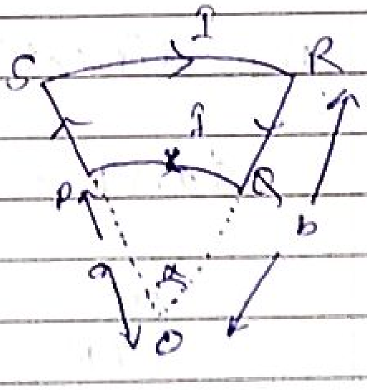
$$B_{circular\ current} = \frac{\mu_0 I}{2r}$$

Total magnetic field induction

$$= \left(\frac{\mu_0 I}{2\pi r} + \frac{\mu_0 I}{2r}\right)$$

$$= \frac{\mu_0 I}{2r}\left(1 + \frac{1}{\pi}\right)$$

(3)



$$\vec{B}_{SR} = \frac{\mu_0 I}{2b}\left[\frac{\theta}{2\pi}\right](-\hat{k})$$

$$\vec{B}_{PQ} = \frac{\mu_0 I}{2a}\left[\frac{\theta}{2\pi}\right](-\hat{k})$$

Total Magnetic Induction =

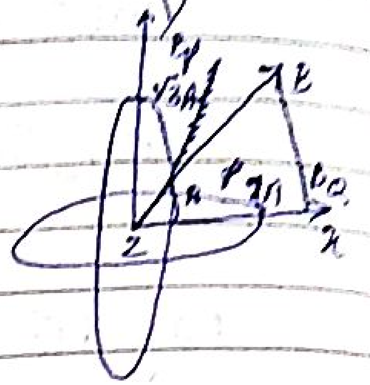
B due to SP & RQ will be zero.

$$\vec{B}_{Net} = \frac{\mu_0 I \theta}{4\pi}\left[\frac{1}{a} - \frac{1}{b}\right]$$

DOMS

$$= \frac{\mu_0 I \theta}{4\pi ab}(b-a)$$

(9)



$$B_p = \frac{\mu_0 I}{2\pi R} = \frac{\mu_0}{2\pi R}.$$

$$B_Q = \frac{\mu_0 I}{2\pi R} = \frac{\mu_0 \sqrt{3}}{2\pi R}$$

$$B = \sqrt{B_p^2 + B_Q^2}$$

$$= \sqrt{\left(\frac{\mu_0}{2\pi R}\right)^2 + \left(\frac{\mu_0\sqrt{3}}{2\pi R}\right)^2}$$

$$= \frac{\mu_0}{2\pi R}\sqrt{4}$$

$$= \frac{\mu_0}{\pi R}$$

For direction

$$\tan\beta = \frac{AB}{BC}$$

$$= \frac{\frac{\mu_0}{2\pi R}}{\frac{\mu_0\sqrt{3}}{2\pi R}} = \frac{1}{\sqrt{3}}$$

$$\beta = 30^\circ$$

The direction of net magnetic field is 30° with the x-direction.

___/___/___

5) We know, magnetic field due to circular loop.

$$= \frac{\mu_0}{4\pi} \frac{2\pi R^2 I}{(x^2+R^2)^{3/2}}$$

$$|\vec{B}| = \frac{\mu_0 R^2 R}{2(x^2+R^2)^{3/2}}$$

$$|\vec{B_{net}}| = \sqrt{2}|\vec{B}| = \frac{\sqrt{2}\mu_0 R^2 I}{2(x^2+R^2)^{3/2}}$$

Direction is along $\frac{-\hat{i}-\hat{j}}{\sqrt{2}}$.