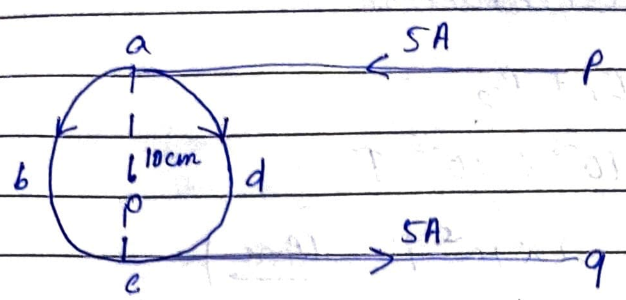
Home assignment

Date
Page

02.07.21 Moving charges and Magnetism

1



$i = 5A$

diameter = 10 cm

Current in the part abc is equal to adc

abc = adc = 2.5A.

radius = Oa = Oc = Ob = Od = 5 cm.

magnetic field induction through at O due to current through circular coil 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 due to current through segment adc.

magnetic field induction at O due to current through pa.

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

$$= \frac{\mu_0}{4\pi}\frac{I}{r} = 10^{-7} \times \frac{5}{5 \times 10^{-2}} = 10^{-5} T$$ outward normally to the paper.

magnetic field induction at O due to current through qc.

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

$$= \frac{\mu_0}{4\pi}\frac{I}{r} = 10^{-7} \times \frac{5}{5 \times 10^{-2}} = 10^{-5} T.$$

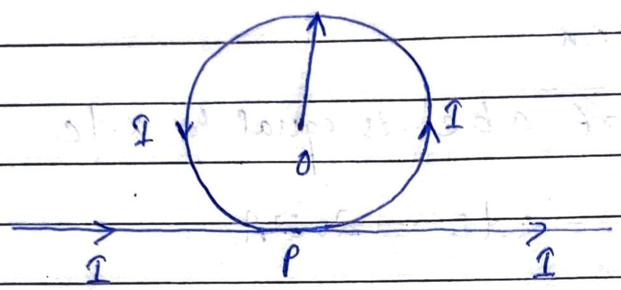
Total magnetic field induction

$B = B_1 + B_2$

$B = 10^{-5} + 10^{-5}\ T$

$B = 2\times10^{-5}\ T$ (Ans)

(2)



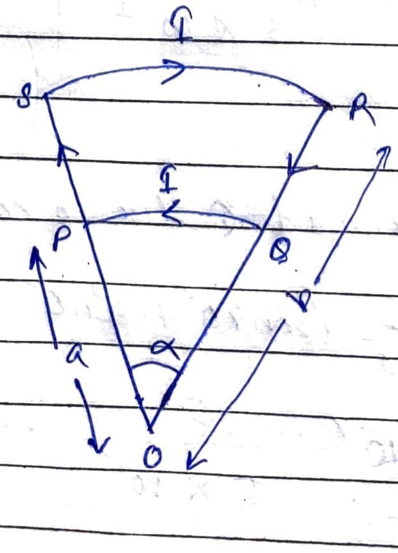
$B_1 = \frac{\mu_0 I}{2r}$

$B_2 = \frac{\mu_0 I}{2\pi r}$

$B_1 + B_2 = \frac{\mu_0 I}{2r} + \frac{\mu_0 I}{2\pi r}$

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

(3)



Date ______
Page ______

$$\vec{B}_{SR} = \frac{\mu_0 i}{2b}\left[\frac{\alpha}{2\pi}\right](-\hat{K})$$

$$\vec{B}_{PQ} = \frac{\mu_0 i}{2a}\left[\frac{\alpha}{2\pi}\right](-\hat{K})$$

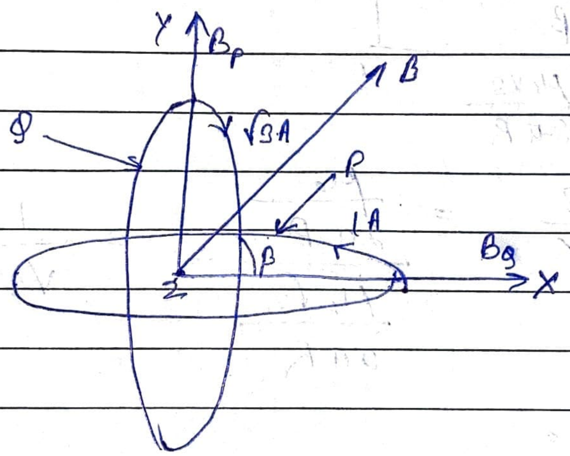
B_{net}

B due to SP and RQ will be 0.

$$\vec{B}_{net} = \frac{\mu_0 i \alpha}{4\pi}\left[\frac{1}{a} - \frac{1}{b}\right]$$

$$\vec{B}_{net} = \frac{\mu_0 i \alpha}{4\pi ab}(b-a) \quad \text{(Ans)}$$

(4)



Magnetic field at the centre of the coil are perpendicular to each other.

B_{net} is the resultant of two fields caused due to coil P and Q.

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

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

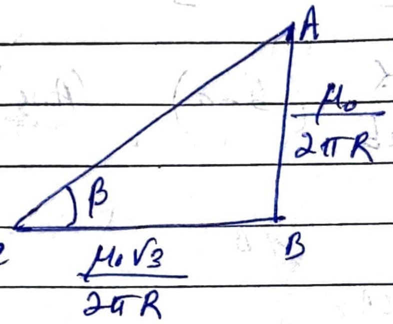
Net magnetic field $B = \sqrt{B_P^2 + B_Q^2}$

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

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

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

For Direction of magnetic field

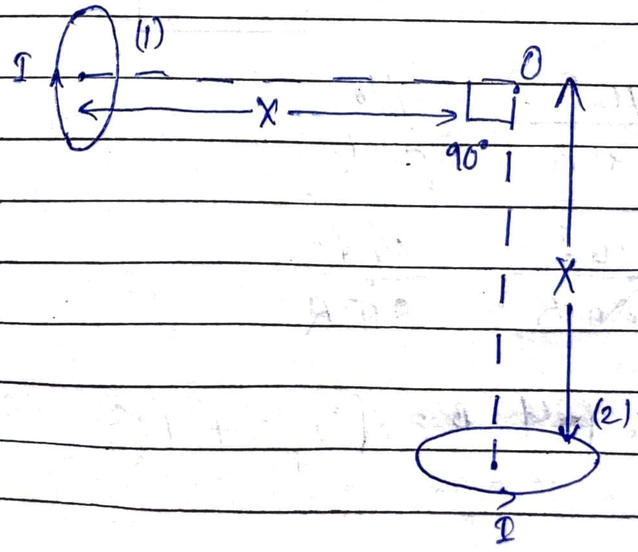


$$\beta = \frac{AB}{BC} = \frac{\frac{\mu_0}{2\pi R}}{\frac{\mu_0\sqrt{3}}{2\pi R}} = \frac{1}{\sqrt{3}} = 30^\circ.$$

$$\beta = 30^\circ$$

The direction of magnetic field is 30° with the X direction.

(I)



Magnetic field due to circular loop $= \frac{\mu_0}{4\pi} \frac{2\pi R^2 I}{(x^2 + R^2)^{3/2}}$

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

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

So $|\vec{B}_{net}|$ & its direction is $\frac{\mu_0 R^2 I}{\sqrt{2}(x^2+R^2)^{3/2}}$.

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