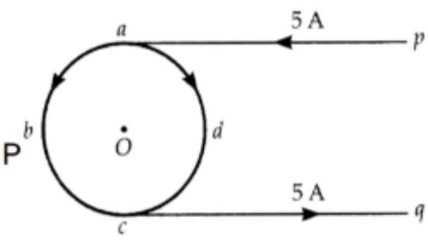
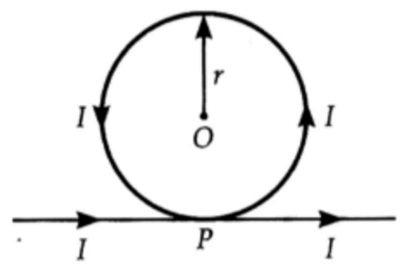
HOME ASSIGNMENT

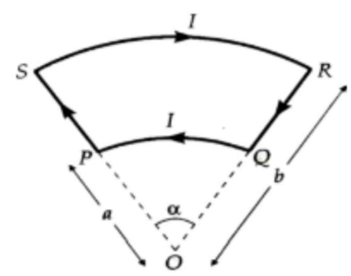
Question1: In figure abcd is a circular coil of the non-insulated thin uniform conductor. Conductors pa and qc are very long straight parallel conductors tangential to the coil at the points a and c. If a current of 5 A enters the coil from P to a, find the magnetic induction at O, the center of the coil. The diameter of the coil is 10cm.



Question2: A long wire is bent as shown in the figure. What will be the magnitude and direction of the field at the center O of the circular portion, if a current I is passed through the wire? Assume that the various portions of the wire do not touch at point P

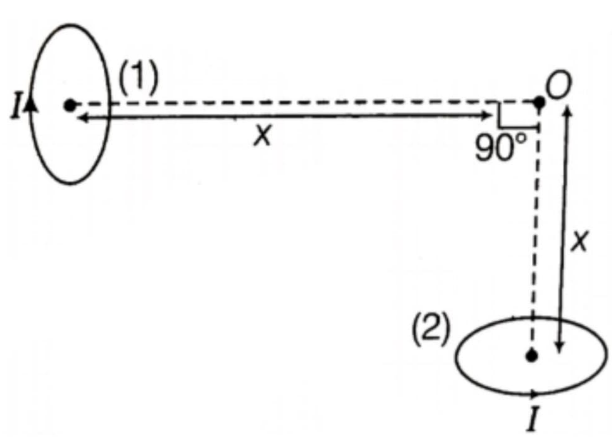


Question3: Figure shows a current loop having two circular segments and joined by two radial lines. Find the magnetic field at the center O.



Question4: Two identical circular coils, P and Q each of radius R, carrying currents $1A$ and $\sqrt{3}A$ respectively, are placed concentrically and perpendicular to each other lying in the XY and YZ planes. Find the magnitude and direction of the net magnetic field at the centre of the coils.

Question5: Two very small identical circular loop (1) and (2) carrying equal current I are placed vertically (with respect to the plane of the paper) with their geometrical axes perpendicular to each other as shown in the figure. Find the magnitude and direction of the net magnetic field produced at the point O.



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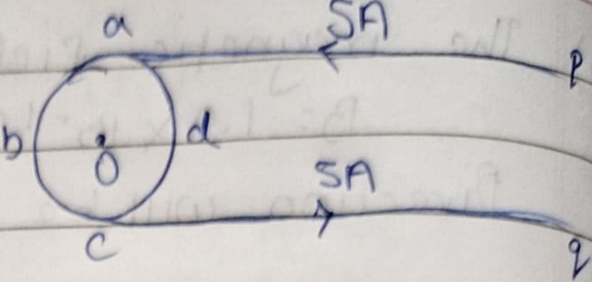
2-July Home Assignment :-



1. $I_{abc} = I_{adc} = 2.5A$
$r = 5cm = 0.05m$

The magnetic induction at O due to abc is equal and opposite to the adc coil so the magnetic induction at O due to the coil is zero.

The magnetic induction at O due to pa conductor.

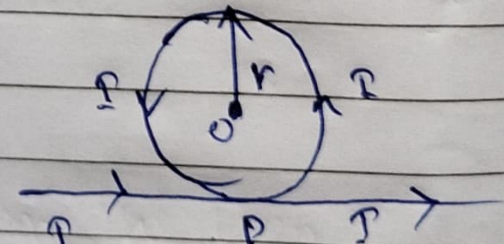
$B_{ap} = \frac{\mu_0 I}{4\pi r} = \frac{4\pi \times 10^{-7} \times 5}{4\pi \times 5 \times 10^{-2}} = 10^{-5}\, T$

Direction is out of the paper.

Similarly,
Magnetic induction at cq $= 10^{-5}\, T$
Direction is normally ~~out~~ into ~~of~~ the ~~plane~~ paper.

Total magnetic induction =
$B = B_{ap} + B_{cq} = 10^{-5} + 10^{-5} = 2 \times 10^{-5}\, T$

2. field at O due to straight conductor wire =

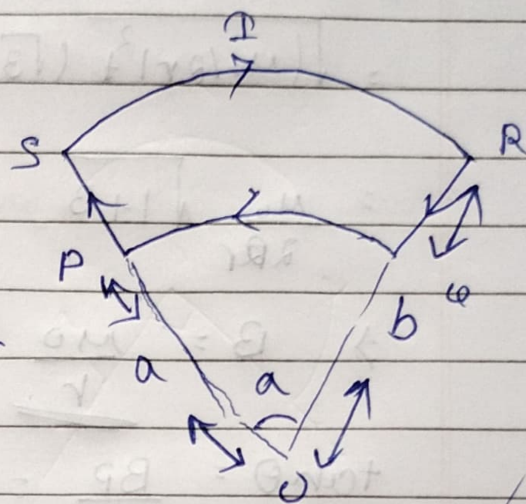


$B_1 = \frac{\mu_0 I}{2\pi r}$, out of the paper

field due to circular loop at point O is
$B_2 = \frac{\mu_0 I}{2r}$, out of the paper

Total Field at O is

$$B = B_1 + B_2 = \frac{\mu_0 I}{2r}\left(1 + \frac{1}{\pi}\right)$$



3. Magnetic Field a O due to SO & OR is zero

The magnetic field due to circular loops $= B = \frac{\mu_0}{4\pi}\frac{I l}{a^2}$

$B_1 \rightarrow \quad l = \alpha a$

$$= \frac{\mu_0}{4\pi}\frac{I\alpha}{a}$$

$B_2 \rightarrow \quad l = \alpha b$

$$= \frac{\mu_0}{4\pi} \times \frac{I\alpha}{b}$$

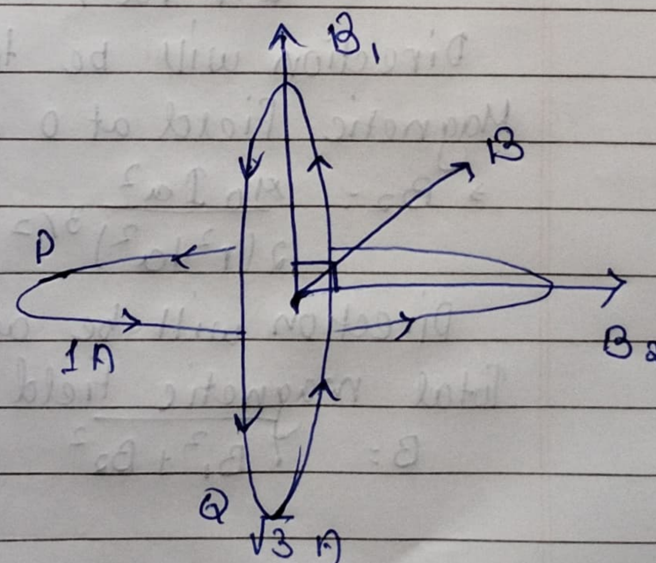
Total magnetic field at O is

$$B = B_1 - B_2 = \frac{\mu_0 I\alpha}{4\pi}\left[\frac{1}{a} - \frac{1}{b}\right]$$

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

4. $I_1 = 1A$

$I_2 = \sqrt{3}A$



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

$$B_q = \frac{\mu_0 I}{2r} = \frac{\sqrt{3}\mu_0}{2r}$$

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

$= \sqrt{(\mu_0/2r)^2 + (\sqrt{3}\mu_0/2r)^2}$

$= \frac{\mu_0}{2r}\sqrt{1+3} = \frac{\mu_0}{2r} \times 2$

$\Rightarrow B = \frac{\mu_0}{r}$

$\tan\theta = \frac{B_P}{B_Q} = \frac{1}{\sqrt{3}}$

$\theta = 30^\circ$

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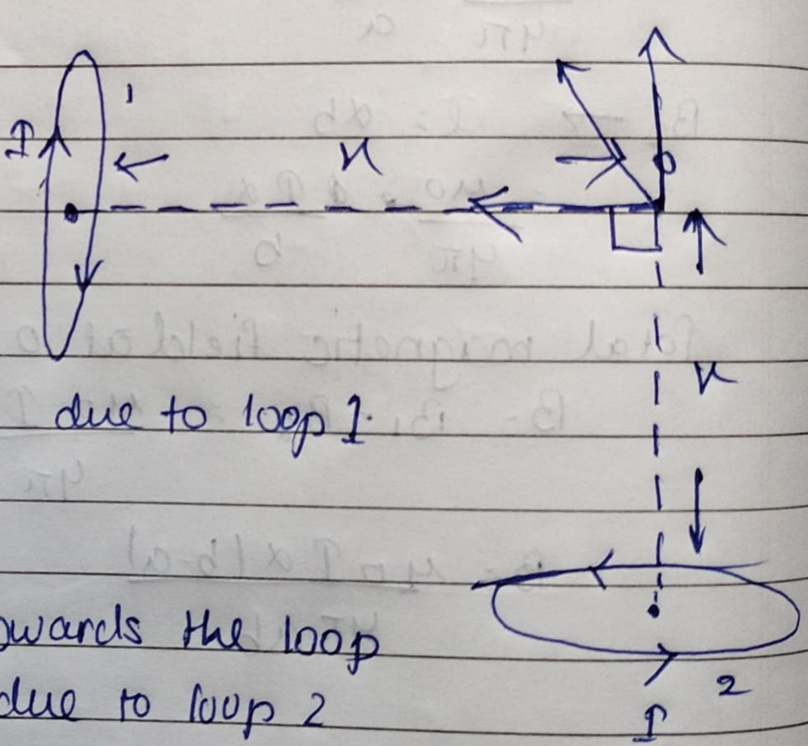

Magnetic field at O due to loop 1.

$\Rightarrow B_1 = \frac{\mu_0 I a^2}{2(r^2+a^2)^{3/2}}$

Direction will be towards the loop

Magnetic Field at O due to loop 2

$\Rightarrow B_2 = \frac{\mu_0 I a^2}{2(r^2+a^2)^{3/2}}$

Direction will be away from the loop

Total magnetic field at O will be

$B = \sqrt{B_1^2 + B_2^2}$ — ①

Here the value of B_1 & B_2 are same so

$B_1 = B_2$

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$$\Rightarrow B = \sqrt{B_1^2 + B_1^2}$$
$$= \sqrt{2B_1^2}$$

$$B = \sqrt{2}B_1 \quad \text{—(11)}$$

By putting the value of B1 in eq-(11)

$$\Rightarrow \frac{\mu_0 I a}{\sqrt{2}(r^2+a^2)^{3/2}}$$

The direction of the net magnetic field will be 45°