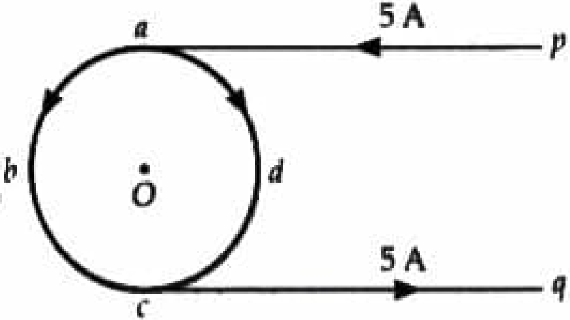
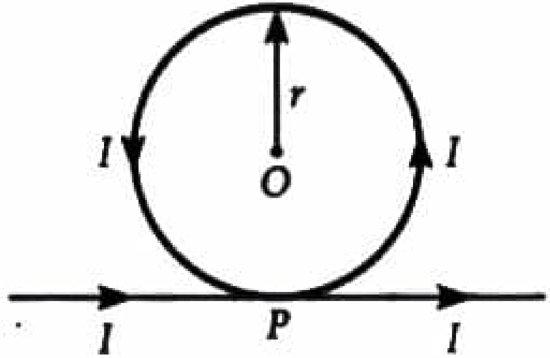
HOME ASSIGNMENT

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



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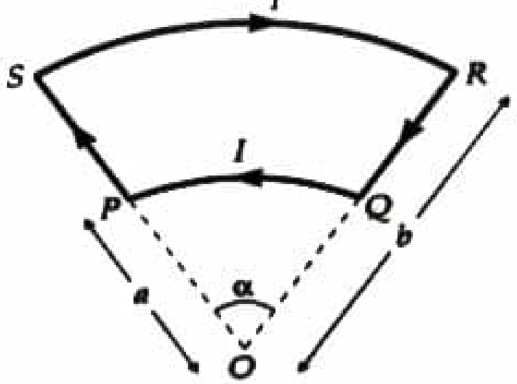
Numerical

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.

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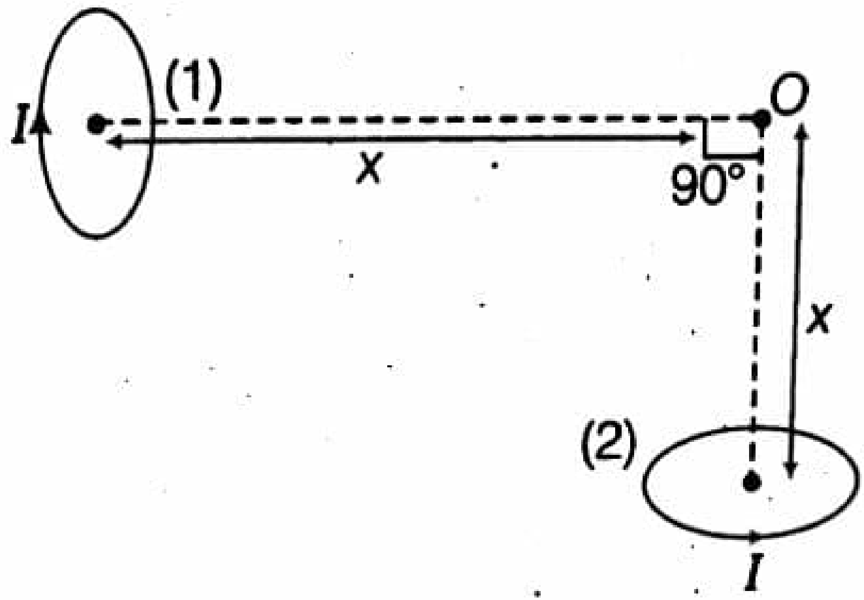
Question5: Two very small identical circular loop (1) and (2) carrying equal current I are placed vertically (with respect to the plane of the paper) with their geometrical axes perpendicular to each other as shown in the figure. Find the magnitude and direction of the net magnetic field produced at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



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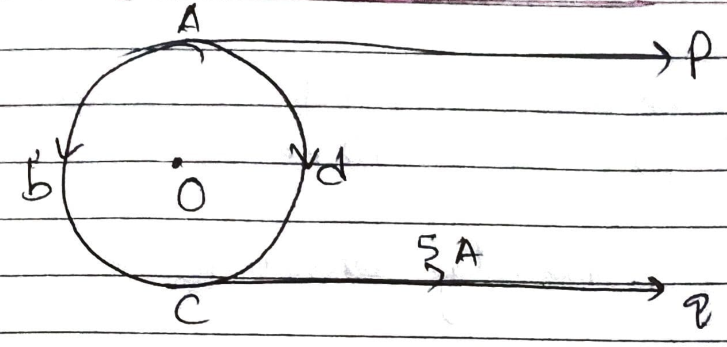
1).



→ Magnetic field at point O due to the straight conductor PA is

$$B_1 = \frac{1}{2}\left[\frac{\mu_0 I}{2\pi x}\right]$$

$$= \frac{4\pi \times 10^{-7} \times 5}{4\pi \times 5 \times 10^{-2}} = 10^{-5}\ T,$$

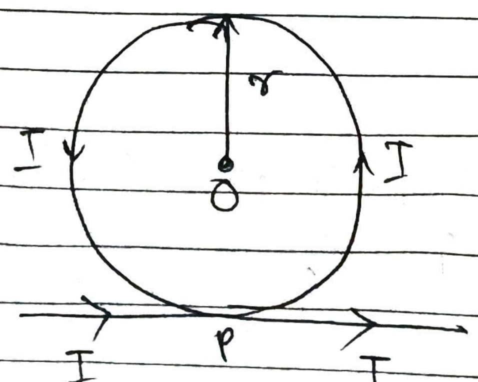
Similarly, magnetic field at a point O due to straight conductor QC is

$$B_2 = \frac{\mu_0 I}{4\pi a} = 10^{-5}\ T,$$

Both the magnetic fields B_1 & B_2 are acting normally out of the plane of the paper. So the total magnetic field $\vec{B}$ is

$$B = B_1 + B_2 = 10^{-5} + 10^{-5} = 2 \times 10^{-5}\ T.$$

2)



Magnitude of the magnetic field at O due to the straight part of the wire is

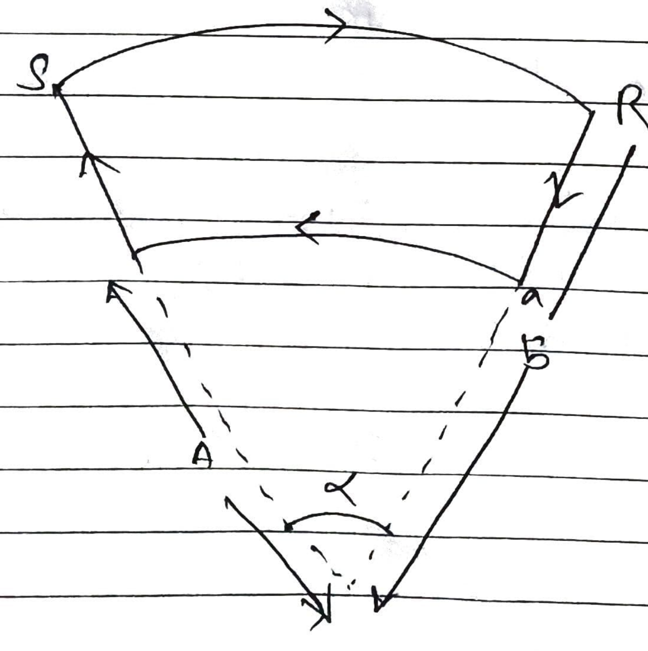
$B_1 = \frac{\mu_0}{2\pi} \cdot \frac{1}{R}$, normally out of the plane of paper magnetic field at the centre O due to the current loop of radius R is

$B_2 = \frac{\mu_0 I}{2R}$, normally into the plane of paper

Resultant field at O is

$B = B_2 - B_1 = \frac{\mu_0 I}{2R}\left(1 - \frac{1}{\pi}\right)$, normally into the plane of paper.

8)



Magnetic field due to slope lines will be zero as they exist on same line.

Due to circular arc.

$$B = \frac{\mu_0 I \theta}{4\pi r}.$$

Here for $r = a$,

$$\vec{B_1} = \frac{\mu_0 I \theta}{4\pi a} \quad \text{(outside)}$$

for $r = b$

$$\vec{B_2} = \frac{\mu_0 I}{2R}.$$

$$B_1 = \frac{\mu_0}{2R} \cdot I \qquad B_2 = \frac{\mu_0}{2R} \cdot I.$$

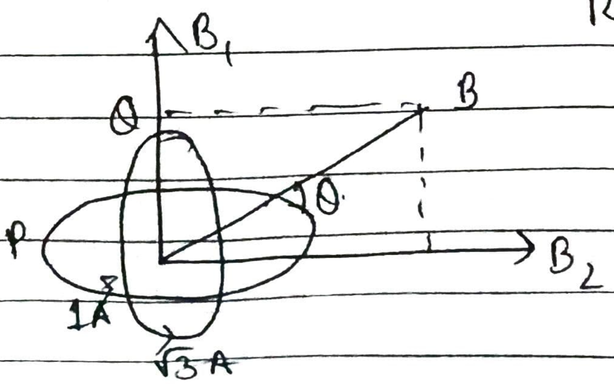
$$B_2 = \frac{\mu_0 \sqrt{3}}{R}.$$

$$B = \sqrt{B_2^2 + B_1^2}$$

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

$$B = \frac{\mu_0}{2R}\sqrt{1+3} = \frac{\mu_0}{2R} \cdot \sqrt{4}$$

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



$$\tan\theta = \frac{B_1}{B_2} = \frac{1}{\sqrt{3}}$$

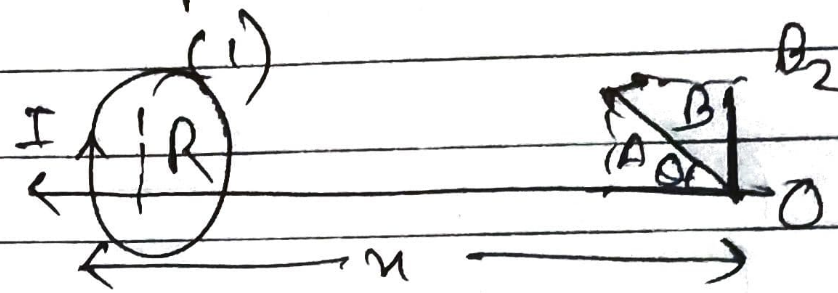
$$\theta = 30^\circ$$

5) Magnetic field at point O, due to circular loop (1).

$B_1 = \frac{\mu_0 I a^2}{2(a^2+x^2)^{3/2}}$, along the axis & towards

the loop (1)
where a is the radius of the

circular loop



magnetic field at point O, due to circular loop (2).

$B_2 = \frac{\mu_0 I a^2}{2(a^2+x^2)^{3/2}}$, along the axis & away.