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Home Assignment

Date:2-7-2021...4-7-2021

PHYSICS

Concept of magnetic field on the axis of a circular current loop(continued)

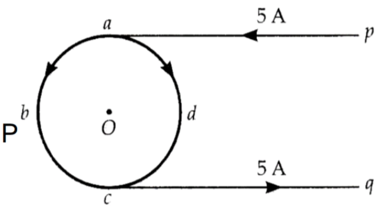
CLASS-XII

SUBJECT : PHYSICS
CHAPTER NUMBER: 04
CHAPTER NAME : MOVING CHARGES AND MAGNETISM

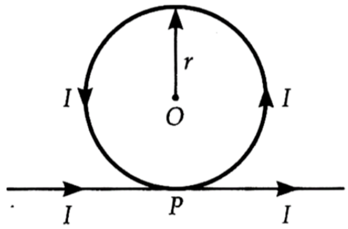
CHANGING YOUR TOMORROW

HOME ASSIGNMENT

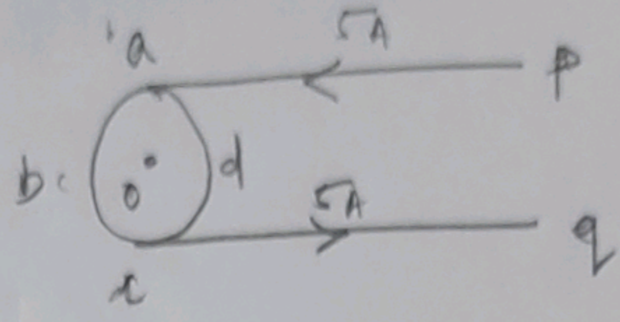
Question1: In figure abcd is a circular coil of the non-insulated thin uniform conductor. Conductors pa and qc are very long straight parallel conductors tangential to the coil at the points a and c. If a current of 5 A enters the coil from P to a, find the magnetic induction at O, the center of the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



Ans!



field due ring at O = 0

due semi infinite wire ab

$B_{ap} = \frac{\mu_0 i}{4\pi r}(\sin\theta_1 + \sin\theta_2)$

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

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

$= 1 \times 10^{-5}$ T

gaven

$B_{dc} = 1 \times 10^{-5}$ T

$B_{net} = B_{ab} + B_{dc} = 2 \times 10^{-5}$ T

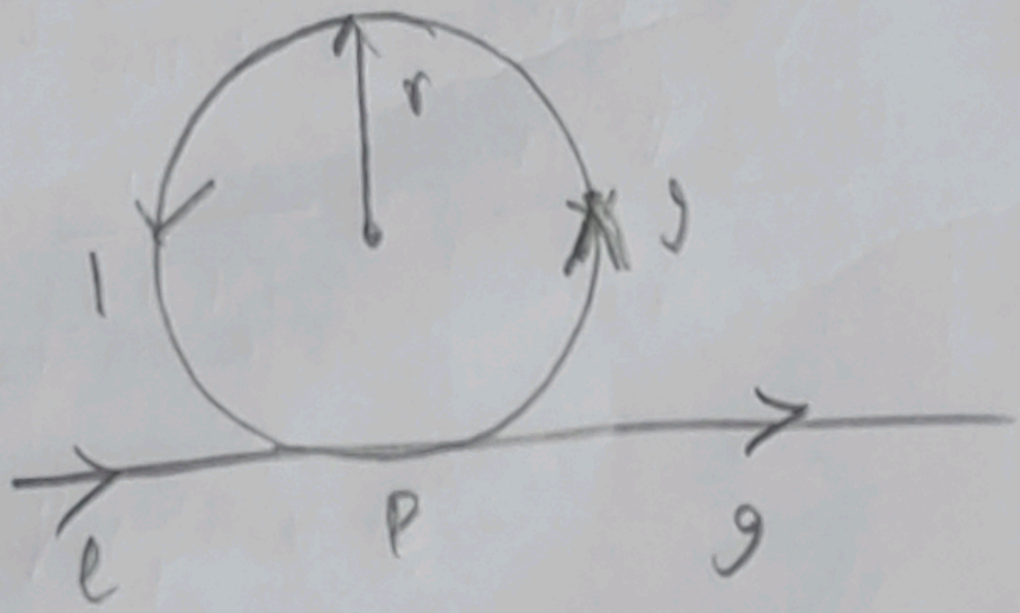
Ans 2

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

$B_{circular}$ " $= \frac{\mu_0 9}{2r}$ ⊙

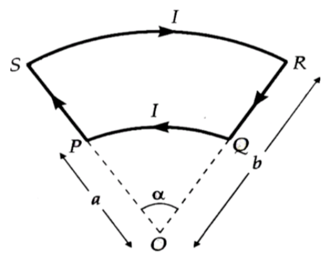
$B_{net} = \left(\frac{\mu_0 9}{2\pi r} + \frac{\mu_0 9}{2r} \right)$ ⊙

$= \frac{\mu_0 9}{2r} \left(1 + \frac{1}{\pi} \right)$ ⊙



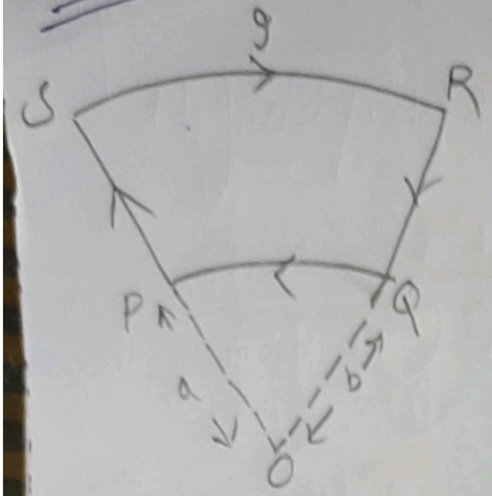
Numerical

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.

Answer 3



Ret = Magnetic field at O. concentric are PQ and RS by.

$$B = \frac{\mu_0 I \theta}{4\pi R} \quad \text{— (i)}$$

θ angle subtended at center.

Magnetic field at O due RS & PQ is 0.

Magnetic field due QP =

$$B_1 = \left(\frac{\theta}{2\pi}\right)\left(\frac{\mu_0 i}{2a}\right) \quad \text{— (ii)}$$

Direction of field vector B₁ is coming out of plane.

Similar

in SR. ie $B_2 = \left(\frac{\theta}{2\pi}\right)\left(\frac{\mu_0 i}{2a}\right)$ — (iii)

B_2 going into plane figure.

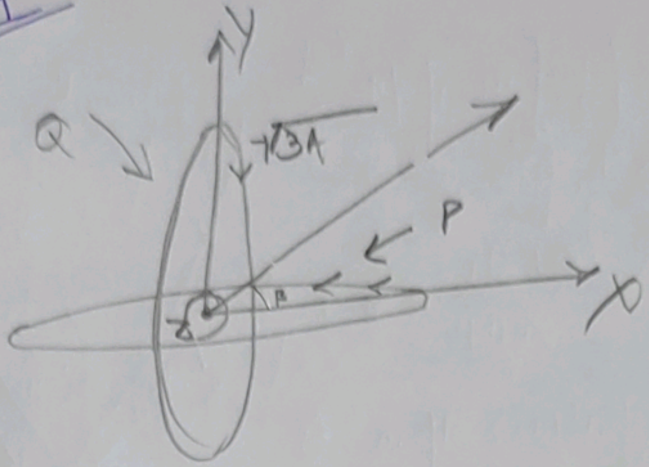
Resultant field at O,

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

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

Thus coming out of plane.

Answer 4



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

So $B_P = \frac{\mu_0 1}{2\pi R} = \frac{\mu_0}{2\pi R}$

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

Now $B = \sqrt{B_p^2 + B_q^2}$

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

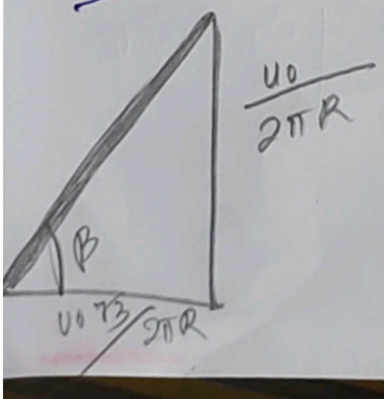
$= \frac{\mu_0}{2\pi R} \sqrt{4}$

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

direction of B

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

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

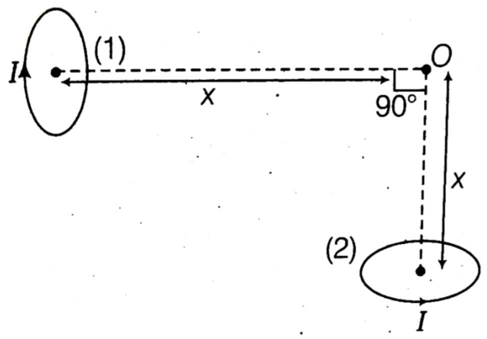


$\beta = 30°$

∴ Direction of net magnet field $= 30°$ along X direction.

Home Assignment

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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Answer 5

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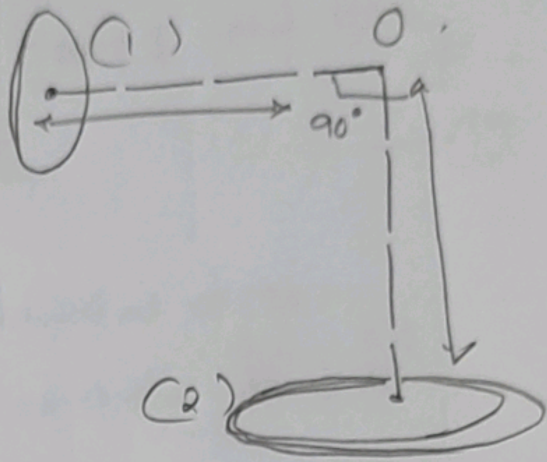
Magnetic field due circular loop



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

$$|\vec{B}| = \frac{\sigma_0 R^2 R}{2(x^2+R^2)^{3/2}}$$

$$|\vec{B}_{net}| = \sqrt{2}\,|\vec{B}| = \frac{\sqrt{2}\,\sigma_0 R^2 I}{2(x^2+R^2)^{3/2}}$$

∴ Magnetic field magnitude $(|\vec{B}_{net}|)$ and direction $= \frac{\sigma_0 R^2 I}{2(x^2+R^2)^{2/3}}$

vector $= \frac{-\hat{i} - \hat{j}}{\sqrt{2}}$


THANK YOU !