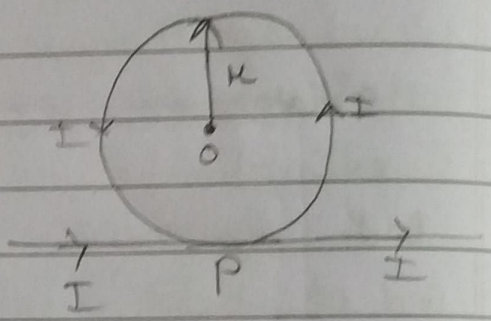
Home Assignment
3rd July

2) A long wire is bent as shown in the figure. What will be the magnitude and direction of the field at the centre 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.



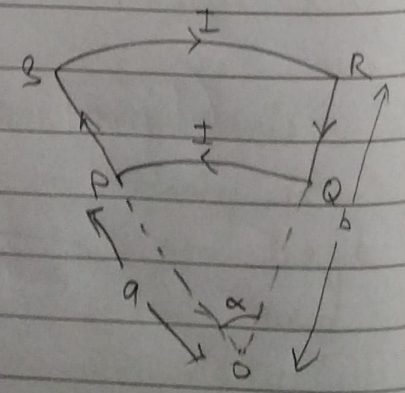
$$\Rightarrow B_1 = \frac{\mu_0 I}{2R}$$

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

$$\frac{\mu_0 I}{2R} + \frac{\mu_0 I}{2\pi R}$$

$$\frac{\mu_0 I}{2R}\left[1 + \frac{1}{\pi}\right]$$

3) Figure shows a current loop having two circular segments and joined by two radial lines. Find the magnetic field at the centre O.



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

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

Bnet

B due to SP & RQ will be zero.

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

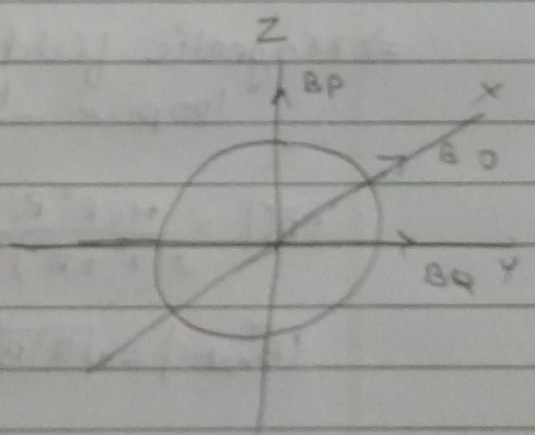
$$\Rightarrow \frac{\mu_0 i \theta}{4\pi ab}(b-a)$$

4) 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.

$\Rightarrow$ Radius = R

$I_P = 1A$

$I_Q = \sqrt{3}A$



for coils in xy and yz planes being mutually perpendicular.

$$B_P = \frac{\mu_0 N I}{2R}$$

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

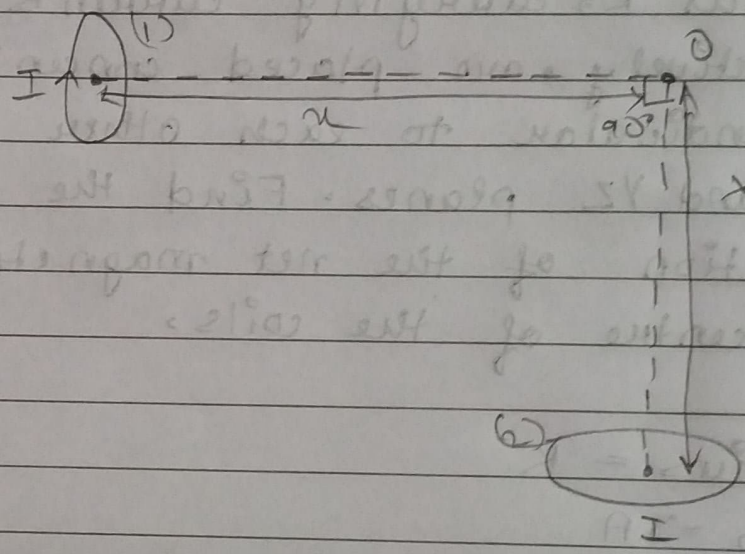
$$B = \sqrt{B_P^2 + B_Q^2}$$

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

$$= \frac{\mu_0 N I}{2R}\sqrt{1+3}$$

$$= \frac{\mu_0 N I}{R}$$

5) Two very small identical circular loop (1) and (2) carrying equal current I are placed vertically 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.



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

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

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

Net magnetic field magnitude ($|\vec{B}_{net}|$) and its direction is $\frac{\mu_0 R^2 I}{\sqrt{2}(x^2+R^2)^{3/2}}$ is along vector $\frac{-\hat{i}-\hat{j}}{\sqrt{2}}$