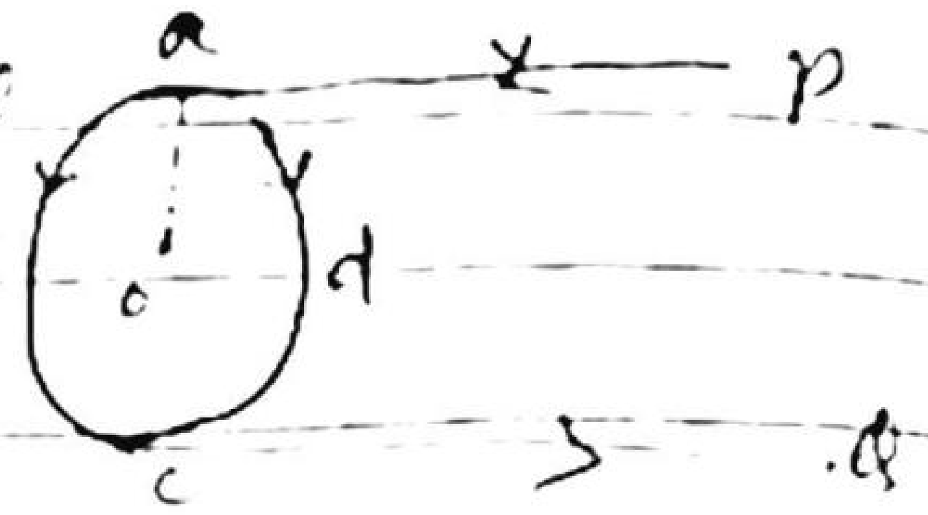
(1) The current in the part abc of the coil is equal to adc of the coil which is equal to 2.5A.



Hence, $r = OA = Od = Ob = OC = 5\ cm = 0.05\ m.$

Magnetic field induction at O due to current through circular coil abcd 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 adc.

Magnetic field induction at O due to current through long straight conductor ap

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

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

outward normally to the plane of paper.

through cQ.

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

$$= 10^{-7} \times \frac{5}{5 \times 10^{-2}} = 10^{-5}\ T.$$

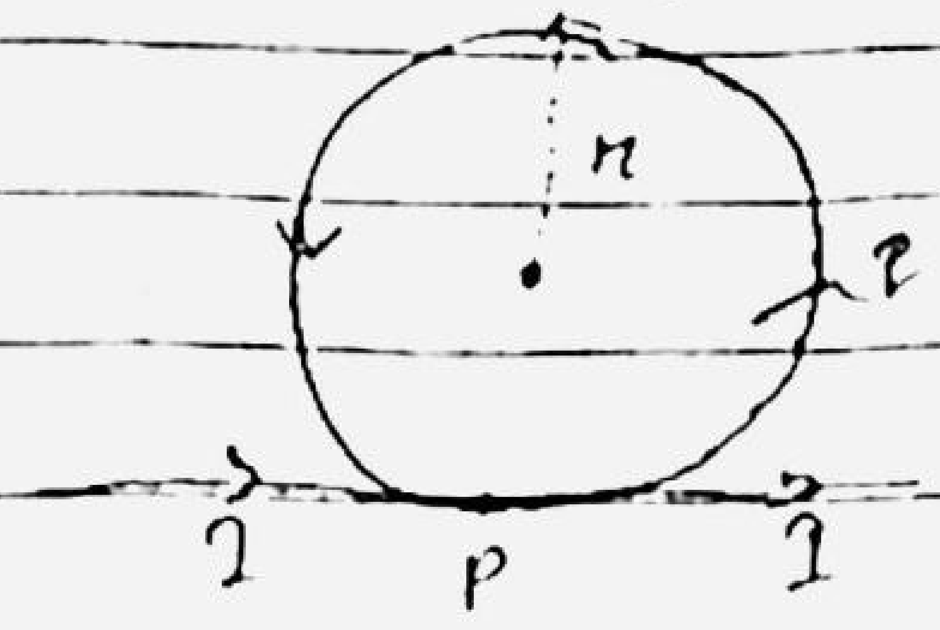
Total magnetic field induction at O

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

(2)

Magnetic field induction at straight line current

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



Magnetic field induction at circular current

$B_{circular\ current} = \frac{\mu_0 I}{2r}$.

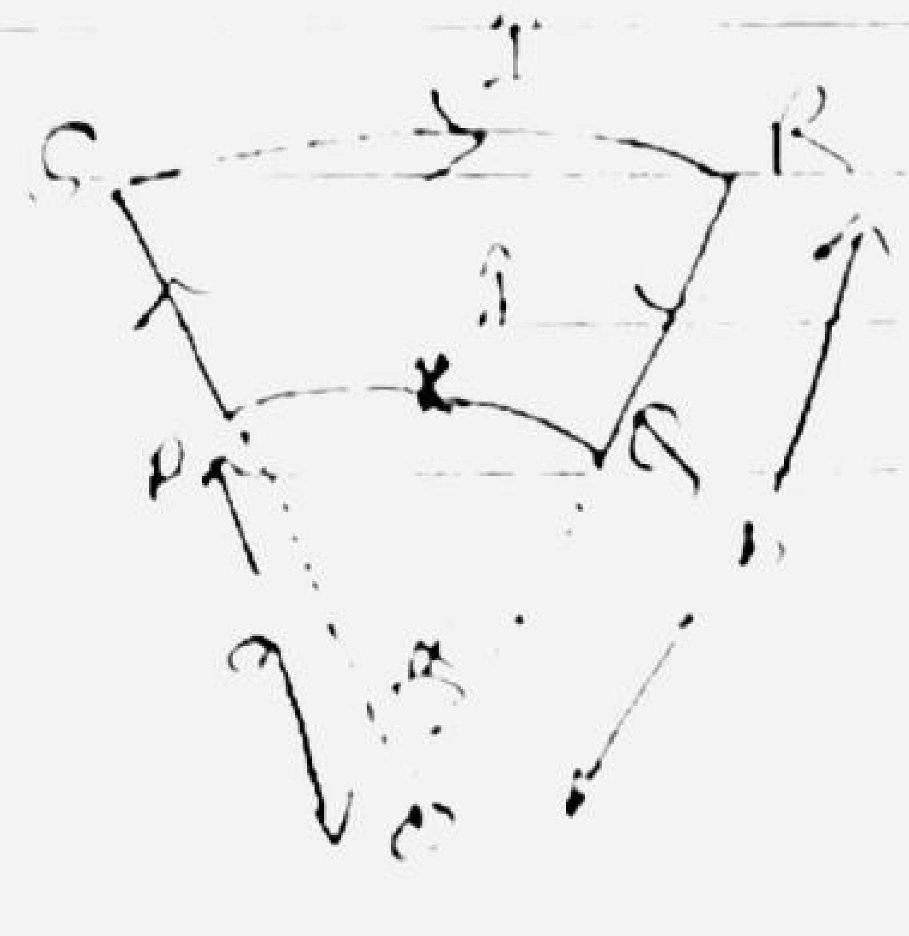
Total magnetic field induction:

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

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

(3)

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



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

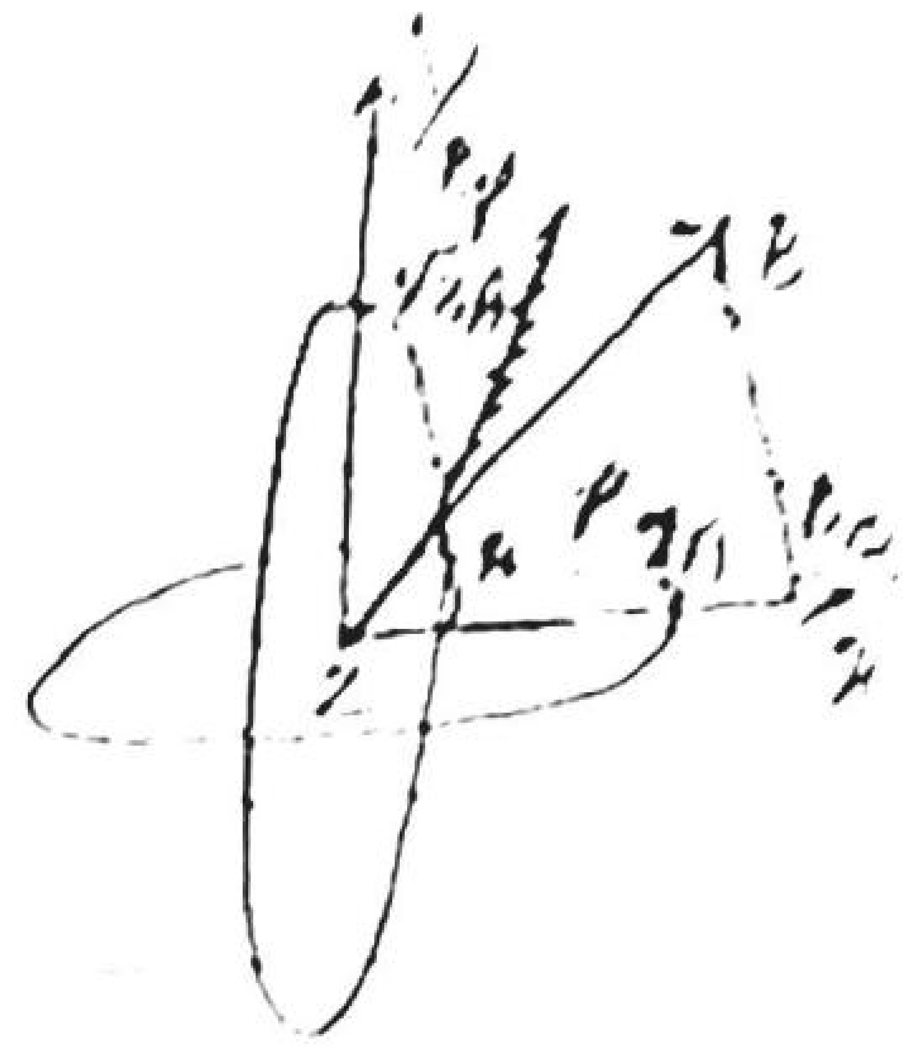
Total Magnetic induction:

B due to SP & RQ will be zero.

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

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

(9)



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

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

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

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

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

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

For direction

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

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

$\beta = 30^\circ$

The direction of net magnetic field is 30° with the x-direction.

5) we know magnetic field due to circular loop.

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

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

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

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

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