1. The current in the part abc of the coil is equal to the current in the part adc of the coil, which is equal to 2.5 A.
Here, $r = Oa = Ob = Oc = Od = 5\text{ cm}$

Magnetic field induction at O due to current through circular coil 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 due to current through segment adc of the coil.

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

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

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

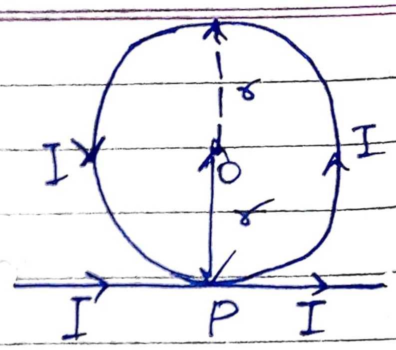
Magnetic field induction at O due to current through long straight conductor cq is

$$B_2 = \frac{\mu_0}{4\pi}\frac{I}{r} = 10^{-7} \times \frac{5}{5 \times 10^{-2}} = 10^{-5}\text{ T}$$

$\therefore$ Total magnetic field induction at O

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

2. $B_{\text{st. line current}} = \dfrac{\mu_0 I}{2\pi r}$



$B_{\text{circular current}} = \dfrac{\mu_0 I}{2r}$

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

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

3. $\vec{B}_{SR} = \dfrac{\mu_0 i}{2b}\left[\dfrac{\alpha}{2\pi}\right](-\hat{k})$

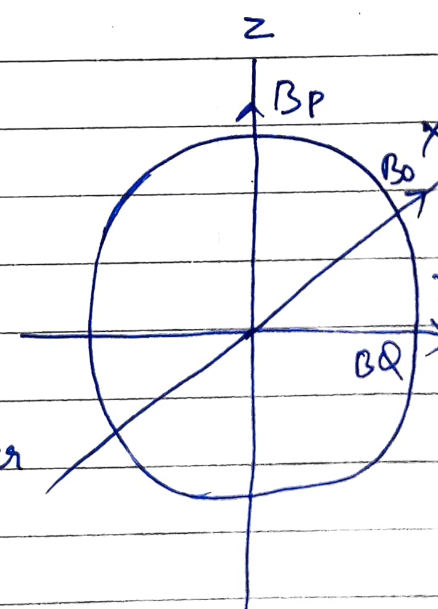
$B_{PQ} = \dfrac{\mu_0 i}{2a}\left[\dfrac{\alpha}{2\pi}\right](-\hat{k})$

$B_{Net} =$

B due to PQ and RS will be zero.

$$= \frac{\mu_0 i\alpha}{4\pi}\left[\frac{1}{a} - \frac{1}{b}\right]$$

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



4. Radius $= R$

$I_p = 1A$

$I_q = \sqrt{3}A$

for coils in xy and yz planes being mutually perpendicular

$B_p = \dfrac{\mu_0 NI}{2R}$, $B_Q = \dfrac{\mu_0 NI\sqrt{3}}{2R}$

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

$$= \sqrt{\left(\frac{\mu_0 NI}{2R}\right)^2 + \left(\frac{\mu_0 NI\sqrt{3}}{2R}\right)^2} = \frac{\mu_0 NI}{2R}\sqrt{1+3}$$

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

5. We know, magnetic field due to circular loop $= \frac{\mu_0}{4\pi} \frac{2\pi R^2 I}{(x^2+R^2)^{3/2}}$

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

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

So net magnetic field magnetic $|\vec{B_{net}}|$ and its direction is $\frac{\mu_0 R^2 I}{\sqrt{2}(x^2+R^2)^{3/2}}$