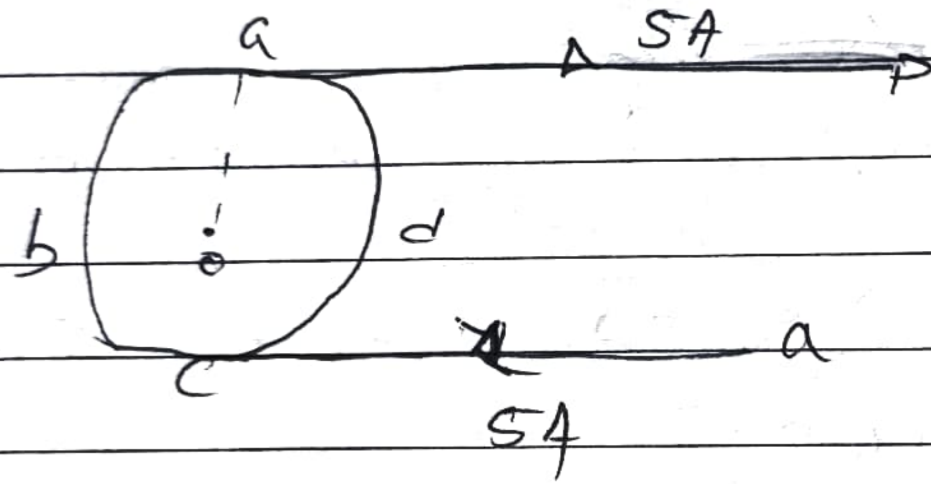
DT. 3rd July

Home Assignment

1.)



Magnetic induction at O due to abc

$$\vec{B_1} = \frac{\mu_0 I}{4r}$$

Magnetic induction at O due to adc

$$\vec{B_2} = \frac{\mu_0 I}{4r}$$

$\vec{B_1}$ & $\vec{B_2}$ are equall and opposite direction
So, magnetic induction due to coil at O is zero.

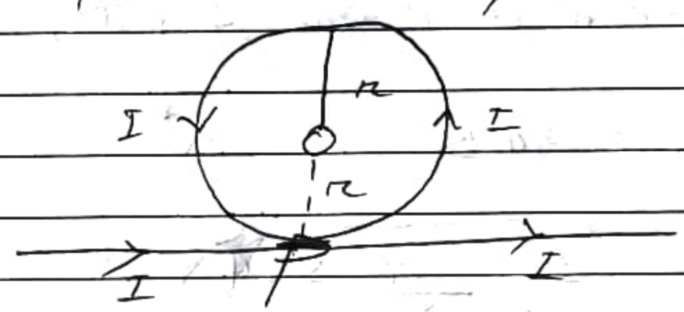
$$B_{AP} = \frac{\mu_0 I}{4\pi a}(\sin\theta_1 + \sin\theta_2)$$

$$= 10^{-7} \times \frac{5}{5\times10^{-2}}(\sin 0^\circ + \sin 90^\circ) = 1\times10^{-5}\,T$$

$B_{BQ} = B_{AP} = 1\times10^{-5}\,T$

$B_{net} = 2\times10^{-5}\,T$ at the center O

2)



B at O due to coil $= \frac{\mu_0 I}{2r}$

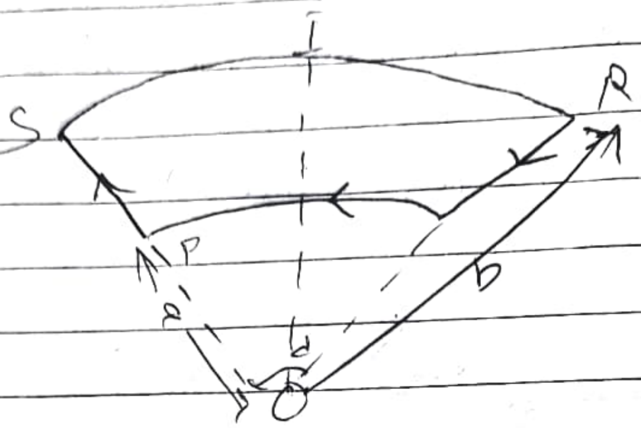
B at O due to straight wire $= \frac{\mu_0 I}{4\pi a}$

$= \frac{\mu_0 I}{4\pi r}$

$B_{net} = \frac{\mu_0 I}{2r} + \frac{\mu_0 I}{4\pi r}$

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

3.)



magnetic field due to SP & RQ at point O = zero as angle betn dl & r = 0° & 180°

magnetic field at O due to PQ,

$$B = \int dB$$

$$= \int \frac{\mu_0}{4\pi} \frac{I dl}{r^2} \sin\theta$$

$$= \frac{\mu_0}{4\pi} \frac{I}{r^2} \int dl$$

$$= \frac{\mu_0}{4\pi} \frac{I}{r^2} r\theta$$

$$= \frac{\mu_0 I \alpha}{4\pi r}$$

B at O $= \dfrac{\mu_0 I \alpha}{4\pi a}$ Now, $\theta = \alpha$, $r = a$

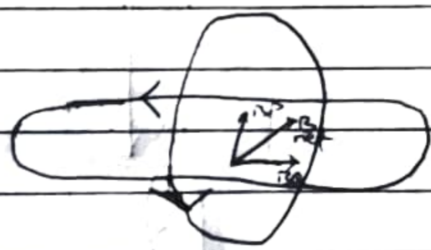
magnetic field at O due to SR, $= \frac{\mu_0 I \theta}{4r}$

$$\vec{B} = \frac{\mu_0 I \alpha}{4\pi b} \qquad R = b, \quad \theta = \alpha$$

$$= \frac{\mu_0 I \alpha}{4\pi a} - \frac{\mu_0 I \alpha}{4\pi b}$$

$$B_{net} = \frac{\mu_0 I \alpha}{4\pi}\left(\frac{b-a}{ab}\right)$$

4.)



Magnetic field at the centre of a closed loop $= \frac{\mu_0 I}{2r}$

$$B_{net} = \sqrt{(B_P)^2 + (B_Q)^2}$$

$$= \sqrt{\left(\frac{\mu_0 I_P}{2r}\right)^2 + \left(\frac{\mu_0 I_Q}{2r}\right)^2}$$

$$= \frac{\mu_0}{2R}\sqrt{I_P^2 + I_Q^2}$$

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

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

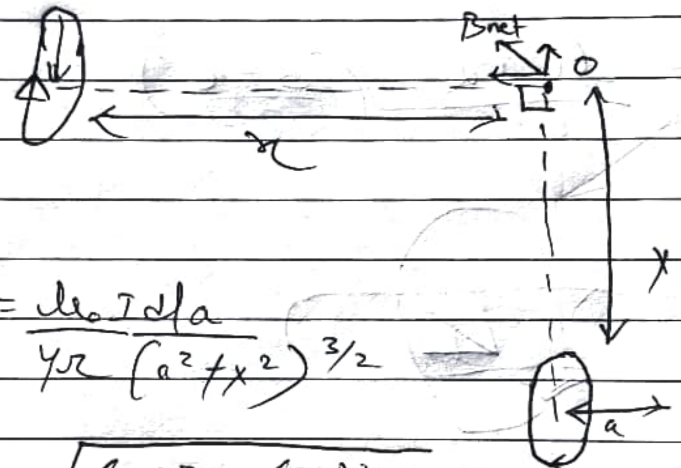
$$= \frac{\mu_0}{\cancel{2}R} \times \cancel{2} = \frac{\mu_0}{R}$$

Resultant magnetic field, makes an angle θ with B_Q which is given by

$$\tan\theta = \frac{B_P}{B_Q} = \frac{I_P}{I_Q} = \frac{1}{\sqrt{3}}$$

$$\theta = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right) = 30^\circ$$

Q.5)



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

$$B_{net} = \sqrt{(B_1)^2 + (B_2)^2 + 2B_1B_2 \cos\theta}$$

$$= \sqrt{(B_1)^2 + (B_2)^2}$$

$$B_{net} = \sqrt{B^2 + B^2}$$

$$= \sqrt{2}\,|B|$$

$$= \sqrt{2} \times \frac{\mu_0}{4\pi} \frac{I dl a}{(a^2+x^2)^{3/2}}$$

$$= \sqrt{2} \times \frac{\mu_0}{2} \frac{I a^2}{(a^2+x^2)^{3/2}}$$

$$= \frac{\mu_0 I a^2}{\sqrt{2}(a^2+x^2)^{3/2}}$$

$\hat{B}_2 = \hat{j}$, let $\vec{B}_2 = 1\hat{j}$

$\hat{B}_1 = -\hat{i}$, let $\vec{B}_1 = -1\hat{i}$

$\vec{B}_{net} = -\hat{i} + \hat{j}$

$$\hat{B}_{net} = \frac{\vec{B}}{|\vec{B}_{net}|} = \frac{-\hat{i} + \hat{j}}{\sqrt{2}}$$

Direction is along the vector, $\frac{-\hat{i} + \hat{j}}{\sqrt{2}}$