Home Assignment 2/07/21

(1) $r = 0.05m$

The magnetic ~~diel~~ field induction at O due to current through circular coil abcd ~~coil~~ will be zero. ~~Because~~ Because magnetic field induction at O due to current through segment abc of the coil is equal and opposite to that adc

B induction due to current through long straight conductor

$$B_1 = \frac{\mu_0}{4\pi}\frac{I}{r}(\sin 90^\circ + \sin 0^\circ) = \frac{1}{2}\frac{\mu_0 I}{2\pi r} =$$

~~out~~ To

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

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

Total magnetic field induction at O

$B = B_1 + B_2 = 10^{-5} + 10^{-5} = \boxed{2 \times 10^{-5}}$ Normally outward to the plane of paper

(2) Field due to straight Conductor

$B_1 = \frac{\mu_0 I}{2\pi r}$, up the plane of the paper

Field due to circular loop at point O

$B_2 = \frac{\mu_0 I}{2r}$, up the plane of paper

Total $B_1 + B_2 = \frac{\mu_0 I}{2\pi r} + \frac{\mu_0 I}{2r} = \boxed{\frac{\mu_0 I}{2r}\left(1 + \frac{1}{\pi}\right)}$

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(3) $B_1 = \frac{\mu_0}{4\pi} \frac{i}{a}$ (outward) $B_2 = \frac{\mu_0}{4\pi} \frac{i\alpha}{b}$ (inward)

$B_3 = 0$ $B_4 = 0$ } O is along straight wire

$B_{net} = B_1 - B_2 = \frac{\mu_0 I\alpha}{4\pi}\left[\frac{1}{a} - \frac{1}{b}\right]$

$$\boxed{B = \frac{\mu_0 I\alpha (b-a)}{4\pi a b}}$$

(4)

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

$B_2 = \frac{\mu_0 I}{2\pi R} = \frac{\mu_0 \sqrt{3}}{2\pi R}$

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

$= \frac{\mu_0}{2\pi R}\sqrt{4} = \boxed{\frac{\mu_0}{4R}}$ $\tan B = \frac{AB}{B} = \frac{\frac{\mu_0}{2\pi R}}{\frac{\mu_0\sqrt{3}}{2\pi R}} = \frac{1}{\sqrt{3}}$

$\boxed{B = 30^\circ}$ Ans

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

(5)

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

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

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