Home Assignment

1. Magnetic field at a point O due to straight conductor is

$$B_1 = \frac{1}{2}\left[\frac{\mu_0 I}{4\pi R}\right]$$

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

Similarly magnetic field at a point O due to straight conductor OC

$$B_2 = \frac{\mu_0 I}{4\pi \cdot 2} = 10^{-5}\ T$$

Both the magnetic fields B_1 and B are acting normally out of plane of paper. So, total magnetic field 'B' is

$$B = B_1 + B_2$$

$$= 10^{-5} + 10^{-5}$$

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

2. Magnitude of the magnetic field at O due to the straight part of the wire

$B_1 = \frac{\mu_0}{2\pi} \cdot \frac{I}{R}$ normally out of plane of paper, magnetic field at O due to current loop of radius is $B_2 = \frac{\mu_0 I}{2R}$

normally into the plane of paper

Resultant field at O is

$B = B_2 - B_1 = \frac{\mu_0 I}{2r}\left(1 - \frac{1}{\pi}\right)$

normally into plane of paper

3. Magnetic field due to slide lines will be zero as they exist on same line

Due to circular arc

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

Here for r = a

$$\vec{B}_1 = \frac{\mu_0 I \theta}{4\pi a} \text{ (outside)}$$

For r = b

$$B_2 = \frac{\mu_0 I \theta}{4\pi b} \text{ (inside)}$$

Net Magnetic field

$$B = B_1 - B_2$$

$$= \frac{\mu_0 I \theta}{4\pi}\left(\frac{1}{a} - \frac{1}{b}\right)$$

4. $B = \frac{\mu_0}{2R} I$

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

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

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

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

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

$= \frac{\mu_0}{2R} (2)$

$\tan\theta = \frac{B_1}{B_2} = \frac{1}{\sqrt{3}}$

$\theta = 30^\circ$

5. Magnetic field at point O due to circular loop

$$B_1 = \frac{\mu_0 I a^2}{2(a^2+x^2)^{\frac{3}{2}}}$$ along the axis, towards loop(1)

where a is the radius of circular loop

Magnetic field at O due to circular loop (2)

$$B_2 = \frac{\mu_0 I a^2}{2(a^2+x^2)^{\frac{3}{2}}}$$ along the axis, away from the loop(2)

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

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