PHY112

Assignment-03

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Section : 02

Course code : PHY112

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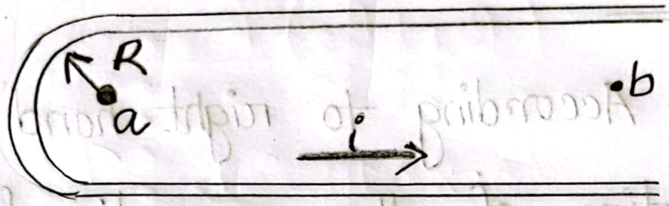
signature

Chapter - 29

* Problem - 5

Solution:

(a)



we know,

for semi-infinite straight-wire,

$$B_a = \frac{\mu_0 i}{4\pi R}$$

[direction, $\vec{B}$ = out of the page]

Here,
current, $i = 10A$
radius, $R = 5.0mm$

Now,

according to the figure,

$$B_a = 2\left(\frac{\mu_0 i}{4\pi R}\right) + \frac{\mu_0 i\pi}{4\pi R}$$

$$= \frac{\mu_0 i}{2R}\left(\frac{1}{\pi} + \frac{1}{2}\right)$$

$$= \frac{(4\pi \times 10^{-7})(10)}{2 \times (0.0050)} \times \left(\frac{1}{\pi} + \frac{1}{2}\right)$$

$$= 1.02 \times 10^{-3}\ T$$

(Ans:)

* Problem- 5

Solution:-

b) According to right hand rule, the direction of the magnetic field at the center due to the current in the wire; the field is $\boxed{\text{out of the page.}}$

(Ans:)

c)
$$B_b = 2\left(\frac{\mu_0 i}{2\pi R}\right)$$

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

$$= \frac{4\pi \times 10^{-7} \times 10}{3.1416 \times 0.0050}$$

$$= 8.0 \times 10^{-4}\ T$$ (Ans:)

d) The direction of $\vec{B}$ at b is also points out of the page.

(Ans:)

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* Problem – 66

a

Given information →

Given,

y or $r_1 = 10$ cm $= 0.01$ cm

$r_2 = 5$ cm $= 0.05$ cm

$I_1 = 6A$

$I_2 = 10$ A

we know,

for wire 1,

$$B_1 = \frac{\mu_0 i_1}{2\pi r_1}$$

$$= \frac{4\pi \times 10^{-7} \times 6 \times 100}{2\pi \times 10}$$

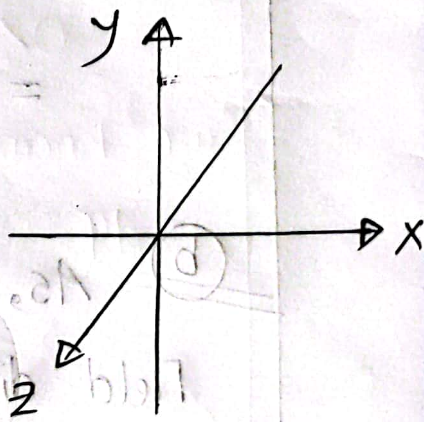
$$= 12 \times 10^{-6} \ T$$

for wire 2,

$$B_2 = \frac{\mu_0 I_2}{2\pi r_2}$$

$$= \frac{4\pi \times 10^{-7} \times 10 \times 100}{2\pi \times 5}$$

$$= 4 \times 10^{-5} \ T$$



Here,
fields from both wires in the same direction ($-k$ unit vector).

$\therefore$ the net field vector,

$$\vec{B} = -(B_1 + B_2)\hat{K} = -\frac{\mu_0 i_A}{2\pi r_A}\hat{K} - \frac{\mu_0 i_B}{2\pi r_B}$$

$$= -5.2 \times 10^{-5}\hat{K} \quad T$$

$$= -(52.0 \times 10^{-6} T)\hat{K} \qquad \text{(Ans:)}$$

for vector direction,

(b) As,

Field direction between given two wires are opposite.

let,

r be the distance from wire→2 and distance between wires $= 5 \, cm$

$\therefore$ The magnitudes are equal and,

$$\vec{B} = 0$$

Now,

$$\frac{10}{r} = \frac{6}{5-r}$$

$\Rightarrow r = 3.12$ cm

And,

$$y = 15 + r$$

$\Rightarrow r = 8.12$ cm

$\Rightarrow r = 0.0812$ m

(Ans:)

$r_B < y < r_A$

$$\therefore \frac{\mu_0 i_A}{2\pi y - r_A} = \frac{\mu_0 i_B}{2\pi y - r_B}$$

(c) As per the question of (c),

$$\frac{\mu_0 i_A}{2\pi y - r_A} = \frac{\mu_0 i_B}{2\pi y - r_B}$$

$$\Rightarrow 6/r = \frac{10}{5+r}$$

$\Rightarrow r = 7.5$ cm

And, $y = 10 + r$

$= 17.5$ cm

$= 0.0175$ m (Ans:)

$y > 10$ cm,

let,

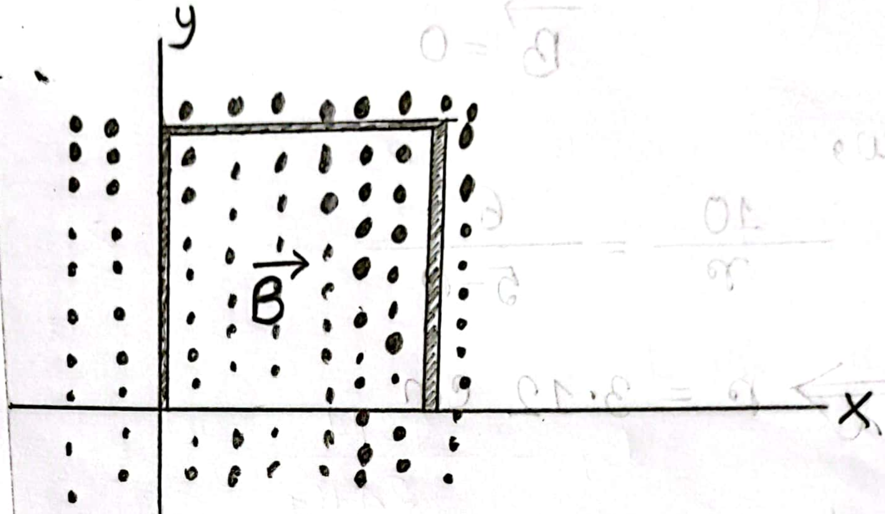
r = distance from wire 1

distance between wires = 5 cm

Chapter - 30

* Problem - 27

Solution:



(a) Let,

We consider a small area of height, dy and width, $l = 0.020\ m = 2.0\ cm$

Here, $0 < y < l$.

We know,

$d\varphi_B = \vec{B} \cdot dA$

$= (4t^2y) \cdot (l \cdot dy)$

Given,

$B = 4.0\, t^2 y$

$t = 2.5\, s$

We need to calculate with intigration.

$\therefore \varphi_B = \int d\varphi_B$

$= \int_0^l (4t^2yl) \cdot dy \quad [l = 0.020\ m]$

$= 2t^2l^3$

Hence,

According to Faraday's law,

$$|\varepsilon| = \left|\frac{d\varphi_B}{dt}\right|$$

$$= 4tl^3$$

∴ At $t = 2.5$ sec,

the magnitude of the emf (induced)

will be $= 4tl^3$

$$= 4 \times 2.5 \times (0.020)^3$$

$$= 8 \times 10^{-5}\ V$$ (Ans:)

(b) Here,

B increases, the current direction is clockwise

So, according to the Lenz's Law,

the induced emf direction is clockwise.

(Ans:)

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