IQRA NATIONAL UNIVERSITY

Elecromagnetic Field Theory

Final Term Assignment Summer 2020

Name: Kaleem Ullah

ID: 13170

Submitted to: Dr. Rafiq Mansoor Sir

ID# 13170

=> Question No (1)

=> Part (A)

Determine the magnetic field at the center of Semicircular piece of wire with radius 0.20m The current carried by the Semicircular of wire is 150 A

Solution:- The radius of the Semicircular Piece of wire = 0.2 m

=> Current carried by Semicircular Piece of wire = 150A

Magnetic field is given as

$$B = \frac{\mu_0 N I}{2a}$$

=> The difference between Biot-Savart Law is given by

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$$\Rightarrow \quad dB = \frac{\mu_0 I}{4\pi} \frac{dI \sin\theta}{r^2}$$

$$B = \frac{\mu_0 I}{4\pi} \int \frac{d\bar{I} \times \hat{r}}{r^2}$$

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

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

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

$$= \frac{4\pi \times 10^{-7}\ \bar{T}\cdot m/A\,(150A)}{4(0.20m)}$$

$$= \boxed{2.4 \times 10^{-4}\ \bar{T}}$$

Answer.

=> Question No (1)

=> Part (B)

Find the force between two charges when they are brought in contact and seperated by 4cm apart charges are 2Nc and -1nc in liN.

Solution :-

=> Before the charges are brought into contact.

F= 11.234 liN

=> After the charges are brought into contact and then seperated.

=> Charge on each sphere is.

$(q1 + q2)/2 = 0.5nC$

⇒ on calculating the force with

$q_1 = q_2 = 0.5\ nC$

So,

$$F = 1.404\ \mu N$$

Answer.

⇒ Question No (2)

⇒ Part (A)

Compute the magnetic field of a long striaght that has a circular loop with radius of 0.05m 2 amp is the reading of the current flowing through this closed loop.

Solution:- Given that

$$\text{Radius} = R = 0.05m$$

$$I = 2amp$$

$$\mu_0 = 4\pi \times 10^{-7}\ N/A^2$$

⇒ Ampere's Law formula is that

$$\oint \vec{B}\ d\vec{l} = \mu_0 I$$

In this case of long striaght wire

$$\oint d\vec{l} = 2\pi R$$

$\Rightarrow \quad = 2 \times 3.14 \times 0.05$

$= \boxed{0.314}$

$$B \oint \vec{dI} = \mu_0 I$$

$$\vec{B} = \frac{\mu_0 I}{2\pi R}$$

$$\vec{B} = \frac{4\pi \times 10^{-7} \times 2}{0.314}$$

$$\boxed{\vec{B} = 8 \times 10^{-6} \ T}$$ Answer.

⇒ Question No (2)

⇒ Part (B)

Determine the Charge that Produce an electri field Strength of 40 v/cm at a distance of 30cm in vaccum (in $10^{-8}c$).

Solution:- As we know

$$E = Q / (4\pi \varepsilon_0 v^2)$$

Putting values

$$Q = (4000 \times 0.3^2)(9 \times 10^9)$$

Then,

$$Q = 4 \times 10^{-8} c$$

in vaccum

Answer.

⇒ Question No (3)

⇒ Part (A)

Given the time varying magnetic field $B = (0.5a_x + 0.6a_y - 0.3a_z)\cos 5000t\ T$ and a square filamentary loop with its corner at (2, 3, 0), (2, -3, 0) and (-2, -3, 0) find the time varying current flowing in the general a_ϕ direction if the total loop resistance is 400 kΩ.

Solution :-

Then,

$$EMF = \oint E \cdot dL = -\frac{d\phi}{dt} = -\frac{d}{dt}\iint_{Loop\ area}$$

$$B \cdot a_z\, da = \frac{d}{dt}(0.3)(4)(6)\cos 5000t$$

⇒ Where the loop normal is chosen as positive a_z, so that the path

⇒ integral for E is taken around the positive a ϕ direction

⇒ Taking the derivative, we find

$EMF = -7.2\,(5000)\sin 5000t$ so that

$$I = \frac{emf}{K} = \frac{-36000 \sin 5000t}{400 \times 10^3}$$

$$= -90 \sin 5000t \text{ mA}$$

Answer.

Thank You