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x ~~ * ~~ x

Q1 :-
a)- Radius of wire = 0.20m
current carried = 150 A

So:-
As we know magnetic field is given as:

$$B = \mu_0 NI/2a$$

Differential form of Biot-Stavart Law

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

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

$$B = \mu_0/4\pi \; I/r^2 \int dI.$$

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

x —— x —— x

Q1:-
b). The radius of circular coil = 5×10^{-2} m
No! of turns " " " = 40.
current carried by " " = 0.25A
Magnetic field $B = \frac{\mu_0 NI}{2a}$

$$= \frac{4\pi \times 10^{-7} T.m/A (40) 0.25 A}{2.50 \times 10^{-2} m}$$

$$= (1.2 \times 10^{-4} T)$$

x —— ~~ * ~~ —— x

Q2:-

a)-

$R = 0.05m$

$I = 2 amp.$

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

Using Ampere Law

$\oint \vec{B} \cdot \vec{dl} = \mu_o I.$

In the case of long straight wire

$\oint \vec{dl} = 2\pi R = 2 \times 3.14 \times 0.05$

$= 0.314$

$B \oint \vec{dl} = \mu_o I.$

$\vec{B} = \mu_o I / 2\pi R$

$\vec{B} = \frac{4\pi \times 10^{-7}}{0.314} \times 2 = (8 \times 10^{-6} T)$

x ——— x ——— x

Q2:-

b)-

Substituting the given point, we find

$V_p = 279.9V$. Then

$E = -\nabla V = -\frac{\partial V}{\partial \rho} a_\rho - \frac{1}{\rho} \frac{\partial V}{\partial \phi} a_\phi$

$= -[50 + 150 \sin\phi] a_\rho - [150 \cos\phi] a_\phi$

Evaluate:-

the above ρ to find E_p.

$= -179.9 a_\rho - 75.0 a_\phi - 75.0 a_\phi \; V/m$

Now:-

$D = \epsilon_0 E$, so $D_p = -1.59 a_\rho - .664 a_\phi \; nC/m^2$

$\rho_v = \nabla \cdot D = \left(\frac{1}{\rho}\right) \frac{d}{d\rho} (\rho D_\rho) + \frac{1}{\rho} \frac{\partial D_\phi}{\partial \phi}$

$= \left[-\frac{1}{\rho} (50 + 150 \sin\phi) + \frac{1}{\rho} 150 \sin\phi\right] \epsilon_0$

$= \frac{-50}{\rho} \epsilon_0 C$

At P_1 $P_v P = -443 \, pC/m^3$.

x —— x —— x

Q3:-

a)- $emf = \oint E \cdot dL = \frac{d\Phi}{dt} = \frac{-d}{dt}\int_{\text{loop area}} B \cdot a_z \, da =$

$\frac{d}{dt}(0.3)(4)(6) \times \cos 5000t$.

where loop normal is chosen as +ive a_z, so integral for E is taken around the +ive a_ϕ direction.

Taking the deravative, we find

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

$I = emf/R$

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

$= (-90 \sin 5000t \; mA)$.