3 Time Varying Fields and Maxwell's Equations

Multiple Choice Questions

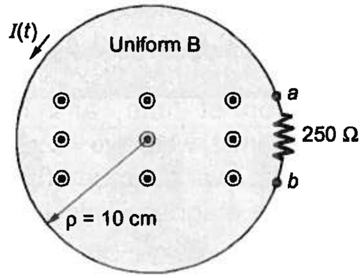
Q.1 A varying magnetic flux linking a coil is given by $\phi = \frac{1}{3}\lambda t^3$. If at time $t = 3$s, the emf induced is 9 V, then the value of λ is

(a) zero (b) 1 Wb/s^2
(c) -1 Wb/s^2 (d) 9 Wb/s^2

Q.2 If the electric field $\bar{E} = 0.1te^{-t}\hat{a}_x$ and $\varepsilon = 4\,\varepsilon_o$; then the displacement current carrying an area of 0.1 m^2 at $t = 0$ will be

(a) zero (b) $0.04\,\varepsilon_o$
(c) $0.4\,\varepsilon_o$ (d) $4\,\varepsilon_o$

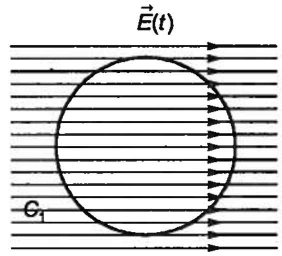
Q.3 Consider the figure shown below. Let $B = 10\cos 120\pi t$ Wb/m² and assume that the magnetic field produced by $I(t)$ is negligible.



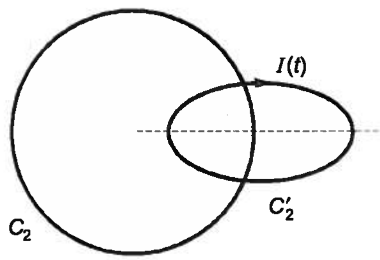
The value of V_{ab} is

(a) $-118.43\cos 120\pi t$ V
(b) $118.43\cos 120\pi t$ V
(c) $-118.43\sin 120\pi t$ V
(d) $118.43\sin 120\pi t$ V

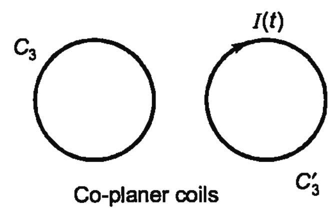
Q.4 Consider coils C_1, C_2, C_3 and C_4 (shown in the following figures) which are placed in the time-varying electric field $\bar{E}(t)$ and electric field produced by the coils C_2', C_3' and C_4' carrying time varying current $I(t)$ respectively.

1.


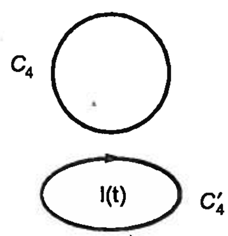
Time varying electric field $\vec{E}(t)$ parallel to the plane of coil C_1

2.


Coil planes are orthgonal

3.


Co-planer coils

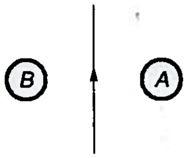
4.


Coil-planes are orthogonal

The electric field will induce an emf in the coils

(a) C_1 and C_2 (b) C_2 and C_3
(c) C_1 and C_3 (d) C_2 and C_4

Q.5 A straight current carrying conductor and two conducting loops A and B are shown in the given figure. If the current in the straight wire is decreasing the induced currents in the two types "A" and "B" will be



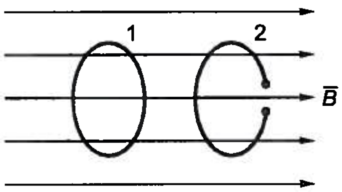
(a) clockwise in both A and B
(b) anticlockwise in both A and B
(c) anticlockwise in A and clockwise in B
(d) clockwise in A and anticlockwise in B

Q.6 Two identical co-axial circular loops carry the same current circulating in the same direction. If the loops approached each other, then the current in
(a) each one of them will increase
(b) both of them will remain the same
(c) each one of them will decrease
(d) one will increase while in the other the current will be decreased.

Q.7 A parallel plate air-filled capacitor has plate area of 10^{-4} m^2 and plate separation of 10^{-3} m. It is connected to a 0.5 V, 3.6 GHz source. The magnitude of the displacement current is ($\varepsilon_0 = 1/36\pi \times 10^{-9}$ F/m)

(a) 10 mA (b) 100 mA
(c) 10 A (d) 1.59 mA

Q.8 Two conducting coils 1 and 2 (identical except that 2 is split) are placed in a uniform magnetic field which decreases at a constant rate as in the figure. If the planes of the coils are perpendicular to the field lines, the following statements are made:



1. an e.m.f. is induced in the split coil 2
2. e.m.fs are induced in both coils
3. equal Joule heating occurs in both coils
4. Joule heating does not occur in any coil

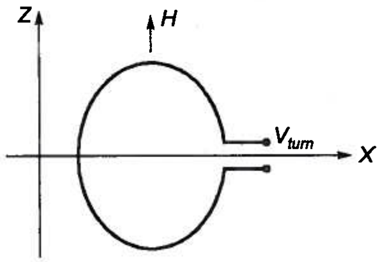
Which of the above statements is/are true ?

(a) 1 and 4 (b) 2 and 4
(c) 3 only (d) 2 only

Q.9 A loop is rotating about the y-axis in a magnetic field $\vec{B} = B_0 \cos(\omega t + \phi)\vec{a}_x T$. The voltage in the loop is
(a) zero
(b) Due to rotation only
(c) due to transformer action only
(d) due to both rotation and transformer action

Numerical Data Type Questions

Q.10 A circular turn of radius 1 m revolves at 60 rpm about its diameter aligned with the x-axis as shown in the figure. The value of μ_0 is $4\pi \times 10^{-7}$ in SI unit. If a uniform magnetic field intensity $\vec{H} = 10^7 \hat{z}$ A/m is applied, them the peak value if the induced voltage, V_{turn} (in Volts), is ________.



Q.11 Consider a one-turn rectangular loop of wire placed in a uniform magnetic field as shown in the figure. The plane of the loop is perpendicular to the field lines. The resistance of the loop is 0.4 Ω, and its inductance is negligible. The magnetic flux density (in Tesla) is a function of time, and is given by $B(t) = 0.25 \sin\omega t$, where $\omega = 2\pi \times 50$ radian/second. The power absorbed (in Watt) by the loop from the magnetic field is ________.