

Practise Set-1

1. The x - and z -components of a static magnetic field in a region are $B_x = B_0 (x^2 - y^2)$ and $B_z = 0$, respectively. Which of the following solutions for its y -component is consistent with the Maxwell equations?

[NET/JRF-(JUNE-2016)]

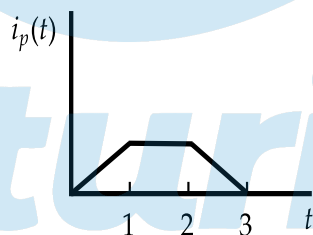
- | | |
|---|--|
| <p>a. $B_y = B_0 xy$</p> <p>c. $B_y = -B_0 (x^2 - y^2)$</p> | <p>b. $B_y = -2B_0 xy$</p> <p>d. $B_y = B_0 (\frac{1}{3}x^3 - xy^2)$</p> |
|---|--|

Solution:

$$\begin{aligned}
 B_x &= B_0 (x^2 - y^2), B_z = 0 \\
 \therefore \vec{\nabla} \cdot \vec{B} &= 0 \Rightarrow \frac{\partial B_x}{\partial x} + \frac{\partial B_y}{\partial y} + \frac{\partial B_z}{\partial z} = 0 \Rightarrow \frac{\partial B_y}{\partial y} \\
 &= -\frac{\partial B_x}{\partial x} = -2B_0 x \Rightarrow B_y = -2B_0 xy
 \end{aligned}$$

So the correct answer is **Option (b)**

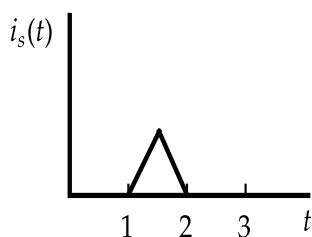
2. A current i_p flows through the primary coil of a transformer. The graph of $i_p(t)$ as a function of time t is shown in the figure below.



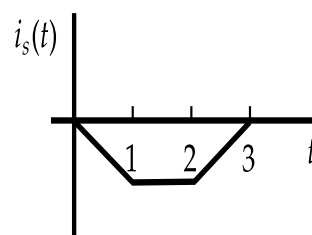
Which of the following graphs represents the current i_s in the secondary coil?

[NET/JRF(JUNE-2014)]

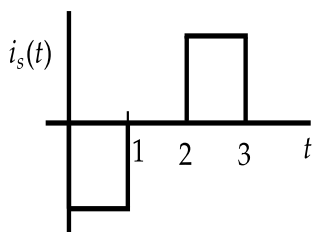
a.



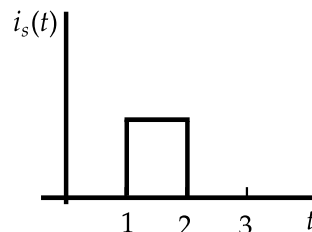
b.



c.



d.

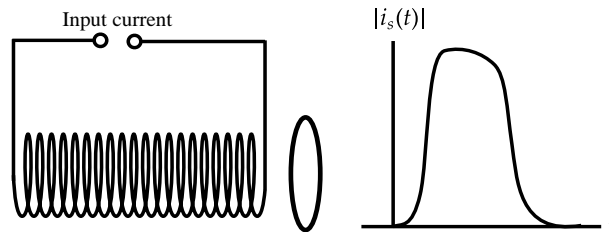


Solution:

$$i_s \propto -\frac{di_p}{dt}$$

So the correct answer is **Option (c)**

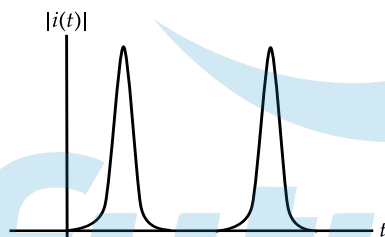
3. A circular conducting wire loop is placed close to a solenoid as shown in the figure bellow. Also shown is the current through the solenoid as a function of solenoid as a function of time.



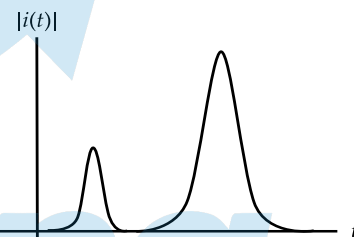
The magnitude $|i(t)|$ of the induced current in the wire loop, as a function of time t , is best represented as.

[NET/JRF(DEC-2019)]

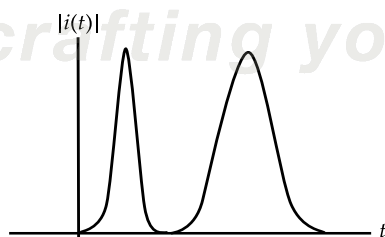
a.



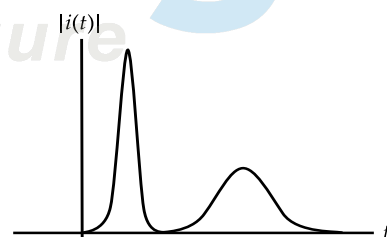
b.



c.



d.



Solution:

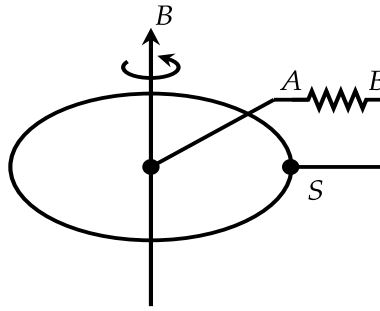
$$\text{Induced e.m.f } \varepsilon = -\frac{d\phi}{dt}, \quad |I(t)| = \frac{|\varepsilon|}{R} \propto \left| \frac{dI_s}{dt} \right|$$

So when current increases, $|I(t)|$ will increase and when it will decrease $|I(t)|$ will decrease.

So the correct answer is **Option (d)**

4. A horizontal metal disc rotates about the vertical axis in a uniform magnetic field pointing up as shown in the figure. A circuit is made by connecting one end A of a resistor to the centre of the disc and the other end B to its edge through a sliding contact. The current that flows through the resistor is

[NET/JRF(DEC-2013)]

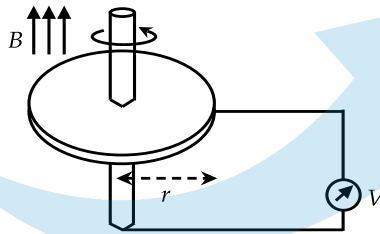


- a. Zero b. DC from A to B c. DC from B to A d. AC,

Solution: So the correct answer is **Option (b)**

5. A conducting circular disc of radius r and resistivity ρ rotates with an angular velocity ω in a magnetic field B perpendicular to it. A voltmeter is connected as shown in the figure below. Assuming its internal resistance to be infinite, the reading on the voltmeter

[NET/JRF(DEC-2016)]



- a. Depends on ω, B, r and ρ
 b. Depends on ω, B and r but not on ρ
 c. Is zero because the flux through the loop is not changing
 d. Is zero because a current the flows in the direction of B

Solution:

Force experienced by charge is

$$\vec{F} = q(\vec{v} \times \vec{B}) \text{ and } v = r\omega$$

So the correct answer is **Option (b)**

6. A uniform magnetic field in the positive z -direction passes through a circular wire loop of radius 1 cm and resistance 1Ω lying in the xy -plane. The field strength is reduced from 10 tesla to 9 tesla in 1s. The charge transferred across any point in the wire is approximately

[NET/JRF-(JUNE-2015)]

- a. 3.1×10^{-4} coulomb b. 3.4×10^{-4} coulomb
 c. 4.2×10^{-4} coulomb d. 5.2×10^{-4} coulomb

Solution:

$$\begin{aligned} \varepsilon &= -\frac{d\phi}{dt} \Rightarrow I = \frac{dq}{dt} = \frac{\varepsilon}{R} \\ &= -\frac{1}{R} \frac{d\phi}{dt} \Rightarrow dq = -\frac{A}{R} dB = \frac{-\pi r^2}{R} dB \end{aligned}$$

$$\Rightarrow dq = \frac{-3.14 \times (10^{-2})^2}{1} \times 1 = 3.14 \times 10^{-4} \text{ coulomb}$$

So the correct answer is **Option (a)**

7. A magnetic field B is $B\hat{z}$ in the region $x > 0$ and zero elsewhere. A rectangular loop, in the xy -plane, of sides l (along the x -direction) and h (along the y -direction) is inserted into the $x > 0$ region from the $x < 0$ region at constant velocity $v = v\hat{x}$. Which of the following values of l and h will generate the largest EMF?

[NET/JRF-(JUNE-2016)]

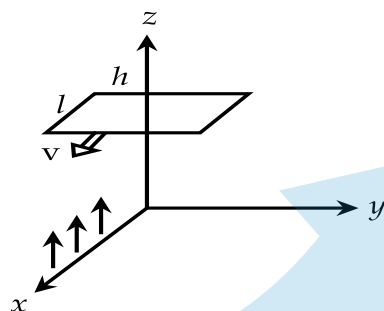
a. $l = 8, h = 3$

b. $l = 4, h = 6$

c. $l = 6, h = 4$

d. $l = 12, h = 2$

Solution:



$$\phi_m \propto Bhx$$

$$\varepsilon \propto \frac{-d\phi_m}{dt} \propto Bvh \propto h$$

So the correct answer is **Option (b)**

8. Consider a solenoid of radius R with n turns per unit length, in which a time dependent current $I = I_0 \sin \omega t$ (where $\omega R/c \ll 1$) flows. The magnitude of the electric field at a perpendicular distance $r < R$ from the axis of symmetry of the solenoid, is

[NET/JRF-(DEC-2011)]

a. 0

b. $\frac{1}{2r} \omega \mu_0 n I_0 R^2 \cos \omega t$

c. $\frac{1}{2} \omega \mu_0 n I_0 r \sin \omega t$

d. $\frac{1}{2} \omega \mu_0 n I_0 r \cos \omega t$

Solution:

$$\oint \vec{E} \cdot d\vec{l} = - \int \frac{\partial \vec{B}}{\partial t} \cdot d\vec{a}; \quad (\vec{B} = \mu_0 n I(t) \hat{z})$$

$$\Rightarrow |\vec{E}| \times 2\pi r = -\mu_0 n \frac{dI}{dt} \int_{r'=0}^r 2\pi r' dr'$$

$$= -\mu_0 n \times I_0 \omega \cos \omega t \times \frac{2\pi r^2}{2}$$

$$\Rightarrow |\vec{E}| = -\frac{1}{2} \times \omega \mu_0 n I_0 r \cos \omega t$$

So the correct answer is **Option (d)**

9. A parallel plate capacitor is formed by two circular conducting plates of radius a separated by a distance d , where $d \ll a$. It is being slowly charged by a current that is nearly constant. At an instant when the

current is I , the magnetic induction between the plates at a distance $\frac{a}{2}$ from the centre of the plate, is

[NET/JRF-(DEC-2016)]

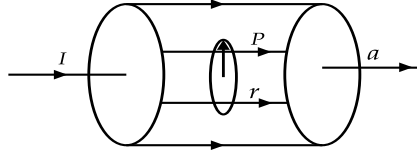
a. $\frac{\mu_0 I}{\pi a}$

b. $\frac{\mu_0 I}{2\pi a}$

c. $\frac{\mu_0 I}{a}$

d. $\frac{\mu_0 I}{4\pi a}$

Solution:



$$|\vec{B}| = \frac{\mu_0 I r}{2\pi a^2}$$

$$|\vec{B}| = \frac{\mu_0 I}{4\pi a} \text{ at } r = \frac{a}{2}$$

So the correct answer is **Option (d)**

10. Suppose the yz -plane forms a chargeless boundary between two media of permittivities ϵ_{left} and ϵ_{right} where $\epsilon_{\text{left}} : \epsilon_{\text{right}} = 1 : 2$, if the uniform electric field on the left is $\vec{E}_{\text{left}} = c(\hat{i} + \hat{j} + \hat{k})$ (where c is a constant), then the electric field on the right \vec{E}_{right} is

[NET/JRF(JUNE-2015)]

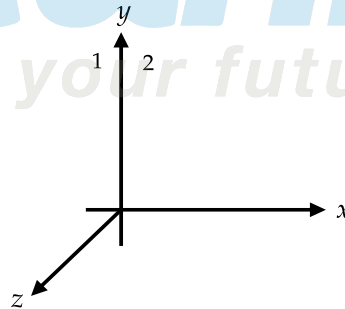
a. $c(2\hat{i} + \hat{j} + \hat{k})$

b. $c(\hat{i} + 2\hat{j} + 2\hat{k})$

c. $c(\frac{1}{2}\hat{i} + \hat{j} + \hat{k})$

d. $c(\hat{i} + \frac{1}{2}\hat{j} + \frac{1}{2}\hat{k})$

Solution:



$$E_1'' = c(\hat{j} + \hat{k}) = E_2''$$

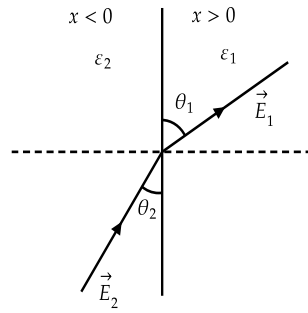
$$D_1^\perp = D_2^\perp \Rightarrow \epsilon_1 E_1^\perp = \epsilon_2 E_2^\perp \Rightarrow E_2^\perp = \frac{\epsilon_1}{\epsilon_2} E_1^\perp$$

$$\Rightarrow E_2^\perp = \frac{1}{2} c \hat{i} \Rightarrow \vec{E}_2 = c \left(\frac{1}{2} \hat{i} + \hat{j} + \hat{k} \right)$$

So the correct answer is **Option (c)**

11. The half space region $x > 0$ and $x < 0$ are filled with dielectric media of dielectric constants ϵ_1 and ϵ_2 respectively. There is a uniform electric field in each part. In the right half, the electric field makes an angle θ_1 to the interface. The corresponding angle θ_2 in the left half satisfies

[NET/JRF(JUNE-2016)]



a. $\epsilon_1 \sin \theta_2 = \epsilon_2 \sin \theta_1$

b. $\epsilon_1 \tan \theta_2 = \epsilon_2 \tan \theta_1$

c. $\epsilon_1 \tan \theta_1 = \epsilon_2 \tan \theta_2$

d. $\epsilon_1 \sin \theta_1 = \epsilon_2 \sin \theta_2$

Solution:

$$\frac{\tan \theta_1}{\tan \theta_2} = \frac{\frac{E_1^\perp}{E_1^\parallel}}{\frac{E_2^\perp}{E_2^\parallel}} = \frac{E_1^\perp}{E_2^\perp} \quad (\because E_1^\parallel = E_2^\parallel)$$

$$D_1^\perp = D_2^\perp \Rightarrow \epsilon_1 E_1^\perp = \epsilon_2 E_2^\perp \Rightarrow \frac{E_1^\perp}{E_2^\perp} = \frac{\epsilon_2}{\epsilon_1} \Rightarrow \frac{\tan \theta_1}{\tan \theta_2} = \frac{\epsilon_2}{\epsilon_1} \Rightarrow \epsilon_1 \tan \theta_1 = \epsilon_2 \tan \theta_2$$

So the correct answer is **Option (c)**

12. Which of the following is not a correct boundary condition at an interface between two homogeneous dielectric media? (In the following \hat{n} is a unit vector normal to the interface, σ and \vec{j}_s , are the surface charge and current densities, respectively.)

[NET/JRF(JUNE-2019)]

a. $\hat{n} \times (\vec{D}_1 - \vec{D}_2) = 0$

b. $\hat{n} \times (\vec{H}_1 - \vec{H}_2) = \vec{j}_s$

c. $\hat{n} \cdot (\vec{D}_1 - \vec{D}_2) = \sigma$

d. $\hat{n} \cdot (\vec{B}_1 - \vec{B}_2) = 0$

Solution:

Since media is homogeneous dielectric: assume uniform polarisation and magnetisation.

σ and \vec{j}_s , are the free surface charge and free surface current densities.

$$\vec{\nabla} \times \vec{D} = 0 \Rightarrow D_1^\parallel = D_2^\parallel$$

$$\because \vec{\nabla} \times \vec{P} = 0 \quad \text{and} \quad D_1^\perp - D_2^\perp = \sigma$$

$$\text{Thus } (\vec{D}_1 - \vec{D}_2) = \sigma \hat{n}$$

$$\Rightarrow \hat{n} \cdot (\vec{D}_1 - \vec{D}_2) = \sigma \quad \text{and} \quad \hat{n} \times (\vec{D}_1 - \vec{D}_2) \neq 0$$

$$\vec{\nabla} \cdot \vec{H} = -\vec{\nabla} \cdot \vec{M} = 0 \Rightarrow H_1^\perp = H_2^\perp$$

$$\because \vec{\nabla} \cdot \vec{M} = 0 \quad \text{and} \quad H_1^\parallel - H_2^\parallel = j_s$$

$$\text{Thus } (\vec{H}_1 - \vec{H}_2) = \vec{j}_s \times \hat{n}$$

$$\Rightarrow \hat{n} \times (\vec{H}_1 - \vec{H}_2) = \vec{j}_s$$

Also

$$\vec{\nabla} \cdot \vec{B} = 0 \Rightarrow B_1^\perp = B_2^\perp \quad \text{and} \quad B_1^\parallel - B_2^\parallel = \mu_0 K \quad (\text{assume } K \text{ is total surface current at interface})$$

$$\text{Thus } (\vec{B}_1 - \vec{B}_2) = \mu_0 (\vec{K} \times \hat{n}).$$

$$\Rightarrow \hat{n} \cdot (\vec{B}_1 - \vec{B}_2) = 0$$

So the correct answer is **Option (a)**

Answer key			
Q.No.	Answer	Q.No.	Answer
1	b	2	c
3	d	4	c
5	b	6	a
7	b	8	d
9	d	10	c
11	c	12	a

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Practise Set-2

1. Two rails of a railroad track are insulated from each other and from the ground, and are connected by a millivoltmeter. What is the reading of the millivoltmeter when a train travels at the speed 90 km/hr down the track? Assume that the vertical component of the earth's magnetic field is 0.2 gauss and that the tracks are separated by two meters. Use $1 \text{ gauss} = 10^{-4} \text{ Tesla} = 10^{-4} \text{ V} \cdot \text{sec}/\text{m}^2$

[JEST-2020]

- a. 10 b. 1 c. 0.2 d. 180

Solution:

$$\begin{aligned} \text{Magnetic flux } \phi_m &= Blx \Rightarrow \text{e.m.f } \varepsilon = -\frac{d\phi_m}{dt} = -Blv \\ \Rightarrow |\varepsilon| &= 0.2 \times 10^{-4} \times 2\text{m} \times \frac{90 \times 10^3}{3600} \text{ Volts} \Rightarrow |\varepsilon| = 1\text{mV} \end{aligned}$$

So the correct answer is **Option (b)**

2. Which of the following expressions represents an electric field due to a time varying magnetic field?

[JEST-2015]

- a. $K(x\hat{x} + y\hat{y} + z\hat{z})$ b. $K(x\hat{x} + y\hat{y} - z\hat{z})$
c. $K(x\hat{x} - y\hat{y})$ d. $K(y\hat{y} - x\hat{x} + 2z\hat{z})$

Solution:

$$\vec{B} \neq \vec{\nabla} \times \vec{A}$$

So the correct answer is **Option (c)**

3. Two parallel rails of a railroad track are insulated from each other and from the ground. The distance between the rails is 1 meter. A voltmeter is electrically connected between the rails. Assume the vertical component of the earth's magnetic field to be 0.2 gauss. What is the voltage developed between the rails when a train travels at a speed of 180 km/h along the track? Give the answer in milli-volts.

[JEST-2018]

Solution:

$$\text{Induced emf } \varepsilon = Blv = (0.2 \times 10^{-4}) \times 1 \text{ m} \times 180 \times \frac{10}{60 \times 60} = 10^{-3} \text{ volts} = 1\text{mV}$$

So the correct answer is **1.0**

4. A very long solenoid (axis along z direction) of n turns per unit length carries a current which increases linearly with time, $i = Kt$. What is the magnetic field inside the solenoid at a given time t ?

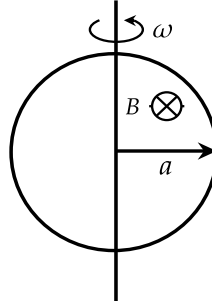
[JEST-2019]

- a. $\vec{B} = \mu_0 n K t \hat{z}$ b. $\vec{B} = \mu_0 n K \hat{z}$
c. $\vec{B} = \mu_0 n K t (\hat{x} + \hat{y})$ d. $\vec{B} = \mu_0 c n K t \hat{z}$

Solution: So the correct answer is **Option (a)**

5. A circular metal loop of radius $a = 1$ m spins with a constant angular velocity $\omega = 20\pi$ rad/s in a magnetic field $B = 3$ Tesla, as shown in the figure. The resistance of the loop is 10 ohms. Let P be the power dissipated in one complete cycle. What is the value of $\frac{P}{\pi^4}$ in Watts?

[JEST-2019]



Solution:

$$\text{Magnetic flux through the loop is } \phi_m = \int_S \vec{B} d\vec{a} = B \times \pi a^2 \times \cos \omega t$$

$$\text{Induced e.m.f } \varepsilon = -\frac{d\phi_m}{dt} = \omega B \times \pi a^2 \times \sin \omega t$$

$$\text{Power dissipated } p = \frac{\varepsilon^2}{R} = \frac{\omega^2 B^2 \pi^2 a^4 \sin^2 \omega t}{R}$$

$$\text{Power dissipated in one complete cycle } P = \langle p \rangle = \frac{\omega^2 B^2 \pi^2 a^4}{2R} \because \langle \sin^2 \omega t \rangle = \frac{1}{2}$$

$$\frac{P}{\pi^4} = \frac{\omega^2 B^2 a^4}{2\pi^2 R} \Rightarrow P = \frac{(20\pi)^2 (3)^2 (1)^4}{2(10)(10)} = 18$$

So the correct answer is **18**

6. Self inductance per unit length of a long solenoid of radius R with n turns per unit length is:

[JEST-2016]

a. $\mu_0 \pi R^2 n^2$

b. $2\mu_0 \pi R^2 n$

c. $2\mu_0 \pi R^2 n^2$

d. $\mu_0 \pi R^2 n$

Solution: So the correct answer is **Option (a)**

7. The $x - y$ plane is the boundary between free space and a magnetic material with relative permeability μ_r . The magnetic field in the free space is $B_x \hat{i} + B_z \hat{k}$. The magnetic field in the magnetic material is

[GATE- 2016]

a. $B_x \hat{i} + B_z \hat{k}$

b. $B_x \hat{i} + \mu_r B_z \hat{k}$

c. $\frac{1}{\mu_r} B_x \hat{i} + B_z \hat{k}$

d. $\mu_r B_x \hat{i} + B_z \hat{k}$

Solution:

$$B_1^\perp = B_z \hat{k} = B_2^\perp \text{ and } H_1^\parallel =$$

$$H_2^\parallel \Rightarrow \frac{B_1^\parallel}{\mu_0} = \frac{B_2^\parallel}{\mu_0 \mu_r} \Rightarrow B_2^\parallel$$

$$= \mu_r B_1^\parallel = \mu_r B_x \hat{i}$$

The magnetic field in the magnetic material is $\mu_r B_x \hat{i} + B_z \hat{k}$

So the correct answer is **Option (d)**

8. At a surface current, which one of the magnetostatic boundary condition is NOT CORRECT?

[GATE- 2013]

- a. Normal component of the magnetic field is continuous.
- b. Normal component of the magnetic vector potential is continuous.
- c. Tangential component of the magnetic vector potential is continuous.
- d. Tangential component of the magnetic vector potential is not continuous.

Solution: So the correct answer is **Option (d)**

9. A circular loop made of a thin wire has radius 2 cm and resistance 2Ω . It is placed perpendicular to a uniform magnetic field of magnitude $|\vec{B}_0| = 0.01$ Tesla. At time $t = 0$ the field starts decaying as $\vec{B} = \vec{B}_0 e^{-t/t_0}$, where $t_0 = 1$ s. The total charge that passes through a cross section of the wire during the decay is Q . The value of Q in μC (rounded off to two decimal places) is

[GATE- 2019]

Solution:

$$\begin{aligned}
 \varepsilon &= -\frac{d\phi}{dt} = -\frac{AdB}{dt}, I \\
 &= \frac{\varepsilon}{R} = -\frac{d\phi}{dt} \frac{1}{R} \\
 \Rightarrow -\frac{d\phi}{dt} &= -\pi r^2 \frac{d}{dt} (B_0 e^{-t/t_0}) \\
 &= \pi r^2 B_0 e^{-t} (t_0 = 1) \\
 Q &= \int_0^\infty I(t) dt = \int_0^\infty \frac{\pi r^2}{R} B_0 e^{-t} dt \\
 &= \frac{\pi r^2 B_0}{R} \left| \frac{e^{-t}}{-1} \right|_0^\infty \\
 &= 3.14 \times (2 \times 10^{-2})^2 \times 0.01 \\
 &= 6.28 \mu C
 \end{aligned}$$

10. A long solenoid is embedded in a conducting medium and is insulated from the medium. If the current through the solenoid is increased at a constant rate, the induced current in the medium as a function of the radial distance r from the axis of the solenoid is proportional to

[GATE- 2015]

- a. r^2 inside the solenoid and $\frac{1}{r}$ outside
- b. r inside the solenoid and $\frac{1}{r^2}$ outside
- c. r^2 inside the solenoid and $\frac{1}{r^2}$ outside
- d. r inside the solenoid and $\frac{1}{r}$ outside

Solution:

$$\oint \vec{E} \cdot d\vec{l} = - \int \frac{\partial \vec{B}}{\partial t} \cdot d\vec{a}$$

For $r < R$, $|\vec{E}| 2\pi r = -\mu_0 n \frac{dI}{dt} \int_{r'=0}^r 2\pi r' dr'$

$$= -\mu_0 n \frac{dI}{dt} \frac{2\pi r^2}{2} \Rightarrow |\vec{E}|$$

$$= -\frac{1}{2} \mu_0 n \frac{dI}{dt} r$$

For $r > R$, $|\vec{E}| 2\pi r = -\mu_0 n \frac{dI}{dt} \int_{r'=0}^R 2\pi r' dr'$

$$= -\mu_0 n \frac{dI}{dt} \frac{2\pi R^2}{2} \Rightarrow |\vec{E}|$$

$$= -\frac{1}{2r} \mu_0 n \frac{dI}{dt} R^2$$

11. Consider an infinitely long solenoid with N turns per unit length, radius R and carrying a current $I(t) = \alpha \cos \omega t$, where α is a constant and ω is the angular frequency. The magnitude of electric field at the surface of the solenoid is

- a. $\frac{1}{2} \mu_0 N R \omega \alpha \sin \omega t$ b. $\frac{1}{2} \mu_0 \omega N R \cos \omega t$
 c. $\mu_0 N R \omega \alpha \sin \omega t$ d. $\mu_0 \omega N R \cos \omega t$

Solution:

$$\vec{B} = \begin{cases} \mu_0 N I(t) \hat{z}, & \text{inside} \\ 0, & \text{outside} \end{cases}$$

Since, $\oint_{\text{line}} \vec{E} \cdot d\vec{l} = - \int \frac{\partial \vec{B}}{\partial t} \cdot d\vec{a}$

$$\Rightarrow |\vec{E}| \times 2\pi R = -\mu_0 N (-\alpha \omega \sin \omega t) \times \pi R^2$$

$$\Rightarrow |\vec{E}| = \frac{1}{2} \mu_0 N R \omega \alpha \sin \omega t$$

So the correct answer is **Option (a)**

12. A medium ($\epsilon_r > 1, \mu_r = 1, \sigma > 0$) is semi-transparent to an electromagnetic wave when

[GATE- 2020]

- a. Conduction current $\gg \gg$ Displacement current
 b. Conduction current $\ll \ll$ Displacement current
 c. Conduction current = Displacement current
 d. Both Conduction current and Displacement current are zero

Solution:

$$\text{Conduction current } J_c = \sigma E = \sigma E_0 \cos \omega t$$

$$\text{Displacement current } J_d = \epsilon \frac{\partial E}{\partial t} \Rightarrow |J_d| = \omega \epsilon E_0 \sin \omega t$$

For semi-transparent medium i.e for poor conductor $\sigma \ll \omega\epsilon$.

$$\text{Let } \omega t = \frac{\pi}{4} \Rightarrow \frac{J_c}{J_d} = \frac{\sigma E_0}{\omega\epsilon E_0} = \frac{\sigma}{\omega\epsilon} \ll 1 \Rightarrow J_c \ll J_d$$

So the correct answer is **Option (b)**

13. A sinusoidal voltage of the form $V(t) = V_0 \cos(\omega t)$ is applied across a parallel plate capacitor placed in vacuum. Ignoring the edge effects, the induced emf within the region between the capacitor plates can be expressed as a power series in ω . The lowest nonvanishing exponent in ω is _____

[GATE- 2020]

Solution:

$$\text{Induced e.m.f } \epsilon = -\frac{d\phi}{dt} = -\frac{AdB}{dt}$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{\text{enc}} + \mu_0 \epsilon_0 \int_S \frac{\partial \vec{E}}{\partial t} \cdot d\vec{a}$$

Consider an amperian loop of radius $r (r < R)$, then $I_{\text{enc}} = 0$ and since

$$E(t) = \frac{V(t)}{d} = \frac{V_0 \cos \omega t}{d}$$

$$\text{Thus } |\vec{B}| \times 2\pi r = \mu_0 \epsilon_0 \times \left(-\frac{V_0 \omega \sin \omega t}{d} \right) \times \pi r^2 \Rightarrow |\vec{B}| \propto \omega \sin \omega t$$

$$\Rightarrow \epsilon \propto \frac{dB}{dt} \propto \omega^2 \cos \omega t \propto \omega^2 \left(1 - \frac{\omega^2 t^2}{2} + \dots \right)$$

The lowest non-vanishing exponent in ω is $n = 2$.

So the correct answer is **2**

Answer key

Q.No.	Answer	Q.No.	Answer
1	b	2	d
3	1.0	4	a
5	18	6	a
7	d	8	d
9	6.28	10	d
11	a	12	b
13	2	14	