Electrodynamics and Rel GATE

https://snboseplc.com/electrodynamics-and-rel-gate/

GATE Questions

Q.No:1 GATE-2012

The space-time dependence of the electric field of a linearly polarized light in free space is given by $xE_0 \cos(\omega t - kz)$ where E_0, ω and k are the amplitude, the angular frequency and the wavevector, respectively. The time averaged energy density associated with the electric field is

(A) $\frac{1}{4}\varepsilon_0 E_0^2$
(B) $\frac{1}{2}\varepsilon_0 E_0^2$
(C) $\varepsilon_0 E_0^2$
(D) $2\varepsilon_0 E_0^2$

Q.No:2 GATE-2012

A plane electromagnetic wave traveling in free space is incident normally on a glass plate of refractive index 3/2. If there is no absorption by the glass, its reflectivity is

(A) 4%
(B) 16%
(C) 20%
(D) 50%

Q.No:3 GATE-2012

The electric and the magnetic fields $\vec{E}(z,t)$ and $\vec{B}(z,t)$, respectively corresponding to the scalar potential $\phi(z,t) = 0$ and vector potential $\vec{A}(z,t) = \hat{i}tz$ are

(A) $\vec{E} = \hat{i}z$ and $\vec{B} = -jt$
(B) $\vec{E} = \hat{i}z$ and $\vec{B} = jt$
(C) $\vec{E} = -\hat{i}z$ and $\vec{B} = -jt$
(D) $\vec{E} = -\hat{i}z$ and $\vec{B} = jt$

Q.No:4 GATE-2012

A plane polarized electromagnetic wave in free space at time $t = 0$ is given by $\vec{E}(x,z) = 10j\exp[i(6x + 8z)]$. The magnetic field $\vec{B}(x,z,t)$ is given by

(A) $\vec{B}(x,z,t) = \frac{1}{c}(6k - 8\hat{i})\exp[i(6x + 8z - 10ct)]$
(B) $\vec{B}(x,z,t) = \frac{1}{c}(6k + 8\hat{i})\exp[i(6x + 8z - 10ct)]$
(C) $\vec{B}(x,z,t) = \frac{1}{c}(6k - 8\hat{i})\exp[i(6x + 8z - ct)]$
(D) $\vec{B}(x,z,t) = \frac{1}{c}(6k + 8\hat{i})\exp[i(6x + 8z + ct)]$

Q.No:5 GATE-2013

A circularly polarized monochromatic plane wave is incident on a dielectric interface at Brewster angle. Which one of the following statements is CORRECT?

(A) The reflected light is plane polarized in the plane of incidence and the transmitted light is circularly polarized.

(B) The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is plane polarized in the plane of incidence.

(C) The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is elliptically polarized.

(D) There will be no reflected light and the transmitted light is circularly polarized.

Q.No:6 GATE-2013

A monochromatic plane wave at oblique incidence undergoes reflection at a dielectric interface. If $\hat{k}_i, \hat{k}_r$ and $\hat{n}$ are the unit vectors in the directions of incident wave, reflected wave and the normal to the surface respectively, which one of the following expressions is correct?

(A) $(\hat{k}_i - \hat{k}_r) \times \hat{n} \neq 0$
(B) $(\hat{k}_i - \hat{k}_r) \times \hat{n} = 0$
(C) $(\hat{k}_i \times \hat{n}) \cdot \hat{k}_r = 0$
(D) $(\hat{k}_i \times \hat{n}) \cdot \hat{k}_r \neq 0$

Q.No:7 GATE-2014

Which one of the following quantities is invariant under Lorentz transformation?

(A) Charge density
(B) Charge
(C) Current
(D) Electric field

Q.No:8 GATE-2014

An unpolarized light wave is incident from air on a glass surface at the Brewster angle. The angle between the reflected and the refracted wave is

(A) 0°
(B) 45°
(C) 90°
(D) 120°

S. N. Bose Physics Learning Centre

Q.No:9 GATE-2014

The electric field of a uniform plane wave propagating in a dielectric, non-conducting medium is given by,

$$\vec{E} = \hat{x}10\cos\left(6\pi \times 10^7 t - 0.4\pi z\right) \text{ V/m}.$$

The phase velocity of the wave is ..... ($\times 10^8$ m/s).

Q.No:10 GATE-2014

If the vector potential

$$\vec{A} = \alpha x\hat{x} + 2y\hat{y} - 3z\hat{z},$$

satisfies the Coulomb gauge, the value of the constant α is .....

Q.No:11 GATE-2014

The intensity of a laser in free space is 150 mW/m^2. The corresponding amplitude of the electric field of the laser is ..... V/m. ($\varepsilon_0 = 8.854 \times 10^{-12}$ C^2/N $\cdot$ m^2)

Q.No:12 GATE-2015

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

(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

Q.No:13 GATE-2016

The electric field component of a plane electromagnetic wave travelling in vacuum is given by $\vec{E}(z,t) = E_0\cos\left(kz - \omega t\right)\hat{i}$. The Poynting vector for the wave is

(A) $(c\varepsilon_0/2)E_0^2\cos^2\left(kz - \omega t\right)\hat{j}$
(B) $(c\varepsilon_0/2)E_0^2\cos^2\left(kz - \omega t\right)\hat{k}$
(C) $c\varepsilon_0 E_0^2\cos^2\left(kz - \omega t\right)\hat{j}$
(D) $c\varepsilon_0 E_0^2\cos^2\left(kz - \omega t\right)\hat{k}$

Q.No:14 GATE-2017

A monochromatic plane wave in free space with electric field amplitude of 1 V/m is normally incident on a fully reflecting mirror. The pressure exerted on the mirror is .....$\times 10^{-12}$ Pa. (up to two decimal places) ($\varepsilon_0 = 8.854 \times 10^{-12}$ F/m).

Q.No:15 GATE-2017

An infinite solenoid carries a time varying current $I(t) = At^2$, with $A \neq 0$. The axis of the solenoid is along the $\hat{z}$ direction. $\hat{r}$ and $\hat{\theta}$ are the usual radial and polar directions in cylindrical polar coordinates. $\vec{B} = B_r\hat{r} + B_\theta\hat{\theta} + B_z\hat{z}$ is the magnetic field at a point outside the solenoid. Which one of the following statements is true?

(A) $B_r = 0, B_\theta = 0, B_z = 0$
(B) $B_r \neq 0, B_\theta \neq 0, B_z = 0$
(C) $B_r \neq 0, B_\theta \neq 0, B_z \neq 0$
(D) $B_r = 0, B_\theta = 0, B_z \neq 0$

Q.No:16 GATE-2017

A uniform volume charge density is placed inside a conductor (with resistivity $10^{-2}\Omega$m). The charge density becomes $1/(2.718)$ of its original value after time ..... femto seconds. (up to two decimal places) ($\varepsilon_0 = 8.854 \times 10^{-12}$ F/m)

Q.No:17 GATE-2017

Consider a metal with free electron density of 6×10^{22} cm^{-3}. The lowest frequency electromagnetic radiation to which this metal is transparent is 1.38×10^{16} Hz. If this metal had a free electron density of 1.8×10^{23} cm^{-3} instead, the lowest frequency electromagnetic radiation to which it would be transparent is ..... $\times 10^{16}$ Hz. (up to two decimal places).

Q.No:18 GATE-2018

A light beam of intensity I_0 is falling normally on a surface. The surface absorbs 20% of the intensity and the rest is reflected. The radiation pressure on the surface is given by XI_0/c, where X is ..... (up to one decimal place). Here c is the speed of light.

Q.No:19 GATE-2018

The number of independent components of a general electromagnetic field tensor is .....

S. N. Bose Physics Learning Centre

Q.No:20 GATE-2018

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) $\frac{1}{2}\mu_0 NR\omega\alpha \sin \omega t$
(B) $\frac{1}{2}\mu_0 \omega NR \cos \omega t$
(C) $\mu_0 NR\omega\alpha \sin \omega t$
(D) $\mu_0 \omega NR \cos \omega t$

Q.No:21 GATE-2018

A constant and uniform magnetic field $\vec{B} = B_0\hat{k}$ pervades all space. Which one of the following is the correct choice for the vector potential in Coulomb gauge?

(A) $-B_0(x+y)\hat{i}$
(B) $B_0(x+y)\hat{j}$
(C) $B_0 x\hat{j}$
(D) $-\frac{1}{2}B_0(x\hat{i} - y\hat{j})$

Q.No:22 GATE-2018

A long straight wire, having radius a and resistance per unit length r, carries a current I. The magnitude and direction of the Poynting vector on the surface of the wire is

(A) $I^2r/2\pi a$, perpendicular to axis of the wire and pointing inwards
(B) $I^2r/2\pi a$, perpendicular to axis of the wire and pointing outwards
(C) $I^2r/\pi a$, perpendicular to axis of the wire and pointing inwards
(D) $I^2r/\pi a$, perpendicular to axis of the wire and pointing outwards

Q.No:23 GATE-2018

An electromagnetic plane wave is propagating with an intensity $I = 1.0 \times 10^5$ Wm^{-2} in a medium with $\epsilon = 3\epsilon_0$ and $\mu = \mu_0$. The amplitude of the electric field inside the medium is ..... $\times 10^3$ Vm^{-1} (up to one decimal place).

($\epsilon_0 = 8.85 \times 10^{-12}$ $\mathrm{C^2N^{-1}m^{-2}}, \mu_0 = 4\pi \times 10^{-7}\mathrm{NA}^{-2}, c = 3 \times 10^8$ ms^{-1})

Q.No:24 GATE-2019

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 .....

Q.No:25 GATE-2019

The electric field of an electromagnetic wave in vacuum is given by

$$\vec{E} = E_0 \cos(3y + 4z - 1.5 \times 10^9 t)\hat{x}.$$

The wave is reflected from the $z = 0$ surface. If the pressure exerted on the surface is $\alpha\epsilon_0 E_0^2$, the value of α (rounded off to one decimal place) is .....

Q.No:26 GATE-2019

The vector potential inside a long solenoid, with n turns per unit length and carrying current I, written in cylindrical coordinates is $\vec{A}(s,\phi,z) = \frac{\mu_0 nI}{2} s\hat{\phi}$. If the term $\frac{\mu_0 nI}{2} s(\alpha \cos\phi\hat{\phi} + \beta \sin\phi\hat{s})$, where $\alpha \neq 0, \beta \neq 0$, is added to $\vec{A}(s,\phi,z)$, the magnetic field remains the same if

(A) $\alpha = \beta$
(B) $\alpha = -\beta$
(C) $\alpha = 2\beta$
(D) $\alpha = \frac{\beta}{2}$

[Useful formulae: $\vec{\nabla}t = \frac{\partial t}{\partial s}\hat{s} + \frac{1}{s}\frac{\partial t}{\partial \phi}\hat{\phi} + \frac{\partial t}{\partial z}\hat{z}$;
$\vec{\nabla} \times \vec{v} = \left(\frac{1}{s}\frac{\partial v_z}{\partial \phi} - \frac{\partial v_\phi}{\partial z}\right)\hat{s} + \left(\frac{\partial v_s}{\partial z} - \frac{\partial v_z}{\partial s}\right)\hat{\phi} + \frac{1}{s}\left(\frac{\partial (s v_\phi)}{\partial s} - \frac{\partial v_s}{\partial \phi}\right)\hat{z}$]

Q.No:27 GATE-2020

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

(A) Conduction current $\gg$ Displacement current
(B) Conduction current $\ll$ Displacement current
(C) Conduction current = Displacement current
(D) Both Conduction current and Displacement current are zero

Q.No:28 GATE-2020

If $\vec{E}$ and $\vec{B}$ are the electric and magnetic fields respectively, then $\vec{E} \cdot \vec{B}$ is

(A) odd under parity and even under time reversal
(B) even under parity and odd under time reversal
(C) odd under parity and odd under time reversal
(D) even under parity and even under time reversal

S. N. Bose Physics Learning Centre

Q.No:29 GATE-2020

A uniform magnetic field $\vec{B} = B_0\hat{y}$ exists in an inertial frame K. A perfect conducting sphere moves with a constant velocity $\vec{\nu} = \nu_0\hat{x}$ with respect to this inertial frame. The rest frame of the sphere is K' (see figure). The electric and magnetic fields in K and K' are related as

$$\left.\begin{array}{ll} \vec{E}'_{\parallel} & \vec{E}'_{\parallel} = \gamma\left(\vec{E}_{\perp} + \vec{\nu}\times\vec{B}\right) \\ \vec{B}'_{\parallel} & \vec{B}'_{\parallel} = \gamma\left(\vec{B}_{\perp} - \frac{\vec{\nu}}{c^2}\times\vec{E}\right) \end{array}\right\}, \gamma = \frac{1}{\sqrt{1-(\nu/c)^2}}.$$

The induced surface charge density on the sphere (to the lowest order in ν/c) in the frame K' is

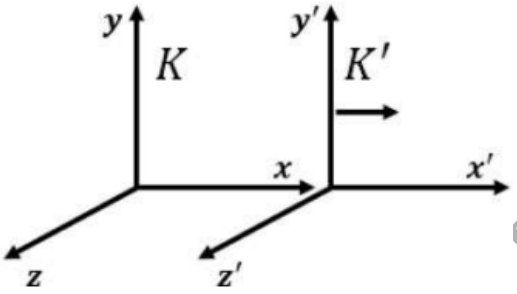


Figure 1: Figure for Q.No:29 GATE-2020

(A) maximum along z'
(B) maximum along y'
(C) maximum along x'
(D) uniform over the sphere

Q.No:30 GATE-2020

A plane electromagnetic wave of wavelength λ is incident on a circular loop of conducting wire. The loop radius is a ($a \ll \lambda$). The angle (in degrees), made by the Poynting vector with the normal to the plane of the loop to generate a maximum induced electrical signal, is .....

Q.No:31 GATE-2020

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 non-vanishing exponent in ω is .....

Q.No:32 GATE-2021

A matter wave is represented by the wave function

$$\Psi(x,y,z,t) = Ae^{i(4x+3y+5z-10\pi t)}$$

where A is a constant. The unit vector representing the direction of propagation of this matter wave is

(A) $\frac{4}{5\sqrt{2}}\hat{x} + \frac{3}{5\sqrt{2}}\hat{y} + \frac{1}{\sqrt{2}}\hat{z}$
(B) $\frac{3}{5\sqrt{2}}\hat{x} + \frac{4}{5\sqrt{2}}\hat{y} + \frac{1}{\sqrt{2}}\hat{z}$
(C) $\frac{1}{5\sqrt{2}}\hat{x} + \frac{3}{5\sqrt{2}}\hat{y} + \frac{1}{\sqrt{2}}\hat{z}$
(D) $\frac{1}{5\sqrt{2}}\hat{x} + \frac{4}{5\sqrt{2}}\hat{y} + \frac{3}{\sqrt{2}}\hat{z}$

Q.No:33 GATE-2021

Consider a tiny current loop driven by a sinusoidal alternating current. If the surface integral of its time-averaged Poynting vector is constant, then the magnitude of the time-averaged magnetic field intensity, at any arbitrary position, $\vec{r}$, is proportional to

(A) $\frac{1}{r^3}$
(B) $\frac{1}{r^2}$
(C) $\frac{1}{r}$
(D) r

Q.No:34 GATE-2021

As shown in the figure, an electromagnetic wave with intensity I_I is incident at the interface of two media having refractive indices $n_1 = 1$ and $n_2 = \sqrt{3}$. The wave is reflected with intensity I_R and transmitted with intensity I_T. Permeability of each medium is the same. (Reflection coefficient $R = I_R/I_I$ and Transmission coefficient $T = I_T/I_I$).

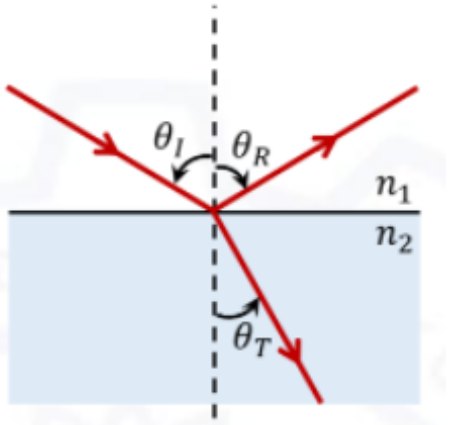


Figure 2: Figure for Q.No:34 GATE-2021

Choose the correct statement(s).

S. N. Bose Physics Learning Centre

(A) $R = 0$ if $\theta_I = 0°$ and polarization of incident light is parallel to the plane of incidence.

(B) $T = 1$ if $\theta_I = 60°$ and polarization of incident light is parallel to the plane of incidence.

(C) $R = 0$ if $\theta_I = 60°$ and polarization of incident light is perpendicular to the plane of incidence.

(D) $T = 1$ if $\theta_I = 60°$ and polarization of incident light is perpendicular to the plane of incidence.

Q.No:35 GATE-2021

An electromagnetic wave having electric field $E = 8\cos(kz - \omega t)\hat{y}$ V cm^{-1} is incident at 90° (normal incidence) on a square slab from vacuum (with refractive index $n_0 = 1.0$) as shown in the figure. The slab is composed of two different materials with refractive indices n_1 and n_2. Assume that the permeability of each medium is the same. After passing through the slab for the first time, the electric field amplitude, in V cm^{-1}, of the electromagnetic wave, which emerges from the slab in region 2, is closest to

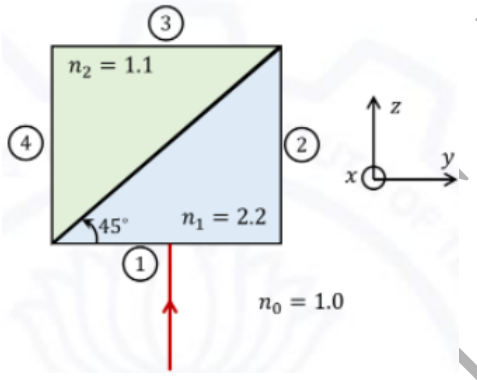


Figure 3: Figure for Q.No:35 GATE-2021

(A) $\frac{11}{1.6}$
(B) $\frac{11}{3.2}$
(C) $\frac{11}{13.8}$
(D) $\frac{11}{25.6}$

Q.No:36 GATE-2022

A point charge q is performing simple harmonic oscillations of amplitude A at angular frequency ω. Using Larmor's formula, the power radiated by the charge is proportional to

(a) $q\omega^2A^2$
(b) $q\omega^4A^2$
(c) $q^2\omega^2A^2$
(d) $q^2\omega^4A^2$

Q.No:37 GATE-2022

For the refractive index $n = n_r(\omega) + in_{im}(\omega)$ of a material, which of the following statements are correct?

(a) n_r can be obtained from n_{im} and vice versa

(b) n_{im} could be zero

(c) n is an analytic function in the upper half of the complex ω plane

(d) n is independent of ω for some materials

Q.No:38 GATE-2022

A spectrometer is used to detect plasma oscillations in a sample. The spectrometer can work in the range of 3×10^{12} rad s^{-1} to 30×10^{12} rad s^{-1}. The minimum carrier concentration that can be detected by using this spectrometer is $n \times 10^{21}$ m^{-3}. The value of n is ———— (Round off to two decimal places)

(Charge of an electron $= -1.6 \times 10^{-19}$ C, mass of an electron $= 9.1 \times 10^{-31}$ kg and $\epsilon_0 = 8.85 \times 10^{-12}$ C^{2}N^{-1}m^{-2})

Q.No:39 GATE-2022

A plane polarized electromagnetic wave propagating in y-z plane is incident at the interface of two media at Brewster's angle. Taking $z = 0$ as the boundary between the two media, the electric field of the reflected wave is given by

$$\vec{E}_R = A_R \cos\left[k_0\left\{\frac{\sqrt{3}}{2}y - \frac{1}{2}z\right\} - \omega t\right]\hat{x}$$

then which among the following statements are correct?

(a) The angle of refraction is $\frac{\pi}{6}$

(b) Ratio of permittivity of the medium of refraction (ϵ_2) with respect to the medium on incidence (ϵ_1), $\frac{\epsilon_2}{\epsilon_1} = 3$

(c) The incident wave can have components of its electric field in y-z plane

(d) The angle of reflection is $\frac{\pi}{6}$

Q.No:40 GATE-2023

Under parity and time reversal transformations, which of the following statements is(are) TRUE about the electric dipole moment p and the magnetic dipole moment μ ?

(A) p is odd under parity and μ is odd under time reversal

(B) p is odd under parity and μ is even under time reversal

(C) p is even under parity and μ is odd under time reversal

Physics Learning Centre · Bose

(D) p is even under parity and μ is even under time reversal

Q.No:41 GATE-2023

Consider an electromagnetic wave propagating in the z-direction in vacuum, with the magnetic field given by $\vec{B} = \vec{B}_0 e^{i(kz-\omega t)}$. If $\vec{B}_0 = 10^{-8}$ T, the average power passing through a circle of radius 1.0 m placed in the xy plane is P (in Watts). Using $\epsilon_0 = 10^{-11} \frac{\text{C}^2}{\text{N m}^2}$, what is the value of $\frac{10^3 P}{\pi}$ (rounded off to one decimal place) ?

Q.No:42 GATE-2024

An unpolarized plane electromagnetic wave in a dielectric medium 1 is incident on a plane interface that separates medium 1 from another dielectric medium 2. Medium 1 and medium 2 have refractive indices n_1 and n_2, respectively, with $n_2 > n_1$. If the angle of incidence is $\tan^{-1}\left(\frac{n_2}{n_1}\right)$, which one of the following statements is true?

(A) The reflected wave is unpolarized

(B) The reflected wave is polarized parallel to the plane of incidence

(C) The reflected wave is polarized perpendicular to the plane of incidence

(D) There is no transmitted wave

Q.No:42 GATE-2024 (continued)

An oscillating electric dipole of moment $\vec{d}(t) = d_0 \cos(\omega t)\hat{z}$ is placed at origin as shown in figure.

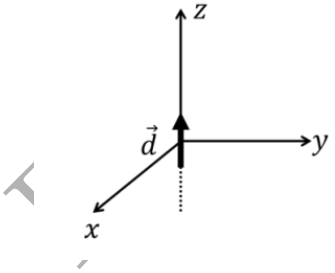


Figure 4: Figure for electric dipole

Consider a point $P(r, \theta, \phi)$ at a very large distance from the dipole. Here r, θ and ϕ are spherical polar coordinates. Which of the following statement is/are true for intensity of radiation?

(A) Intensity is zero if P is on the z axis

(B) Intensity is zero at $P\left(r = R, \theta = \frac{\pi}{2}, \phi = \frac{\pi}{4}\right)$

(C) Intensity at $P\left(r = R, \theta = \frac{\pi}{2}, \phi = \frac{\pi}{4}\right)$ is greater than that at $P\left(r = R, \theta = \frac{\pi}{4}, \phi = \frac{\pi}{4}\right)$

(D) Intensity at $P\left(r = R, \theta = \frac{\pi}{2}, \phi = \frac{\pi}{4}\right)$ is equal to that at $P\left(r = R, \theta = \frac{\pi}{4}, \phi = \frac{\pi}{4}\right)$

Q.No:43 GATE-2025

In coordinates (t, x), a contravariant second rank tensor A has non-zero diagonal components $A^{tt} = P$ and $A^{xx} = Q$, with all other components vanishing, and P, Q being real constants. Here, t is time and x is space coordinate. Consider a Lorentz transformation $(t, x) \to (t', x')$ to another frame that moves with relative speed v in the $+x$ direction, so that $A \to A'$. If A'^{tt} and A'^{xx} are the diagonal components of A', then setting the speed of light $c = 1$, and with $\gamma = \frac{1}{\sqrt{1-v^2}}$, which of the following option(s) is/are correct?

(A) $A'^{tt} = \gamma^2 P + \gamma^2 v^2 Q$

(B) $A'^{tt} = \gamma^2 v^2 P + v^2 Q$

(C) $A'^{xx} = \gamma^2 v^2 P + \gamma^2 Q$

(D) $A'^{xx} = v^2 P + \gamma^2 Q$

Q.No:44 GATE-2026

In free space, an electromagnetic wave is travelling whose wavevector is

$$\vec{k} = 10(\hat{x} + \sqrt{3}\hat{y}) \text{ m}^{-1}.$$

The electric field component of this electromagnetic wave is given by

$$\vec{E}(\vec{r}, t) = \hat{z}\, 600 \cos(\vec{k} \cdot \vec{r} - \omega t) \text{ V.m}^{-1}.$$

The speed of light in free space is $c = 3.0 \times 10^8$ m.s^{-1}. The corresponding magnetic field $\vec{B}(\vec{r}, t)$ is

(A) $\vec{B}(\vec{r}, t) = 2 \times 10^{-6}(\sqrt{3}\hat{x} - \hat{y}) \cos(\vec{k} \cdot \vec{r} - \omega t)$ V.m^{-2}.s

(B) $\vec{B}(\vec{r}, t) = 10^{-6}(\sqrt{3}\hat{x} - \hat{y}) \cos(\vec{k} \cdot \vec{r} - \omega t)$ V.m^{-2}.s

(C) $\vec{B}(\vec{r}, t) = 2 \times 10^{-5}(-\sqrt{3}\hat{x} + \hat{y}) \cos(\vec{k} \cdot \vec{r} - \omega t)$ V.m^{-2}.s

(D) $\vec{B}(\vec{r}, t) = 10^{-5}(\sqrt{3}\hat{x} - \hat{y}) \cos(\vec{k} \cdot \vec{r} - \omega t)$ V.m^{-2}.s

Q.No:45 GATE-2026

An infinitely large thin sheet in the xy-plane carries uniform positive charge density and is moving with constant velocity v in the $+x$ direction (see figure below). The direction of the corresponding Poynting vector is

S. N. Bose Physics Learning Centre

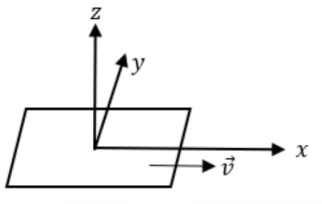


Figure 5: Figure for Q.No:45 GATE-2026

(A) $+x$ for both $z < 0$ and $z > 0$
(B) $+x$ for $z < 0$ and $-x$ for $z > 0$
(C) $-x$ for $z < 0$ and $+x$ for $z > 0$
(D) $-x$ for both $z < 0$ and $z > 0$

Q.No:46 GATE-2026

A capacitor is made of two circular metal plates of radius 1 m separated by a distance of $d = 1$ mm. The space between them is filled by a dielectric with permittivity $\epsilon_r = 5$.

The capacitor is connected to a voltage

$$V = 10 \sin(2\pi \times 10^6 \times t) \text{ volts},$$

where t is in seconds.

The maximum value of the magnetic field in between the plates at a radial distance $r = 0.5$ m from the centre of the capacitor is

$$B \times 10^{-6} \text{ T}.$$

The value of B (rounded off to two decimal places) is _____. (Speed of light in vacuum $c = 3 \times 10^8$ m.s^{-1})

S. N. Bose Physics Learning Centre

Question No.	**Entrance with year**	Answer
1	GATE-2012	Option A
2	GATE-2012	Option A
3	GATE-2012	Option D
4	GATE-2012	Option A
5	GATE-2013	Option C
6	GATE-2013	Option C
7	GATE-2014	Option B
8	GATE-2014	Option C
9	GATE-2014	1.49–1.51
10	GATE-2014	0.99–1.01
11	GATE-2014	10.58–10.70
12	GATE-2015	Option D
13	GATE-2016	Option D
14	GATE-2017	8.80–8.90
15	GATE-2017	Option D
16	GATE-2017	87.50–89.50
17	GATE-2017	2.35–2.45
18	GATE-2018	1.8
19	GATE-2018	6
20	GATE-2018	Option A
21	GATE-2018	Option C
22	GATE-2018	Option A
23	GATE-2018	6.5–6.7
24	GATE-2019	6.26–6.30
25	GATE-2019	0.8
26	GATE-2019	Option D
27	GATE-2020	Option B
28	GATE-2020	Option C
29	GATE-2020	Option A
30	GATE-2020	(−270)–(−90) OR 90–270
31	GATE-2020	2
32	GATE-2021	Option A
33	GATE-2021	Option C
34	GATE-2021	Option B
35	GATE-2021	Option A
36	GATE-2022	Option d
37	GATE-2022	Option a, c
38	GATE-2022	2.70–2.96
39	GATE-2022	Option a, b, c
40	GATE-2023	Option A
41	GATE-2023	11.5–13.7
42	GATE-2024	Option C
42	GATE-2024	Option A, C
43	GATE-2025	Option A, C
44	GATE-2026	Option B
45	GATE-2026	Option A
46	GATE-2026	0.8–0.9

S. N. Bose Physics Learning Centre