Magnetostatics GATE & CSIR

https://snboseplc.com/magnetostatics-gate/

GATE Questions

Q.No:1 GATE-2013

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

1. Normal component of the magnetic field is continuous.
2. Normal component of the magnetic vector potential is continuous.
3. Tangential component of the magnetic vector potential is continuous.
4. Tangential component of the magnetic vector potential is not continuous.

Q.No:2 GATE-2013

In a constant magnetic field of 0.6 Tesla along the z direction, find the value of the path integral $\oint \vec{A} \cdot \vec{dl}$ in the units of (Tesla m^2) on a square loop of side length $(1/\sqrt{2})$ meters. The normal to the loop makes an angle of 60° to the z-axis, as shown in the figure. The answer should be up to two decimal places _____.

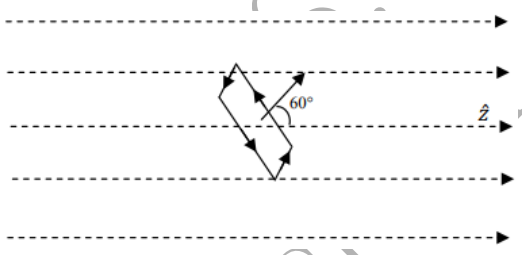


Figure 1: Figure for Q.No:2 GATE-2013

Q.No:3 GATE-2014

The value of the magnetic field required to maintain non-relativistic protons of energy $1MeV$ in a circular orbit of radius $100mm$ is _____ Tesla. (Given: $m_p = 1.67 \times 10^{-27}kg, e = 1.6 \times 10^{-19}C$)

Q.No:4 GATE-2015

Given that the magnetic flux through the closed loop $PQRSP$ is ϕ. If $\int_P^R \vec{A} \cdot \vec{dl} = \phi_1$ along PQR, the value of $\int_P^R \vec{A} \cdot \vec{dl}$ along PSR is

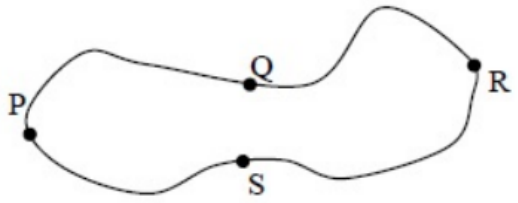


Figure 2: Figure for Q.No:4 GATE-2015

1. $\phi - \phi_1$
2. $\phi_1 - \phi$
3. $-\phi_1$
4. ϕ_1

Q.No:5 GATE-2016

Which of the following magnetic vector potentials gives rise to a uniform magnetic field $B_0\hat{k}$?

1. $B_0 z\hat{k}$
2. $-B_0 x\hat{j}$
3. $\frac{B_0}{2}(-y\hat{i} + x\hat{j})$
4. $\frac{B_0}{2}(y\hat{i} + x\hat{j})$

Q.No:6 GATE-2016

The magnitude of the magnetic dipole moment associated with a square shaped loop carrying a steady current I is m. If this loop is changed to a circular shape with the same current I passing through it, the magnetic dipole moment becomes $\frac{pm}{\pi}$. The value of p is _____.

Q.No:7 GATE-2016

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

1. $B_x\hat{i} + B_z\hat{k}$
2. $B_x\hat{i} + \mu_r B_z\hat{k}$
3. $\frac{1}{\mu_r}B_x\hat{i} + B_z\hat{k}$
4. $\mu_r B_x\hat{i} + B_z\hat{k}$

Q.No:8 GATE-2018

An infinitely long straight wire is carrying a steady current I. The ratio of magnetic energy density at distance r_1 to that at r_2 $(= 2r_1)$ from the wire is _____.

Physics Learning Centre S. N. Bose

Q.No:9 GATE-2019

A solid cylinder of radius R has total charge Q distributed uniformly over its volume. It is rotating about its axis with angular speed ω. The magnitude of the total magnetic moment of the cylinder is

1. $QR^2\omega$
2. $\frac{1}{2}QR^2\omega$
3. $\frac{1}{4}QR^2\omega$
4. $\frac{1}{8}QR^2\omega$

Q.No:10 GATE-2019

An infinitely long wire parallel to the x-axis is kept at $z = d$ and carries a current I in the positive x direction above a superconductor filling the region $z \leq 0$ (see figure). The magnetic field $\vec{B}$ inside the superconductor is zero so that the field just outside the superconductor is parallel to its surface. The magnetic field due to this configuration at a point $(x, y, z > 0)$ is

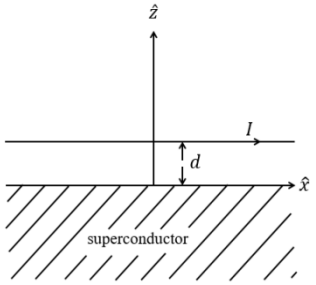


Figure 3: Figure for Q.No:10 GATE-2019

1. $\left(\frac{\mu_0 I}{2\pi}\right) \frac{-(z-d)\hat{j}+y\hat{k}}{[y^2+(z-d)^2]}$
2. $\left(\frac{\mu_0 I}{2\pi}\right) \left[\frac{-(z-d)\hat{j}+y\hat{k}}{y^2+(z-d)^2} + \frac{(z+d)\hat{j}-y\hat{k}}{y^2+(z+d)^2}\right]$
3. $\left(\frac{\mu_0 I}{2\pi}\right) \left[\frac{-(z-d)\hat{j}+y\hat{k}}{y^2+(z-d)^2} - \frac{(z+d)\hat{j}-y\hat{k}}{y^2+(z+d)^2}\right]$
4. $\left(\frac{\mu_0 I}{2\pi}\right) \left[\frac{y\hat{j}+(z-d)\hat{k}}{y^2+(z-d)^2} + \frac{y\hat{j}-(z+d)\hat{k}}{y^2+(z+d)^2}\right]$

Q.No:11 GATE-2020

Far from the Earth, the Earth's magnetic field can be approximated as due to a bar magnet of magnetic pole strength $4 \times 10^{14} Am$. Assume this magnetic field is generated by a current carrying loop encircling the magnetic equator. The current required to do so is about $4 \times 10^n A$, where n is an integer. The value of n is _____. (Earth's circumference: $4 \times 10^7 m$)

Q.No:12 GATE-2021

Consider a solenoid of length L and radius R, where $R \ll L$. A steady-current flows through the solenoid. The magnetic field is uniform inside the solenoid and zero outside.

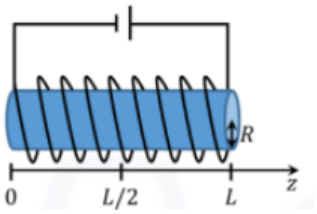


Figure 4: Figure for Q.No:12 GATE-2021

Among the given options, choose the one that best represents the variation in the magnitude of the vector potential, $(0, A_\varphi, 0)$ at $z = L/2$, as a function of the radial distance (r) in cylindrical coordinates.

Useful information: The curl of a vector $\vec{F}$, in cylindrical coordinates is

$$\vec{\nabla}\times\vec{F}(r,\varphi,z) = \hat{r}\left[\frac{1}{r}\frac{\partial F_z}{\partial \varphi} - \frac{\partial F_\varphi}{\partial z}\right] + \hat{\varphi}\left[\frac{\partial F_r}{\partial z} - \frac{\partial F_z}{\partial r}\right] + \hat{z}\frac{1}{r}\left[\frac{\partial (rF_\varphi)}{\partial r} - \frac{\partial}{\partial}\right.$$

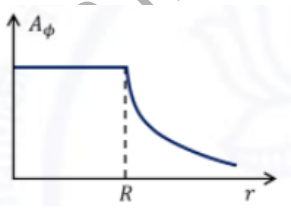


Figure 5: * (A)

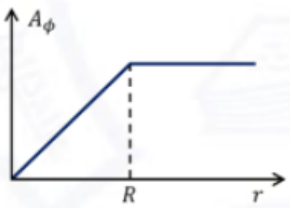


Figure 6: * (B)

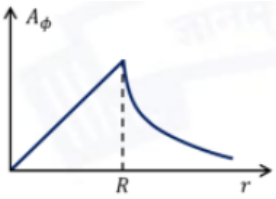


Figure 7: * (C)

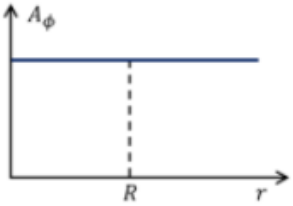


Figure 8: * (D)

Q.No:13 GATE-2021

A material is placed in a magnetic field intensity H. As a result, bound current density J_b is induced and magnetization of the material is M. The magnetic flux density is B. Choose the correct option(s) valid at the surface of the material.

Physics Learning Centre S. N. Bose

1. $\nabla \cdot M = 0$
2. $\nabla \cdot B = 0$
3. $\nabla \cdot H = 0$
4. $\nabla \cdot J_b = 0$

Q.No:14 GATE-2021

Consider a cross-section of an electromagnet having an air-gap of $5cm$ as shown in the figure. It consists of a magnetic material ($\mu = 20000\mu_0$) and is driven by a coil having $NI = 10^4 A$, where N is the number of turns and I is the current in Ampere.

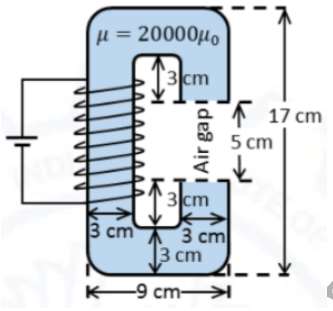


Figure 9: Figure for Q.No:14 GATE-2021

Ignoring the fringe fields, the magnitude of the magnetic field $\vec{B}$ (in Tesla, rounded off to two decimal places) in the air-gap between the magnetic poles is _____.

Q.No:15 GATE-2023

Consider an isolated magnetized sphere of radius R with a uniform magnetization $\vec{M}$ along the positive z direction, with the north and south poles of the sphere lying on the z axis. It is given that the magnetic field inside the sphere is $\vec{B} = \frac{2\mu_0}{3}\vec{M}$, where μ_0 is the permeability of vacuum. Which of the following statements is(are) CORRECT?

1. The bound volume current density is zero.
2. The bound surface current density has maximum magnitude at the equator, where this magnitude equals $|\vec{M}|$.
3. The auxiliary field $\vec{H} = -\frac{2}{3}\vec{M}$.
4. Far from the sphere, the magnetic field is due to a dipole of moment $\vec{m}$, where $\frac{\vec{m}}{4\pi R^3} = \frac{B}{2\mu_0}\hat{z}$.

Q.No:16 GATE-2024

An infinitely long cylinder of radius R carries a frozen-in magnetization

$$\vec{M} = ke^{-s}\hat{z},$$

where k is a constant and s is the distance from the axis of the cylinder. The magnetic permeability of free space is μ_0. There is no free current present anywhere. The magnetic flux density ($\vec{B}$) inside the cylinder is

1. 0
2. $\mu_0 ke^{-R}\hat{z}$
3. $\mu_0 ke^{-s}\hat{z}$
4. $\mu_0 ke^{-s}\left(\frac{R}{s}\right)\hat{z}$

Q.No:17 GATE-2025

The wire loop shown in the figure carries a steady current I. Each straight section of the loop has length d. A part of the loop lies in the xy-plane and the other part is tilted at 30° with respect to the xz-plane. The magnitude of the magnetic dipole moment of the loop (in appropriate units) is

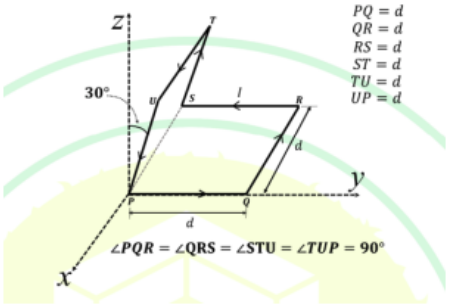


Figure 10: Figure for Q.No:18 GATE-2025

1. $\sqrt{2}\,Id^2$
2. $2\,Id^2$
3. $\sqrt{3}\,Id^2$
4. Id^2

Q.No:18 GATE-2025

A linear magnetic material in the form of a cylinder of radius R and length L is placed with its axis parallel to the z-axis. The cylinder has uniform magnetization $M\hat{k}$. Which of the following option(s) is/are correct?

1. The magnetic field at any point outside the cylinder can be expressed as the gradient of a scalar function.
2. The bound volume current density is zero.
3. The surface current density on the curved surface is non-zero.
4. The surface current densities on the flat surfaces (top and bottom) are non-zero.

Q.No:19 GATE-2026

Consider a particle of mass $m = 9.0 \times 10^{-5}$ kg and charge $q = 3.0 \times 10^{-4}$ C in a uniform electromagnetic field $\vec{E} = 2\hat{x}\,\mathrm{V.m^{-1}}$, $\vec{B} = 3\hat{z}\,\mathrm{V.m^{-2}s}$. The particle is released from the coordinates $(0, 5\,\mathrm{m}, 0)$ at time $t = 0$. Starting from initial speed zero, it comes back to the y-axis for the first time at time t. The value of t in seconds (rounded off to two decimal places) is _____.

CSIR Questions

Q.No:1 CSIR Dec-2014

Ignoring the fringe fields, the magnitude of the magnetic field $\vec{B}$ (in Tesla, rounded off to two decimal places) in the air-gap between the magnetic poles is _____.

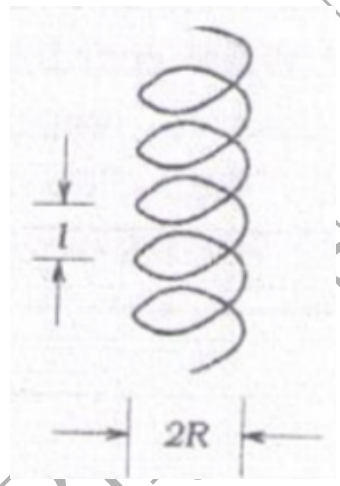


Figure 11: Figure for Q.No:1 CSIR Dec-2014

The ratio ℓ/R of the pitch ℓ to the radius R of the helical path is

1. $\pi/2$
2. 4π
3. 2π
4. π

Q.No:2 CSIR June-2015

A proton moves with a speed of 300 m/s in a circular orbit in the xy-plane in a magnetic field 1 tesla along the positive z direction. When an electric field of 1 V/m is applied along the positive y-direction, the centre of the circular orbit

1. remains stationary
2. moves at 1 m/s along the negative x-direction
3. moves at 1 m/s along the positive z-direction
4. moves at 1 m/s along the positive x direction.

Q.No:3 CSIR Dec-2015

Given a uniform magnetic field $\mathbf{B} = B_0\hat{k}$ (where B_0 is a constant), a possible choice for the magnetic vector potential $\mathbf{A}$ is

1. $B_0 y\hat{i}$
2. $-B_0 y\hat{i}$
3. $B_0(x\hat{j} + y\hat{i})$
4. $B_0(x\hat{i} - y\hat{j})$

Q.No:4 CSIR Dec-2015

A small magnetic needle is kept at $(0, 0)$ with its moment along the x-axis. Another small magnetic needle is at the point $(1, 1)$ and is free to rotate in the xy-plane. In equilibrium the angle θ between their magnetic moments is such that

1. $\tan\theta = 1/3$
2. $\tan\theta = 0$
3. $\tan\theta = 3$
4. $\tan\theta = 1$

Q.No:5 CSIR June-2016

A loop of radius a, carrying a current I, is placed in a uniform magnetic field $\mathbf{B}$. If the normal to the loop is denoted by $\hat{n}$, the force $\mathbf{F}$ and the torque $\mathbf{T}$ on the loop are

1. $\mathbf{F} = 0$ and $\mathbf{T} = \pi a^2 I\hat{n} \times \mathbf{B}$
2. $\mathbf{F} = \frac{\mu_0}{4\pi}\mathbf{I} \times \mathbf{B}$ and $\mathbf{T} = 0$
3. $\mathbf{F} = \frac{\mu_0}{4\pi}\mathbf{I} \times \mathbf{B}$ and $\mathbf{T} = I\hat{n} \times \mathbf{B}$
4. $\mathbf{F} = 0$ and $\mathbf{T} = \frac{1}{\mu_0\varepsilon_0} I\mathbf{B}$

S. N. Bose Physics Learning Centre

Q.No:6 CSIR June-2017

A set of N concentric circular loops of wire, each carrying a steady current I in the same direction, is arranged in a plane. The radius of the first loop is $r_1 = a$ and the radius of the n^{th} loop is given by $r_n = nr_{n-1}$. The magnitude B of the magnetic field at the centre circles in the limit $N \to \infty$, is

1. $\mu_0 I(e^2 - 1)/4\pi a$
2. $\mu_0 I(e - 1)/\pi a$
3. $\mu_0 I(e^2 - 1)/8a$
4. $\mu_0 I(e - 1)/2a$

Q.No:7 CSIR June-2017

A constant current I is flowing in a piece of wire that is bent into a loop as shown in the figure.

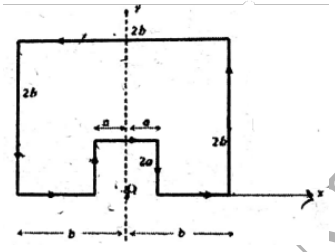


Figure 12: Figure for Q.No:7 CSIR June-2017

The magnitude of the magnetic field at the point O is

1. $\frac{\mu_0 I}{4\pi\sqrt{5}} \ln\left(\frac{a}{b}\right)$
2. $\frac{\mu_0 I}{4\pi\sqrt{5}} \left(\frac{1}{a} - \frac{1}{b}\right)$
3. $\frac{\mu_0 I}{4\pi\sqrt{5}} \left(\frac{1}{a}\right)$
4. $\frac{\mu_0 I}{4\pi\sqrt{5}} \left(\frac{1}{b}\right)$

Q.No:8 CSIR Dec-2017

A circular current carrying loop of radius a carries a steady current. A constant electric charge is kept at the centre of the loop. The electric and magnetic fields, $\vec{E}$ and $\vec{B}$ respectively, at a distance d vertically above the centre of the loop satisfy

1. $\vec{E} \perp \vec{B}$
2. $\vec{E} = 0$
3. $\vec{\nabla}(\vec{E} \cdot \vec{B}) = 0$
4. $\vec{\nabla} \cdot (\vec{E} \times \vec{B}) = 0$

Q.No:9 CSIR June-2018

The loop shown in the figure below carries a steady current I.

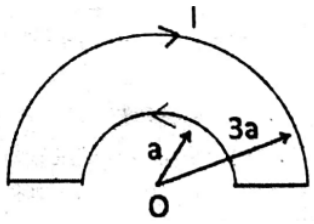


Figure 13: Figure for Q.No:9 CSIR June-2018

The magnitude of the magnetic field at the point O is

1. $\frac{\mu_0 I}{2a}$
2. $\frac{\mu_0 I}{6a}$
3. $\frac{\mu_0 I}{4a}$
4. $\frac{\mu_0 I}{3a}$

Q.No:10 CSIR Dec-2018

Two current-carrying circular loops, each of radius R, are placed perpendicular to each other, as shown in the figure below.

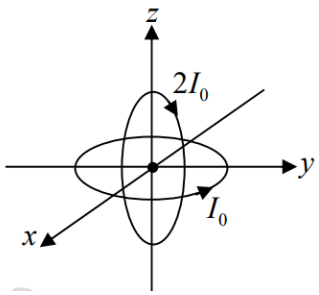


Figure 14: Figure for Q.No:10 CSIR Dec-2018

The loop in the xy-plane carries a current I_0 while that in the xz-plane carries a current $2I_0$. The resulting magnetic field $\vec{B}$ at the origin is

1. $\frac{\mu_0 I_0}{2R}[2\hat{j} + \hat{k}]$
2. $\frac{\mu_0 I_0}{2R}[2\hat{j} - \hat{k}]$
3. $\frac{\mu_0 I_0}{2R}[-2\hat{j} + \hat{k}]$
4. $\frac{\mu_0 I_0}{2R}[-2\hat{j} - \hat{k}]$

S. N. Bose Physics Learning Centre

Q.No:11 CSIR Dec-2018

A rotating spherical shell of uniform surface charge and mass density has total mass M and charge Q. If its angular momentum is L and magnetic moment is μ, then the ratio μ/L is

1. $\frac{Q}{3M}$
2. $\frac{2Q}{3M}$
3. $\frac{Q}{2M}$
4. $\frac{3Q}{4M}$

Q.No:12 CSIR June-2019

Consider a planar wire loop as an n-sided regular polygon, in which R is the distance from the centre to a vertex. If a steady current I flows through the wire, the magnitude of the magnetic field at the centre of the loop is

1. $\frac{\mu_0 I}{2R}\sin\left(\frac{2\pi}{n}\right)$
2. $\frac{\mu_0 nI}{4\pi R}\sin\left(\frac{\pi}{n}\right)$
3. $\frac{\mu_0 nI}{2\pi R}\tan\left(\frac{2\pi}{n}\right)$
4. $\frac{\mu_0 nI}{2\pi R}\tan\left(\frac{\pi}{n}\right)$

Q.No:13 CSIR June-2019

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 $\mathbf{j}_s$ are the surface charge and current densities, respectively.)

1. $\hat{n}\times(\mathbf{D}_1-\mathbf{D}_2)=0$
2. $\hat{n}\times(\mathbf{H}_1-\mathbf{H}_2)=\mathbf{j}_s$
3. $\hat{n}\cdot(\mathbf{D}_1-\mathbf{D}_2)=\sigma$
4. $\hat{n}\cdot(\mathbf{B}_1-\mathbf{B}_2)=0$

Q.No:14 CSIR Dec-2019

A positively charged particle is placed at the origin (with zero initial velocity) in the presence of a constant electric and a constant magnetic field along the positive z and x directions, respectively. At large times, the overall motion of the particle is adrift along the

1. positive y-direction
2. negative z-direction
3. positive z-direction
4. negative y-direction

Q.No:15 Assam CSIR Dec-2019

A charged particle, starting from rest, is accelerated to a speed v in a uniform electric field $\vec{E}=E\hat{i}$ for a distance L. The particle is then injected in a region with a uniform magnetic field $\vec{B}=B\hat{k}$ and no electric field, so that it moves in a circular trajectory of radius R. The speed v of the particle may be expressed as

1. $\frac{RE}{2LB}$
2. $\frac{2LE}{RB}$
3. $\frac{LE}{2RB}$
4. $\frac{2RE}{LB}$

Q.No:16 CSIR June-2020

Three infinitely long wires, each carrying equal current are placed in the xy-plane along $x=0,+d$ and $-d$. On the xy-plane, the magnetic field vanishes at

1. $x=\pm\frac{d}{2}$
2. $x=\pm d\left(1+\frac{1}{\sqrt{3}}\right)$
3. $x=\pm d\left(1-\frac{1}{\sqrt{3}}\right)$
4. $x=\pm\frac{d}{\sqrt{3}}$

Q.No:17 CSIR Feb-2022

In an experiment to measure the charge to mass ratio e/m of the electron by Thomson's method, the values of the deflecting electric field and the accelerating potential are $6\times10^6 N/C$ (newton per coulomb) and $150V$, respectively. The magnitude of the magnetic field that leads to zero deflection of the electron beam is closest to

1. 0.6 T
2. 1.2 T
3. 0.4 T
4. 0.8 T

Q.No:18 CSIR Feb-2022

The vector potential for an almost point like magnetic dipole located at the origin is $\vec{A}=\frac{\mu sin\theta}{4\pi r^2}\hat{\phi}$ where (r,θ,ϕ) denote the spherical polar coordinates and $\hat{\phi}$ is the unit vector along $\hat{\phi}$. A particle of mass m and charge q , moving in the equatorial plane of the dipole, starts at time= $t=0$ with an initial speed v_0 and an impact parameter b . Its instantaneous speed at the point of closest approach is

S. N. Bose Physics Learning Centre

1. v_0
2. $0/0$
3. $v_0 + \frac{\mu q}{4\pi m b^2}$
4. $\sqrt{v_0^2 + (\frac{\mu q}{4\pi m b^2})^2}$

Q.No:19 CSIR Sep-2022

A part of an infinitely long wire, carrying a current I, is bent in a semi-circular arc of radius r (as shown in the figure).

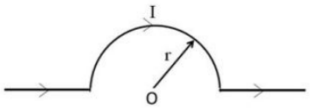


Figure 15: Figure for Q.No:19 CSIR Sep-2022

The magnetic field at the centre O of the arc is

1. $\frac{\mu_0 I}{4r}$
2. $\frac{\mu_0 I}{4\pi r}$
3. $\frac{\mu_0 I}{2r}$
4. $\frac{\mu_0 I}{2\pi r}$

Q.No:20 CSIR Sep-2022

Two parallel conducting rings, both of radius R, are separated by a distance R. The planes of the rings are perpendicular to the line joining their centers, which is taken to be x-axis.

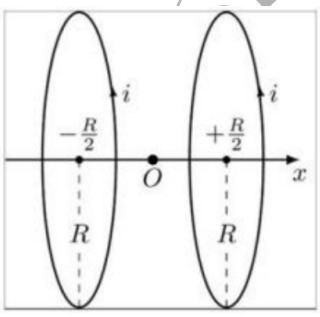


Figure 16: Figure for Q.No:20 CSIR Sep-2022

If both the rings carry the same current i along the same direction, the magnitude of the magnetic field along $x-$axis is best represented by

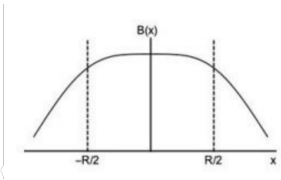


Figure 17: * (1)

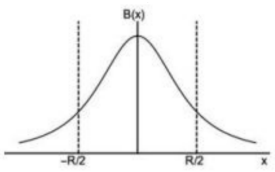


Figure 18: * (2)

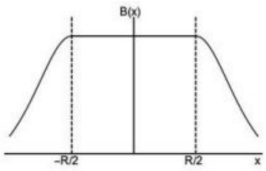


Figure 19: * (3)

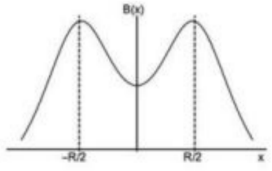


Figure 20: * (4)

Q.No:21 CSIR Sep-2022

A stationary magnetic dipole $\mathbf{m} = m\hat{k}$ is placed above an infinite surface ($z = 0$) carrying uniform surface current density $\vec{\kappa} = \kappa\hat{i}$. The torque on the dipole is

1. $\frac{\mu_0}{2} m\kappa\hat{i}$
2. $-\frac{\mu_0}{2} m\kappa\hat{i}$
3. $\frac{\mu_0}{2} m\kappa\hat{j}$
4. $-\frac{\mu_0}{2} m\kappa\hat{j}$

Q.No:22 CSIR Dec-2023

A small bar magnet is placed in a magnetic field $\mathbf{B}(\mathbf{r}) = B(x)\hat{z}$. The magnet is initially at rest with its magnetic moment along $\hat{y}$. At later times, it will undergo

1. angular motion in the yz plane and translational motion along $\hat{y}$
2. angular motion in the yz plane and translational motion along $\hat{x}$
3. angular motion in the zx plane and translational motion along $\hat{z}$
4. angular motion in the xy plane and translational motion along $\hat{z}$

Q.No:23 CSIR June-2024

A particle of unit mass and unit charge is moving in a magnetic field, which varies as $\mathbf{B}(\mathbf{r}) = b_0\mathbf{r}/r^3$ (b_0 is a constant) over a region far away from the origin. If $\mathbf{L}$ is the instantaneous angular momentum of the particle within that region, then $\frac{d\mathbf{L}}{dt}$ is

S. N. Bose Physics Learning Centre

1. $2b_0 \frac{d}{dt}\left(\frac{\mathbf{r}}{r}\right)$
2. $-b_0 \frac{d}{dt}\left(\frac{\mathbf{r}}{r}\right)$
3. $b_0 \frac{d}{dt}\left(\frac{\mathbf{r}}{r}\right)$
4. 0

Q.No:24 CSIR Dec-2024

A sphere with uniform charge and mass density, having total charge Q and mass M, rotates about an axis through its center with angular velocity ω. The ratio of its magnetic dipole moment to its angular momentum is

1. $\frac{2Q}{M}$
2. $\frac{Q}{M}$
3. $\frac{Q}{2M}$
4. $\frac{Q}{4M}$

Q.No:25 CSIR Dec-2024

An electron enters a region of uniform electric and magnetic fields $\vec{E}_0$ and $\vec{B}_0$. Its velocity, $\vec{v}$, $\vec{E}_0$, and $\vec{B}_0$ are mutually perpendicular to each other. Initially, E_0 is so adjusted that the electron suffers no deflection. E_0 is then switched off and the electron moves in a circular path of radius R. The speed of the electron and its charge to mass ratio would be

1. $\frac{2E_0}{B_0}$, $\frac{E_0}{2B_0^2R}$
2. $\frac{2E_0}{B_0}$, $\frac{E_0}{B_0^2R}$
3. $\frac{E_0}{B_0}$, $\frac{E_0}{B_0^2R}$
4. $\frac{E_0}{B_0}$, $\frac{2E_0}{B_0^2R}$

Q.No:26 CSIR June-2025

A circular loop of radius a (in the $x-y$ plane) and a square loop of side b (in the $x-z$ plane) are kept at a distance r. Both carry current I as shown in the figure. If $r \gg a, b$, the torque exerted on the square loop by the circular loop is

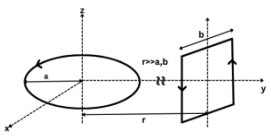


Figure 21: Figure for Q.No:26 CSIR June-2025

1. $-\frac{\mu_0}{4\pi}\frac{1}{r^3}\pi a^2 b^2 I^2\,\hat{z}$
2. 0
3. $\frac{\mu_0}{4\pi}\frac{1}{r^3}\pi a^2 b^2 I^2\,\hat{x}$
4. $-\frac{\mu_0}{4\pi}\frac{1}{r^3}\pi a^2 b^2 I^2\,\hat{x}$

Q.No:27 CSIR June-2025

Two identical cubes are shown in figures (a) and (b). The magnitude of the magnetic field at the centre of the cube in (a), produced by the currents as shown, is B_0. The magnitude of the magnetic field at the centre of the cube in (b) will be

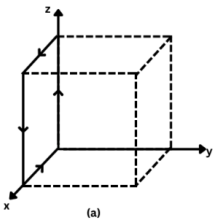


Figure 22: * (a)

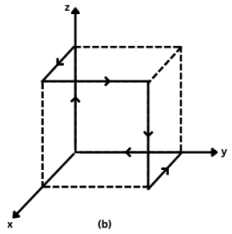


Figure 23: * (b)

1. $\sqrt{3}\,B_0$
2. $2\,B_0$
3. $\frac{3}{2}\,B_0$
4. $\sqrt{2}\,B_0$

Q.No:28 CSIR June-2025

A long cylinder of radius R carries a magnetization $\vec{M} = k\rho^2\hat{\phi}$, where k is a constant, ρ is the radial distance from the axis and $\hat{\phi}$ is the azimuthal unit vector. The magnetic field inside and outside the cylinder would be

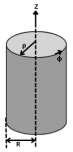


Figure 24: Figure for Q.No:28 CSIR June-2025

1. $\vec{B}_{\text{inside}} = 0, \quad \vec{B}_{\text{outside}} = \mu_0 k\rho^2\hat{\phi}$
2. $\vec{B}_{\text{inside}} = \mu_0 k\rho^2\hat{\phi}, \quad \vec{B}_{\text{outside}} = 0$
3. $\vec{B}_{\text{inside}} = \vec{B}_{\text{outside}} = \mu_0 k\rho^2\hat{\phi}$
4. $\vec{B}_{\text{inside}} = \vec{B}_{\text{outside}} = 0$

S. N. Bose Physics Learning Centre

Q.No:29 CSIR June-2026

A particle with charge q, which is confined to move in the xy-plane, is subjected to a magnetic field with magnitude B pointing in the $+z$-direction. The particle moves in a circle (C) of radius R. If $\vec{p}$ is the canonical momentum, then the following integral

$$\oint_C \vec{p} \cdot d\vec{l}$$

has the magnitude: ($d\vec{l}$ is in the direction of motion)

1. $qB\pi R^2$
2. $2qB\pi R^2$
3. $3qB\pi R^2$
4. $4qB\pi R^2$

Question No.	Entrance with year	
1	GATE-2013	Option D
2	GATE-2013	Ans: 0.15
3	GATE-2014	Ans: 1.41–1.47
4	GATE-2015	Option B
5	GATE-2016	Option C
6	GATE-2016	Ans: 4
7	GATE-2016	Option D
8	GATE-2018	Ans: 4
9	GATE-2019	Option C
10	GATE-2019	Option B
11	GATE-2020	Ans: 7
12	GATE-2021	Option C
13	GATE-2021	Option B, D
14	GATE-2021	Ans: 0.24–0.26
15	GATE-2023	Option A, B, D
16	GATE-2024	Option C
17	GATE-2025	Option D
18	GATE-2025	Option A, B, C
19	GATE-2026	Ans: 0.6–0.7
1	CSIR Dec-2014	Option 2
2	CSIR June-2015	Option 4
3	CSIR Dec-2015	Option 4
4	CSIR Dec-2015	Option 3
5	CSIR June-2016	Option 1
6	CSIR June-2017	Option 4
7	CSIR June-2017	Option 2
8	CSIR Dec-2017	Option 4
9	CSIR June-2018	Option 2
10	CSIR Dec-2018	Option 3
11	CSIR Dec-2018	Option 3
12	CSIR June-2019	Option 4
13	CSIR June-2019	Option 1
14	CSIR Dec-2019	Option 1
15	Assam CSIR Dec-2019	Option 2
16	CSIR June-2020	Option d
17	CSIR Feb-2022	Option 4
18	CSIR Feb-2022	Option 1
19	CSIR Sep-2022	Option 1
20	CSIR Sep-2022	Option 1
21	CSIR Sep-2022	Option 1
22	CSIR Dec-2023	Option 2
23	CSIR June-2024	Option 3
24	CSIR Dec-2024	Option 3
25	CSIR Dec-2024	Option 3
26	CSIR June-2025	Option 4
27	CSIR June-2025	Option 1
28	CSIR June-2025	Option 2
29	CSIR June-2026	Option 1

S. N. Bose Physics Learning Centre