PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Electrostatics - CSIR NET Physics PYQs

Electromagnetism . All PYQs (2015-2025) with answer key

24 questions . Answer key included

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Q1. [Dec 2015] . 3.5 marks
Electromagnetism > Electrostatics

CSIR NET	2015 Dec	3.5 M

A hollow metallic sphere of radius a, which is kept at a potential V_0 has a charge Q at its centre. The potential at a point outside the sphere, at a distance r from the centre, is

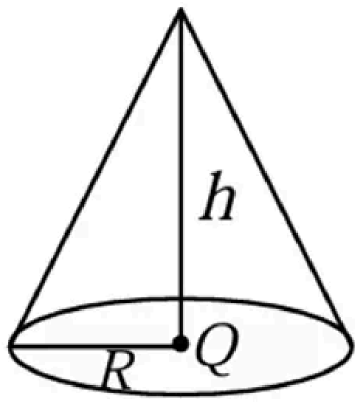
1. V_0
2. $\frac{Q}{4\pi\epsilon_0 r} + \frac{V_0 a}{r}$
3. $\frac{Q}{4\pi\epsilon_0 r} + \frac{V_0 a^2}{r^2}$
4. $\frac{V_0 a}{r}$

Q2. [Dec 2015] . 3.5 marks
Electromagnetism > Electrostatics

CSIR NET	2015 Dec	3.5 M

Consider a charge Q at the origin of 3 - dimensional coordinate system. The flux of the electric field through the curved surface of a cone that has a height h and a circular base of radius R (as shown in the figure) is

1. $\frac{Q}{\epsilon_0}$
2. $\frac{Q}{2\epsilon_0}$
3. $\frac{hQ}{R\epsilon_0}$
4. $\frac{QR}{2h\epsilon_0}$



Q3. [June 2015] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2015 June	3.5 M

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 $\vec{E}_{\text{left}} = c(\hat{\imath} + \hat{\jmath} + \hat{k})$ (where c is a constant), then the electric field on the right $\vec{E}_{\text{right}}$ is

1. $c(2\hat{\imath} + \hat{\jmath} + \hat{k})$
2. $c(\hat{\imath} + 2\hat{\jmath} + 2\hat{k})$
3. $c\left(\frac{1}{2}\hat{\imath} + \hat{\jmath} + \hat{k}\right)$
4. $c\left(\hat{\imath} + \frac{1}{2}\hat{\jmath} + \frac{1}{2}\hat{k}\right)$

Q4. [Dec 2016] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2016 Dec	3.5M

The charge per unit length of a circular wire of radius a in the xy-plane, with its centre at the origin, is $\lambda = \lambda_0 \cos\theta$, where λ_0 is a constant and the angle θ is measured from the positive x-axis. The electric field at the centre of the circle is

1. $\vec{E} = -\frac{\lambda_0}{4\epsilon_0 a}\hat{\imath}$

2. $\vec{E} = \frac{\lambda_0}{4\epsilon_0 a}\hat{\imath}$

3. $\vec{E} = -\frac{\lambda_0}{4\epsilon_0 a}\hat{\jmath}$

4. $\vec{E} = \frac{\lambda_0}{4\pi\epsilon_0 a}\hat{k}$

Q5. [Dec 2016] . 5.0 marks
Electromagnetism > Electrostatics

CSIR NET	2016 Dec	5M

Suppose that free charges are present in a material of dielectric constant $\epsilon = 10$ and resistivity $\rho = 10^{11} \Omega - \mathrm{m}$. Using Ohm's law and the equation of continuity for charge, the time required for the charge density inside the material to decay by $1/e$ is closest to

1. 10^{-6} s
2. 10^{6} s
3. 10^{12} s
4. 10 s

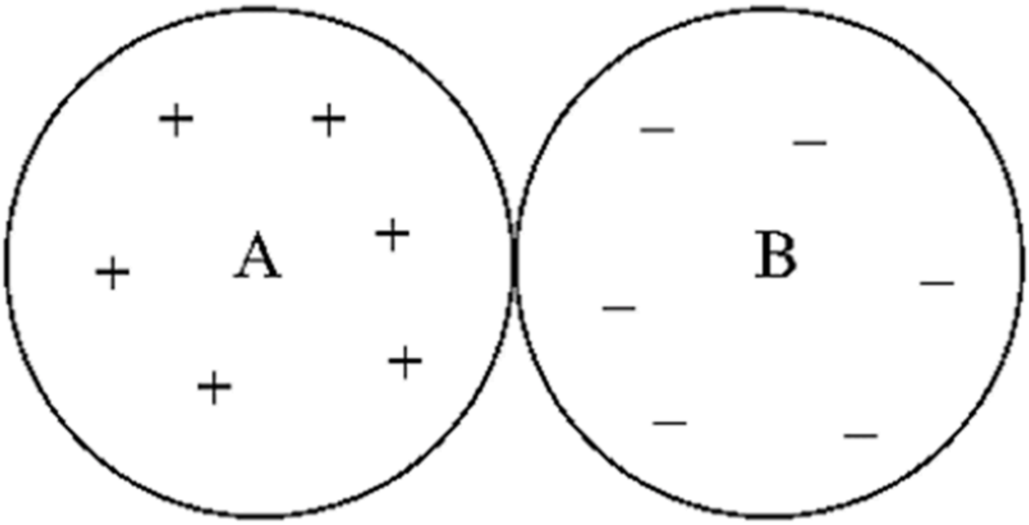
Q6. [Dec 2016] . 5.0 marks

Electromagnetism > Electrostatics

CSIR NET	2016 Dec	5M

Two uniformly charged insulating solid spheres A and B , both of radius a, carry total charges $+Q$ and $-Q$, respectively. The spheres are placed touching each other as shown in the figure. If the potential at the centre of the sphere A is V_A and that at the centre of B is V_B, then the difference $V_A - V_B$ is

1. $\frac{Q}{4\pi\varepsilon_0 a}$
2. $\frac{-Q}{2\pi\varepsilon_0 a}$
3. $\frac{Q}{2\pi\varepsilon_0 a}$
4. $\frac{-Q}{4\pi\varepsilon_0 a}$



Q7. [June 2016] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2016 June	3.5M

Four equal charges of $+Q$ each are kept at the vertices of a square of side R. A particle of mass m and charge $+Q$ is placed in the plane of the square at a short distance $a(\ll R)$ from the centre. If the motion of the particle is confined to the plane, it will undergo small oscillations with an angular frequency

1. $\sqrt{\dfrac{Q^2}{2\pi\epsilon_0 R^3 m}}$

2. $\sqrt{\dfrac{Q^2}{\pi\epsilon_0 R^3 m}}$

3. $\sqrt{\dfrac{\sqrt{2}Q^2}{\pi\epsilon_0 R^3 m}}$

4. $\sqrt{\dfrac{Q^2}{4\pi\epsilon_0 R^3 m}}$

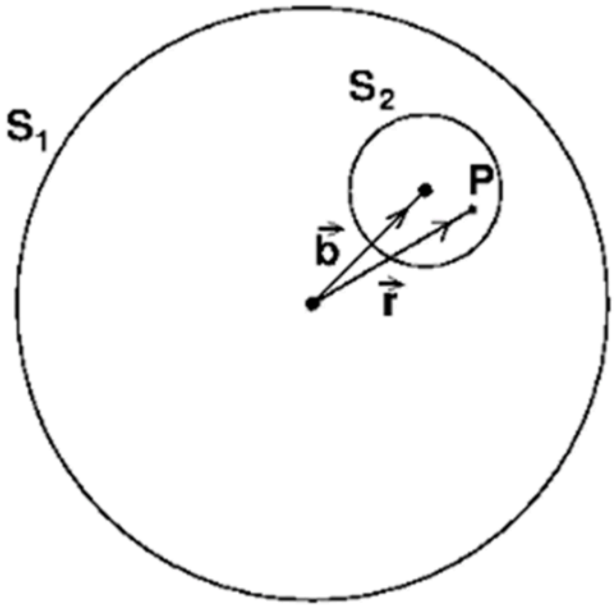
Q8. [June 2016] . 5.0 marks

Electromagnetism > Electrostatics

CSIR NET	2016 June	5M

Consider a sphere S_1 of radius R which carries a uniform charge of density ρ. A smaller sphere S_2 of radius $a < R/2$ is cut out and removed from it. The centres of the two spheres are separated by the vector $\vec{b} = \hat{n}R/2$, as shown in the figure.

The electric field at a point P inside S_2 is



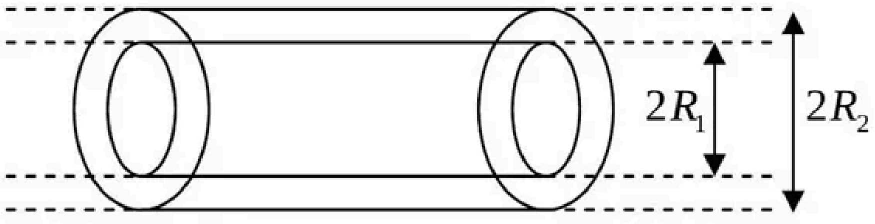
1. $\frac{\rho R}{3\varepsilon_0}\hat{n}$
2. $\frac{\rho R}{3\varepsilon_0 a}(\vec{r} - \hat{n}a)$
3. $\frac{\rho R}{6\varepsilon_0}\hat{n}$
4. $\frac{\rho a}{3\varepsilon_0 R}\vec{r}$

Q9. [June 2017] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2017 June	3.5M

Two long hollow co-axial conducting cylinders of radii R_1 and $R_2 (R_1 < R_2)$ are placed in vacuum as shown in the figure below.



The inner cylinder carries a charge $+\lambda$ per unit length and the outer cylinder carries a charge $-\lambda$ per unit length. The electrostatic energy per unit length of this system is

1. $\frac{\lambda^2}{\pi\epsilon_0} ln(R_2/R_1)$
2. $\frac{\lambda^2}{4\pi\epsilon_0} (R_2^2/R_1^2)$
3. $\frac{\lambda^2}{4\pi\epsilon_0} ln(R_2/R_1)$
4. $\frac{\lambda^2}{2\pi\epsilon_0} ln(R_2/R_1)$

Q10. [June 2017] . 5.0 marks

Electromagnetism > Electrostatics

CSIR NET	2017 June	5M

The charge distribution inside a material of conductivity σ and permittivity $\in$ at initial time $t = 0$ is $\rho(r, 0) = \rho_0$, a constant. At subsequent times $\rho(r, t)$ is given by

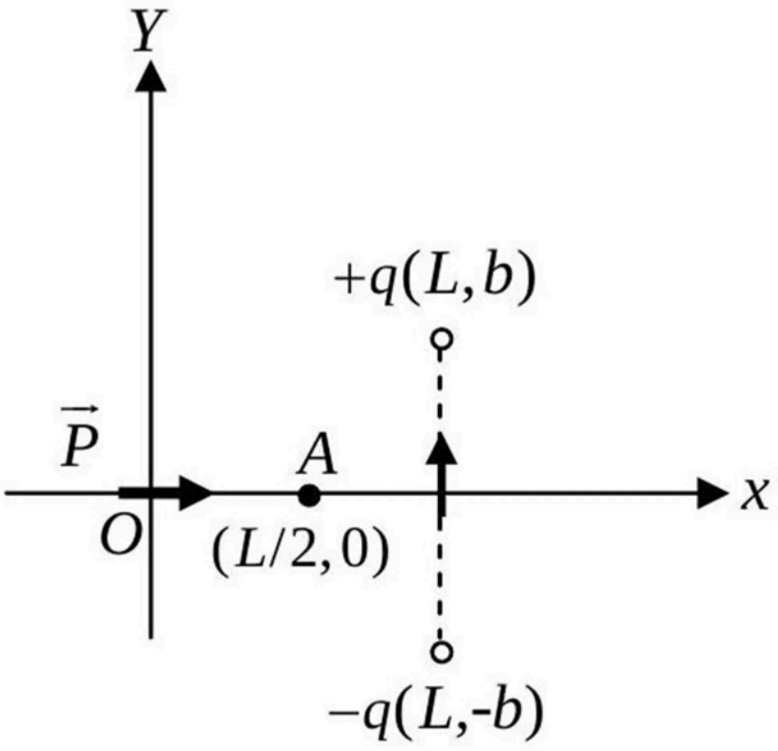
1. $\rho_0 exp\left(-\frac{\sigma t}{\epsilon}\right)$
2. $\frac{1}{2}\rho_0\left[1 + \exp\left(\frac{\sigma t}{\epsilon}\right)\right]$
3. $\frac{\rho_0}{\left[1 - \exp\left(\frac{\sigma t}{\epsilon}\right)\right]}$
4. $\rho_0 \cosh\frac{\sigma t}{\epsilon}$

Q11. [Dec 2018] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2018 Dec	3.5M

An electric dipole of dipole moment $\vec{P} = qb\hat{i}$ is placed at origin in the vicinity of two charges $+q$ and $-q$ at (L, b) and $(L, -b)$, respectively, as shown in the figure. The electrostatic potential at the point $\left(\frac{L}{2}, 0\right)$ is



1. $\frac{qb}{\pi\varepsilon_0}\left(\frac{1}{L^2} + \frac{2}{L^2+4b^2}\right)$
2. $\frac{4qbL}{\pi\varepsilon_0[L^2+4b^2]^{3/2}}$
3. $\frac{qb}{\pi\varepsilon_0 L^2}$
4. $\frac{3qb}{\pi\varepsilon_0 L^2}$

Q12. [June 2018] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2018 June	3.5M

Two-point charges $+2Q$ and $-Q$ are kept at point with Cartesian coordinates $(1,0,0)$, respectively, in front of an infinite grounded conducting plate at $x = 0$. The potential at $(x, 0,0)$ for $x \gg 1$ depends on x as

1. x^{-3}
2. x^{-5}
3. x^{-2}
4. x^{-4}

Q13. [Dec 2019] . 3.5 marks
Electromagnetism > Electrostatics

CSIR NET	2019 Dec	3.5M

The yz - plane at $x = 0$ carries a uniform surface charge density σ. A unit point charge is moved from a point ($\delta, 0,0$) on one side of the plane to a point ($-\delta, 0,0$) on the other side. If δ is an infinitesimally small positive number, the work done in moving the charge is

1. 0
2. $\frac{\sigma}{\varepsilon_0}\delta$
3. $-\frac{\sigma}{\varepsilon_0}\delta$
4. $\frac{2\sigma}{\varepsilon_0}\delta$

Q14. [June 2020] . 3.5 marks
Electromagnetism > Electrostatics

CSIR NET	2020 June	3.5M

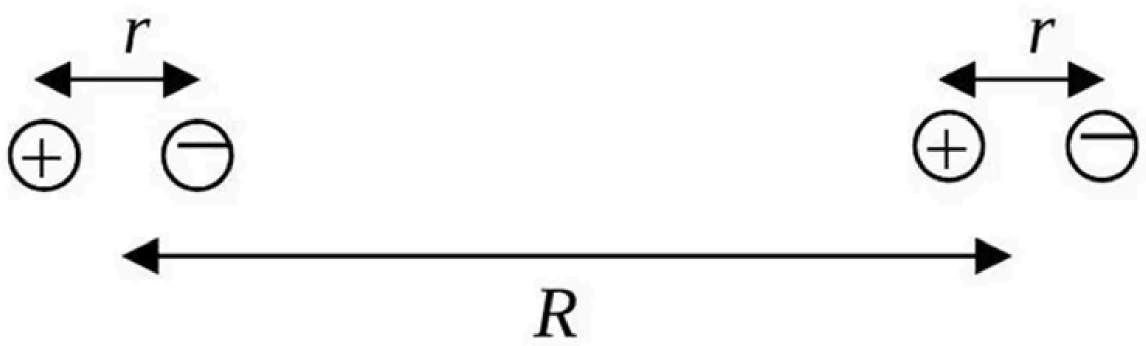
Three point charges q are placed at the corners of an equilateral triangle. Another point charge -Q is placed at the centroid of the triangle. If the force on each of the charges q vanishes, then the ratio Q/q is

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

Q15. [June 2021] . 5.0 marks
Electromagnetism > Electrostatics

CSIR NET	2021 June	5M

A linear diatomic molecule consists of two identical small electric dipoles with an equilibrium separation R, which is assumed to be a constant. Each dipole has charges $\pm q$ of mass m separated by r when the molecule is at equilibrium. Each dipole can execute simple harmonic motion of angular frequency ω.



Recall that the interaction potential between two dipoles of moments $\vec{p}_1$ and $\vec{p}_2$, separated by $\vec{R}_{12} = R_{12}\hat{n}$ is $(\vec{p}_1 \cdot \vec{p}_2 - 3(\vec{p}_1 \cdot \hat{n})(\vec{p}_2 \cdot \hat{n})/(4\pi \epsilon_0 R_{12}^3)$. Assume that $R \gg r$ and let $\Omega^2 = \frac{q^2}{4\pi\epsilon_0 m R^3}$. The angular frequencies of small oscillations of the diatomic molecule are

1. $\sqrt{\omega^2 + \Omega^2}$ and $\sqrt{\omega^2 - \Omega^2}$
2. $\sqrt{\omega^2 + 3\Omega^2}$ and $\sqrt{\omega^2 - 3\Omega^2}$
3. $\sqrt{\omega^2 + 4\Omega^2}$ and $\sqrt{\omega^2 - 4\Omega^2}$
4. $\sqrt{\omega^2 + 2\Omega^2}$ and $\sqrt{\omega^2 - 2\Omega^2}$

Q16. [June 2022] . 5.0 marks
Electromagnetism > Electrostatics

CSIR NET	2022 June	5M

Two small metallic objects are embedded in a weakly conducting medium of conductivity σ and dielectric constant $\in$. A battery connected between them leads to a potential difference V_0. It is subsequently disconnected at time $t = 0$. The potential difference at a later time t is

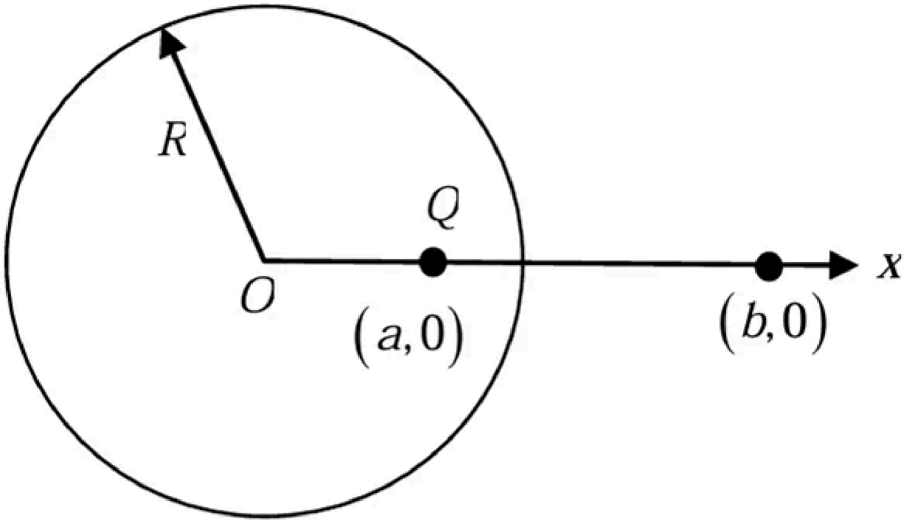
1. $V_0 e^{-\frac{t\sigma}{4\epsilon}}$
2. $V_0 e^{-\frac{t\sigma}{2\epsilon}}$
3. $V_0 e^{-\frac{3t\sigma}{4\epsilon}}$
4. $V_0 e^{-\frac{t\sigma}{\epsilon}}$

Q17. [Dec 2023] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2023 Dec	3.5 M

A conducting shell of radius R is placed with its centre at the origin as shown below. A point charge Q is placed inside the shell at a distance a along the x-axis from the centre.



The electric field at a distance $b > R$ along the x-axis from the centre is

1. $\frac{Q}{4\pi\varepsilon_0 b^2}\hat{x}$
2. $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{(b-a)^2} - \frac{aR}{(ab-R^2)^2}\right]\hat{x}$
3. $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{(b-a)^2} + \frac{aR}{(ab-R^2)^2}\right]\hat{x}$
4. $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{b^2} - \frac{R^2}{a^2b^2}\right]\hat{x}$

Q18. [Dec 2023] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2023 Dec	3.5 M

A one dimensional infinite long wire with uniform linear charge density λ is placed along the z-axis. The potential difference $\delta V = V(\rho + a) - V(\rho)$, between two points at radial distances $\rho + a$ and ρ from the z-axis, where $a \ll \rho$, is closest to

1. $-\frac{\lambda}{2\pi\varepsilon_0}\frac{a^2}{\rho^2}$
2. $-\frac{\lambda}{2\pi\varepsilon_0}\frac{a}{\rho}$
3. $\frac{\lambda}{2\pi\varepsilon_0}\frac{a}{\rho}$
4. $\frac{\lambda}{2\pi\varepsilon_0}\frac{a^2}{\rho^2}$

Q19. [June 2023] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2023 June	3.5M

The electric potential on the boundary of a spherical cavity of radius R, as a function of the polar angle θ, is $V_0 \cos^2 \frac{\theta}{2}$. The charge density inside the cavity is zero everywhere. The potential at a distance $R/2$ from the centre of the sphere is

1. $\frac{1}{2} V_0 \left(1 + \frac{1}{2} \cos\theta\right)$
2. $\frac{1}{2} V_0 \cos\theta$
3. $\frac{1}{2} V_0 \left(1 + \frac{1}{2} \sin\theta\right)$
4. $\frac{1}{2} V_0 \sin\theta$

Q20. [Dec 2024] . 5.0 marks

Electromagnetism > Electrostatics

CSIR NET	2024 Dec	5M

A static charge distribution produces an electric field

$$\vec{E} = \frac{Q}{4\pi\epsilon_0}\frac{e^{-br}}{r^3}\vec{r},$$

where $Q, b > 0$ are constants. The charge density of the distribution is given by

1. $\frac{Q}{4\pi}\left[-\frac{b}{2r^2}\right]$
2. $\frac{Q}{4\pi}e^{-b}\left[-\frac{b}{r^2} - 4\pi\delta(\vec{r})\right]$
3. $\frac{Q}{4\pi}e^{-br}\left[-\frac{2b}{r^2}\right]$
4. $\frac{Q}{4\pi}e^{-br}\left[-\frac{b}{r^2} + 4\pi\delta(\vec{r})\right]$

Q21. [Dec 2024] . 5.0 marks

Electromagnetism > Electrostatics

CSIR NET	2024 Dec	5M

Consider a spherical region of radius $\frac{R}{2}$ centered at the origin of the coordinate system. Three point charges each of magnitude Q are placed at $(0,0,R),(0,R,0)$ and $(\sqrt{2}R,0,0)$. What is the magnitude of the average electric field over the spherical region due to these charges in units of $\frac{Q}{4\pi\epsilon_0 R^2}$?

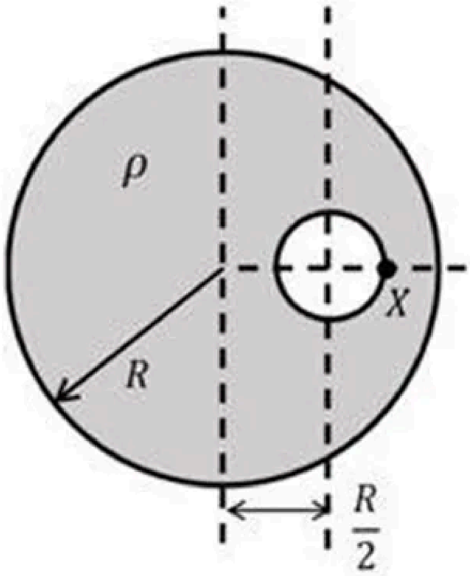
1. $\frac{3}{5}$
2. 0
3. $\frac{5}{2}$
4. $\frac{3}{2}$

Q22. [Dec 2025] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2025 Dec	3.5M	EMT

A solid sphere of radius R has uniform charge density ρ. A spherical volume of radius $\frac{R}{4}$ is scooped out from the sphere as shown. The electric field at the point marked X is ($\hat{r}$ denotes the unit vector along the radially outward direction)



1. $\frac{2\rho R}{9\varepsilon_0}\hat{r}$
2. $\frac{\rho R}{6\varepsilon_0}\hat{r}$
3. $\frac{\rho R}{3\varepsilon_0}\hat{r}$
4. $\frac{\rho R}{9\varepsilon_0}\hat{r}$

Q23. [Dec 2025] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2025 Dec	3.5M	EMT

Two well separated conducting spheres (A and B) of radii 10 cm and 20 cm carry charges +30 C and -20 C respectively. When they are connected by a thin conducting wire, the final charge on A is Q_A and that on B is Q_B. The values of Q_A and Q_B respectively, are closest to

1. 6.7 C and 3.3 C
2. 2.0 C and 8.0 C
3. 3.3C and 6.7 C
4. 8.0 C and 2.0 C

Q24. [June 2025] . 5.0 marks
Electromagnetism > Electrostatics

CSIR NET	2025 June	5M	EMT

The charge density of the electron cloud of a hydrogen atom is given by $\rho(\vec{r}) = -\frac{e}{8\pi a^3}\exp(-r/a)$, where a is some characteristic length. The potential energy due to the interaction between the proton (sitting at the origin) and the electron cloud is given by

1. $-\frac{e^2}{2\pi\varepsilon_0 a}$
2. $-\frac{e^2}{4\pi\varepsilon_0 a}$
3. $-\frac{e^2}{\pi\varepsilon_0 a}$
4. $-\frac{e^2}{8\pi\varepsilon_0 a}$

Answer Key

24 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Electromagnetism	Electrostatics	**4**
Q2	Electromagnetism	Electrostatics	**2**
Q3	Electromagnetism	Electrostatics	**3**
Q4	Electromagnetism	Electrostatics	**1**
Q5	Electromagnetism	Electrostatics	**4**
Q6	Electromagnetism	Electrostatics	**3**
Q7	Electromagnetism	Electrostatics	**3**
Q8	Electromagnetism	Electrostatics	**3**
Q9	Electromagnetism	Electrostatics	**3**
Q10	Electromagnetism	Electrostatics	**1**
Q11	Electromagnetism	Electrostatics	**3**
Q12	Electromagnetism	Electrostatics	**4**
Q13	Electromagnetism	Electrostatics	**1**
Q14	Electromagnetism	Electrostatics	**2**
Q15	Electromagnetism	Electrostatics	**3**
Q16	Electromagnetism	Electrostatics	**4**
Q17	Electromagnetism	Electrostatics	**1**
Q18	Electromagnetism	Electrostatics	**2**
Q19	Electromagnetism	Electrostatics	**1**
Q20	Electromagnetism	Electrostatics	**4**
Q21	Electromagnetism	Electrostatics	**4**
Q22	Electromagnetism	Electrostatics	**2**
Q23	Electromagnetism	Electrostatics	**3**
Q24	Electromagnetism	Electrostatics	**4**

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