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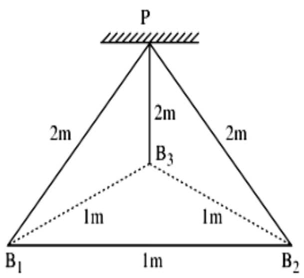
# Class 12
# Electric Charges and Fields

## Based on Coulomb's Law

1. Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If $\mathrm{M} =$ mass, $\mathrm{L} =$ length, Time $= \mathrm{t}$ and $\mathrm{A} =$ electric current, then [JEE Main 13]
(a) $[\varepsilon_0] = \mathrm{M^{-1}L^{-3}T^2A}$ (b) $[\varepsilon_0] = \mathrm{M^{-1}L^{-3}T^4A^2}$
(c) $[\varepsilon_0] = \mathrm{M^{-1}L^2T^{-1}A^{-2}}$ (d) $[\varepsilon_0] = \mathrm{M^{-1}L^2T^{-1}A}$
2. Two spherical conductors $B$ and $C$ having equal radii and carrying equal charges in them repel each other with a force $F$ when kept apart at some distance. A third spherical conductor having same radius as that of $B$ but uncharged, is brought in contact with $B$, then brought in contact with $C$ and finally removed away from both. The new force of repulsion between $B$ and $C$ is [AIEEE 2004]
(a) $\frac{F}{4}$ (b) $\frac{3F}{4}$
(c) $\frac{F}{8}$ (d) $\frac{3F}{8}$
3. Three charges $+Q, q, +Q$ are placed respectively, at distance, $0, d/2$ and $d$ from the origin, on the $x$-axis. If the net force experienced by $+Q$, placed at $x = 0$, is zero, then value of $q$ is [JEE Main Jan 19]
(a) $+Q/2$ (b) $-Q/2$
(c) $-Q/4$ (d) $+Q/4$
4. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density $0.8\ g\ cm^{-3}$ the angle remains the same. If density of the material of the sphere is $1.6\ g\ cm^{-3}$ the dielectric constant of the liquid is [AIEEE 2010]
(a) 1 (b) 4
(c) 3 (d) 2

**Based on Forces between Multiple Charges: The Superposition Principle**

5. Three identical charged balls each of charge $2C$ are suspended from a common point $P$ by silk threads of $2\ m$ each (as shown in figure). They form an equilateral triangle of side $1\ m$.




The ratio of net force on a charged ball to the force between any two charged balls will be

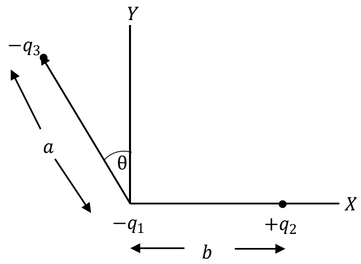
(a) 1 : 1 (b) 1 : 4
(c) $\sqrt{3} : 2$ (d) $\sqrt{3} : 1$ [JEE Main June 22]
6. Four charges equal to – Q are placed at the four corners of the square and a charge $q$ is at its centre. If the system is in equilibrium, the value of $q$ is [AIEEE 2004]
(a) $-\frac{Q}{4}(1 + 2\sqrt{2})$ (b) $\frac{Q}{4}(1 + 2\sqrt{2})$
(c) $-\frac{Q}{2}(1 + 2\sqrt{2})$ (d) $\frac{Q}{2}(1 + 2\sqrt{2})$
7. Three charges $-q_1, +q_2$ and $-q_3$ are placed as shown in the figure. The $x$-component of the force on $-q_1$ is proportional to [AIEEE 2003]

(a) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\cos\theta$

(b) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\sin\theta$

(c) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\cos\theta$

(d) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\sin\theta$




8. Two charges, each equal to $q$, are kept at $x = -a$ and $x = a$ on the $x$-axis. A particle of mass $m$ and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge $q_0$ is given a small displacement $(y << a)$ along the $y$-axis, the net force acting on the particle is proportional to [JEE Main 13]

(a) $y$

(b) $-y$

(c) $\frac{1}{y}$

(d) $-\frac{1}{y}$

9. A charge Q is placed at each of the opposite corners of a square. A charge $q$ is placed at each of the other two corners. If the net electrical force on Q is zero, then $Q/q$ equals [AIEEE 2009]

(a) $-2\sqrt{2}$

(b) $-1$

(c) $1$

(d) $-\frac{1}{\sqrt{2}}$

**Based on Relation between Electric Field, Electric Charges and Electric Force**

10. A vertical electric field of magnitude $4.9 \times 10^5\ N/C$ just prevents a water droplet of a mass 0.1 g from falling. The value of charge on the droplet will be (Given $g = 9.8\ m/s^2$) [JEE Main June 22]

(a) $1.6 \times 10^{-9}$ C

(b) $2.0 \times 10^{-9}$ C

(c) $3.2 \times 10^{-9}$ C

(d) $0.5 \times 10^{-9}$ C

11. The bob of a simple pendulum has mass 2 g and a charge of 5.0 μC. It is at rest in a uniform electric field of intensity $2000\ \text{Vm}^{-1}$. At equilibrium, the angle that the Pendulum makes with the vertical (take $g = 10\ ms^{-1}$) is [JEE Main April 19]

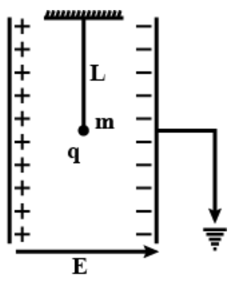
(a) $\tan^{-1}(5.0)$

(b) $\tan^{-1}(2.0)$

(c) $\tan^{-1}(0.5)$

(d) $\tan^{-1}(0.2)$

12. A simple pendulum of length $L$ is placed between the plates of a parallel plate capacitor having electric field $E$, as shown in the figure. Its bob has mass m and charge $q$. The time period of the pendulum is given by [JEE Main April 19]




(a) $2\pi\sqrt{\frac{L}{\left(g - \frac{qE}{m}\right)}}$

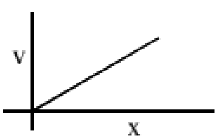
(b) $2\pi\sqrt{\frac{L}{\left(g + \frac{qE}{m}\right)}}$

(c) $2\pi\sqrt{\frac{L}{\sqrt{g^2 + \left(\frac{qE}{m}\right)^2}}}$

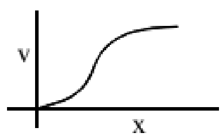
(d) $2\pi\sqrt{\frac{L}{\sqrt{g^2 - \frac{q^2E^2}{m^2}}}}$

13. A particle of mass $m$ and charge $q$ is released from rest in a uniform electric field. If there is no other force on the particle the dependence of its speed $v$ on the distance $x$ travelled by it is correctly given by (graphs are schematic and not drawn to scale) [JEE Main Jan 20]

(a)




(b)

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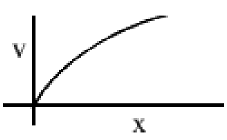
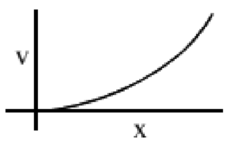



(d)



14. A particle of mass $m$ and charge $q$ has an initial velocity $\vec{v} = v_0\hat{j}$. If an electric field $\vec{E} = E_0\hat{i}$ and magnetic field $\vec{B} = B_0\hat{i}$ act on the particle, its speed will double after a time

(a) $\frac{3mv_0}{qE_0}$ (b) $\frac{\sqrt{2}mv_0}{qE_0}$

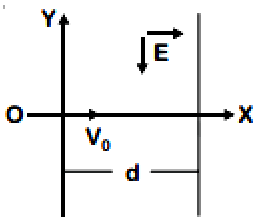
(c) $\frac{\sqrt{3}mv_0}{qE_0}$ (d) $\frac{2mv_0}{qE_0}$ [JEE Main Jan 20]

15. A particle of charge $q$ and mass $m$ is subjected to an electric field $E = E_0(1 - ax^2)$ in the $x$-direction, where $a$ and $E_0$ are constants. Initially the particle was at rest at $x = 0$. Other than the initial point of the kinetic energy of the particle becomes zero when the distance of the particle from the origin is

(a) $\sqrt{\frac{2}{a}}$ (b) $\sqrt{\frac{1}{a}}$

(c) $a$ (d) $\sqrt{\frac{3}{a}}$ [JEE Main Sept 20]

16. A charged particle (mass $m$ and charge $q$) moves along $X$-axis with velocity $v_0$. When it passes through the origin it enters a region having uniform electric field $\vec{E} = -E\hat{j}$ which extends upto $x = d$. Equation of path of electron in the region $x > d$ is




[JEE Main Sept 20]

(a) $y = \frac{qEd}{mv_0^2}(x - d)$ (b) $y = \frac{qEd^2}{mv_0^2}x$

(c) $y = \frac{qEd}{mv_0^2}\left(\frac{d}{2} - x\right)$ (d) $y = \frac{qEd}{mv_0^2}x$

### Based on Electric Fields of Point Charges

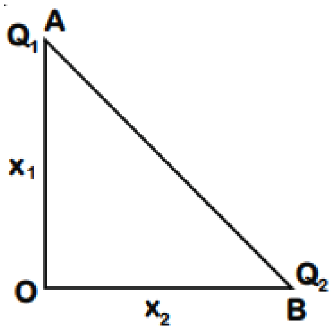
17. Two point charges $+8q$ and $-2q$ are located at $x = 0$ and $x = L$ respectively. The location of point on $X-$ axis at which the net electric field due to these two point charge is zero is

[AIEEE 2005]

(a) $2L$ (b) $\frac{L}{4}$

(c) $8L$ (d) $4L$

18. Charges $Q_1$ and $Q_2$ are at points $A$ and $B$ of a right angle triangle $OAB$ (see figure). The resultant electric field at point $O$ is perpendicular to the hypotenuse, then $\frac{Q_1}{Q_2}$ is proportional to [JEE Main Sept 20]




(a) $\frac{x_2^2}{x_1^2}$ (b) $\frac{x_1^3}{x_2^3}$

(c) $\frac{x_1}{x_2}$ (d) $\frac{x_2}{x_1}$

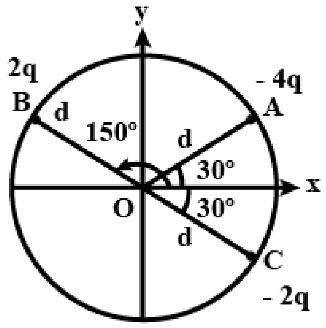
19. Two point charges $q_1(\sqrt{10}\ \mu C)$ and $q_2(-25\ \mu C)$ are placed on the $x$-axis at $x = 1\ m$ and $x = 4\ m$ respectively. The electric field (in V/m) at a point $y = 3\ m$ on $y$-axis is $\left[\text{Take}\ \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \text{Nm}^2\text{C}^{-2}\right]$ [JEE Main April 19]

(a) $(-63\hat{i} + 27\hat{j}) \times 10^2$ (b) $(81\hat{i} - 81\hat{j}) \times 10^2$

(c) $(63\hat{i} - 27\hat{j}) \times 10^2$ (d) $(-81\hat{i} + 81\hat{j}) \times 10^2$

20. Three charged particles $A, B$ and $C$ with charges $-4q, 2q$ and $-2q$ are present on the circumference of a circle of radius $d$. The charged particles $A, C$ and centre $O$ of the circle form an equilateral triangle as shown in the figure. Electric field at $O$ along $x$-direction is

(a) $\frac{\sqrt{3}q}{\pi\varepsilon_0 d^2}$




(b) $\frac{3\sqrt{3}q}{4\pi\varepsilon_0 d^2}$

(c) $\frac{\sqrt{3}q}{4\pi\varepsilon_0 d^2}$

(d) $\frac{2\sqrt{3}q}{\pi\varepsilon_0 d^2}$

[JEE Main Sept 20]

21. For point charges $-q, +q, +q$ and $-q$ are placed on $y$-axis at $y = -2d, y = -d, y = +d$ and $y = +2d$, respectively. The magnitude of the electric field $E$ at a point the $x$-axis at $x = D$, with $D \gg d$, will behave as

(a) $E \propto \frac{1}{D^3}$

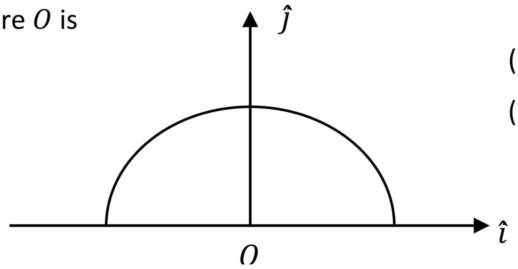
(b) $E \propto \frac{1}{D^4}$

(c) $E \propto \frac{1}{D}$

(d) $E \propto \frac{1}{D^2}$ [JEE Main April 19]

### Based on Electric Fields of Continuous Charge Distributions

22. A thin semi-circular ring of radius $r$ has a positive charge $q$ distibuted uniformly over it. The net field $E$ at the centre $O$ is [JEE Main 15]



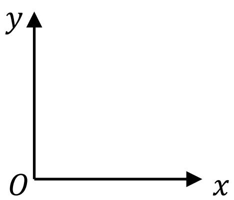

(a) $\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$

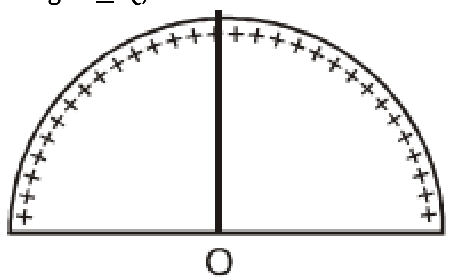
(b) $\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$

(c) $-\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$

(d) $-\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$

23. A wire of length $L(= 20 \text{ cm})$, is bent into a semicircular arc. If the two equal halves of the arc, were each to be uniformly charged with charges $\pm$ Q,




$[|Q| = 10^3\varepsilon_0$ Coulomb, where $\varepsilon_0$ is the permittivity (in SI units) of free space] the next electric field at the centre $O$ of the semicircular arc would be [AIEEE 2010]

(a) $(50 \times 10^3 \text{N/C})\hat{j}$

(b) $(50 \times 10^3 \text{ N/C})\,\hat{\imath}$

(d) $(25 \times 10^3 \text{ N/C})\,\hat{j}$

(d) $(25 \times 10^3 \text{ N/C})\,\hat{\imath}$

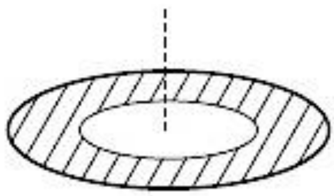
24. A thin disc of radius $b = 2a$ has concentric hole of radius $'a'$ in it (see figure). It carries uniform surface charge $'\sigma'$ on it. If the electrical field on its axis at height $'h'(h << a)$ from its centre is given as 'Ch', then value of 'C' is [JEE Main 15]

(a) $\frac{\sigma}{2a\varepsilon_0}$

(b) $\frac{\sigma}{4a\varepsilon_0}$

(c) $\frac{\sigma}{8a\varepsilon_0}$

(d) $\frac{\sigma}{a\varepsilon_0}$



25. For a uniformly charged ring of radius $R$, the electric field on its axis has the largest magnitude at a distance $h$ from its centre. Then value of $h$ is [JEE Main Jan 19]

(a) $\frac{R}{\sqrt{5}}$

(b) $R$

(c) $\frac{R}{\sqrt{2}}$

(d) $R\sqrt{2}$

26. Charge is distributed with in a sphere of radius $R$ with a volume charge density $\rho(r) = \frac{A}{r^2}e^{-2r/a}$, where $A$ and $a$ are constants. If $Q$ is the total charge of this charge distribution, the radius $R$ is [JEE Main April 19]

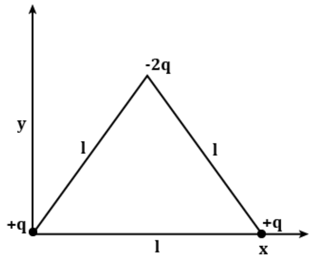
(a) $\frac{a}{2}\log\left(1-\frac{Q}{2\pi aA}\right)$ (b) $a\log\left(1-\frac{Q}{2\pi aA}\right)$

(c) $a\log\left(1-\frac{1}{Q/2\pi aA}\right)$ (d) $\frac{a}{2}\log\left(1-\frac{1}{Q/2\pi aA}\right)$

### Based on Dipole Moment, Dipole Field and Torque on a Dipole

27. An electric dipole is placed at an angle of $30°$ to a non-uniform electric field. The dipole will experience **[AIEEE 2006]**
(a) a torque as well as translational force
(b) a torque only
(c) a translational force only in the direction of the field
(d) a translational force only in a direction normal to direction of the field.

28. Determine the electric dipole moment of the system of three charges, placed on the vertices of an equilateral triangle, as shown in the figure. **[JEE Main Jan 19]**

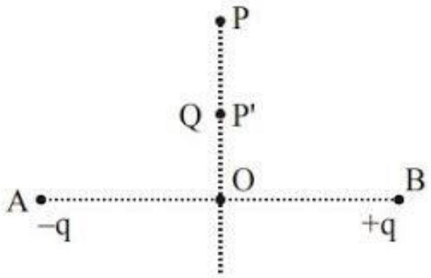



(a) $(ql)\frac{(\hat{i}+\hat{j})}{\sqrt{2}}$ (b) $\sqrt{3}ql\frac{(\hat{i}-\hat{j})}{\sqrt{2}}$

(c) $-\sqrt{3}ql\hat{j}$ (d) $2\ ql\hat{j}$

29. An electric dipole of moment $\vec{p}=\left(-\hat{\imath}-3\hat{\jmath}+2\hat{k}\right)\times10^{-29}$ Cm is at the origin $(0,0,0)$. The electric field due to this dipole at $\vec{r}=+\hat{\imath}+3\hat{\jmath}+5\hat{k}$ (note that $\vec{r}.\vec{p}=0$) is parallel to **[JEE Main Jan 20]**
(a) $\left(+\hat{\imath}+3\hat{\jmath}-2\hat{k}\right)$ (b) $\left(+\hat{\imath}-3\hat{\jmath}-2\hat{k}\right)$
(c) $\left(-\hat{\imath}-3\hat{\jmath}+2\hat{k}\right)$ (d) $\left(-\hat{\imath}+3\hat{\jmath}-2\hat{k}\right)$

30. Charge $-q$ and $+q$ located at $A$ and $B$, respectively, constitute an electric dipole. Distance $AB=2a$, $O$ is the midpoint of the dipole and $OP$ is perpendicular to $AB$. A charge $Q$ is placed at $P$ where $OP=\ y$ and $y\gg2a$. The charge $Q$ experiences an **[JEE Main Jan 19]**



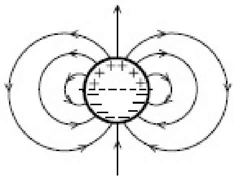

Electrostatic force $F$. If $Q$ is now moved along the equatorial line to $P'$ such that $OP'=\left(\frac{y}{3}\right)$ and $\frac{y}{3}\gg2a$, the force on $Q$ will be close to
(a) $\frac{F}{3}$ (b) $3F$
(c) $9F$ (d) $27F$

31. An electric dipole has a fixed dipole moment $\vec{p}$, which makes angle θ with respect to $x$-axis. When subjected to an electric field $\vec{E}=E\hat{\imath}$, it experiences a torque $\vec{T_1}=\tau\hat{k}$. When subjected to an electric field $\vec{E_2}=\sqrt{3}E_1\hat{\jmath}$, it experiences a torque $\vec{T_2}=-\vec{T_1}$. The angle θ is
(a) $30°$ (b) $45°$
(c) $60°$ (d) $90°$ **[JEE Main 17]**

32. An electric dipole is formed by two equal and opposite charges $q$ with separation $d$. The charges have same mass $m$. It is kept in a uniform electric field $E$. If it is slightly rotated from its equilibrium orientation then its angular frequency $\omega$ is **[JEE Main April 19]**
(a) $\sqrt{\frac{2qE}{md}}$ (b) $\sqrt{\frac{qE}{2md}}$
(c) $2\sqrt{\frac{qE}{md}}$ (d) $\sqrt{\frac{qE}{md}}$

## Based on Electrical Field Lines

33. A long cylindrical shell carries a positive surface charge σ in the upper half and negative surface charge – σ in the lower half. The electric field lines around the cylinder will look like figure given (figures are schematic and not drawn to scale) in **[JEE Main 15]**

(a)


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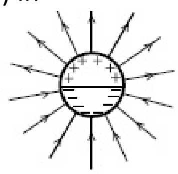

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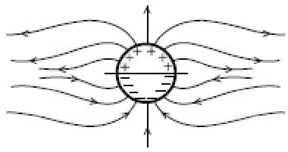

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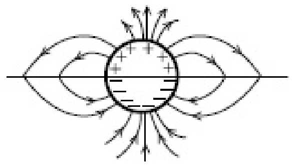
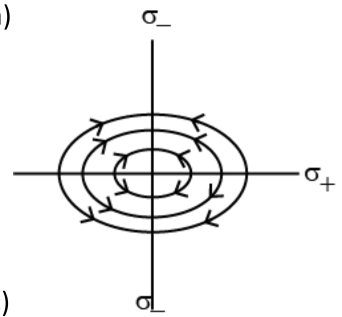


34. Two charged thin infinite plane sheets of uniform surface charge density $\sigma_+$ and $\sigma_-$, where $|\sigma_+| > |\sigma_-|$, intersect at right angle. Which of the following best represents the electric field lines for this system?

(a)
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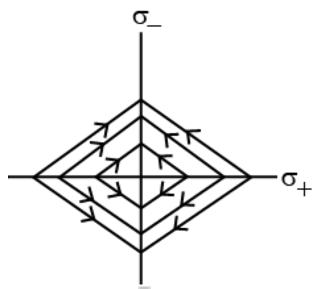


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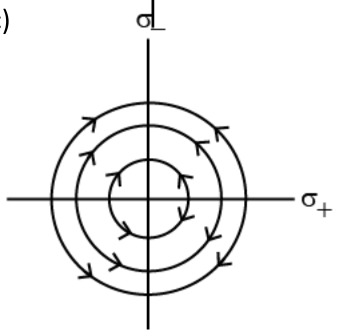


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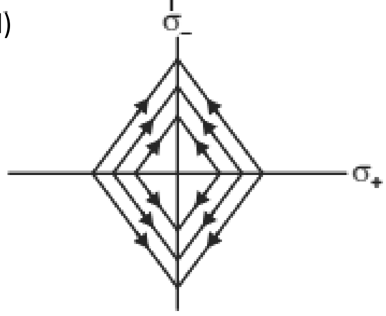
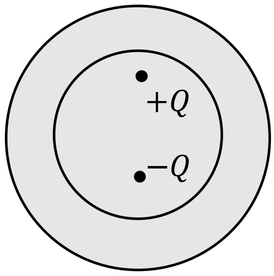



[JEE Main Sept 20]

### Based on Gauss's Theorem

35. In finding the electric field using Gauss law the formula $\vec{E} = \frac{q_{enc}}{\varepsilon_0|A|}$ is applicable. In the formula $\varepsilon_0$ is permittivity of free space, $A$ is the area of Gaussian surface and $q_{enc}$ is charge enclosed by the Gaussian surface. This equation can be used in which of the following situation ? [JEE Main Jan 20]
   (a) For any choice of Gaussian Surface.
   (b) Only when the Gaussian surface is an equipotential surface.
   (c) Only when $|\vec{E}|$ = constant on the surface.
   (d) Only when the Gaussian surface is an equipotential surface and $|\vec{E}|$ is constant on the surface.
36. If the amounts of electric flux entering and leaving an enclosed surface respectively are $\phi_1$ and $\phi_2$, the electric charge inside the surface will be [AIEEE 2003]
   (a) $(\phi_2 - \phi_1)\varepsilon_0$ (b) $(\phi_2 + \phi_1)\varepsilon_0$
   (c) $\frac{\phi_2 - \phi_1}{\varepsilon_0}$ (d) $\frac{\phi_2 + \phi_1}{\varepsilon_0}$
37. Shown in the figure are two point charges +Q and – Q inside the cavity of a spherical shell. The chargers are kept near the surface of cavity

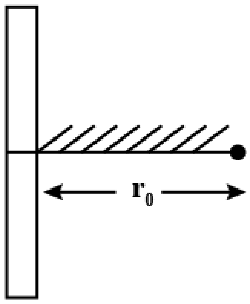



on opposite sides of the centre of the shell. If $\sigma_1$ is the surface charge on the inner surface and $Q_1$ net charge on it and $\sigma_2$ the surface charge on the outer surface and $Q_2$ next charge on it, then **[JEE Main 15]**

(a) $\sigma_1 \neq 0, Q_1 = 0;\ \sigma_2 \neq 0, Q_2 = 0$
(b) $\sigma_1 = 0, Q_1 = 0;\ \sigma_2 = 0, Q_2 = 0$
(c) $\sigma_1 \neq 0, Q_1 \neq 0;\ \sigma_2 \neq 0, Q_2 \neq 0$
(d) $\sigma_1 \neq 0, Q_1 = 0;\ \sigma_2 = 0, Q_2 = 0$

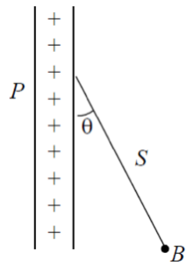
**Based on Applications of Gauss's Theorem**

38. A positive point charge is released from rest at a distance $r_0$ from a positive line charge with uniform density. The speed $(v)$ of the point charge, as a function of instantaneous distance $r$ from line charge, is proportional to **[JEE Main April 19]**




(a) $v \propto \sqrt{\ln\left(\frac{r}{r_0}\right)}$
(b) $v \propto \ln\left(\frac{r}{r_0}\right)$
(c) $v \propto e^{+r/r_0}$
(d) $v \propto \left(\frac{r}{r_0}\right)$

39. A charged ball $B$ hangs from a silk thread $S$, which makes an angle θ with a large charge conducting sheet $P$ as shown in the figure. The surface charge density of the sheet is proportional to **[AIEEE 2005]**



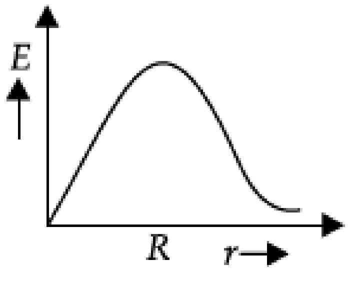

(a) $\cos\theta$
(b) $\cot\theta$
(c) $\sin\theta$
(d) $\tan\theta$

40. Two infinite planes each with uniform surface charge density $+\sigma$ are kept in such a way that the angle between then is 30°. The electric field in the region shown between them is given by **[JEE Main Jan 20]**

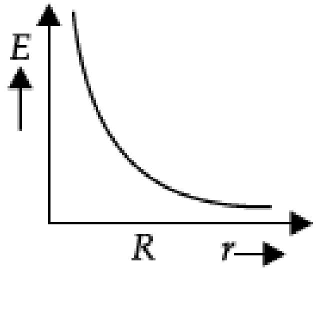
(a) $\frac{\sigma}{2\varepsilon_0}\left[(1+\sqrt{3})\hat{y} + \frac{\hat{x}}{2}\right]$
(b) $\frac{\sigma}{\varepsilon_0}\left[\left(1+\frac{\sqrt{3}}{2}\right)\hat{y} + \frac{\hat{x}}{2}\right]$
(c) $\frac{\sigma}{2\varepsilon_0}\left[(1+\sqrt{3})\hat{y} - \frac{\hat{x}}{2}\right]$
(d) $\frac{\sigma}{2\varepsilon_0}\left[\left(1-\frac{\sqrt{3}}{2}\right)\hat{y} - \frac{\hat{x}}{2}\right]$

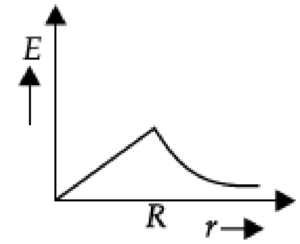
41. In a uniformly charged sphere of total charge $Q$ and radius $R$, the electric field $E$ is plotted as function of distance from the centre. The graph to which would correspond to the above will be **[AIEEE 12]**

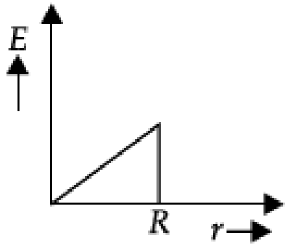
(a)



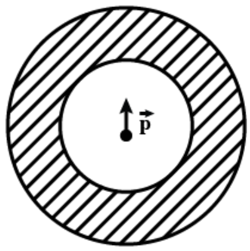

(b)



(c)



(d)


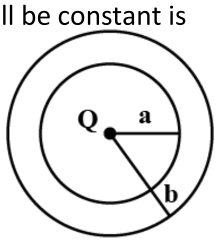

42. Consider the force $F$ on a charge $'q'$ due to a uniformly charged spherical shell of radius $R$ carrying charge $Q$ distributed uniformly over it. Which one of the following statements is true for $F$, if $'q'$ is placed at distance $r$ from the centre of the shell?
(a) $F = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$ for all $r$
(b) $F = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{R^2} > F > 0$ for $r < R$
(c) $F = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$ for $r > R$
(d) $F = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$ for $r < R$ [JEE Main Sept. 20]

43. Shown in the figure is a shell made of a conductor. It has inner radius $a$ and outer radius $b$, and carries charge $Q$. At its centre is a dipole $\overrightarrow{p}$ as shown.
In this case


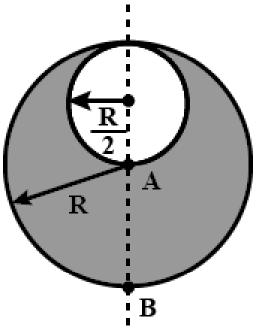
[JEE Main April 19]
(a) Surface charge density on the outer surface depends on $\overrightarrow{p}$
(b) Surface charge density on the inner surface is uniform and equal to $\frac{(Q/2)}{4\pi a^2}$
(c) Electric field outside the shell is the same as that of point charge at the centre of the shell.
(d) Surface charge density on the inner surface of the shell is zero everywhere.

44. Let $\rho(r) = \frac{Q}{\pi R^4}r$ be the charge density distribution for a solid sphere of radius $R$ and total charge $Q$ for a point $'P'$ inside the sphere at distance $r_1$ from the centre of the sphere, the magnitude of the electric field is [AIEEE 2009]
(a) 0
(b) $\frac{Q}{4\pi\varepsilon_0 r_1^2}$
(c) $\frac{Qr_1^2}{4\pi\varepsilon_0 R^4}$
(d) $\frac{Qr_1^2}{3\pi\varepsilon_0 R^4}$

45. Let there be a spherically symmetric charge distribution with charge density varying
$$\rho(r) = \rho_0\left(\frac{5}{4} - \frac{r}{R}\right)$$
as upto $r = R$ and $\rho(r) = 0$ for $r > R$
where $r$ is the distance from the origin. The electric field at a distance $r(r < R)$ from the origin is given by [AIEEE 2010]
(a) $\frac{\rho_0 r}{3\varepsilon_0}\left(\frac{5}{4} - \frac{r}{R}\right)$
(b) $\frac{4\pi\rho_0 r}{3\varepsilon_0}\left(\frac{5}{3} - \frac{r}{R}\right)$
(c) $\frac{\rho_0 r}{4\varepsilon_0}\left(\frac{5}{3} - \frac{r}{R}\right)$
(d) $\frac{4\rho_0 r}{3\varepsilon_0}\left(\frac{5}{4} - \frac{r}{R}\right)$

46. The region between two concentric spheres of radii $'a'$ and $'b'$, respectively (see figure), has volume charge density $\rho = \frac{A}{r}$, where $A$ is a constant and $r$ is the distance from the centre. At the centre of the spheres is a point charge $Q$. The value of $A$ such that the electric field in region between the spheres will be constant is
(a) $\frac{Q}{2\pi(b^2 - a^2)}$
(b) $\frac{2Q}{\pi(b^2 - a^2)}$
(c) $\frac{2Q}{\pi a^2}$
(d) $\frac{Q}{2\pi a^2}$ [JEE Main 16]


47. Consider a sphere of radius $R$ which carries a uniform charge density ρ. If a sphere of radius $\frac{R}{2}$ is carved out of it, as shown, the ratio $\left|\frac{\overrightarrow{E_A}}{\overrightarrow{E_B}}\right|$ of magnitude of electric field $\overrightarrow{E_A}$ and $\overrightarrow{E_B}$ respectively, at points $A$ and $B$ due to the remaining portion is




(a) $\frac{18}{34}$ (b) $\frac{21}{34}$

(c) $\frac{17}{54}$ (d) $\frac{9}{17}$ [JEE Main Jan 20]

48. Let a total charge $2Q$ be distributed in a sphere of radius $R$, with the charge density given by $\rho(r) = kr$, where $r$ is the distance from the centre. Two charges $A$ and $B$, of $-Q$ each, are placed on diametrically opposite points, at equal distance, $a$, from the centre. If $A$ and $B$ do not experience any force, then [JEE Main April 19]

(a) $a = \frac{3R}{2^{1/4}}$ (b) $a = R/\sqrt{3}$

(c) $a = 2^{-1/4}R$ (d) $a = 8^{-1/4}R$

| Answers: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | **2.** | **3.** | **4.** | **5.** | **6.** | **7.** | **8.** | **9.** | **10.** |
| (b) | (d) | (c) | (d) | (d) | (b) | (b) | (a) | (a) | (b) |
| 11. | **12.** | **13.** | **14.** | **15.** | **16.** | **17.** | **18.** | **19.** | **20.** |
| (c) | (c) | (c) | (c) | (d) | (c) | (a) | (c) | (c) | (a) |
| **21.** | **22.** | **23.** | **24.** | **25.** | **26.** | **27.** | **28.** | **29.** | **30.** |
| (b) | (d) | (c) | (b) | (c) | (d) | (a) | (c) | (a) | (d) |
| **31.** | **32.** | **33.** | **34.** | **35.** | **36.** | **37.** | **38.** | **39.** | **40.** |
| (c) | (a) | (a) | (d) | (d) | (a) | (b) | (a) | (d) | (d) |
| **41.** | **42.** | **43.** | **44.** | **45.** | **46.** | **47.** | **48.** | | |
| (c) | (c) | (c) | (c) | (c) | (d) | (d) | (d) | | |