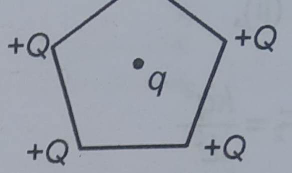
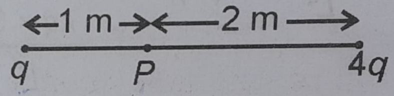
$\frac{Qq}{4\pi\varepsilon_0 a^2}$ towards that corner which didn't contain any charge originally because $-Q$ will attract $+q$ towards itself.



EXERCISE 1.1

[Properties of electric charge, Coulomb's law, Principle of superposition]

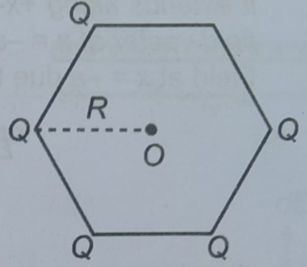
1. Two charged particles q and $4q$ are kept at distance 3 m as shown in figure,



The force on a charge Q kept at P is

(1) $5KQq$ (2) KQq (3) $2Kq^2$ (4) Zero

hexagon as shown in figure. $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$



(1) $\frac{kQ}{R}$

(2) $\frac{kQ}{R^2}$

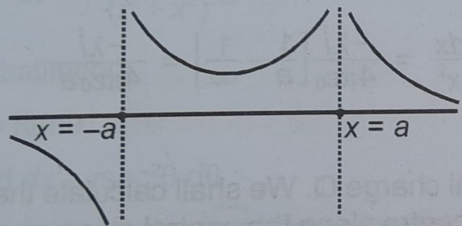
(3) $\frac{2kQ}{R^2}$

(4) Zero

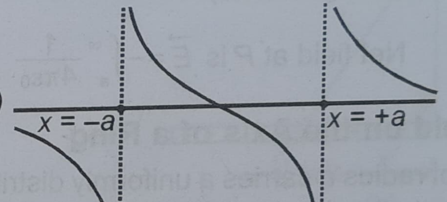
9. Two charges $-4q$ and q are kept at $(-a, 0)$ and $(a, 0)$ respectively. The graph showing the variation of electric field along x-axis is

Understand the reference for conceptual clarity

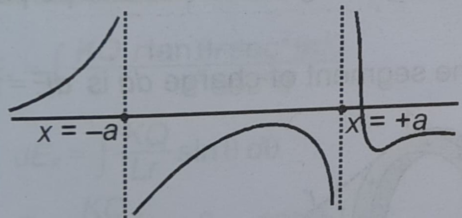
(1)



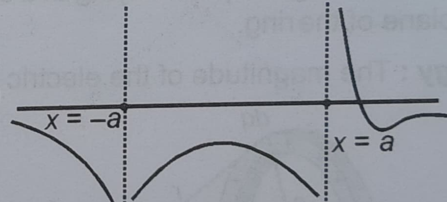
(2)



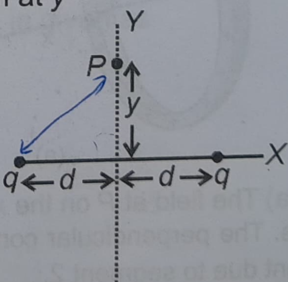
(3)



(4)



10. In the following figure, the electric field on y-axis will be maximum at y =



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

(2) $\frac{d}{3}$

(3) $\frac{d}{\sqrt{2}}$

(4) $\frac{d}{\sqrt{3}}$

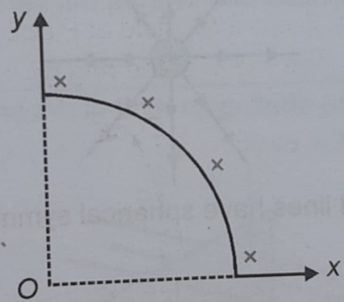
$$\vec{E} = \begin{cases} \frac{\sigma}{2\varepsilon_0}\hat{k}, & z > 0 \\ -\frac{\sigma}{2\varepsilon_0}\hat{k}, & z < 0 \end{cases}$$

EXERCISE 1.3

[Electric field of a continuous charge distribution, Electric field due to linear charge distribution, Electric field on the axis of a ring]

11. A wire is bent in the form of a regular pentagon of edge length a. A total of charge q is distributed over it. Find the electric field at the centre of the pentagon.

12. A wire with a linear charge density λ forms a quarter of a circle of radius R and is placed as shown in the figure with its centre of curvature at the origin O. The electric field at O will be

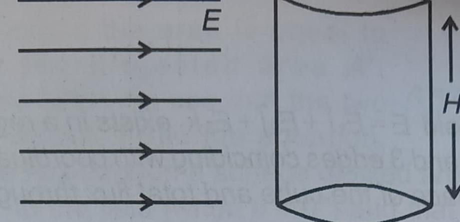


Cleared

(1) $\frac{\lambda}{4\pi\varepsilon_0 R}[\hat{i} + \hat{j}]$ (2) $\frac{\lambda}{2\pi\varepsilon_0 R}[-\hat{i} + \hat{j}]$ (3) $\frac{\lambda}{\sqrt{2}\,\pi\varepsilon_0 R}[\hat{i} - \hat{j}]$ (4) $\frac{\lambda}{4\pi\varepsilon_0 R}[-\hat{i} - \hat{j}]$

13. A point charge q is kept at the centre of a fixed semicircular thread having a uniform charge per unit length λ, the radius of the semicircular thread being R. The force required to keep the charge stationary is

(1) $\frac{\lambda q}{2\pi\varepsilon_0 r}$ (2) $\frac{\lambda q}{4\pi\varepsilon_0 r}$ (3) $\frac{\lambda q}{8\pi\varepsilon_0 r}$ (4) Zero

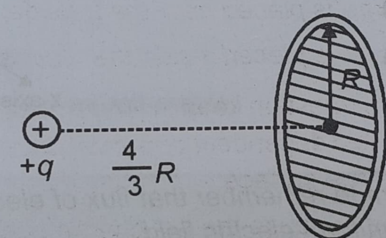


(1) $E.\pi R^2$ (2) $E.RH$ (3) $E.2RH$ (4) Zero

19. If a uniform electric field $\vec{E} = (2.0\hat{i} + 3.0\hat{j})$ N/C exists in a region then electric flux through a plane surface of area 20.0 cm^2 parallel to the y-z plane in Nm^2/C will be

(1) 1.0×10^{-3} (2) 4.0×10^{-3} (3) 3.0×10^{-3} (4) Zero

20. Find the flux through the disc.

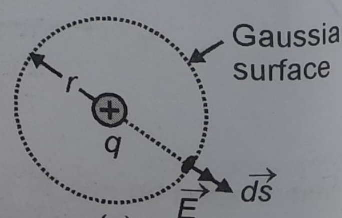


(1) $\frac{q}{10\varepsilon_0}$ (2) $\frac{q}{5\varepsilon_0}$ (3) $\frac{q}{6\varepsilon_0}$ (4) $\frac{q}{2\varepsilon_0}$

GAUSS'S LAW

The Gauss's law relates the flux through a closed surface (a surface that encloses some volume) with the charges present inside the surface.

Consider a point charge q surrounded by a spherical surface of radius r centered on the charge, as in Figure (a). The magnitude of the electric field everywhere on the surface on the sphere is $E = k\frac{q}{r^2}$.



The electric field is perpendicular to the spherical surface at all points on

EXERCISE 1.6

[Methodology for applying Gauss's Law, Electric field due to a shell of charge, uniform sphere of charge, infinite thin non-conducting sheet]

26. Electric field intensity due to a spherical shell at its centre (surface charge density σ)
(1) $\frac{\sigma}{2\varepsilon_0}$ (2) $\frac{\sigma}{4\varepsilon_0}$ (3) $\frac{\sigma}{\varepsilon_0}$ (4) Zero

27. Electric field in a region of sphere is radially outward from origin and varies with distance r from origin as $E = kr^2$. Find the charge enclosed in a sphere of radius a centered at origin.
(1) $4k\varepsilon_0\pi a^3$ (2) $4k\varepsilon_0\pi a^4$ (3) $\frac{4}{3}k\varepsilon_0\pi a^5$ (4) $4k\varepsilon_0\pi a^6$

28. An infinitely long solid cylinder of radius R has uniform volume charge density ρ. The magnitude of electric field at point P which is at a distance $\frac{R}{2}$ from axis of cylinder is
(1) $\frac{\rho R}{2\varepsilon_0}$ (2) $\frac{\rho R}{4\varepsilon_0}$ (3) $\frac{\rho R}{\varepsilon_0}$ (4) $\frac{\rho R^2}{8\varepsilon_0}$

29. An infinite line of charge with linear density of charge, $\lambda = 2.0 \times 10^{-6}$ C/m exists. The electrostatic force on a point charge of 5.0 mC at a distance of 50 cm from the line of charge will be
(1) 18 N (2) 360 N (3) 9 N (4) 120 N

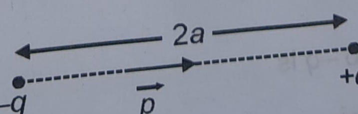
30. An infinite line of charge of linear charge density 5.0 nC/m exists along y-axis. The electric field at point $A(1\,\text{m}, 2\,\text{m}, \sqrt{3}\,\text{m})$ is

$n = 10^{-9}$

(1) $11.3[\hat{i} - \sqrt{3}\hat{k}]$ N/C (2) $22.5[\hat{i} + \sqrt{3}\hat{k}]$ N/C (3) $45[\hat{i} - \sqrt{3}\hat{k}]$ N/C (4) $45[\hat{i} + \sqrt{3}\hat{j}]$ N/C

ELECTRIC DIPOLE

A configuration of two charges of same magnitude q, but of opposite sign, separated by a small distance (say $2a$) is called an electric dipole.



$2q$ a $-3q$

32. Work done by an external agent in rotating an electric dipole slowly from the position of stable equilibrium to unstable equilibrium in uniform electric field,

P = dipole moment, E = electric field intensity

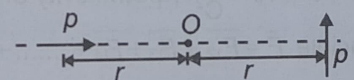
(1) PE (2) $2PE$ (3) Zero (4) $-2PE$

33. The force on an electric dipole having dipole moment $\vec{P} = P_0\hat{i}$ placed in an electric field $\vec{E} = \alpha x\hat{i}$, where α is a positive constant, will be

(1) $P_0\,\alpha$ in the positive x-direction (2) $P_0\,\alpha$ in the negative x-direction

(3) $P_0\,\alpha$ in the negative y-direction (4) Zero

34. The magnitude of net electric field at point O, equidistant from two short dipoles, each of dipole moment p, is $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$



(1) $\frac{2kp}{r^3}$ (2) $\frac{3kp}{r^3}$ (3) $\frac{\sqrt{5}\,kp}{r^3}$ (4) Zero

35. An electric dipole consisting of two equal and opposite point charges (q, m) and dipole length $= 2l$ is slightly disturbed (angularly) from its position of stable equilibrium.

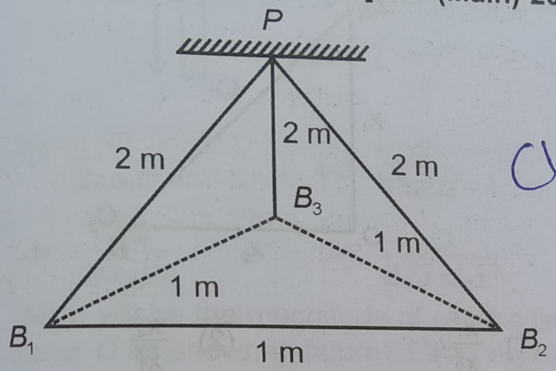
The minimum time during which its gets aligned with the electric field.

(1) $\frac{\pi}{2}\sqrt{\frac{ml}{qE}}$ (2) $\frac{\pi}{4}\sqrt{\frac{ml}{qE}}$ (3) $2\pi\sqrt{\frac{ml}{qE}}$ (4) $\pi\sqrt{\frac{ml}{qE}}$

Torque

force between any two charged balls will be:

[JEE (Main)-2022]



Cleared

(1) 1 : 1 (2) 1 : 4

(3) $\sqrt{3}$: 2 (4) $\sqrt{3}$: 1

35. Two point charges Q each are placed at a distance d apart. A third point charge q is placed at a distance x from mid-point on the perpendicular bisector. The value of x at which charge q will experience the maximum Coulombs force is : [JEE (Main)-2022]

(1) $x = d$ (2) $x = \frac{d}{2}$

(3) $x = \frac{d}{\sqrt{2}}$ (4) $x = \frac{d}{2\sqrt{2}}$

36. Two identical charged particles each having a mass 10 g and charge 2.0×10^{-7} C are placed on a horizontal table with a separation of L between them such that they stay in limited equilibrium. If the coefficient of friction between

respectively. The magnitude of the electric field E at a point on the x-axis at $x = D$, with $D >> d$, will behave as [JEE (Main)-2019]

(1) $E \propto \frac{1}{D^3}$ (2) $E \propto \frac{1}{D}$ last page step-3

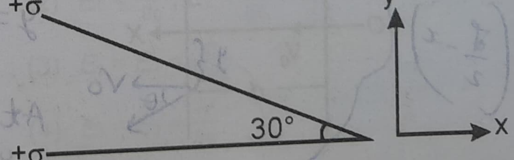
(3) $E \propto \frac{1}{D^4}$ (4) $E \propto \frac{1}{D^2}$

39. 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)-2019]

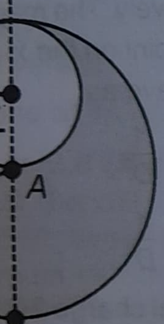
(1) $a = \frac{3R}{2^{1/4}}$ (2) $a = R/\sqrt{3}$ last page step-3

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

40. Two infinite planes each with uniform surface charge density $+\sigma$ are kept in such a way that the angle between them is 30°. The electric field in the region shown between them is given by [JEE (Main)-2020]



f radius R which carries a
ity ρ. If a sphere of radius
f it, as shown, the ratio
of electric field $\vec{E}_A$ and
points A and B due to the
[JEE (Main)-2020]



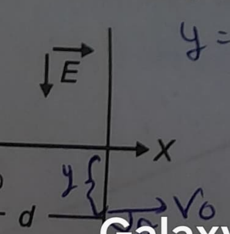
$\frac{18}{34}$

(2) $\frac{18}{54}$

(4) $\frac{17}{54}$

e (mass m and charge q)
xis with velocity V_0. When it
he origin it enters a region
lectric field $\vec{E} = -E\hat{j}$ which
. Equation of path of electron
is

[JEE (Main)-2020]



$y = \frac{1}{2} \times \frac{qE}{m} \times \left(\frac{d}{V_0}\right)^2$

$y = -\frac{qEd}{mV_0^2} x + C$

$x = d$

$y = -\frac{qEd^2}{2mV_0^2}$

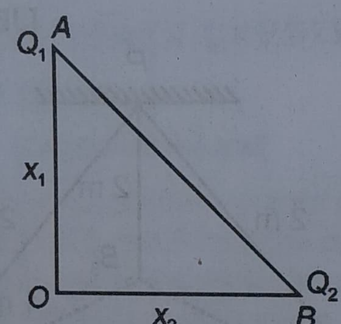
(3) $y = \frac{qEd}{mV_0^2}\left(\frac{d}{2} - x\right)$ (4) $y = \frac{qEd}{mV_0^2}x$

43. 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 position the kinetic energy of the particle becomes zero when the distance of the particle from the origin is **[JEE (Main)-2020]**

(1) $\sqrt{\frac{3}{a}}$ (2) $\sqrt{\frac{2}{a}}$

(3) $\sqrt{\frac{1}{a}}$ (4) a

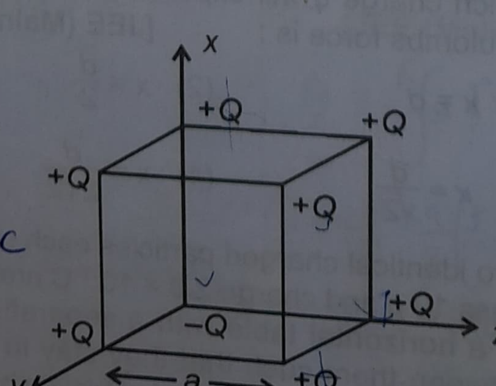
44. Charges Q_1 and Q_2 are at points A and B of a right angle triangle OAB (see figure). The resultant electric field at point O is perpendicular to the hypotenuse, then Q_1/Q_2 is proportional to **[JEE (Main)-2020]**



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

(3) $\frac{x_1}{x_2}$ (4) $\frac{x_2}{x_1}$

45. A cube of side 'a' has point charges $+Q$ located at each of its vertices except at the origin where the charge is $-Q$. The electric field at the centre of cube is : **[JEE (Main)-2021]**

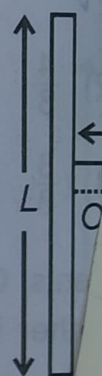


(2) $\frac{}{3\sqrt{3}\pi\varepsilon_0 a^2}$

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

(4) $\frac{-2Q}{3\sqrt{3}\pi\varepsilon_0 a^2}$

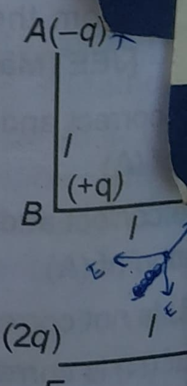
46*. Find the electri
in figure) on the
uniformly charge
a charge Q. The
the centre of the



(1) $\frac{Q}{3\pi\varepsilon_0 L^2}$

(3) $\frac{\sqrt{3}Q}{4\pi\varepsilon_0 L^2}$

47. What will b
point O as
figure is l



(1) $\frac{q}{4\pi\varepsilon_0 (2l)^2}$

(3) $\frac{1}{4\pi\varepsilon_0}\frac{q}{l^2}$

Corporate O

Galaxy F13
12:59 pm

Cleared

51. A long cylindrical volume contains a uniformly distributed charge of density ρ. The radius of cylindrical volume is R. A charge particle (q) revolves around the cylinder in a circular path. The kinetic energy of the particle is:

[JEE (Main)-2022]

(1) $\frac{\rho q R^2}{4\varepsilon_0}$

(2) $\frac{\rho q R^2}{2\varepsilon_0}$

(3) $\frac{q\rho}{4\varepsilon_0 R^2}$

(4) $\frac{4\varepsilon_0 R^2}{q\rho}$

Cleared

52. If two charges q_1 and q_2 are separated with distance 'd' and placed in a medium of dielectric constant k. What will be the equivalent distance between charges in air for the same electrostatic force?

[JEE (Main)-2023]

(1) $2d\sqrt{k}$

(2) $d\sqrt{k}$

(3) $1.5d\sqrt{k}$

(4) $k\sqrt{d}$

53. A point charge of 10 μC is placed at the origin. At what location on the X-axis should a point charge of 40 μC be placed so that the net electric field is zero at $x = 2$ cm on the X-axis?

[JEE (Main)-2023]

(1) $x = 8$ cm

(2) $x = 6$ cm

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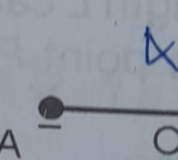

(1) $\frac{2}{3}$

(3) $\frac{3}{2}$

56. Given bel
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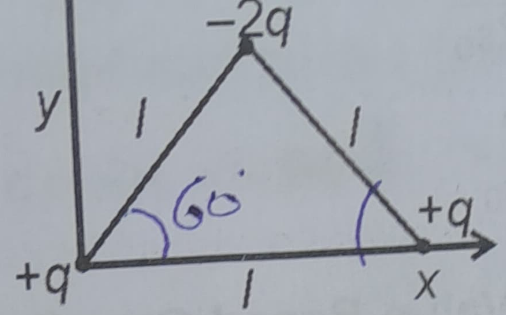


(1) $2ql\,\hat{j}$

(2) $\sqrt{3}\,ql\,\dfrac{\hat{j}-\hat{i}}{\sqrt{2}}$

(3) $-\sqrt{3}\,ql\,\hat{j}$

(4) $(ql)\dfrac{\hat{i}+\hat{j}}{\sqrt{2}}$

59. Given below are two statements :

Statement I : An electric dipole is placed at the centre of a hollow sphere. The flux of electric field through the sphere is zero but the electric field is not zero anywhere in the sphere.

Statement II : If R is the radius of a solid metallic sphere and Q be the total charge on it. The electric field at any point on the spherical surface of radius $r (< R)$ is zero but the electric flux passing through this closed spherical surface of radius r is not zero.

In the light of the above statements, choose the correct answer from the options given below.

[JEE (Main)-2021]

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are false

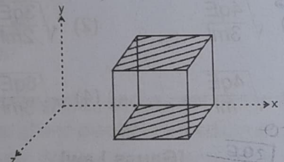
(3) Statement I is true but Statement II is false

(4) Both Statement I and Statement II are true

options given below: [JEE (Main)-2021]

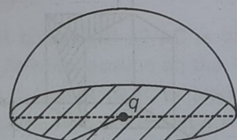
(1) (d) Only
(2) (c) and (d) Only
(3) (a) and (c) Only
(4) (b) and (d) Only

63. A cube is placed inside an electric field, $\vec{E} = 150y^2\hat{j}$. The side of the cube is 0.5 m and is placed in the field as shown in the given figure. The charge inside the cube is: [JEE (Main)-2021]



(1) 8.3×10^{-11} C (2) 3.8×10^{-11} C
(3) 8.3×10^{-12} C (4) 3.8×10^{-12} C

64. If a charge q is placed at the centre of a closed hemispherical non-conducting surface, the total flux passing through the flat surface would be: [JEE (Main)-2022]



(1) $\frac{q}{\varepsilon_0}$ (2) $\frac{q}{2\varepsilon_0}$

Cleared

(3) $\frac{q}{4\varepsilon_0}$ (4) $\frac{q}{2\pi\varepsilon_0}$

65. Two identical metallic spheres A and B when placed at certain distance in air repel each other with a force of F. Another identical uncharged sphere C is first placed in contact with A and then in contact with B and finally placed at midpoint between spheres A and B. The force experienced by sphere C will be [JEE (Main)-2022]

(1) $3F/2$

when C is placed in contact with A, charge on A & C will be = q/2
Now, C is placed
$q_A = q_B = q$
$F = \frac{kq^2}{r^2}$

of strength 1×10^5 NC^{-1}. If the charge on the particle is 40 μC and the initial velocity is 200 ms^{-1}, how much distance it will travel before coming to the rest momentarily? [JEE (Main)-2022]

(1) 1 m (2) 5 m
(3) 10 m (4) 0.5 m

67. In a cuboid of dimension $2L \times 2L \times L$, a charge q is placed at the center of the surface 'S' having area of $4L^2$. The flux through the opposite surface to 'S' is given by [JEE (Main)-2023]

(1) $\frac{q}{2\varepsilon_0}$
(2) $\frac{q}{6\varepsilon_0}$
(3) $\frac{q}{12\varepsilon_0}$
(4) $\frac{q}{3\varepsilon_0}$

Numerical Value Based Questions

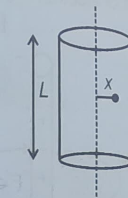
68. An infinite number of point charges, each carrying 1 μC charge, are placed along the y-axis at y = 1 m, 2 m, 4 m, 8 m ______.
The total force on a 1 C point charge, placed at the origin, is $x \times 10^3$ N.
The value of x, to the nearest integer, is ______.
[Take $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ Nm^2/C^2] [JEE (Main)-2021]

69. Three point charges of magnitude 5 μC, 0.16 μC and 0.3 μC are located at the vertices A, B, C of a right angled triangle whose sides are AB = 3 cm, $BC = 3\sqrt{2}$ cm and CA = 3 cm and point A is the right angle corner. Charge at point A, experiences ______ N of electrostatic force due to the other two charges. [JEE (Main)-2022]

Cleared

70. A particle of mass 1 mg and charge q is lying at the mid-point of two stationary particles kept at a distance '2 m' when each is carrying same charge 'q'. If the free charged particle is displaced from its equilibrium ...

electric field inside the cylindrical ... distance $x = \frac{2\varepsilon_0}{\rho}$ m from its axis is ... Vm^{-1} [JEE (Ma...



72. Two electric dipoles of dipole ... 1.2×10^{-30} C-m and 2.4×10^{-30} C-m ... in two different uniform electric fields ... 5×10^4 NC^{-1} and 15×10^4 NC^{-1} res... The ratio of maximum torque exper... the electric dipoles will be $\frac{1}{x}$. The ... is ______. [JEE (Ma...

73. The electric field in a region is $\vec{E} = \left(\frac{3}{5}E_0\hat{i} + \frac{4}{5}E_0\hat{j}\right)\frac{N}{C}$. The ratio ... reported field through the rectangul... of area 0.2 m^2 (parallel to y – z pla... of the surface of area 0.3 m^2 (paral... plane) is a : b, where a = ______
[Here, $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors ... and z-axes respectively] [JEE (Ma...

74. The electric field in a region is $\vec{E} = \frac{2}{5}E_0\hat{i} + \frac{3}{5}E_0\hat{j}$ with $E_0 = 4.0 \times 10$... flux of this field through a rectangula... area 0.4 m^2 parallel to the Y – Z plan... Nm^2 C^{-1}. [JEE (Ma...

Cleared

75. The volume charge density of a s... radius 6 m is 2 μC cm^{-3}. The numbe... of force per unit surface area co... from the surface of the sphere is ... 10^{10} NC^{-1}

is ________. [JEE (Main)-2022]

73. The electric field in a region is given by $\vec{E} = \left(\frac{3}{5}E_0\hat{i} + \frac{4}{5}E_0\hat{j}\right)\frac{N}{C}$. The ratio of flux of reported field through the rectangular surface of area 0.2 m² (parallel to y – z plane) to that of the surface of area 0.3 m² (parallel to x – z plane) is a : b, where a = ________.

[Here, $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along x, y and z-axes respectively]

[JEE (Main)-2021]

74. The electric field in a region is given by $\vec{E} = \frac{2}{5}E_0\hat{i} + \frac{3}{5}E_0\hat{j}$ with $E_0 = 4.0 \times 10^3 \frac{N}{C}$. The flux of this field through a rectangular surface area 0.4 m² parallel to the Y – Z plane is ____ $Nm^2\,C^{-1}$. [JEE (Main)-2021]

Cleared

75. The volume charge density of a sphere of radius 6 m is 2 μC cm⁻³. The number of lines of force per unit surface area coming out from the surface of the sphere is ________ × 10^{10} NC⁻¹.

$E = \frac{\rho R}{3\varepsilon_0} = \frac{2 \times 6}{2 \times 8.85 \times 10^{-12}}$

[Given : Permittivity of vacuum $\varepsilon_0 = 8.85 \times 10^{-12}$ C² N⁻¹ – m⁻²). [JEE (Main)-2022]

$= 0.45 \times 10^{12}$

$= 45 \times 10^{10}$

is ________ × 10^{-9} N.

[Given: $4\pi\varepsilon_0 = \frac{1}{9 \times 10^9}$ SI unit] [JEE (Main)-2021]

Cleared

78. A stream of a positively charged particles having $\frac{q}{m} = 2 \times 10^{11} \frac{C}{kg}$ and velocity $\vec{v}_0 = 3 \times 10^7 \hat{i}$ m/s is deflected by an electric field $1.8\hat{j}$ kV/m. The electric field exists in a region of 10 cm along x direction. Due to the electric field, the deflection of the charge particles in the y direction is ____ mm. [JEE (Main)-2023]

last pa

Clear

79. A uniform electric field of 10 N/C is created between two parallel charged plates (as shown in figure). An electron enters the field symmetrically between the plates with a kinetic energy 0.5 eV. The length of each plate is 10 cm. The angle (θ) of deviation of the path of electron as it comes out of the field is ________ (in degree). [JEE (Main)-2023]

last pa

$\tan\theta = \frac{v_2}{u}$

80. A point charge $q_1 = 4q_0$ is placed at origin. Another point charge $q_2 = -q_0$ is placed at x = 12 cm. Charge of proton is q_0. The proton is placed on x axis so that the electrostatic force on the proton is zero. In this situation, the position of the proton from the origin is ________ cm. [JEE (Main)-2023]

$\frac{}{4\pi\varepsilon_0 r^2}, 0$ (4) $\frac{}{4\pi\varepsilon_0 r^2}, \frac{}{4\pi\varepsilon_0 r}$

32. Two insulated charged conducting spheres of radii 20 cm and 15 cm respectively and having an equal charge of 10 μC are connected by a copper wire and then they are separated. Then

(1) Both spheres will have equal charges

(2) Surface charge density on the 20 cm sphere will be greater than that on the 15 cm sphere

(3) Surface charge density on the 15 cm sphere will greater than that on the 20 cm sphere

(4) Surface charge density on the two spheres will be equal

33. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. The potential at a distance of 2 cm from the center of the sphere is

(1) Zero (2) 10 V (3) 4 V (4) 10/3 V

34. A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting spherical shell. The potential difference between the surface of solid sphere and the shell is *V*. The shell is now given a charge –3Q. The new potential difference between the same surfaces will be

(1) *V* (2) 2*V* (3) 4*V* (4) –2*V*

35. A soap bubble of radius 3 cm is charged with 9.0 nC. The excess pressure inside the bubble, if surface tension of soap solution = 3×10^{-3} N/m is

(1) 0.26 N/m² (2) 0.36 N/m² (3) 0.44 N/m² (4) 0.52 N/m²

$\Delta P_{net} = \frac{4T}{R} - \frac{\sigma^2}{2\varepsilon_0}$

DIELECTRICS AND POLARIZATION

Until now, you have studied the behaviour of a conductor kept in an electrostatic field. When a conductor is placed in an external electric field, the free charge carriers move and charge distribution in the conductor adjusts itself in such a way that the electric field due to induced charges opposes the external field within the conductor. This happens until, in the static situation, the two fields cancel each other and the net electrostatic field in the conductor is zero. Now let us study the behavior of an insulator in an external electric field. Insulators are called Dielectrics. In contrast to conductors, they have no or negligible number of charge carriers. In a dielectric, free movement of charges is not possible. Therefore, they behave differently. When a dielectric material is kept in an electric field, the external field induces dipole moment by stretching or re-orienting molecules of the dielectric. This results in development of net charges on the surface of the dielectric which produce a field that opposes the external field. However, the opposing field so induced does not exactly cancel the external field. It only reduces it. The extent of the effect depends on the nature of the dielectric. To understand the effect, let us take a look at the charge distribution of a dielectric at the molecular level.

In general the dielectric can be classified into Polar and Non-polar dielectrics. The molecules of a ...olar or non-polar. In a non-polar molecule, the centres of positive and negative ...le thus has no permanent (or intrinsic) dipole moment. Examples of ...drogen (H_2) molecules which, because of their symmetry, ... in which the centres of positive

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

(3) Statement I is correct but statement II is incorrect

cleared

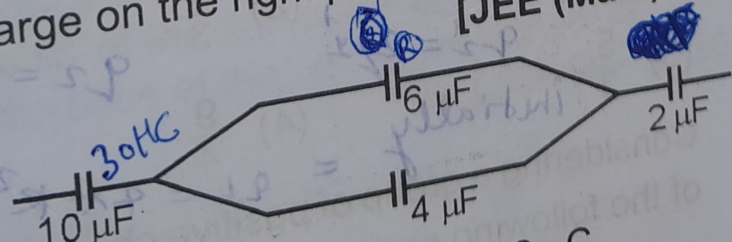
(4) Statement I is incorrect but statement II is correct

41. Two uniformly charged spherical conductors A and B of radii 5 mm and 10 mm are separated by a distance of 2 cm. If the spheres are connected by a conducting wire, then in equilibrium condition, the ratio of the magnitude of the electric fields at the surface of the sphere A and B will be **[JEE (Main)-2022]**

(1) 1 : 2
(2) 2 : 1
(3) 1 : 1
(4) 1 : 4

[Capacitance]

42. In the figure shown below, the charge on the left plate of the 10 μF capacitor is –30 μC. The charge on the right plate of the 6 μF capacitor is **[JEE (Main)-2019]**

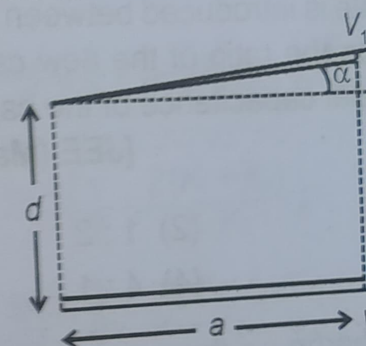


12 μC

(1) 40 μF and 10 μF (2) 20 μ

(3) 60 μF and 40 μF (4) 50 μ

45*. A capacitor is made of two squa of side 'a' making a very small a them, as shown in figure. The c be close to [JE

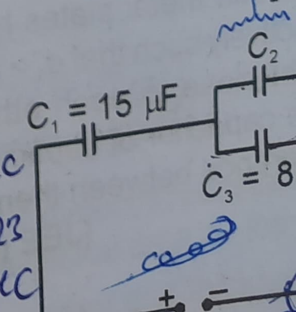


(1) $\frac{\varepsilon_0 a^2}{d}\left(1-\frac{3\alpha a}{2d}\right)$ (2) $\frac{\varepsilon_0}{c}$

1 cleard (3) $\frac{\varepsilon_0 a^2}{d}\left(1+\frac{\alpha a}{d}\right)$ (4) $\frac{\varepsilon_0}{c}$

46*. In the circuit shown in the figure is 750 μC and the voltage ac is 20 V. Then the charge on c [J

$Q_3 = C_3V_3$
$V_3 = 20V$
$Q_3 = 160\ \mu C$
$Q = Q_2 + Q_3$
$590\ \mu C$



(1) $v \propto \sqrt{\ln\left(\frac{r}{r_0}\right)}$ (2) $v \propto e^{+r/r_0}$

(3) $v \propto \ln\left(\frac{r}{r_0}\right)$ (4) $v \propto \left(\frac{r}{r_0}\right)$

Numerical Value Based Questions

78. A 60 pF capacitor is fully charged by a 20 V supply. It is then disconnected from the supply and is connected to another uncharged 60 pF capacitor in parallel. The electrostatic energy that is lost in this process by the time the charge is redistributed between them is (in nJ) ________. [JEE (Main)-2020]

Cleared

79. The average translational kinetic energy of N_2 gas molecules at ____ °C becomes equal to the K.E. of an electron accelerated from rest through a potential difference of 0.1 volt. (Given $k_B = 1.38 \times 10^{-23}$ J/K) (Fill the nearest integer). [JEE (Main)-2021]

Clear

Start

80. A capacitor C_1 of capacitance 5 μF is charged to a potential of 30 V using a battery. The battery is then removed and the charged capacitor is connected to an uncharged capacitor C_2 of capacitance 10 μF as shown in figure. When the switch is closed charge flows between the capacitors. At equilibrium, the charge on the capacitor C_2 is ____ μC. [JEE (Main)-2022]

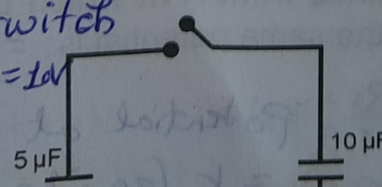
before closing the switch

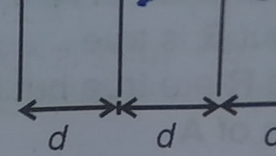
$Q = C_1V_0$
$= 5 \times 30$
$= 150\ \mu C$

After closing the switch

$V = \frac{Q}{C_1+C_2} = \frac{150}{10+5} = 10V$

$= 10 \times 10$





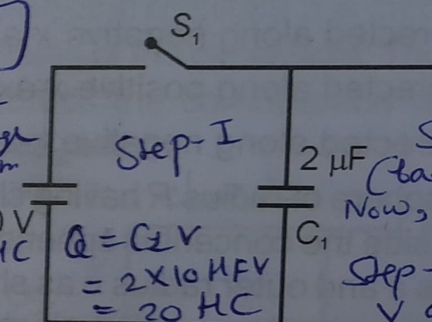
Cleared

83. A 2 μF capacitor C_1 is potential difference of 10 Then the battery is remove is connected to an unch C_2 of 8 μF. The charge in condition is ________ μC. (Rou Integer)

Step-III

$C_1V + C_2V = Q$
$= 2V + 8V$
$= 20$
$10V = 20$
$\boxed{V = 2V}$

Step-IV
Find charge C_2 on eqm
$Q = C_2V$
$8 \times 2 = 16\ \mu C$



84. A parallel plate capacitor 100 m² and plate separation between the plates is filled 5 m with a material of diele 10. The resultant capacitan is 'x' pF.

The value of $\varepsilon_0 = 8.85 \times 10^{-12}$

The value of 'x' to the nearest [JE

$\frac{\varepsilon_0 A}{d - t + t/k}$

85. The equivalent capacitance