IMPORTANT QUESTIONS

VERY SHORT ANSWER QUESTIONS

(1 mark)

Previous Years' Questions

Q. 1. The force acting between two point charges q_1 and q_2 kept at some distance apart in air is attractive or repulsive when (*i*) $q_1q_2 > 0$ (*ii*) $q_1q_2 < 0$. *[CBSE (F) 2007]*

Ans. (*i*) repulsive (*ii*) attractive.

Q. 2. Write S.I. unit of (*i*) electric field intensity and (*ii*) electric dipole moment. *[CBSE Delhi 2003]*

Ans. (*i*) S.I. unit of electric field intensity is newton/coulomb (NC^{-1}).

(*ii*) S.I. unit of electric dipole moment is coulomb × metre (C-m).

Q. 3. Name the physical quantity whose S.I. unit is JC^{-1}. Is it a scalar or a vector quantity? *[CBSE Delhi 2010]*

Ans. Electric potential. It is a scalar quantity.

Q. 4. Why should electrostatic field be zero inside a conductor? *[CBSE Delhi 2012]*

Ans. The charge inside the conductor is zero, so electric field is zero.

Q. 5. Name the physical quantity which has its unit joule coulomb^{-1}. Is it a scalar or a vector quantity? *[CBSE Delhi 2010]*

Ans. The physical quantity having unit joule coulomb^{-1} is **electric potential.** It is a scalar quantity.

Q. 6. Why must electrostatic field be normal to the surface at every point of a charged conductor? *[CBSE Delhi 2012]*

Ans. In the static situation, $\vec{E}$ has to ensure that the free charges on the surface do not experience any force.

Q. 7. Why is electrostatic potential constant throughout the volume of the conductor and has the same value (as inside) on its surface? *[CBSE Delhi 2012]*

Ans. Electric field intensity is zero throughout the volume and the potential just inside, has to be equal to potential on the surface.

Q. 8. What is the geometrical shape of equipotential surfaces due to a single isolated charge? *[CBSE Delhi 2013]*

Ans. Spherical shape with point charges $q > 0$ or $q < 0$ at the centre.

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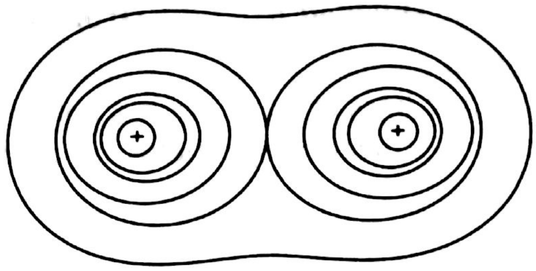
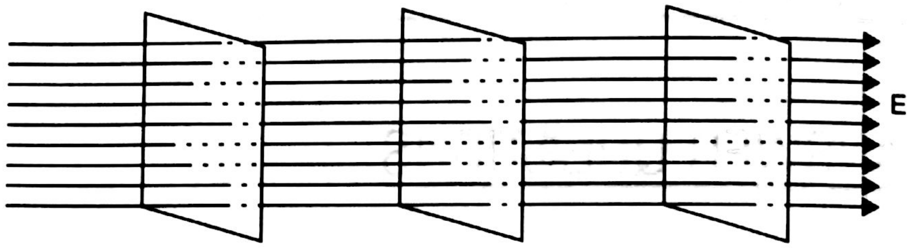
Q. 9. Depict the equipotential surfaces for a system of two identical positive point charges placed distance '*d*' apart. *[CBSE Delhi 2*

Ans. Equipotential surfaces due to two identical charges is shown in fig.



Q. 10. Draw an equipotential surface in a uniform electric field. *[CBSE (AI) 2*

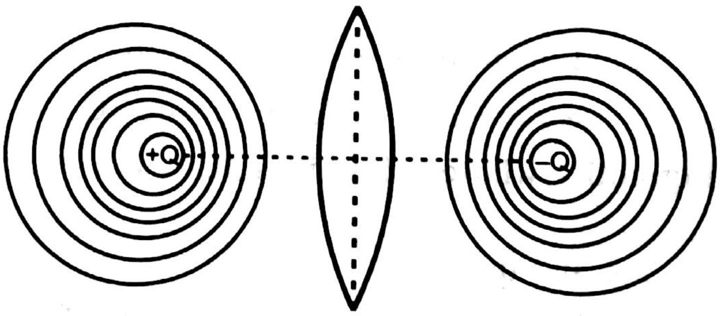
Ans.



Q. 11. Draw an equipotential surface for a system consisting of two charges *Q*, – *Q* separated by distance *r* in air. Locate the points where the potential due to the dipole is zero.

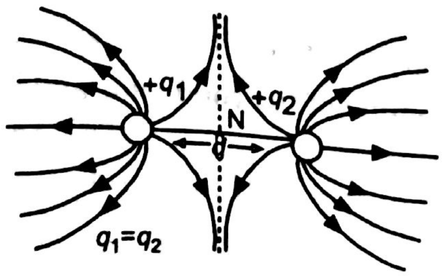
[CBSE (AI) 2013, 2

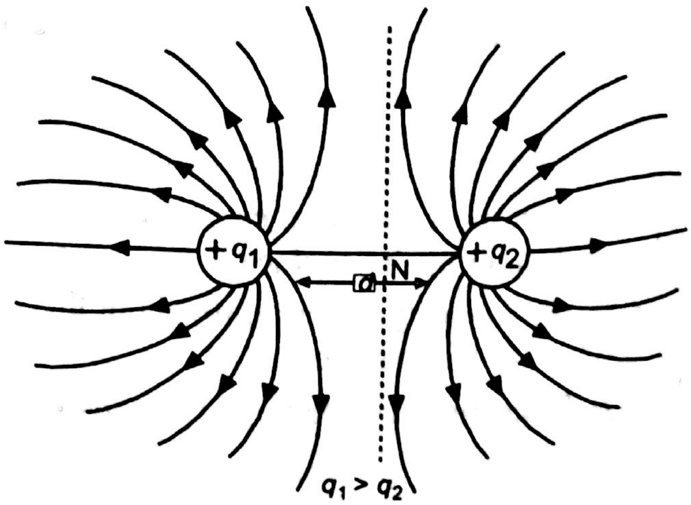
Ans. Electric potential is zero at all points in the plane passing through the dipole equator.



Q. 12. Sketch the electric lines of force for two point charges q_1 and q_2 for $q_1 = q_2$ and $q_1 >$ separated by a distance *d*.

Ans. When the charges are *equal*, the neutral point *N* lies at the *centre* of the line joining the charges. However, when the charges are unequal, the point *N* is *closer to the smaller charge*.





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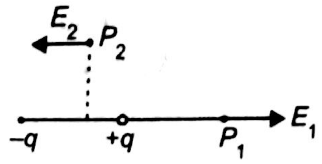
Q. 13. What is the angle between the directions of electric field at any
(*i*) axial point and
(*ii*) equatorial point due to an electric dipole?

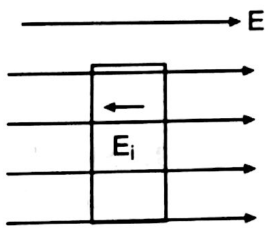


Ans. The directions of electric field $\vec{E}_1$ at axial point P_1 and electric field $\vec{E}_2$ at equatorial point P_2 are shown in fig. Obviously, angle between $\vec{E}_1$ and $\vec{E}_2$ is **180°.**

Q. 14. Express dielectric constant in terms of capacitance. ***[CBSE Delhi 2006, 2005]***

Ans. The dielectric constant of a medium is defined as the ratio of capacitance of capacitor when filled with a medium to capacitor of same capacitance when medium is removed.

i.e., $$K = \frac{C_{medium}}{C_0}$$



Q. 15. What is the function of a dielectric in a capacitor ? ***[CBSE Delhi 2002]***

Ans. Dielectric reduces the effective charge on plates and hence increases the capacitance.

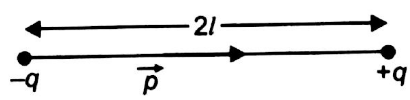
Q. 16. How does the electric field inside a dielectric decrease when it is placed in an external electric field ? ***[CBSE Delhi 2005]***

Ans. When a dielectric is placed in an external electric field, the charges are induced on the faces of dielectric which produce opposite electric field in the dielectric, thus net electric field is reduced.

Q. 17. Define electric dipole moment. Is it a scalar or a vector quantity ? What is its SI unit? ***[CBSE (AI) 2013, 2011, Delhi 2006, (F) 2013, 2012, 2009]***

Ans. The electric dipole moment is defined as the numerical product of either charge and the distance between the charges. Its direction is from negative to positive charge.

i.e., $$\vec{p} = q\,2\,\vec{l}$$



Electric dipole moment is a vector quantity.

Its SI unit is coulomb-metre.

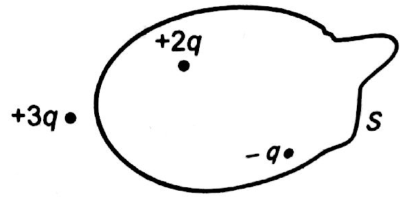
Q. 18. An electric dipole of dipole moment 20 × 10^{-6} C is enclosed by closed surface. What is the net electric flux coming out of this surface? ***[CBSE Delhi 2005]***

Ans. Zero.

Reason : Net charge enclosed by surface = Net charge on dipole $= q - q = 0$

$\therefore$ Total electric flux $= \frac{1}{\varepsilon_0} \times$ net charge enclosed $= 0$

Q. 19. Fig. shows three point charges +2*q*, −*q* and +3*q*. Two charges +2*q* and −*q* are enclosed within a surface '*S*'. What is the electric flux due to this configuration through the surface '*S*'? ***[CBSE Delhi 2010]***



Ans. Electric flux $= \frac{1}{\varepsilon_0} \times$ (Net charge enclosed within the surface)

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

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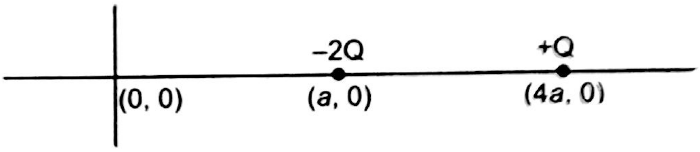
Q. 20. **Two charges of magnituds – 2Q and + Q are located at points (*a*, 0) and (4*a*, 0) respectively. What is the electric flux due to these charges through a sphere of radius '3*a*' with its centre at the origin?**

[CBSE (AI) 2013]

Ans. Electric flux, $\varphi = \frac{-2Q}{\varepsilon_0}$

Concept: (*i*) Mark the position of the charges on number line.

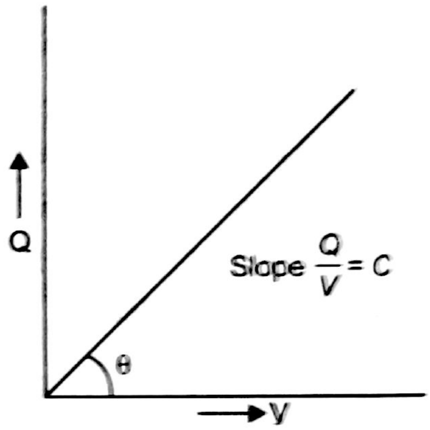
(*ii*) Draw a sphere of radius 3*a* about the origin and observe that which charge is inside the sphere, and then use Gauss theorem.



Q. 21. **Sketch graph to show how charge *Q* given to a capacitor of capacitance *C* varies with the potential difference.**

Ans. The graph of charge (*Q*) versus potential difference (*V*) is a straight line whose slope is equal to capacitance '*C*'.

$$\text{Slope} = \tan\theta = \frac{Q}{V} = C$$



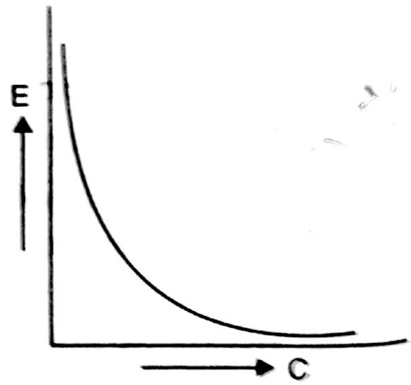
Q. 22. **The graph shown here shows the variation of total energy (*E*) stored in a capacitor against the value of the capacitance (*C*) itself. Which of the two : the charge on capacitor or the potential used to charge it is kept constant for this graph?**

Ans. The given graph represents

$$E \propto \frac{1}{C}$$

This is satisfied by the expression, $E = \frac{q^2}{2C} \propto \frac{1}{C}$ for constant *q*.

That is, the charge (*q*) is kept constant.



Q. 23. **What orientation of an electric dipole in a uniform electric field corresponds to its (*i*) stable and (*ii*) unstable equilibrium?**

[CBSE Delhi 2010]

Ans. (*i*) In stable equilibrium the dipole moment is parallel to the direction of electric field (*i.e.*, $\theta = 0$).

(*ii*) In unstable equilibrium P.E. is maximum, so $\theta = \pi$ so dipole moment is antiparallel to electric field.

Q. 24. **The force between two point charges kept at a distance *r* apart in air is *F*. If the same charges are kept in water at the same distance, how does the force between them change?**

Ans. The force in air $F_a = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$

The force in water $F_w = \frac{1}{4\pi\varepsilon_0 K} \frac{q_1 q_2}{r^2}$

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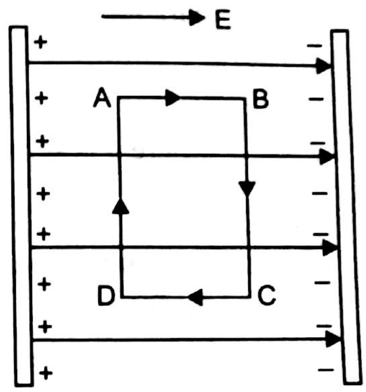
$$\therefore \quad \frac{F_w}{F_a} = \frac{1}{K}$$

Dielectric constant of water is 81, so the force in water reduces to $\frac{1}{81}$ times.

Q. 25. A uniform electric field exists between two charged plates as shown in the fig. What should be the work done in moving a charge q along the closed rectangular path $ABCDA$?

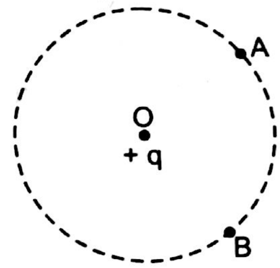


Ans. Work done in an electric field is independent of the path and depends only on the initial and final positions. Here initial and final points are coincident.

$$\text{Work} = q \times (V_{final} - V_{initial}) = q(V_A - V_A) = 0$$

So, net work done is zero.

Q. 26. What should be the work done if a point charge $+q$ is taken from a point A to the point B on the circumference drawn with another point $+q$ at the centre?



Ans. The potential of points A and B are same being equal to

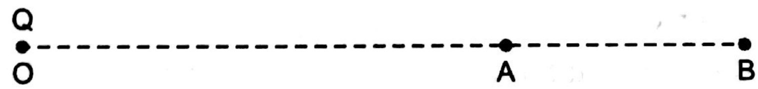
$$V_A = V_B = \frac{1}{4\pi\varepsilon_0} \frac{q}{R}$$

where R is the radius of the circle.

Work done $\quad W = q(V_B - V_A) = q(V_A - V_A) = 0.$

Q. 27. A point charge Q is placed at point O as shown in the figure. Is the potential difference $V_A - V_B$ positive, negative, or zero, if Q is (*i*) positive (*ii*) negative?

[CBSE Delhi 2011]



Ans. The potential due to a point charge decreases with increase of distance. So, in case (*i*) $V_A - V_B$ is positive.

For case (*ii*) $V_A - V_B$ is negative.

Q. 28. Why is the potential inside a hollow spherical charged conductor constant and has the same value as on its surface? ***[CBSE (F) 2012]***

Ans. Electric field intensity is zero inside the hollow spherical charged conductor. So, no work is done in moving a test charge inside the conductor and on its surface. Therefore, there is no potential difference between any two points inside or on the surface of the conductor.

$$V_A - V_B = -\int \vec{E}.\vec{dl} = 0$$

$$\Rightarrow V_A = V_B = \text{Constant}$$

Q. 29. Why do the equipotential due to a uniform electric field not intersect each other?

[CBSE (F) 2012]

Ans. This is because, at the point of intersection there will be two values of electric potential which is not possible.

Q. 30. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. What is the potential at the centre of the sphere? ***[CBSE (AI) 2011]***

Ans. Potential at centre of sphere = 10 V. Potential at all points inside the hollow metal sphere (or any surface) is always equal to the potential at the surface.

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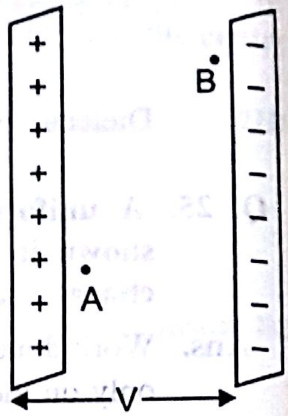
Q. 31. Two protons, *A* and *B*, are placed between two parallel plates having a potential difference *V* as shown in fig. Will the protons experience equal or unequal force ?



Ans. The electric field strength at all points between the two oppositely charged parallel plates are same; so protons *A* and *B* will experience equal force

$$F_A = F_B = eE = e\frac{V}{d}$$

where *d* is separation between the plates.

Q. 32. How much work is done in moving a 500 μC charge between two points on an equipotential surface?

OR

Why is there no work done in moving a charge from one point to another on an equipotential surface? ***[CBSE (F) 2012]***

Ans. For equipotential surface each point is at the same potential, so

$$V_{final} = V_{initial}$$

so $$W = q(V_{final} - V_{initial}) = 0$$

OR

The potential difference between any two points of equipotential surface is zero. We have

$$V_1 - V_2 = \frac{W}{q} = 0 \qquad (\because 0)$$

$$\Rightarrow \quad W = 0$$

So, the work done in moving a charge on an equipotential surface is zero.

Q. 33. The distance of the field point, on the equatorial plane of a small electric dipole is halved. By what factor does the electric field due to the dipole change? ***[CBSE Delhi 2004C]***

Ans. For small dipole, $E_{equator} = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3} \propto \frac{1}{r^3}$

When *r* is halved, the electric field strength become 8-times of the original field.

Q. 34. The distance of the field point on the axis of a small dipole is doubled. By what factor will the electric field, due to the dipole change? ***[CBSE Delhi 2004C]***

Ans. For a small dipole, $E_{axis} = \frac{1}{4\pi\varepsilon_0}\frac{2p}{r^3} \propto \frac{1}{r^3}$

When the distance *r* is doubled, the electric field strength becomes $\frac{1}{8}$ times the original field.

Q. 35. Name the dielectric whose molecules have (*i*) non-zero and (*ii*) zero dipole moment. ***[CBSE (AI) 2004C]***

Ans. (*i*) The dielectric having non-zero dipole moment is water.

(*ii*) The dipole having zero dipole moment is diamond (or silicon).

Q. 36. Define dielectric constant of a medium. What is the value of dielectric constant for a metal ? ***[CBSE Delhi 2004C]***

Ans. The dielectric constant of a medium is defined on the ratio of permittivity of medium to the permittivity of free space. The dielectric constant is also called the relative permittivity of medium

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$$\varepsilon_r = K = \frac{\varepsilon}{\varepsilon_0}$$

The value of dielectric constant for a metal is **infinity** *i.e.*, $K_{metal} = \infty$.

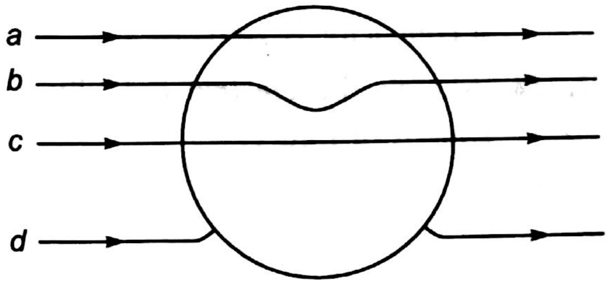
Q. 37. If the radius of the Gaussian surface enclosing a charge is halved, how does the electric flux through the Gaussian surface change? *[CBSE (AI) 2008C]*

Ans. Electric flux through a Gaussian surface, enclosing the charge q is

$$\phi_E = \frac{1}{\varepsilon_0} q$$

This is independent of radius of Gaussian surface, so if radius is halved, the electric flux through the surface will remain **unchanged.**

Q. 38. A metallic sphere is placed in a uniform electric field as shown in the figure. Which path is followed by electric field lines and why?



Ans. Path (d) is followed by electric field line.

Reason: There are no electric field lines within a metallic sphere and field lines are normal at each point of the surface.

Q. 39. A charge $Q\ \mu C$ is placed at the centre of a cube. What would be the flux through one face ? *[CBSE (AI) 2012, CBSE (F) 2010]*

Ans. Electric flux through whole cube $= \frac{Q}{\varepsilon_0}$. Electric flux through one face $= \frac{1}{6}\frac{Q}{\varepsilon_0}$ μVm.

Q. 40. A charge q is placed at the centre of a cube of side *l*. What is the electric flux passing through two opposite faces of the cube? *[CBSE (AI) 2012]*

Ans. By symmetry, the flux through each of the six faces of the cube will be same when charge q is placed at its centre.

$$\therefore \qquad \phi_E = \frac{1}{6} \cdot \frac{q}{\varepsilon_0}$$

Other Important Questions

Q. 41. An arbitrary surface encloses a dipole. What is the electric flux through this surface? *[NCERT Exemplar]*

Ans. Net charge on a dipole $= -q + q = 0$. According to Gauss's theorem, electric flux through the surface,

$$\oint \vec{E} . d\vec{S} = \frac{1}{\varepsilon_0} \times q = 0$$

Q. 42. A metallic spherical shell has an inner radius R_1 and outer radius R_2. A charge Q is placed at the centre of the spherical cavity. What will be surface charge density on (*i*) the inner surface, and (*ii*) the outer surface? *[NCERT Exemplar]*

Ans. When a charge + Q is placed at the centre of spherical cavity,

the charge induced on the inner surface = $-Q$

the charge induced on the outer surface = $+Q$

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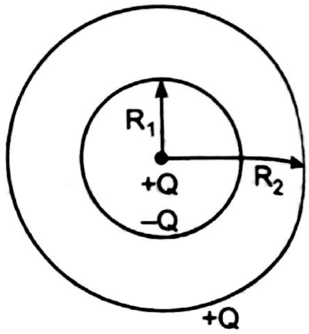
$\therefore$ Surface charge density on the inner surface = $\dfrac{-Q}{4\pi R_1^2}$

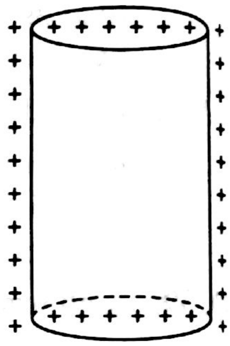
Surface charge density on the outer surface = $\dfrac{+Q}{4\pi R_2^2}$



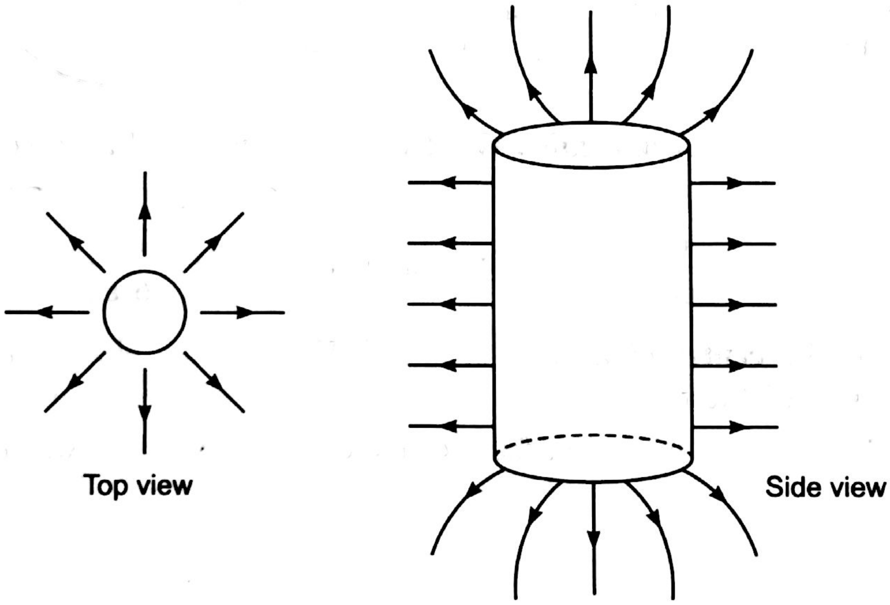
Q. 43. The dimensions of an atom are of the order of an Angstrom. Thus there must be large electric fields between the protons and electrons. Why then is the electrostatic field inside a conductor zero? *[NCERT Exemplar]*

Ans. The electric fields bind the atoms to neutral entity. Fields are caused by excess charges. There can be no excess charge on the inter surface of an isolated conductor. So, the electrostatic field inside a conductor is zero.

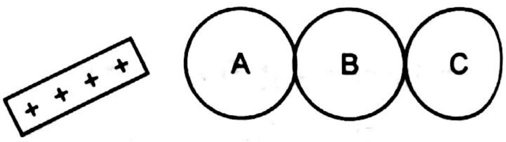
Q. 44. Sketch the electric field lines for a uniformly charged hollow cylinder shown in figure. *[NCERT Exemplar]*



Ans.



Q. 45. You are given three uncharged spherical conductors A, B and C, touching each other. A glass rod carrying positive charge is brought near sphere A as shown. What will be the charges on spheres A, B and C?



Ans. By induction, the electrons will be transferred from *C* to *A*, so sphere *A* will be negatively charged and *C* will be positively charged; while sphere *B* will remain neutral.

Q. 46. A proton and an electron are placed freely in an electric field. Which of the particles will have greater acceleration and why?

Ans. Force on a charged particle in an electric field

$$F = qE$$

for an electron or proton $q = e$

$$\therefore \quad F = eE$$ (same for electron and proton but oppositely directed)

If m is mass of particle

$\therefore$ acceleration $a = \dfrac{F}{m} = \dfrac{eE}{m}$

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As mass of electron is smaller than that of proton, the acceleration of electron will be greater than that of proton.

Q. 47. A small metallic charged sphere is placed at the centre of large uncharged spherical shell and the two are connected by a wire. Will any charge flow on the outer shell ?

Ans. Yes, the whole charge will flow to the outer shell; because charge always resides on outer surface of a conductor.

Q. 48. Does the electric potential rise or fall along an electric line of force?

Ans. The electric potential falls along a line of force because a line of force is always directed from higher to lower potential.

Q. 49. Can electric potential at a point be zero, while the electric field is not zero?

Ans. Yes, electric potential is zero at all points on equatorial line of electric dipole, while electric field strength is not zero.

Q. 50. Can electric field at a point be zero, while electric potential is not zero?

Ans. Yes, inside a hollow charged metallic conductor, the electric field is zero, but electric potential is finite.

Q. 51. Consider two conducting spheres of radii R_1 and R_2 with $R_1 > R_2$. If the two are at the same potential, the larger sphere has more charge than the smaller sphere. State whether the charge density of the smaller sphere is more or less than that of the larger one.

[NCERT Exemplar]

Ans. Since two spheres are at the same potential, therefore

$$V_1 = V_2$$

$$\frac{Q_1}{4\pi\varepsilon_0 R_1} = \frac{Q_2}{4\pi\varepsilon_0 R_2}$$

$$\Rightarrow \quad \frac{Q_1}{Q_2} = \frac{R_1}{R_2} \qquad \ldots(i)$$

Given, $R_1 > R_2$

$\therefore \quad Q_1 > Q_2$

$\Rightarrow$ Larger sphere has more charge

Now, $\sigma_1 = \dfrac{Q_1}{4\pi R_1^2}$ and $\sigma_2 = \dfrac{Q_2}{4\pi R_2^2}$

$$\frac{\sigma_2}{\sigma_1} = \frac{Q_2}{Q_1} \cdot \frac{R_1^2}{R_2^2}$$

$$\Rightarrow \quad \frac{\sigma_2}{\sigma_1} = \frac{R_2}{R_1} \cdot \frac{R_1^2}{R_2^2} = \frac{R_1}{R_2} \qquad \text{[From equation } (i)]$$

Since $R_1 > R_2$, therefore $\sigma_2 > \sigma_1$.

Charge density of smaller sphere is more than that of larger one.

Q. 52. Do free electrons travel to region of higher potential or lower potential?

[NCERT Exemplar]

Ans. Free electrons would travel to regions of higher potentials as they are negatively charged.

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Q. 53. Can there be a potential difference between two adjacent conductors carrying the same charge? *[NCERT Exemplar]*

Ans. Yes, if the sizes are different.

Q. 54. Two protons are brought nearer; what will be the effect on potential energy of system?

Ans. A repulsive force acts between protons, if they are brought nearer, work must be done by external force; hence the potential energy of system increases.

Q. 55. An electron and a proton are brought nearer; how does the potential energy of system change?

Ans. There is attractive force between an electron and a proton, therefore when they come nearer, the work is done by the system itself and so the potential energy of system **decreases.**

Q. 56. A charge q is placed inside a closed surface. What is the electric flux through the surface?

Ans From Gauss theorem electric flux, $\phi = \frac{q}{\varepsilon_0}$.

Q. 57. A charge q is placed just outside a closed surface. What is the electric flux through the surface?

Ans. Zero, charge enclosed by surface $\Sigma q = 0$.

Q. 58. There are two metallic spheres; one is bigger than the other. Which has greater capacitance?

Ans. The bigger sphere has greater capacitance since capacitance of a spherical conductor $C \propto r$.

Q. 59. Where does the energy of a charged capacitor reside?

Ans. The energy of a charged capacitor resides in the medium between the plates.

Q. 60. Two spheres of copper of the same radii, one hollow and the other solid, are charged to the same potential. Which sphere possesses more charge?

Ans. The radii of both the sphere are equal, therefore their capacitances will be the same and hence their charges $Q = CV$ will be same.

Q. 61. Is there any conductor which can be given any amount of charge?

Ans. Yes, earth is such a conductor. Any quantity of charge given to it retains its potential zero.

Q. 62. The capacitance of a charged capacitor is C and the energy stored in it is U. What is the value of charge on the capacitor ?

Ans. Energy stored $U = \frac{Q^2}{2C}$ where Q is charge on capacitor.

$\Rightarrow$ $Q^2 = 2CU$

Charge $Q = \sqrt{2CU}$

Q. 63. What is the net charge on a charged capacitor?

Ans. Zero; since charges on plates of capacitor are $+Q$ and $-Q$; $\Sigma Q = +Q - Q = 0$

Q. 64. Can we give any amount of charge to a capacitor? Why?

Ans. **No. Reason:** When we give charge to a capacitor continuously, the potential difference between its plates goes on increasing. Finally a stage will come when the electric field between the plates will exceed the dielectric strength of medium; thus puncturing the dielectric *i.e.* breaking the dielectric into positive and negative charges; so the capacitor will be discharged giving sparking.

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Q. 65. Which of the following is a dielectric substance: Germanium, mica, carbon?

Ans. Mica.

Q. 66. Why should circuit containing capacitor be handled causiously even when there is no current?

Ans. When there is no current in the circuit, the capacitor may have charge. Therefore by handling a charged capacitor a person may get a severe shock; hence the circuit containing a capacitor must be handled causiously.

Q. 67. Is there any material which when inserted between the plates of a capacitor reduces its capacitance?

Ans. No, for any material $K > 1$.

Q. 68. The plates of a charged capacitor are connected by a voltmeter. If the plates of the capacitor are moved farther apart, what will be the effect on the reading of voltmeter?

Ans. Capacitance $C \propto \frac{1}{d}$, *i.e.*, when plates are moved farther, the capacitance decreases. As charge (Q) on capacitors is constant, the potential $V = \frac{Q}{C}$ increases, hence reading of voltmeter increases.

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