AISSCE Home Assignment – 01

UNIT – I ELECTROSTATICS

Chapter – 01 Electric charges and Fields

CBSE 2023

Set I

1. The magnitude of the electric field due to a point charge object at a distance 4.0 m is 9 N/C. From the same charged object the electric field of magnitude, 16 N/C will be at a distance of

(a) 1 m (b) 2 m (c) 3 m (d) 6 m

Set II

2. An isolated point charge particle produces an electric field $\vec{E}$ at a point 3 m away from it. The distance of the point at which the field is $\frac{\vec{E}}{4}$ will be

(a) 2 m (b) 3 m (c) 4 m (d) 6 m

Set III

3. An electric dipole moment 2×10^{-8} C m in a uniform electric field experiences a maximum torque of 6×10^{-1} N m. The magnitude of electric field is

(a) 2.2×10^{3} Vm^{-1} (b) 1.2×10^{4} Vm^{-1} (c) 3.0×10^{4} Vm^{-1} (d) 4.2×10^{3} Vm^{-1}

4. A point charge q_0 is moving along a circular path of radius a, with a point charge - Q at the centre of the circle. The kinetic energy of q_0 is

(a) $\frac{q_0 Q}{4\pi\varepsilon_0 a}$ (b) $\frac{q_0 Q}{8\pi\varepsilon_0 a}$ (c) $\frac{q_0 Q}{4\pi\varepsilon_0 a^2}$ (d) $\frac{q_0 Q}{8\pi\varepsilon_0 a^2}$

5. **Assertion (A) :** Work done in moving b a charge around a closed path, in an electric field is always zero.
Reason (R) : Electrostatic force is a conservative force.

6. (a) (i) Use Gauss's law to obtain an expression for n the electric field due to an infinitely long thin straight wire with uniform linear charge density λ.
(ii) An infinitely long positively charged straight wire has a linear charge density λ. An electron is revolving in a circle with a constant speed v such that the wire passes through the centre, and is perpendicular to the plane of the circle. Find the kinetic energy of the electron in terms of magnitudes of its charge and linear charge density λ of the wire.
(iii) Draw the graph of kinetic energy as a function of linear charge density λ. (5)

7. Consider two identical point charges located at points (0,0) and (a,0). Is there a point on the line joining them at which the electric field is zero? (2)

CBSE 2022

1. A negatively charged object X is repelled by another charged object Y. However an object Z is attracted to object Y. which of the following is the most possibility for the object Z?

   (a) positively charged only (b) negatively charged only
   (c) neutral or positively charged (d) neutral or negatively charged

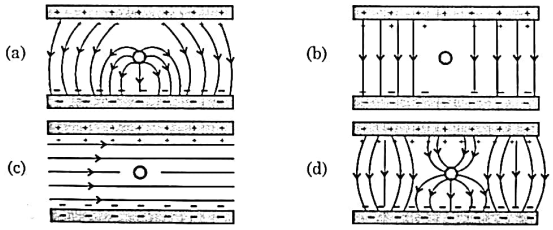
2. In an experiment three microscopic latex spheres are sprayed into a chamber and become charged with charges +3e, +5e and -3e respectively. All the three spheres come in contact simultaneously for a moment and got separated. Which one of the following are possible values for the final charge on the sphere?

   (a) +5e, -4e, +5e (b) +6e, +6e, -7e (c) -4e, +3.5e, +5.5e (d) +5e, -8e, +7e

3. An object has net charge 1 C and gains 5.0 x 1018 electrons. The net charge on the object becomes-

   (a) - 0.80 C (b) + 0.80 C (c) + 1.80 C (d) + 0.20 C

4. Which of the following diagrams correctly represents the electric field between two charged plates if a neutral conductor is placed in between the plates?



5. The magnitude of electric field due to a point charge 2q, at a distance r is E. Then the magnitude of the electric field due to a uniformly charged thin spherical shell of radius R with total charge q at distance r/2 (r >> R) will be

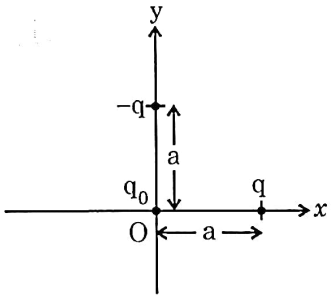
   (a) E/4 (b) 0 (c) 2E (d) 4E

6. A square sheet of side 'a' is lying parallel to XY plane at z = a. The electric field in the region is $\overrightarrow{E} = c\,z^2\,\hat{k}$. The electric flux through the sheet is

   (a) $a^4\,c$ (b) $\frac{1}{3}a^3\,c$ (c) $\frac{1}{3}a^4\,c$ (d) 0

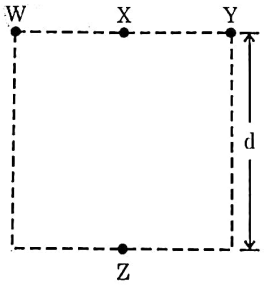
7. Three charges q, -q and q_0 are placed as shown in figure. The magnitude of the net force on charge q_0 at point O is $\left[k = \frac{1}{4\pi\epsilon_o}\right]$

   (a) 0 (b) $\frac{2\,k\,q\,q_0}{a^2}$ (c) $\frac{\sqrt{2}\,k\,q\,q_0}{a^2}$ (d) $\frac{1}{\sqrt{2}}\frac{k\,q\,q_0}{a^2}$



8. Four objects W, X, Y and Z, each with charge +q are held fixed at four points of a square of side d as shown in figure. Objects X and Z are on the midpoints of the side of the square. The electrostatic force exerted by object W on object X is F. Then the magnitude of the force exerted by object W on Z is

   (a) $\frac{F}{7}$ (b) $\frac{F}{5}$ (c) $\frac{F}{3}$ (d) $\frac{F}{2}$



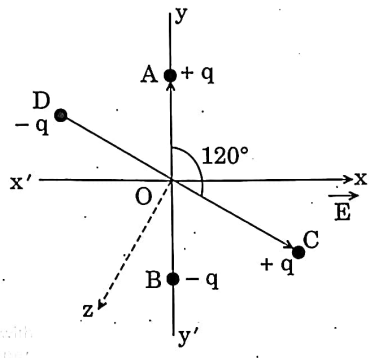
9. **Assertion (A) :** A negative charge in an electric field moves along the direction of electric field.
   Reason (R) : On a negative charge a force acts in the direction of the electric field.

CBSE 2020

(SET – 1)

1. If the electric flux entering and leaving a closed surface in air are ϕ_1 and ϕ_2 respectively, the net electric charge enclosed within the surface is _____. (1)

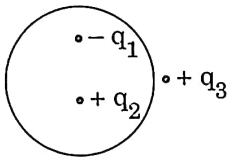
2. Two small identical dipoles AB and CD each of dipole moment $\vec{p}$ are kept at angle of 120^0 to each other in an external electric field $\vec{E}$ pointing along the x- axis as shown in the figure. Find the
   (a) dipole moment of the arrangement, and
   (b) magnitude and direction of the net torque acting on it. (3)



3. (a) Use Gauss's law to show that due to a uniformly charged spherical shell of radius R, the electric field at any point situated outside the shell at distance r from its centre is equal to the electric field at the same point, when the entire charge on the shell were concentrated at its centre. Also plot the graph showing the variation of electric field with r, for $r \leq R$ and $r \geq R$.
   (b) Two point charges of + 1μC and + 4 μC are kept 30 cm apart. How far from the + 1μC charge on the line joining the two charges, will the net electric field be zero? (5)

(SET – 2)

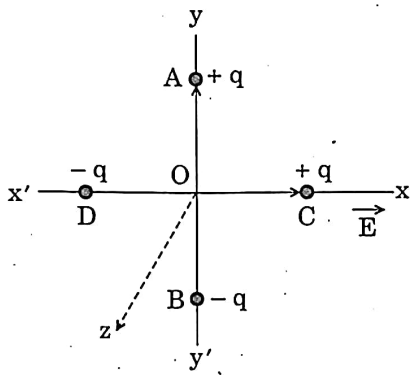
1. Electric flux through a spherical surface shown in the figure, is _____. (1)



2. (a) Two electric field lines cannot cross each other. Also they cannot form closed loops. Give reasons.
   (b) A particle of charge 2 μC and mass 1.6 g is moving with a velocity $4\,\hat{i}$ ms^{-1}. At t = 0 the particles enters in a region having an electric field $\vec{E}$ (in NC^{-1}) = $80\,\hat{i} + 60\,\hat{j}$. Find velocity of the particle at t = 5 s. (3)

(SET – 3)

1. Two small identical dipoles AB and CD each of dipole moment $\vec{p}$ are kept at angle of 90^0 to each other in an external electric field $\vec{E}$ pointing along the x- axis as shown in the figure. Find the
   (a) dipole moment of the arrangement, and
   (b) magnitude and direction of the net torque acting on it. (3)



CBSE 2019

1. Two large charged plane sheets of charge densities + σ and -2σ C/m^2 are arranged vertically with a separation of d distance between them. Deduce expressions for the electric field at points (i) to the left of the first sheet, (ii) to the right of the second sheet, and (iii) between the sheets. (3)

2. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge Q.
   (a) A charge q is placed at the centre of the shell. Find out the surface charge density on the inner and outer surface of the shell.

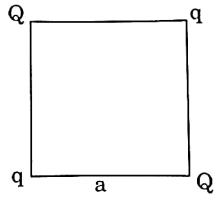
(b) Is the electric field inside a cavity (with no charge) zero; independent of the fact whether the shell is Spherical or not? Explain. (3)

3. Draw the pattern of electric field lines due to an electric dipole. (1)

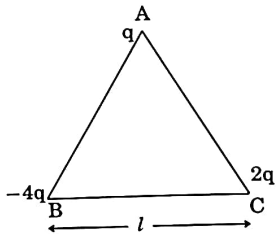
4. Draw the pattern of electric field lines due to two positive charges placed a distance d apart. (1)

CBSE 2018

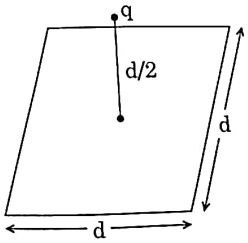
1. Four charges Q, q, Q and q are placed at the corners of a square of side 'a' as shown in figure. Find the (a) resultant electric force on a charge Q, and (b) potential energy of this system. (3)



2. Three charges q, -4q and 2q are placed at the vertices of an equilateral triangle ABC of side 'l' as shown in figure.
   (a) Obtain the expression for the magnitude of the resultant electric force acting on charge q.
   (b) Find out the amount of work done to separate the charge at infinite distance. (3)



3. (a) Define electric flux.is it scalar or vector quantity?
   A point charge q is at a distance of d/2 directly above the centre of a square of side 'd' as shown in the figure. Use Gauss' law to obtain the expression for the electric flux through the square.
   (b) If the point charge is moved to a distance 'd' from the centre of the square and the side is doubled, explain how the electric flux will be affected. (5)



4. (a) Use Gauss' law to derive the expression for the electric field E due to a straight uniformly charged infinite line of charge density λ C/m.
   (b) Draw a graph to show the variation of E with perpendicular distance 'r' from the line of charge.
   (c) Find the work done in bringing a charge 'q' from perpendicular distance r_1 to r_2 ($r_2 > r_1$). (5)

CBSE 2017

1. (a) Derive an expression for the electric field E due to a dipole of length '2a' at appoint at distance r from The centre of the dipole on the axial line.

   (b) Draw the graph E versus r for r >> a.
   (c) If this dipole were kept in a uniform external electric field E_0, diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expressions for the torque acting on the dipole in both the cases. (5)

2. (a) Use Gauss's theorem to find the electric field due to a uniformly charged infinitely large plane thin sheet with surface charge density σ. (5)

(b) An infinitely large thin plane sheet has a uniform surface charge density + σ. Obtain the expression for amount of work done in bringing charge q from infinity to a point, distant r, in front of charged sheet.

CBSE 2016

1. Use Gauss's law to find the electric field due to a uniformly charged infinite plane sheet. What is the direction of field for positive and negative charge densities? (3)

CBSE 2015

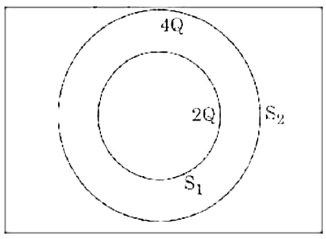
1. Why do the electrostatic field lines not form closed loops? (1)

2. (a) Define electric flux. Write its S. I. unit.
"Gauss's law in electrostatics is true for any closed surface, no matter what its shape or size is." Justify this statement with the help of a suitable example.
(b) Use Gauss's law to prove that electric field inside a uniformly charged spherical shell is zero. (5)

CBSE 2014

1. Two balls having equal positive charge 'q' Coulombs are suspended by two insulating strings of equal length. What would be the effect on the force when a plastic sheet is inserted between the two? (1)

2. (a) Deduce the expression for the torque acting on a dipole of dipole moment **p** in the presence of a uniform electric field **E.**
(b) Consider two hollow concentric spheres, S_1 and S_2, enclosing charges 2Q and 4Q respectively as shown in the figure.
(i) Find out the ratio of the electric flux through them.
(ii) How will the electric flux through the sphere S_1 change If a medium of dielectric constant 'ϵ_r' is introduced in the space inside S_1 in place of air ? Deduce the expression. (5)



CBSE 2013

1. Two charges of magnitudes -2Q and +Q are located at points (a,0) and (4a,0) respectively. What is the electric flux due to these charges through a sphere of radius '3a' with its centre at origin? (1)

2. (a) Define electric dipole moment. Is it a vector or scalar? Derive the expression for the electric field of a dipole at a point on the equatorial plane of the dipole. (3)

3. Using Gauss's law deduce the expression for the electric field due to a uniformly charged spherical shell of radius R at a point (i) outside and (ii) inside the shell. Plot a graph showing variation of electric field as the function of $r > R$ and $r < R$. (r being the distance from the centre of the shell.) (5)