CHAPTER-1
ELECTRIC CHARGES AND FIELDS
ASSIGNMENT-1

(1 MARK QUESTION)

Q1. In an experiment three microscopic latex spheres are sprayed into a chamber and became charged with charges +3e, +5e and -3e respectively. All the spheres came in contact simultaneously for a moment and got separated. Which one of the following possible values for the final charge on spheres?

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

Q2. An object has charge of 1 C and gains 5.0 x 10^{18} electrons. The net charge on the object becomes

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

Q3. Two equal 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?

Q4. Sketch the electric field line for +q and –q.

Q5. Why do the electric field lines never cross each other?

Q6. Why do the electrostatic field lines not form closed loops?

Q7. Draw the electric field lines of a point charge Q where (i) $Q>0$ (ii) $Q<0$

Q8. A proton is placed in a uniform electric field directed along the positive x-axis. In which direction will it tend to move?

Assertion & Reason

Direction: (FOR ALL THE ASSERTION & REASON QUESTIONS)

Two statements are given. One labelled Assertion (A) and the other labelled reasoning. Select the correct answers to their questions from the codes (a), (b), (c) and (d) are given below.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is also false.

Q9. **Assertion:** A point charge is brought in an electric field, then electric field at a nearby pointmay increase or decrease.

Reason: The electric field is dependent on the nature of charge

Q10. **Assertion:** Electronic lines of force cross each other.

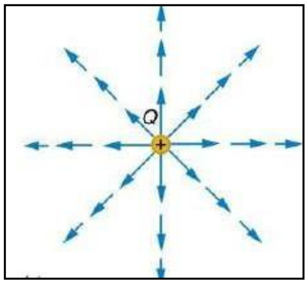
Reason: Electric field at a point does not superimpose to give one resultant electric field.

Q11. **Assertion:** A way from a charge filed lines gets weaker and density of field lines is lessresulting in well separated lines.

Reason: Only a finite number of lines can be drawn from a charge.

Case Based MCQs

Direction: Answer the questions from Q12 to Q14 on the following case.



An electric field lines in general is a curve drawn in such way that the tangent to it at each point is in the direction of the electric field at that point. A field lines is a space curve, i.e. a curve in three dimensions. Electric field lines are then used to pictorially map the electric field around a charge or a configuration of charges:

The density of field lines in more near the charge. Away from the charge, the field is weak, so the density of field lines is less.

Q12. Direction of electric field on field lines is determined by

(a) Field lines moving from –ve to +ve charge.

(b) At the point of intersection of field lines.

(c) By the tangent at that point on the field lines.

(d) None of above.

Q13. The electric field lines of negatively charged particles are

(a) Radial and outwards. (c) Radial and inwards.

(b) Circular and anti-clockwise. (d)Circular and clockwise.

Q14. The spacing between two electric field lines indicate it

(a) Charge (b) Position (c) Strength (d) None of the above

MCQs

Q15. The dimensional formula of electric flux is

(a) $[M^1L^2T^{-2}A^{-1}]$ (b) $[M^{-1}L^3T^{-3}A^1]$ (c) $[M^1L^3T^{-3}A^{-1}]$ (d) $[M^1L^{-3}T^{-3}A^{-1}]$

Q16. What is the SI unit of electric flux

(a) $\frac{N}{C}$ x m^2 (b) N x m^2 (c) $\frac{N}{m^2}$ x C (d) $\frac{N^2}{m^2}$ x C^2

Q17. If $\oint_s \vec{E}\cdot\vec{dS} = 0$ inside a surface that means:

(a) There is no net charge present inside the surface

(b) Uniform electric field inside the surface

(c) Discontinuous field lines inside the surface

(d) Charge present inside the surface

Q18. Four charges +8Q -3Q +5Q and -10Q are kept inside a closed surface. What will be the outgoing flux through the surface

(a) 26 V-m (b) 0 V-m (c) 10 V-m (d) 8 V-m

Q19. Electric flux over an area in an electric field represents the .... crossing this area.

Q20. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the .... will remain the same.

Q21. If $\oint_s \vec{E}\cdot\vec{dS} = 0$ over a surface, then

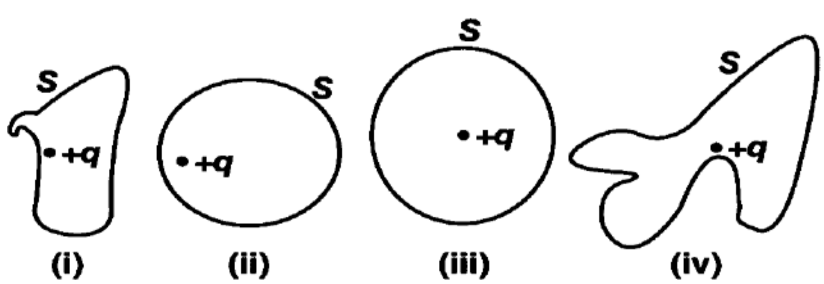
(a) the electric field inside the surface and on it is zero

(b) the electric field inside the surface is necessarily uniform

(c) the number of flux lines entering the surface must be equal to the number of flux lines leaving it

(d) all charges must necessarily be outside the surface

Q22. The electric flux through the surface



(a) In fig (iv) is the largest

(b) fig (iii) is the least

(c) fig (ii) is same as fig (iii) but is smaller than fig (iv)

(d) is the same for all the figures

Q23. **Assertion-** Electric flux is a vector quantity.

Reason- Electric flux is expressed as vector product of electric field vector and area vector.

Q24. **Assertion-** Electric flux through closed spherical surface enclosing an electric dipole is zero.

Reason- Net charge enclosed inside a spherical surface when a dipole is inside it is zero.

Q25. **Assertion-** Gaussian surface is purely imaginary surface.

Reason- Electric field at every point on a Gaussian surface is same.

Q26. **Assertion-** Gaussian surface can be drawn outside the body or within the body.

Reason- It is purely imaginary surface.

Q27. **Assertion-** Electric field at a point inside spherical shell with a charge uniformly spread on its outer surface is zero.

Reason- There is no charge enclosed within the closed shell.

Q28. **Assertion-** Electric field at any point away from linear charge distribution decreases with distance.

Reason- Electric field at any point away from linear charge distribution is expressed as

$E=\frac{\lambda}{2\pi \epsilon_o r}$.

Two-mark questions

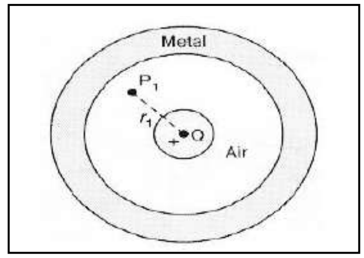
Q29. State the superposition principle for electrostatic force on a charge due to number of charges.

Q30. A force F is acting between two point charges q_1 and q_2. If a third charge q_3 is placed quite close to q_2, what happens to the force between q_1 and q_2?

Q31. i) The electric field E due to a point charge at any point near it is defined as $E=\lim_{q\to 0}$ E/q, where q is the test charge and F is the force acting on it. What is the physical significance of $\lim_{q\to 0}$ in this expression?

(ii) Draw electric field lines of a point charge Q when a. Q>0 b. Q<0

Q32. A small metal sphere carrying a charge +Q is located at the center of a spherical cavity is a large uncharged metallic spherical shell. Write the charges on the inner and outer surfaces of the shell. Write the expression for the electric field at the point P_1.



Q33. Two point charges q_1 and q_2 are located at point (a,0,0) and (0, b,0) respect. Find the electric field due to both these charges at the point (0,0, e).

Q34. What is Gaussian surface? What is its use?

Q35. S_1 and S_2 are two hollow concentric spheres (S_2 outer sphere and S_1 inner sphere) enclosing charges 9Q and 3Q respectively. What is the ratio of electric flux through S_1 and S_2? What would be electric flux through S_1, if air inside S_1 is replaced by a medium of dielectric constant 3?

Q36. A hollow cube of side 5cm encloses a charge of 6C at its centre. What is the net flux through one of the square face of cube? How would flux through square face change if 6C charge is placed as 4C and 2C inside the cube at two different points?

Three-mark questions

Q37. A particle of charge 2μC and mass 1.6g is moving with a velocity $4\hat{i}\ ms^{-1}$. At t = 0 the particles enters in a region having an electric field E (in $N\ C^{-1}$) = $80\hat{i} + 60\hat{j}$. Find the velocity of particle at t = 5s.

Q38. A particle of mass 10^{-3} kg and charge 5C enters into a uniform electric field of 2×10^5 N/C, moving with a velocity of 20 m/s in a direction opposite to that of the field. Calculate the distance it would travel before coming to rest.

Q39. State and prove Gauss Theorem.

Q40. Using Gauss theorem obtain an expression for electric field intensity at a point due to infinitely long line charge distribution. Sketch graphically variation of E with distance r.

Q41. Using Gauss theorem obtain an expression for electric field intensity at a point due to thin infinite sheet.

Four-mark questions

Q42. Read the following passage and answer questions below it.

A spherical dome in an expo consists of magical fan fixed inside it. The blades offan have a total charge of 6 C deposited on it. The dome is also surrounded by four such identical fans fixed outside it, each carrying a charge of 6 C on its blade. When a fan inside the dome is switched ON, the charge deposited on the blades of a fan flies offbut remains inside the dome. However, when the fans outside the dome are switched ON charge deposited on the blades remain confined to blades. The dome is coveredby electro sensitive glittering sheet whose glittering intensity varies directly as the electric flux falling upon its surface varies.

1. What is the net electric flux through the closed surface of dome, when all the fans areswitched OFF?

a) 6C/ ϵ o b) 1 C/ ϵ o c) 30C/ ϵ o d) 1 C/12 ϵ o

2. What is the net electric flux through the closed surface of dome, when all the fans areswitched ON?

a) 30C/ ϵ o b) 1 C/ ϵ o c) 6C/ ϵ o d) 1 C/12 ϵ o

3. Which of the following observations is correct for glittering intensity of electro sensitivesheet covering the dome?

a) Glittering intensity is zero when fan inside the dome is switched OFF
b) Glittering intensity is maximum when fan inside the dome is switched ON
c) Glittering intensity is always constant whether the fan inside is switched ON or OFF
d) Glittering intensity varies as outside fans are switched ON

4. Name the principle which explains the observation of glittering intensity of electro sensitive sheet.

a) Coulomb's law in electrostatics b) Gauss theorem in electrostatics
c) Superposition principle of charge d) None of the above

Five-mark questions

Q43. Two point charges of +1 μC and +4 μC are kept 30 cm apart. How far from the +1μC chargeon the line joining the two charges will the net electric field be zero?

Q44. (a) Define electric field intensity. Write its SI unit.

(b) Two point charges 4 μc & 1 μc are separated by a distance of 2m in air. Find the Point on the line joining the charges at which the net electric field of the system is zero.

Q45. Obtain the expression for electric field intensity due to a

(a) Point charge and

(b) due to system of charge Plot the graph for the variation for E and r.