CBSE 12th Physics
Chapter 1
Unsolved Important Questions

1 Mark Questions:

Q.1. Which orientation of an electric dipole in a uniform electric field would correspond stable equilibrium?

Q.2. Define electric dipole moment. Write its S.I. unit.

Q.3. A charge 'q' is placed at the center of a cube of side l. What is the electric flux passing through each face of the cube?

Q.4. 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 center at the origin?

Q.5. What is the force between two small charges of 2×10^{-7}C placed 30 cm apart in air?

Q.6. A plot of magnetic flux (ϕ) versus current (I) is shown in the figure for two inductors A and B. Which of the two has larger value of self-inductance?

Q.7. Figure shows three point charges, + 2q, – q and + 3q. Two charges + 2q and – q are enclosed within a surface 'S'. What is the electric flux due to this configuration through the surface 'S'?

Q.8. Why should electrostatic field be zero inside a conductor?

2 Marks Questions:

Q.9. Define electric flux. Write its S. I. unit. A charge q is enclosed by a spherical of radius R. if the radius is to half, how would the electric flux through the surface change?

Q.10. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge 'Q'. A Charge 'q' is placed at the center of the shell.

(a) What is the surface charge density on the (i) inner surface, (ii) outer surface of the shell?

(b) Write the expression for the electric field rice at a point x > r_2 from the center of the shell.

Q.11. Show that the electric at the surface of a charged conductor is given by $\vec{E} = \frac{\sigma}{\varepsilon_0}\hat{n}$, where is the charge density is a unit vector normal to the surface in the outward direction.

Q.12. A thin straight infinitely long conducting wire having charge density λ is enclosed by a cylindrical surface of radius r and length l, its axis coinciding with the length of the wire. Find the expression for the electric flux through the surface of the cylinder.

Q.13. Plot a graph showing the variation of coulomb force (F) versus $\left(\frac{1}{r^2}\right)$, where r is the distance between the two charges of each pair of changes:
$(1\ \mu C, 2\mu C)$ and $(2\mu C, -3\mu C)$, interpret the graphs obtained

Q.14. An electric dipole is held in a uniform electric field.
(i) Show that the net force acting it is zero.
(ii) The dipole is aligned to the field. Find the work done in rotating it through the angle of 180.

Q.15. Considering the case of a parallel plate capacitor being charged, show how one is required to generalize Ampere's circuital law to include the term due to displacement current.

Q.16. An infinite number of charges, each of coulomb, are placed along x-axis at x = 1m, 3m, 9m and so on. Calculate the electric field at the point x = 0 due to these charges if all the charges are of the same sign.

Q.17. A sphere S_1 of radius r_1 encloses a charge Q, if there is another concentric sphere S_2 of the radius r_2 $(r_2 > r_1)$ and there are no additional charges between S_1 and S_2. Find the ratio of electric flux through S_1 and S_2.

Q.18. Two small identical electrical dipoles AB and CD, each of dipole moment 'p' are kept at an angle of 120 ^{0} as shown in the figure. What is the resultant dipole moment of this combination? If this system is subjected to electric field $(\vec{E})$ directed along + X direction, what will be the magnitude and direction of the torque acting on this?

Q.19. A hollow cylindrical box of length 1m and area of cross-section $25cm^2$ is placed in a three-dimensional coordinate system as shown in the figure. The electric field in the region is given by $\vec{E} = 50\,x\,\hat{\imath}$, where E is in NC^{-1} and x is in metres. Find:

(i) Net flux through the cylinder.
(ii) Charge enclosed by the cylinder.

Q.20. Given a uniform electric field $\vec{E} = 5 \times 10^3\ \hat{\imath}$ N/C, find the flux of this field through a square of 10 cm on a side whose plane is parallel to the y - z plane. What would be the flux through the same square if the plane makes a 30° angle with the x-axis?

Q.21. An electric dipole of length 4cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of $4\sqrt{3}$ Nm. Calculate the potential energy of the dipole, if it has change ± 8nC.

3 Marks Questions:

Q.22. A positive point charge (+q) is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines originating from the point on to the surface of the plate. Derive the expression for the electric field at the surface of a charged conductor.

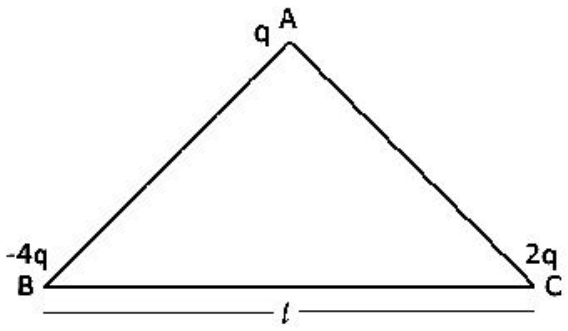
Q.23. State Gauss's theorem in electrostatics. Apply this theorem to derive an expression for electric field intensity at a point outside a uniformly charged thin spherical shell.

Q.24. A thin conducting spherical shell of radius R has charge Q spread uniformly over its surface. Using Gauss's law, derive an expression for an electric field at a point outside the shell. Draw a graph of electric field E(r) with distance r from the centre of the shell for $0 \leq r \leq \infty$.

Q.25. Using Gauss's law obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius R at a point outside the shell. Draw a graph showing the variation of electric field with r, for r > R and r < R.

Q.26. (i) Drive the expression for electric field at a point on the equatorial line of an electric dipole.
(ii) Depict the orientation of the dipole in (i) stable, (ii) unstable equilibrium in a uniform electric field.

Q.27. (a) Three point charges q, -4q and 2q are place at the vertices of an equilateral triangle ABC of side '*l*' as shown in the figure. Obtain the expression for the magnitude of the resultant electric force acting on the charge q.

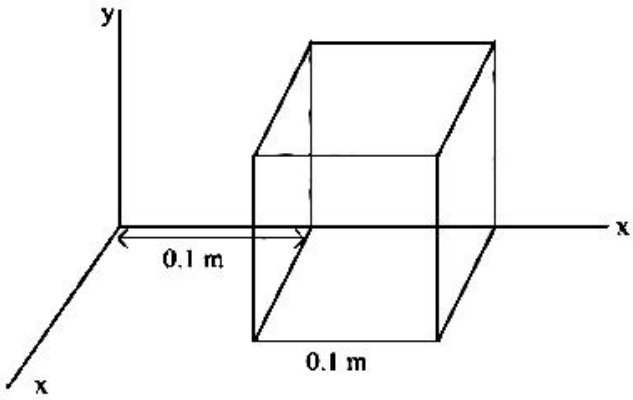


(b) Find out the amount of the work done to separate the charges at infinite distance.

5 Marks Questions:

Q.28. (a) Define electric flux. Write its SI units.

(b) The electric field components due to a charge inside the cube of side 0.1 m are as shown:



$$E_x = \alpha x, where\ \alpha = 500 \text{N/C-m}$$

$$E_y = 0, E_z = 0.$$

Calculate (i) the flux through the cube, and (ii) the charge inside the cube.

Q.29. (a) Define electric dipole moment. Is it a scalar or a vector? derive the expression for the electric field of a dipole at a point on the equatorial plane of the dipole.

(b) Draw the equipotential surfaces due to an electric dipole. Locate the points where the potential due to the dipole is zero.

Q.30. Using Gauss' law deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point (i) outside and (ii) inside the shell. Plot a graph showing variation of electric field as a function of r > R and r < R. (r being the distance from the center of the shell)

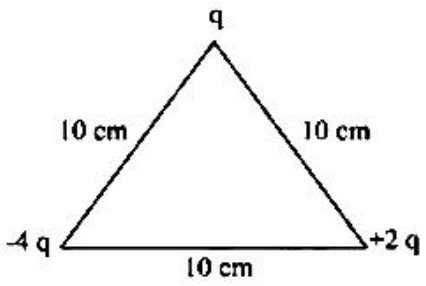
Q.31. (a) Derive an expression for the electric field E due to a dipole of length "2a' at a point distant r from the center of the dipole on the axial line.
(b) Draw a graph of E versus r for r >> a.
(c) If this dipole were kept in a uniform external electric field E_0, diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expressions for the torque acting on the dipole in both the cases.

Q.32. (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. (b) An infinitely large thin plane sheet has a uniform surface charge density +σ. Obtain the expression for the amount of work done in bringing a point charge q from infinity to a point, distance r, in front of the charged plane sheet.

Q.33. (a) Derive ab expression for the torque experienced by an electric dipole kept in a uniform electric field.

(b) Calculate the work done to dissociate the system of three charged placed on the vertices of a triangle as shown.

$$Here\ q = 1.6 \times 10^{-10} C$$



Q.34. (a) Define electric flux. Write its S.I. units.

(b) Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.

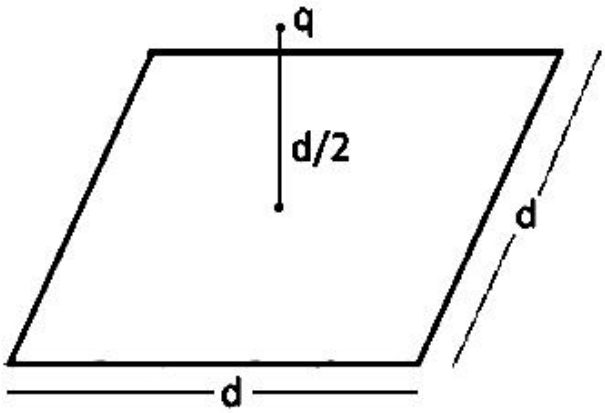
(c) How is the field directed if

(i) The sheet is positively charged,

(ii) negatively charged?

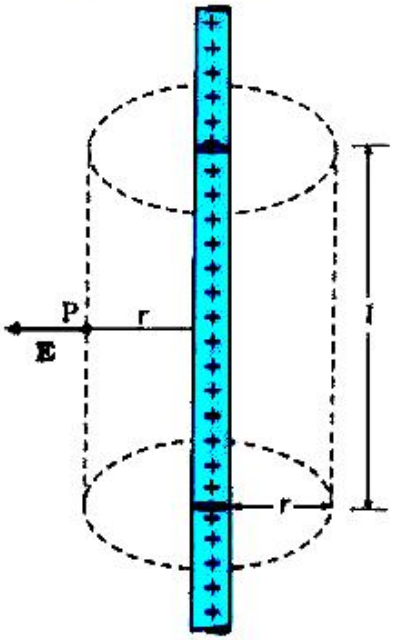
Q.35. (a) Define electric flux, Is it a scalar or a vector quantity?

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 now moved to a distance 'd' from the center of the square and the side of the square is doubled, explain how the electric flux will be affected.

Q.36. (a) Use Gauss' law to derive the expression for the electric field ($\vec{E}$) 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 $(r_2 > r_1)$