

# **ADHIKAANSH**

# **ACADEMY**

## **(IITJEE NEET IX X XI XII)**

**RUN BY:**

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# **PHYSICS NOTES**

## **(CLASS 12<sup>TH</sup>)**



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**CBSE Class-1 Physics Quick Revision Notes**  
**Chapter-01: Electric Charges and Fields**

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- **Like Charges and Unlike Charges:**

Like charges repel and unlike charges attract each other.

- **Conductors and Insulators:**

Conductors allow movement of electric charge through them, insulators do not.

- **Quantization of Electric Charge:**

It means that total charge ( $q$ ) of a body is always an integral multiple of a basic quantum of charge ( $e$ )

$$q = ne$$

where  $n = 0, \pm 1, \pm 2, \pm 3, \dots$

- **Additivity of Electric Charges:**

Total charge of a system is the algebraic sum of all individual charges in the system.

- **Conservation of Electric Charges:**

The total charge of an isolated system remains unchanged with time.

- **Superposition Principle:**

It is the properties of forces with which two charges attract or repel each other are not affected by the presence of a third (or more) additional charge(s).

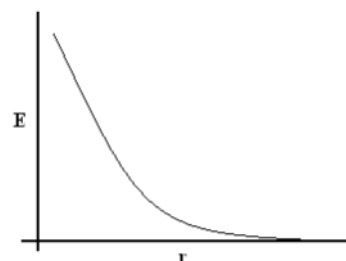
- **The Electric Field  $E$  at a Point due to a Charge Configuration:**

It is the force on a small positive test charges  $q$  placed at the point divided by a magnitude

$$\frac{|q|}{4\pi\epsilon_0 r^2}$$

It is radially outwards from  $q$ , if  $q$  is positive and radially inwards if  $q$  is negative.

$E$  at a point varies inversely as the square of its distance from  $Q$ , the plot of  $E$  versus  $r$  will look like the figure given below.



- **Coulomb's Law:**

The mutual electrostatic force between two point charges  $q_1$  and  $q_2$  is proportional to the product  $q_1q_2$  and inversely proportional to the square of the distance  $r_{21}$  separating them.

$$\vec{F}_{21}(\text{force on } q_2 \text{ due to } q_1) = \frac{k(q_1q_2)}{r_{21}^2} \hat{r}_{21}$$

Where  $\hat{r}_{21}$  is a unit vector in the direction from  $q_1$  to  $q_2$  and  $k = \frac{1}{4\pi\epsilon_0}$  is the

proportionality constant.

- **An Electric Field Line:**

It is a curve drawn in such a way that the tangent at each point on the curve gives the direction of electric field at that point.

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- **Important Properties of Field Lines:**

These are:

(i) Field lines are continuous curves without any breaks.

(ii) Two field lines cannot cross each other.

(iii) Electrostatic field lines start at positive charges and end at negative charges – they cannot form closed loops.

- **Electric Field at a Point due to Charge q:**

$$\vec{E} = \frac{\vec{F}}{q}$$

- **Electric Field due to an Electric Dipole in its Equatorial Plane at a Distance r from the Centre:**

$$E = \frac{-p}{4\pi\epsilon_0} \frac{1}{(a^2 + r^2)^{\frac{3}{2}}}$$
$$\cong \frac{-p}{4\pi\epsilon_0}, \text{ for } r \gg a$$

- **Electric Field due to an Electric Dipole on the Axis at a Distance r from the Centre:**

$$E = \frac{2pr}{4\pi\epsilon_0(r^2 - a^2)^2}$$
$$\cong \frac{2p}{4\pi\epsilon_0 r^3}, \text{ for } r \gg a$$

- **A Dipole Placed in Uniform Electric Field E experiences:**

Torque  $\vec{\tau}$ ,

$$\vec{\tau} = \vec{p} \times \vec{E}$$

- **The Electric Flux:**

$\phi = \int d\phi = \int \vec{E} \cdot d\vec{s}$  is a 'dot' product, hence it is scalar.

$\Delta\phi$  is positive for all values of  $\theta < \frac{\pi}{2}$

$\Delta\phi$  is negative for all values of  $\theta > \frac{\pi}{2}$

- **Gauss's Law:**

The flux of electric field through any closed surface S is  $1/\epsilon_0$  times the total charge enclosed by S.

$$\phi = \int \vec{E} \cdot d\vec{s} = \frac{q}{\epsilon_0}$$

- Electric field outside the charged shell is as though the total charge is concentrated at the centre. The same result is true for a solid sphere of uniform volume charge density.

- The electric field is zero at all points inside a charged shell.

- 
- **Electric field E, due to an infinitely long straight wire of uniform linear charge density  $\lambda$ :**

$$E = \frac{\lambda}{2\pi\epsilon_0 r} \cdot \hat{n}$$

where r is the perpendicular distance of the point from the wire and  $\hat{n}$  is the radial unit vector in the plane normal to the wire passing through the point.

- **Electric field E, due to an infinite thin plane sheet of uniform surface charge density  $\sigma$ :**

$$E = \frac{\sigma}{2\epsilon_0} \cdot \hat{n}$$

Where  $\hat{n}$  is a unit vector normal to the plane, outward on either side.

- **Electric field E, due to thin spherical shell of uniform surface charge density  $\sigma$ :**

$$E = \frac{q}{4\pi\epsilon_0 r^2} \cdot \hat{r} \quad (r \geq R)$$

$$E = 0 \quad (r < R)$$

where r is the distance of the point from the centre of the shell and R the radius of the shell, q is the total charge of the shell &  $q = 4\pi R^2 \sigma$ .

- Electric field E along the outward normal to the surface is zero and  $\sigma$  is the surface charge density. Charges in a conductor can reside only at its surface. Potential is constant within and on the surface of a conductor. In a cavity within a conductor (with no charges), the electric field is zero.

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