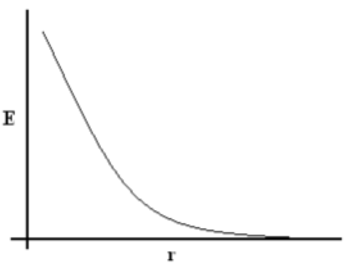
CBSE Class-1 Physics Quick Revision Notes
Chapter-01: Electric Charges and Fields

- **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, ±1, ±2, ±3, ….
- **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 uncharged 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
  $$\frac{|q|}{4\pi\varepsilon_0 r^2}$$
  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.
  $$\vec{F}_{21}(\textit{force}\ \text{on}\ q_2\ \text{due to}\ q_1) = \frac{k(q_1q_2)}{r_{21}^2}\hat{r}_{21}$$
  Where $\hat{r}_{21}$ is a unit vector in the direction from q_1 to q_2 and $k = \frac{1}{4\pi\varepsilon_0}$ 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.

- **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:**

$$E = \frac{-p}{4\pi\varepsilon_0}\frac{1}{(a^2+r^2)^{\frac{3}{2}}}$$

$$\cong \frac{-p}{4\pi\varepsilon_0}, \; for \text{ r>>a}$$

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

$$E = \frac{2pr}{4\pi\varepsilon_0(r^2-a^2)^2}$$

$$\cong \frac{2p}{4\pi\varepsilon_0 r^3}, \; for \text{ r>>a}$$

- **A Dipole Placed in Uniform Electric Field E experiences:**
  Torque $\vec{\tau}$,

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

- **The Electric Flux:**
  $\phi = \int d\phi = \int \vec{E}.d\vec{s}$ 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/ε0 times the total charge enclosed by S.

$$\phi = \int \vec{E}.d\vec{s} = \frac{q}{\varepsilon_0}$$

- 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 λ:**

  $$E = \frac{\lambda}{2\pi\varepsilon_0 r}.\hat{n}$$

  where r is the perpendicular distance of the point from the wire and 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 σ:**

  $$E = \frac{\sigma}{2\varepsilon_0}.\hat{n}$$

  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 σ:**

  $$E = \frac{q}{4\pi\varepsilon_0 r^2}.\hat{r} \quad (r \geq R)$$

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

  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 σ 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.