— By Dr. Bharat Singh.
H.O.D Physics

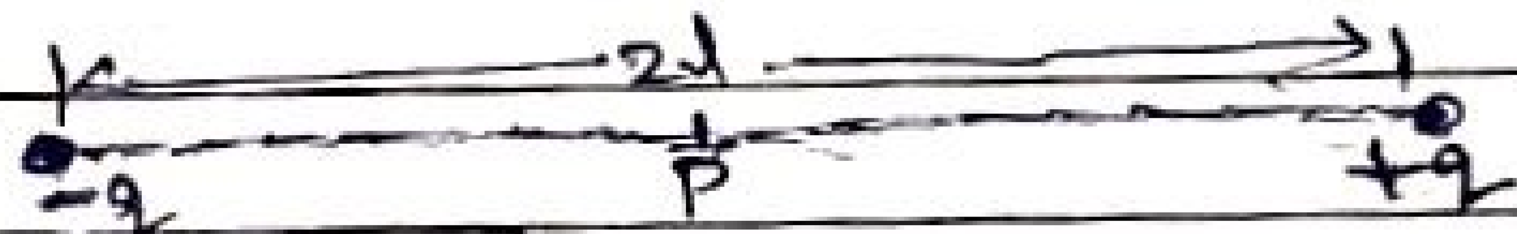
Applications of Gauss law & Electric dipole Moment

The applications of gauss law are described below!—

1. Derivation of coulomb's law using Gauss's law.
2. Electric field due to infinite line charge
3. Electric field intensity for an infinite sheet of charge.
4. the field of conductor (electric field at any point due to infinite charged conducting plate)
5. Electric field due to a solid charged sphere.

* Electric dipole Moment :—

An electric dipole is defined as two equal and opposite point charge seperated by a small distance. The product of one charge and the distance between the charges is called the magnitude of the electric dipole moment. $\vec{P}$.



Electric dipole moment $\boxed{\vec{p} = q \cdot 2\vec{l}}$

where, q = magnitude of each charge.

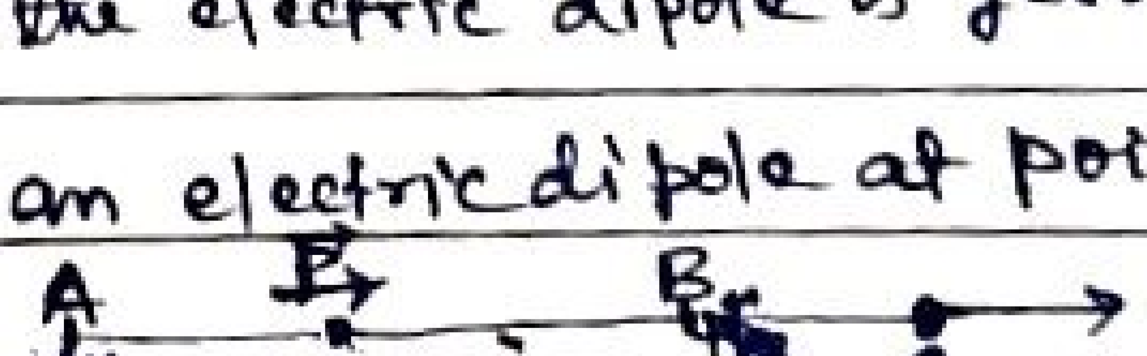
$2l$ = seperation between two charges

The S.I unit of electric dipole moment is the coulomb-meter (C.m). The electric dipole mount is the vector quantity and its directions is also from −ve to the +ve charge.

* Electric field due to a electric dipole :—

the electric field produced by an electric dipole is called a dipole field. the total charge of the electric dipole is zero but dipole field is not zero.

Case (I) Electric field due to an electric dipole at points on the axial line.



consider an electric dipole placed on x-axis. A point C is located at a distance of r from the mid point O of the dipole along the axial line. At point C the electric field due to +q is given as.

$$\vec{E}_+ = \frac{1}{4\pi\epsilon_0} \frac{q}{(r-a)^2} \hat{p} \quad \text{--- (1)}$$

At point C, the electric field due to −q is given as.

$$\vec{E}_- = -\frac{1}{4\pi\epsilon_0} \frac{q}{(r+a)^2} \hat{p} \quad \text{--- (2)}$$

$\hat{p}$ is used to denote the electric dipole moment unit vector from −q to +q at point C, Hence, Total electric field $\vec{E} = \frac{1}{4\pi\epsilon_0} q \left(\frac{4ra}{(r^2-a^2)^2}\right) \hat{p}$