MIC-4 : 1 Electric field Electrostatics

Introduction:

When a unit +ve charge is kept near a charge the force felt by the charge is called Electric field. It is a vector quantity and it represented by E. Consider that an electric charge q is placed in space. If another charge q_0 comes near the charge q, then the charge q_0 experiences a force of attraction or repulsion. The force experienced by q_0 is responsible for the electric field which is created by the charge q.

If a charge q_0 (test charge) is placed in the space surrounding the charge q (source charge) then test charge experiences a force. The source charge (q) can be a point-charge, a group of point charges, or a continuous distribution of charges. In addition, the test charge must be Varishingly small so that it does not adjust the electric field of the source charge.

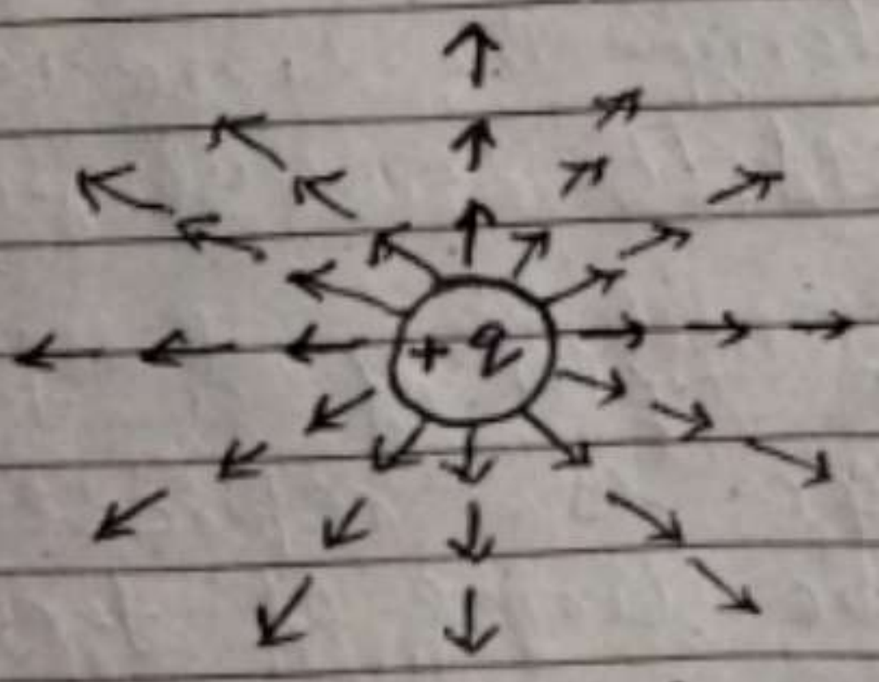


Fig. Electric field around charge q

The electric field will be directed radially outward for +ve charge and radially inward for -ve charge.

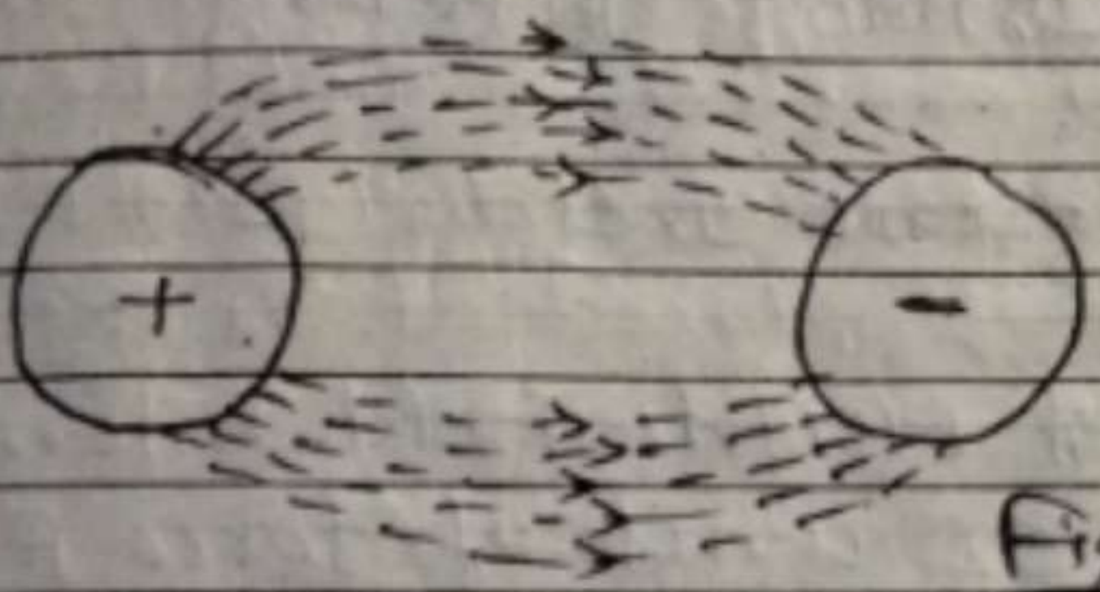
Electric Lines of Force

Electric field lines are path used to visualise Electric fields. Electric field lines can be Curved lines or Straight lines. The tangent gives the direction of the electric field intensity at that point. An electric line of force is an imaginary line. These lines always travel from +ve charge to -ve charge as shown in figure:.

This line is continuous line or Curve which is drawn in the tangent to it at any point gives the direction of the lines of electric force at that point. The direction in which a small free +ve charge will move along the line will be the direction of the line of force.

In Space, the field of a +ve electric charge is represented by the electric lines of force which

consist of a family of straight lines that radiate uniformly in all direction from where the charge originates. When second +ve charge is placed in this region Then this charge will travel radially far from the 1st charge



Figure

Properties of Electric lines of Force :-

1.) Every electric line of force is Conceptually assumed to have no Physical existence.

2.) Total number of lines of force emerges from a charge body is equivalent to the charge of the body which is measured in Coulomb.

3.) All electric line of force is outwards from Positive charge and inward to the -ve charge.

4.) The direction of electric field at any point in the field indicated by a tangent drawn at any point on an electric line of force.

5) Each electric line of force originates normally from the surface of the charged body.

6.) They can only contract longitudinally.

7.) They can enlarge laterally.

Unit of Electric field ($\vec{E}$)

1.) SI Unit of Electric Field Intensity:
Newton is the SI unit of force F and Coulomb is the SI unit of charge q_0.
Therefore, from equation ① $\vec{E} = \frac{\vec{F}}{q_0}$
for $\vec{E}$ its SI unit is Newton Per Coulomb, i.e. N/C or NC^{-1}.

2.) Dimensional Formula for Electric field Strength:-

Formula $E = \frac{F}{q_0}$ —— ①

⇒ Dimensional formula for

$E = \frac{\text{Dimensional formula } F}{\text{Dimensional formula } q_0}$

$= \frac{[MLT^{-2}]}{[AT]} = [MLT^{-3}A^{-1}]$