Electric field:

It is defined as the region upto which a charge can attract or repel any other ~~object~~ charge.

Electric field intensity:

Electric field intensity at any point in an electric field is defined as the electrostatic force per unit test charge acting on a negligibly small positive test charge placed at that point. Hence

$$\vec{E} = \lim_{q_0 \to 0} \frac{\vec{F}}{q_0}$$

The electric field $\vec{E}$ is a vector quantity and its direction is same that of the force $\vec{F}$ exerted on a positive test charge.

Its SI unit is $= N/C$

$q = It$

and dimension is $[E] = \frac{[F]}{[q]}$

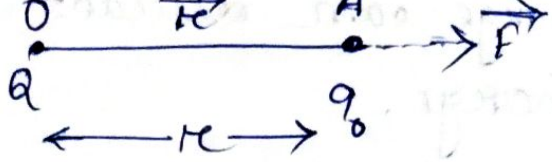
$$= \frac{[MLT^{-2}]}{[AT]}$$

$$= [MLT^{-3}A^{-1}]$$

As $\vec{E}$ varies from point to point, so in general $\vec{E}$ is not a ~~vector~~ single vector but a set of infinite vectors $\vec{E}(r)$. Thus the electric field is an exaple of vector field.

* Electric field due to a point charge :

Let us consider a source charge Q at ~~poin~~ the origine and a test charg q_0 is placed at point A as shown in the fig. and we have to find the electric field at point A,



According to Coulomb's law force on the test charge is-

$$\vec{F} = \frac{KQq_0}{r^2}\hat{r}$$

where- $\hat{r}$ is a unit vectror from Q to q_0

$\therefore$ Electric field at point A-

$$\vec{E} = \frac{\vec{F}}{q_0}$$

$$= \frac{1}{q_0}\left(\frac{KQq_0}{r^2}\right)\hat{r}$$

$$\vec{E} = \frac{KQ}{r^2}\hat{r}$$

and $|\vec{E}| = \frac{KQ}{r^2}$ ← magnitude of the electric field.

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* Electric field due to a system of point charges :
(Principle of superposition of electric field)

According to this principle the $\vec{E}$ at any point due to a group of charges is equal to the vector sum of the electric field produced by each charge individually at that point.

Hence, the electric field at a point due to the system of N charges is -

$$\vec{E} = \vec{E_1} + \vec{E_2} + \vec{E_3} + \cdots + \vec{E_N}$$

Q^n. 5: