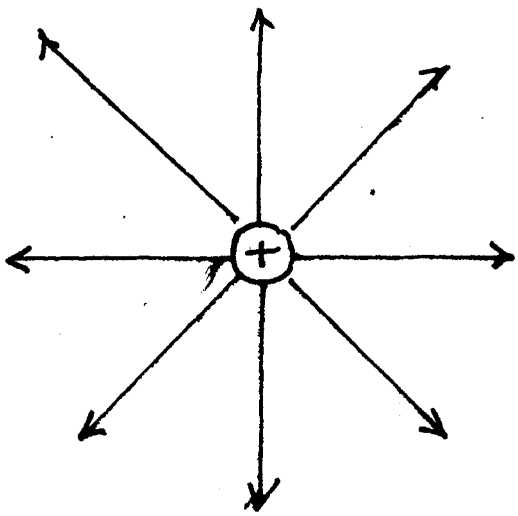
FIELD

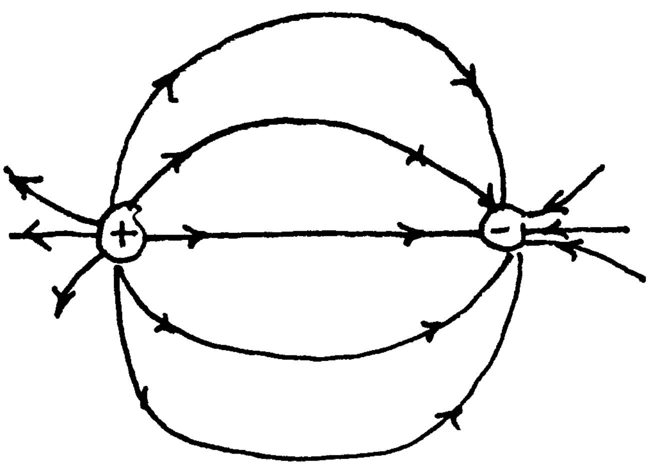
LINES OF FORCE

Again Faraday's invention to provide visual description of field - imaginary lines drawn in such a way ~~as to~~ that the direction at any point is the same as the direction of the $\vec{E}$ field at that point

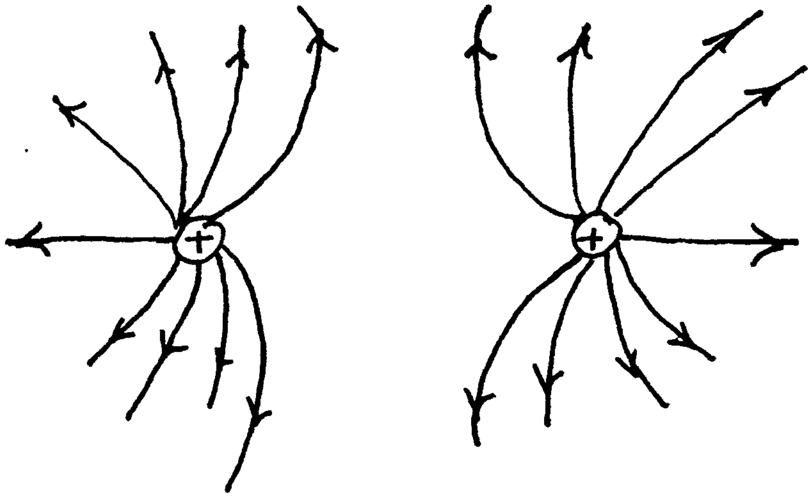


① Originate (point outward) from ⊕ charge

Also indicate magnitude of field. Notice how spacing increases between lines as $r \to$ $E \propto \frac{1}{r^2}$



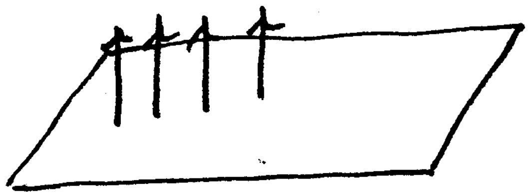
② Terminate (point toward) on ⊖ charge



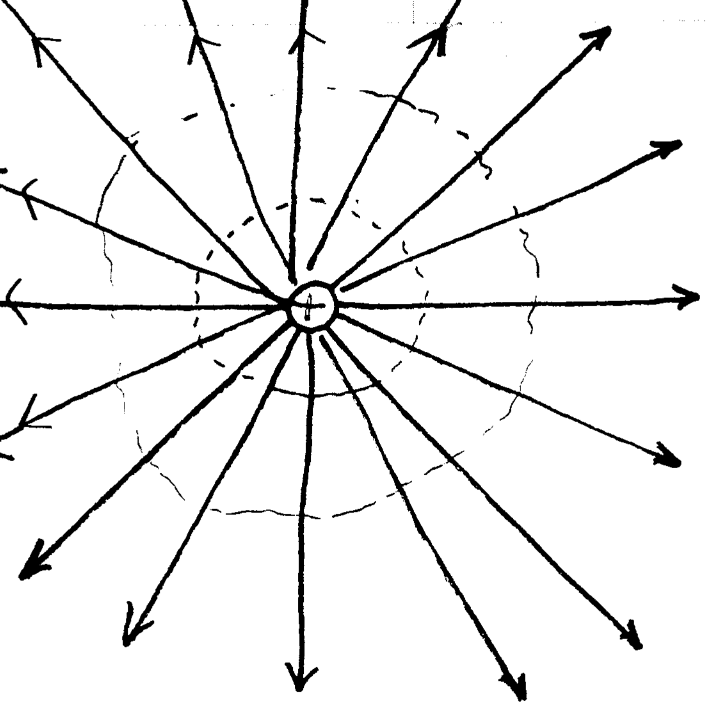
③ Never intersect
(only 1 can pass through each point of field

④ Magnitude of field given by number of lines per unit area crossing surface $\perp$ to field lines $\propto$ electric intensity

Uniform field



Linear straight
parallel
uniformly spaced.



GAUSS'S LAW

ELECTRIC FLUX

Suppose we take a point charge $+q$ and look at the Electric Field lines emanating from it. We draw an imaginary sphere centered on this charge with radius $R \Rightarrow$ $A = 4\pi R^2$. If there are N lines of force then the number of lines passing through a surface element of unit surface area is $\underline{N/4\pi R^2}$. A sphere of radius $2R$ has $A = 4\pi(2R)^2 = 16\pi R^2$ thus the number of lines passing through the sphere per unit surface area is is $\underline{N/16\pi R^2}$ — The total number $\underline{N}$ of lines of force stays the same but at any radius R the field strength depends upon the distance from the charge. The number of field lines passing through a unit surface area is a measure of the <u>electric field intensity</u>. The fact that the number of lines passing through a surface element at R = 2R is 1/4 the number passing through an element at R = R is a statement that at R = 2R the field is $\frac{1}{4}$ as strong as the field at R = R. Still there are a total of N lines of force

at any r $\qquad E = \frac{kq}{r^2}$ $\qquad$ fieldstrength depends on distance

and $\qquad A = 4\pi r^2$

But the <u>product</u> is constant

$$EA = 4\pi \cancel{r^2} \frac{kq}{\cancel{r^2}}$$

Flux velocity $\vec{v}$

flux = v a $\qquad$ flux = 0 $\qquad$ flux = v a cos θ