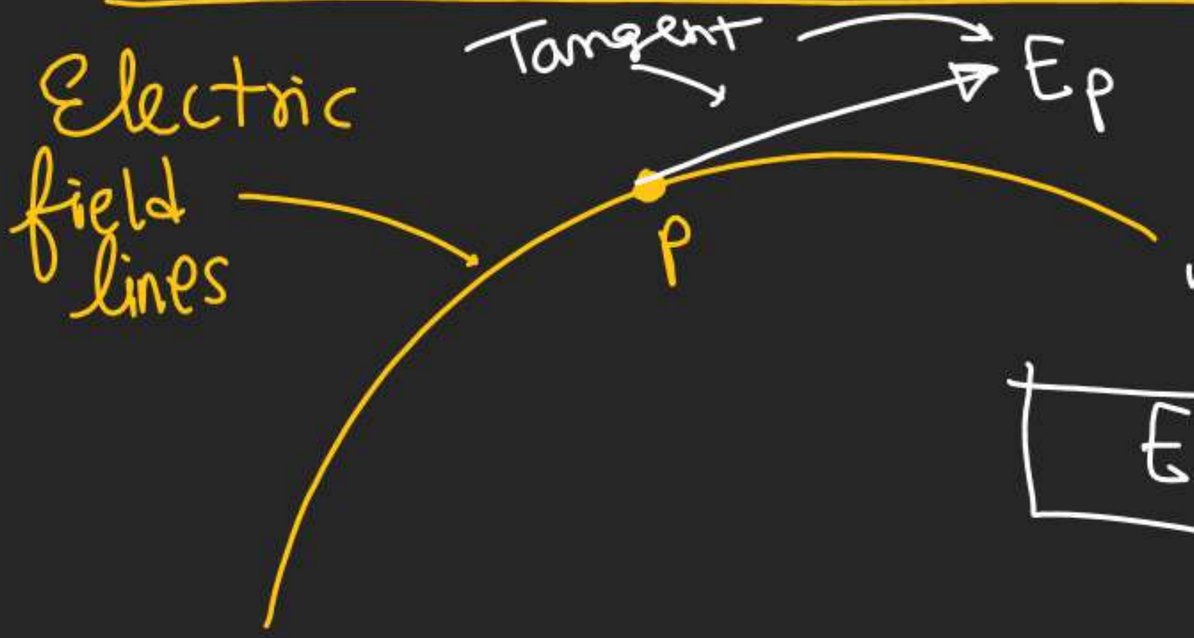
ELECTRIC FIELD LINE

Electric field strength / Intensity of E
↳ value of electric field.

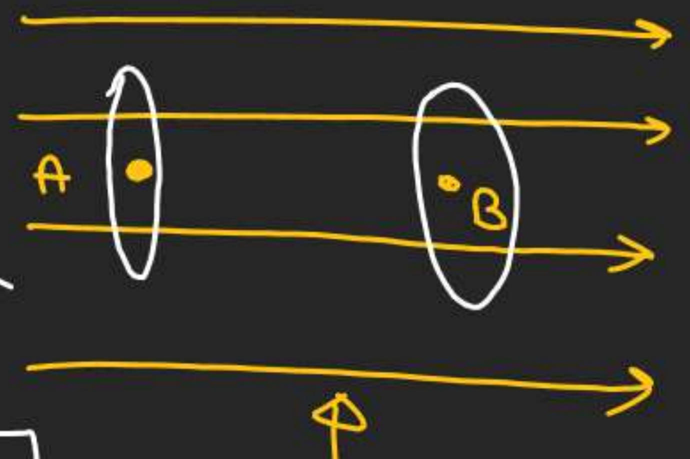
Electric lines force

The idea of lines of force was introduced by Michael Faraday.

A line of force is an imaginary curve, a tangent to which at a point gives the direction of the net electric field intensity at that point and the number of lines of force per unit area normal to the surface surrounding that point gives the magnitude of intensity at that point.



$$\boxed{E_A = E_B}$$



Field lines
↳ For uniform electric field

$E_A > E_B$

Field lines
↳ Non-uniform Electric field.

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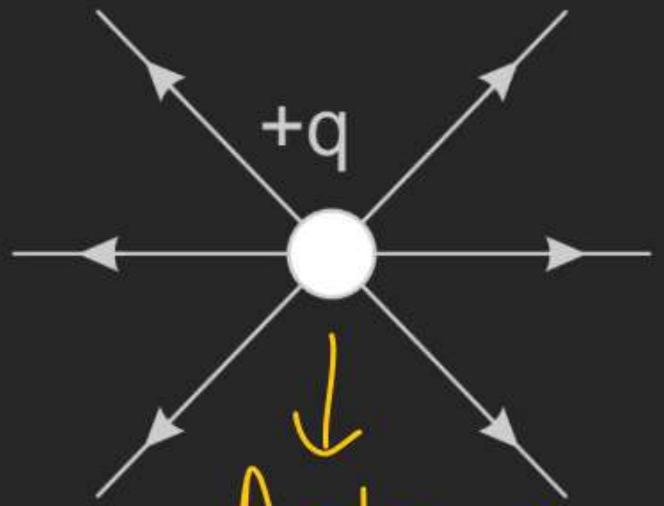
ELECTRIC FIELD LINE

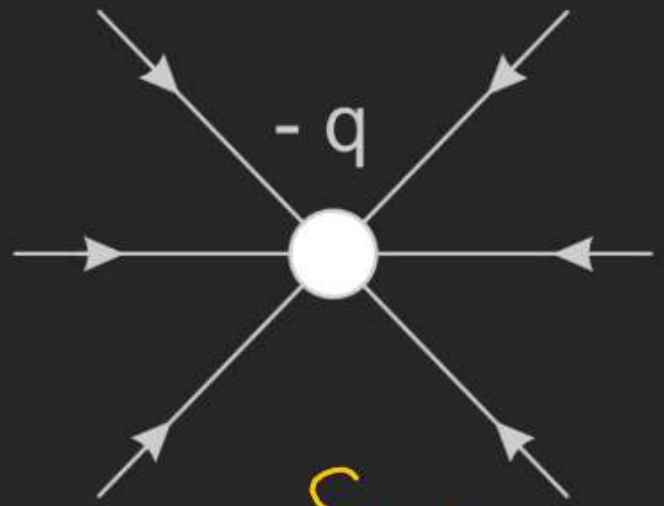
Properties

They originate from a positive charge and terminate to a negative charge.

Number of lines originating or terminating on a charge is proportional to the magnitude of the charge. [illegible] electric lines are associated with a body which encloses a charge ' q '.



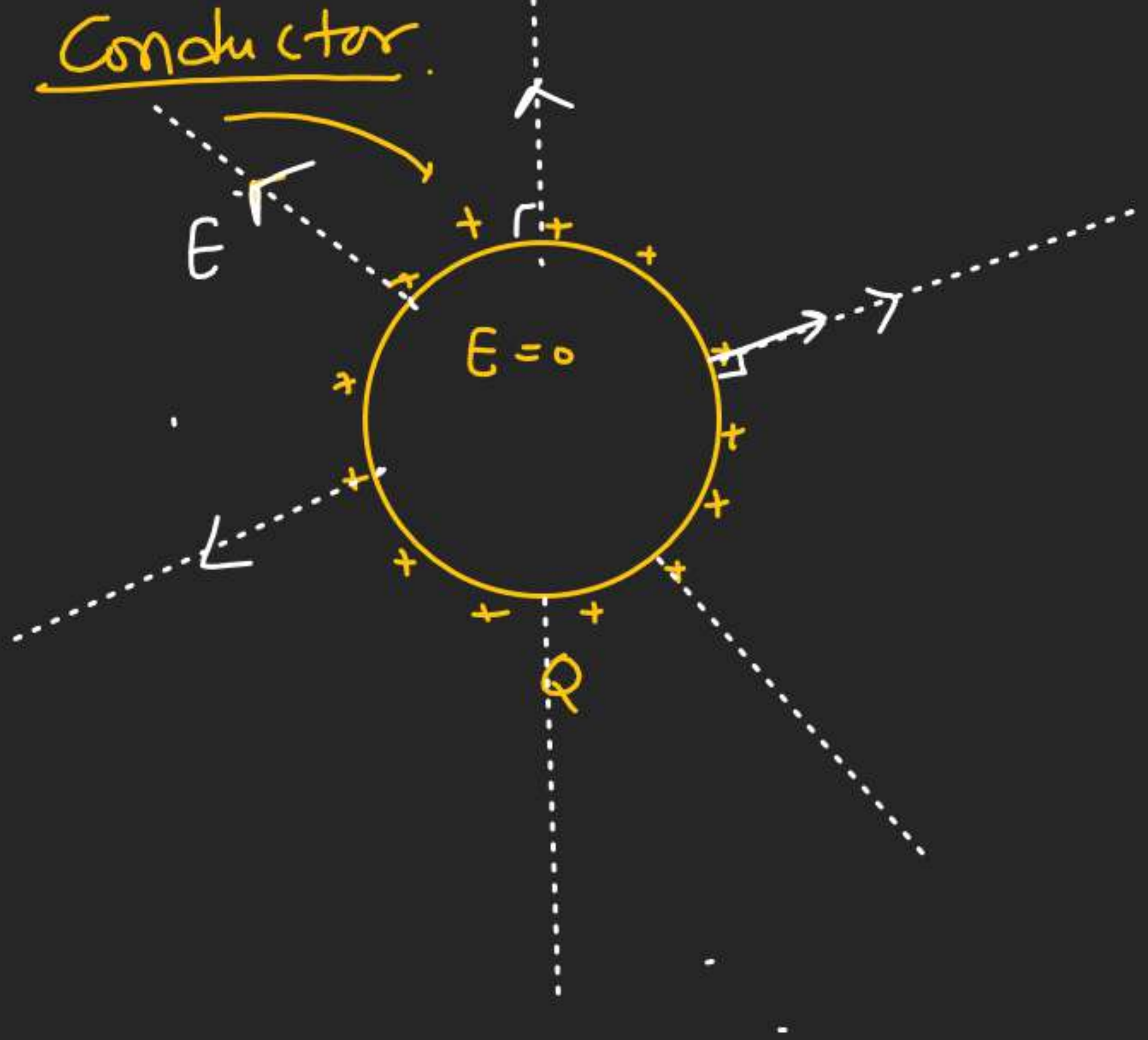
Acts as a Source

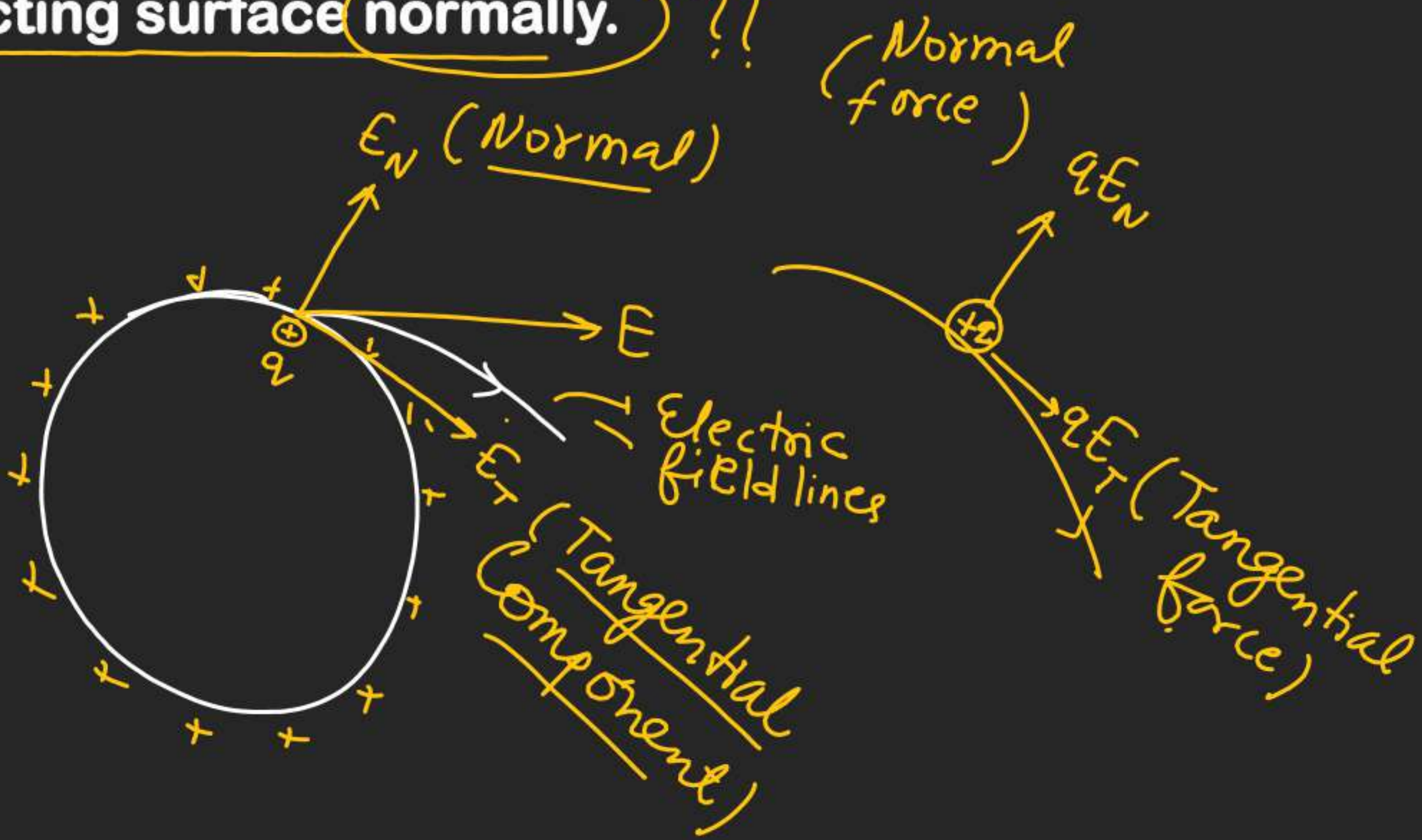


Sink

ELECTRIC FIELD LINE

Lines of force exist only where there is an electric field, since field inside a conductor or at a neutral point is zero, hence there can not be any lines of force. Lines of force enter or leave a conducting surface normally. ??





⇒ "If field lines are not normal to the conductor then the tangential component of electric field produces tangential force due to which charges on the surface of the conductor starts moving which doesn't happen actually means no tangential force or no tangential electric field."

ELECTRIC FIELD LINE

A conductor in electrostatic equilibrium has the following properties-

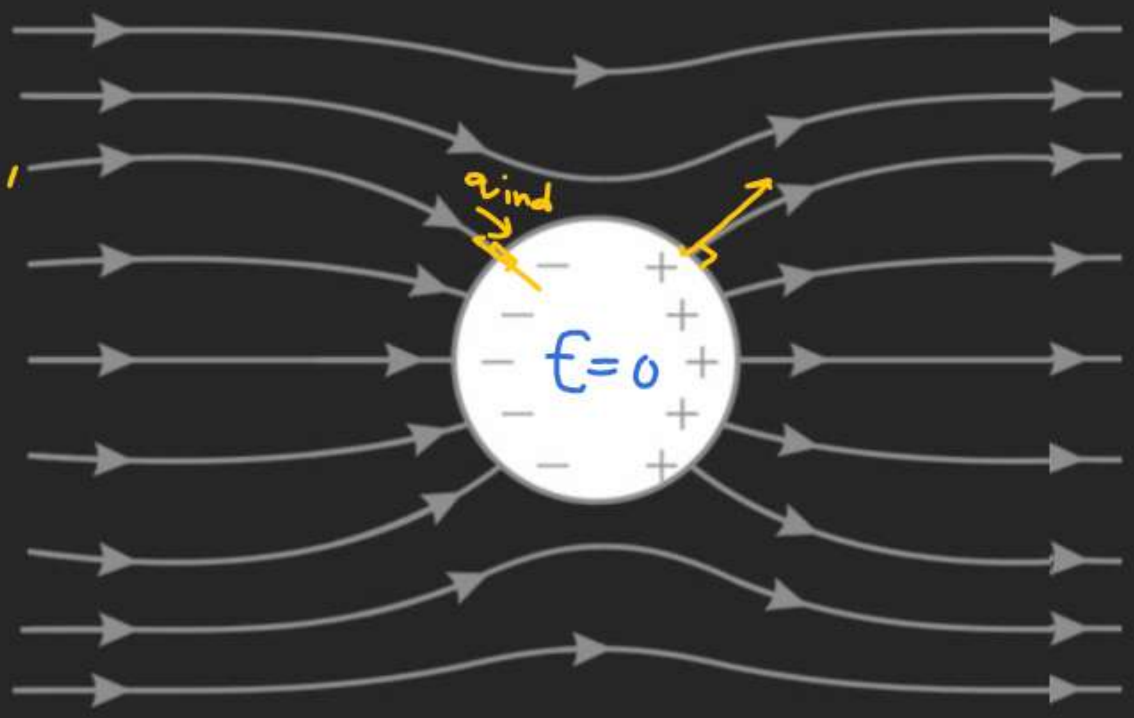
(i) The electric field intensity is zero inside a conductor.

(ii) Just outside a conductor, the electric field lines are perpendicular to its surface sinking or originating depending on the nature of charge on the surface.

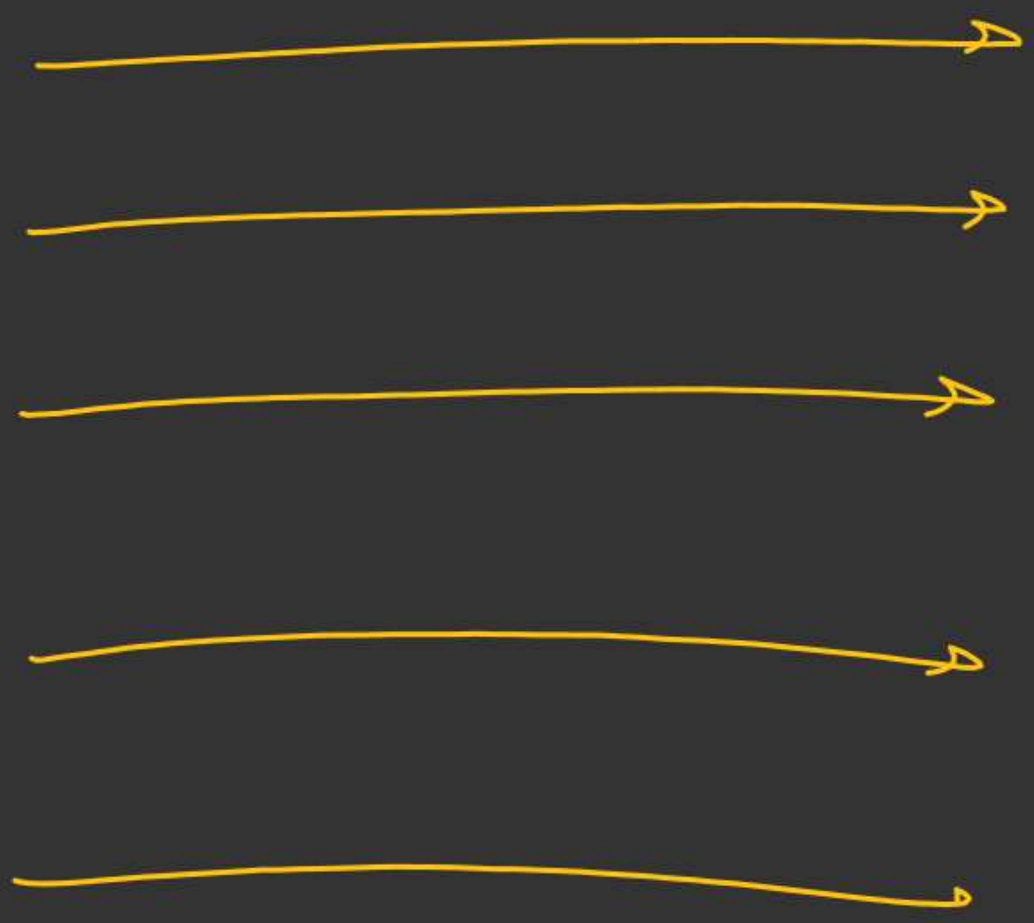
(iii) An excess charge always resides only on the outer surface of an isolated conductor.

ELECTRIC FIELD LINE

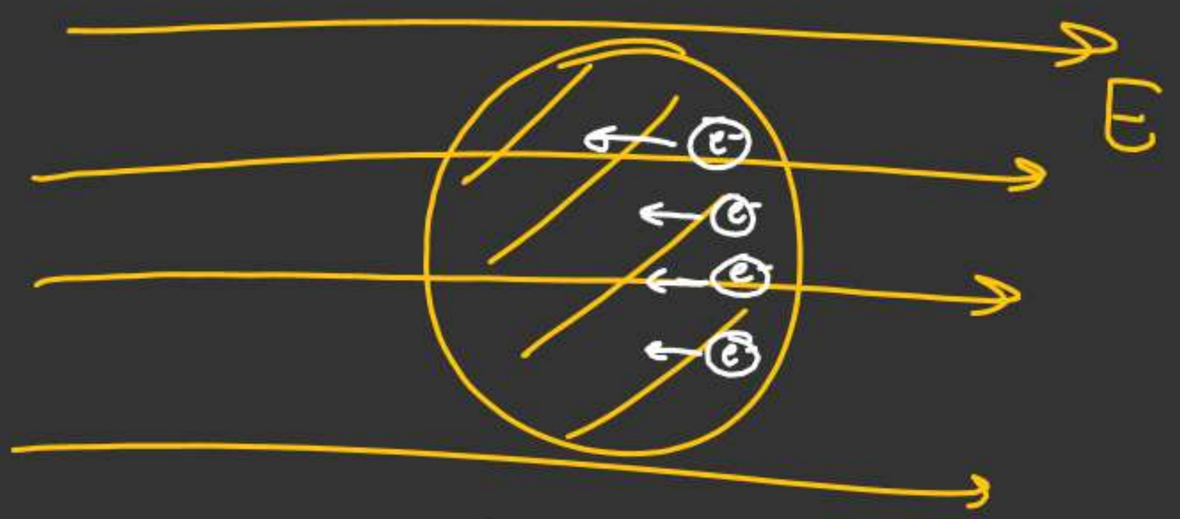
Neutral conductor immersed in an applied electric field. The external field polarizes the conductor making one side positive and the other negative, which creates a self field that cancels the applied field and causes a zero internal electric field.

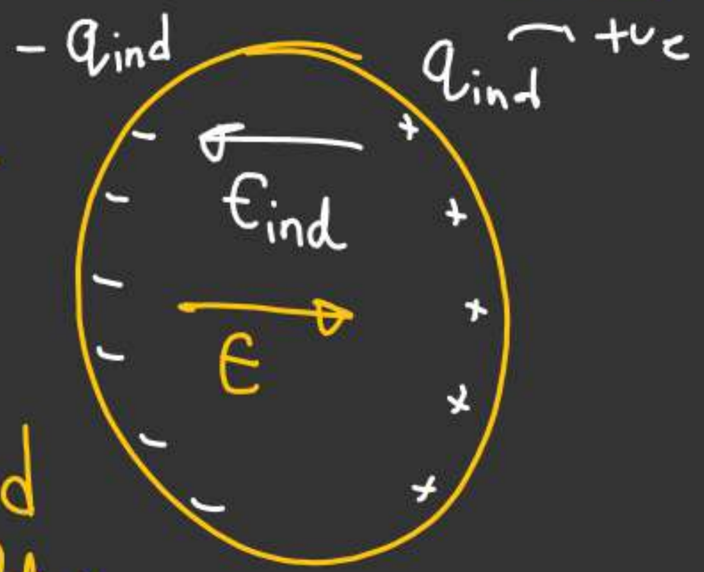


Electric field



(Spherical) Neutral conductor





In Conductor

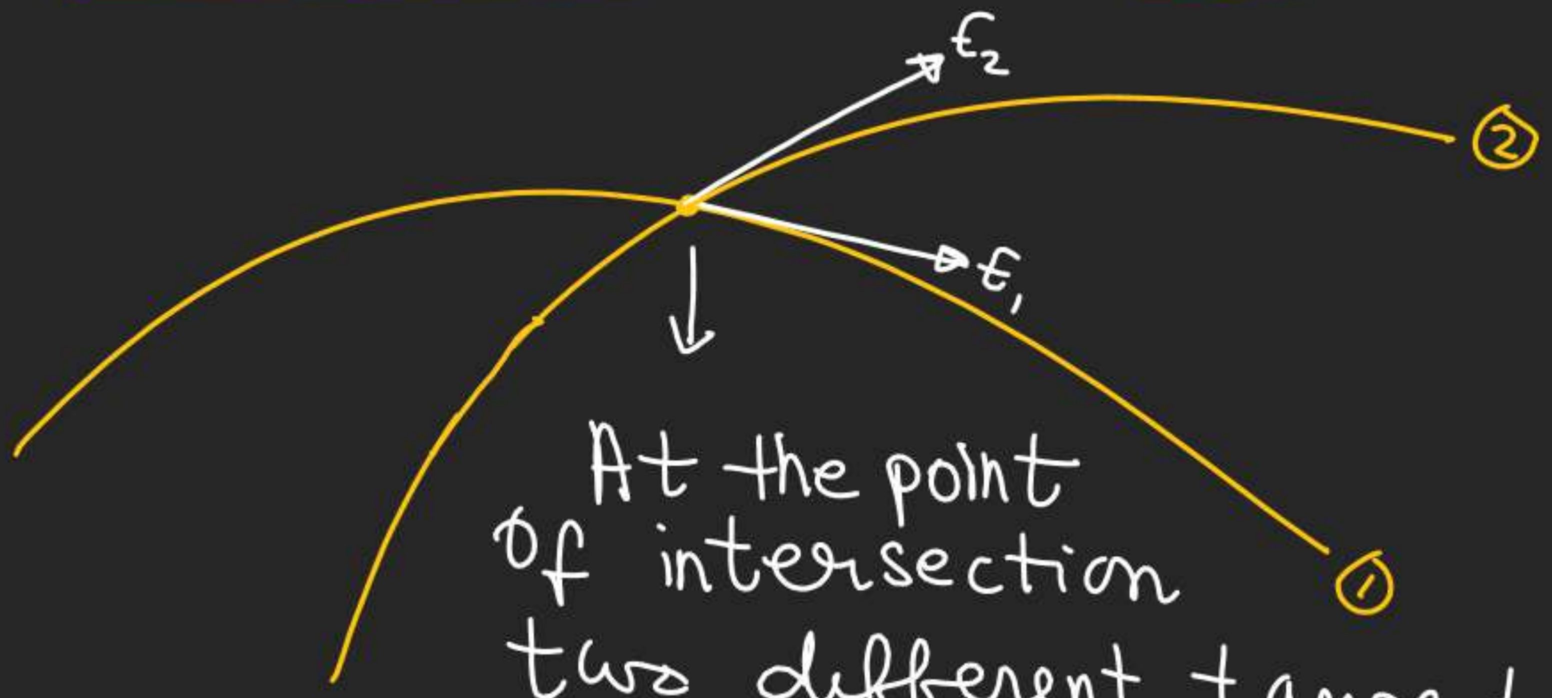
$\boxed{E_{ind} = E}$

↳ Net field Inside the Conductor zero

ELECTRIC FIELD LINE

Lines of force never cross each other.

They never cross because if they do so, then at the point of intersection the net intensity will have two different directions which is not possible.



At the point of intersection two different tangent i.e two different direction of electric field at a point which is not possible.

ELECTRIC FIELD LINE

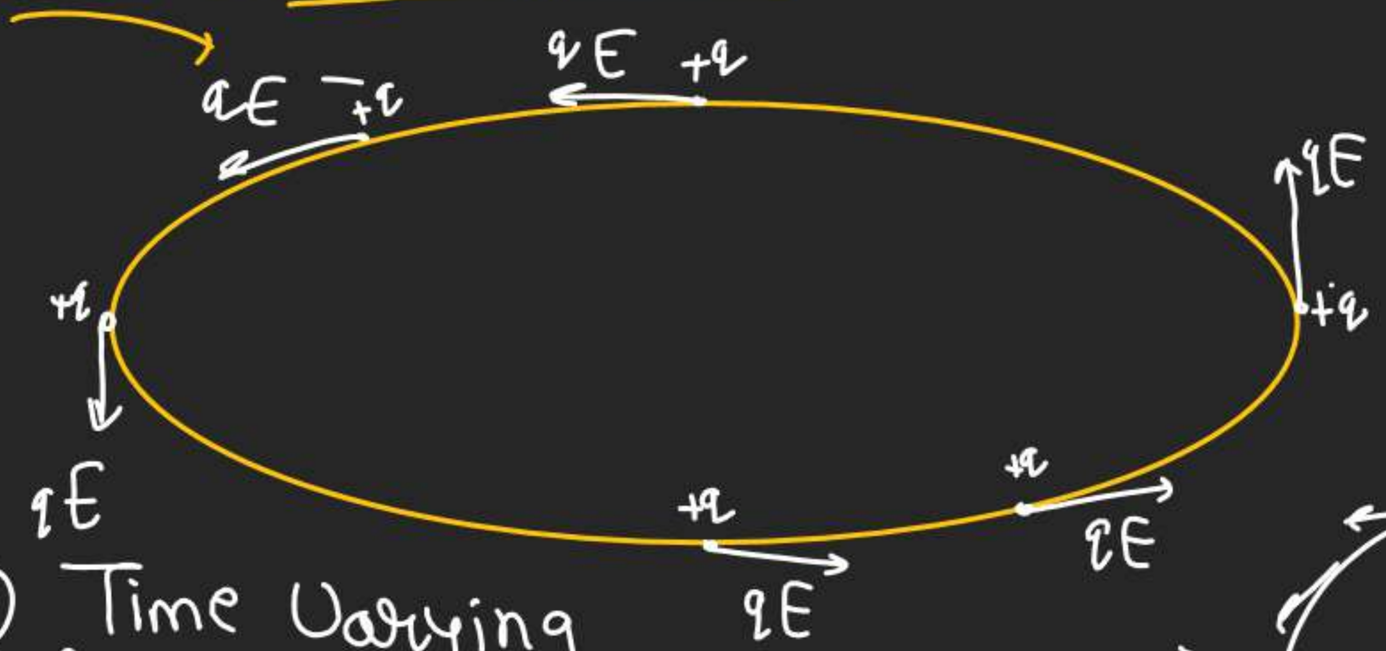
$W = F\,ds\cos\theta$

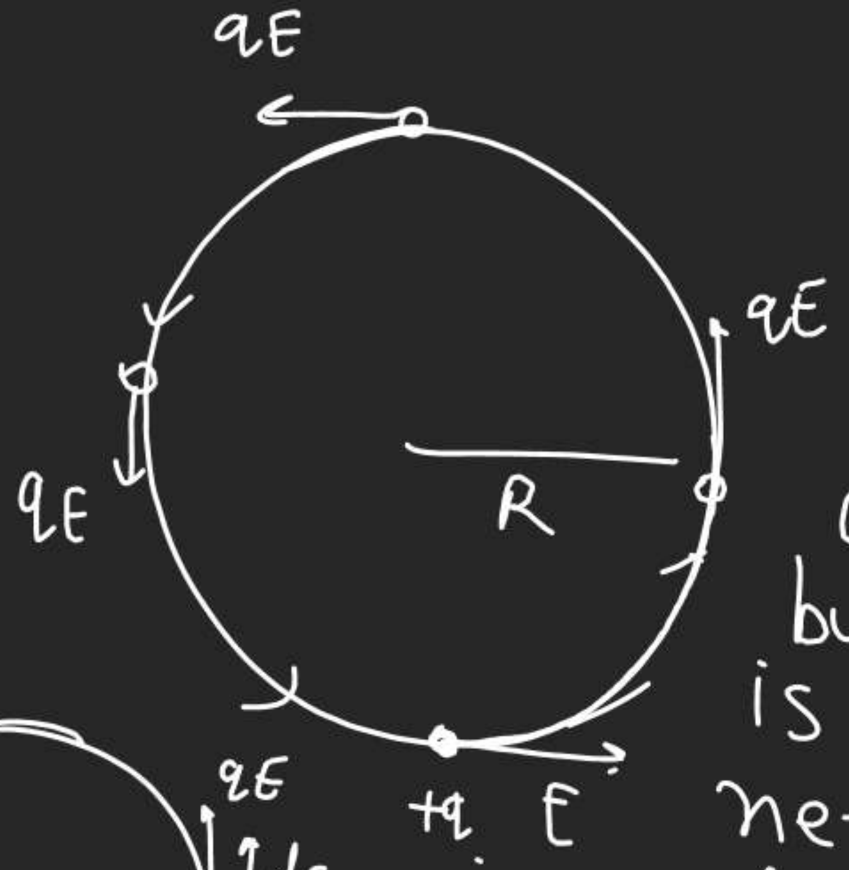
$F \parallel ds \quad \theta = 0$

They never form a closed loop when produced by a $\boxed{\text{static charge.}}$

If they do so, then the work done round a closed path will not be zero which contradicts conservative nature.

Electric field lines



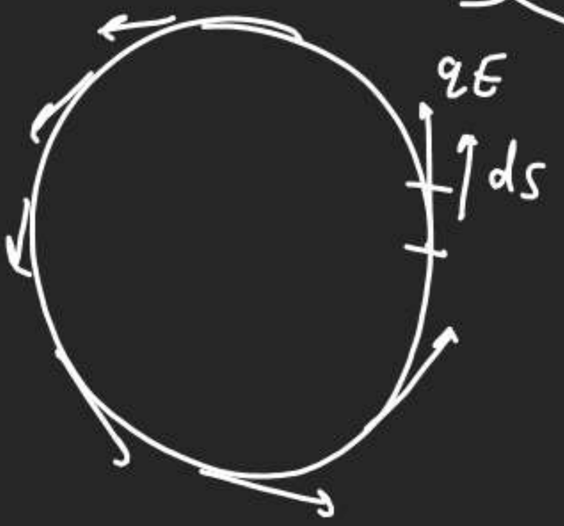


Work done by Electric field force

$= [qE\,2\pi R]$

which is not zero but Electric field is conservative so net work in a close loop should zero

[(*) Time Varying Magnetic field produces induced Electric field which is always Circular]



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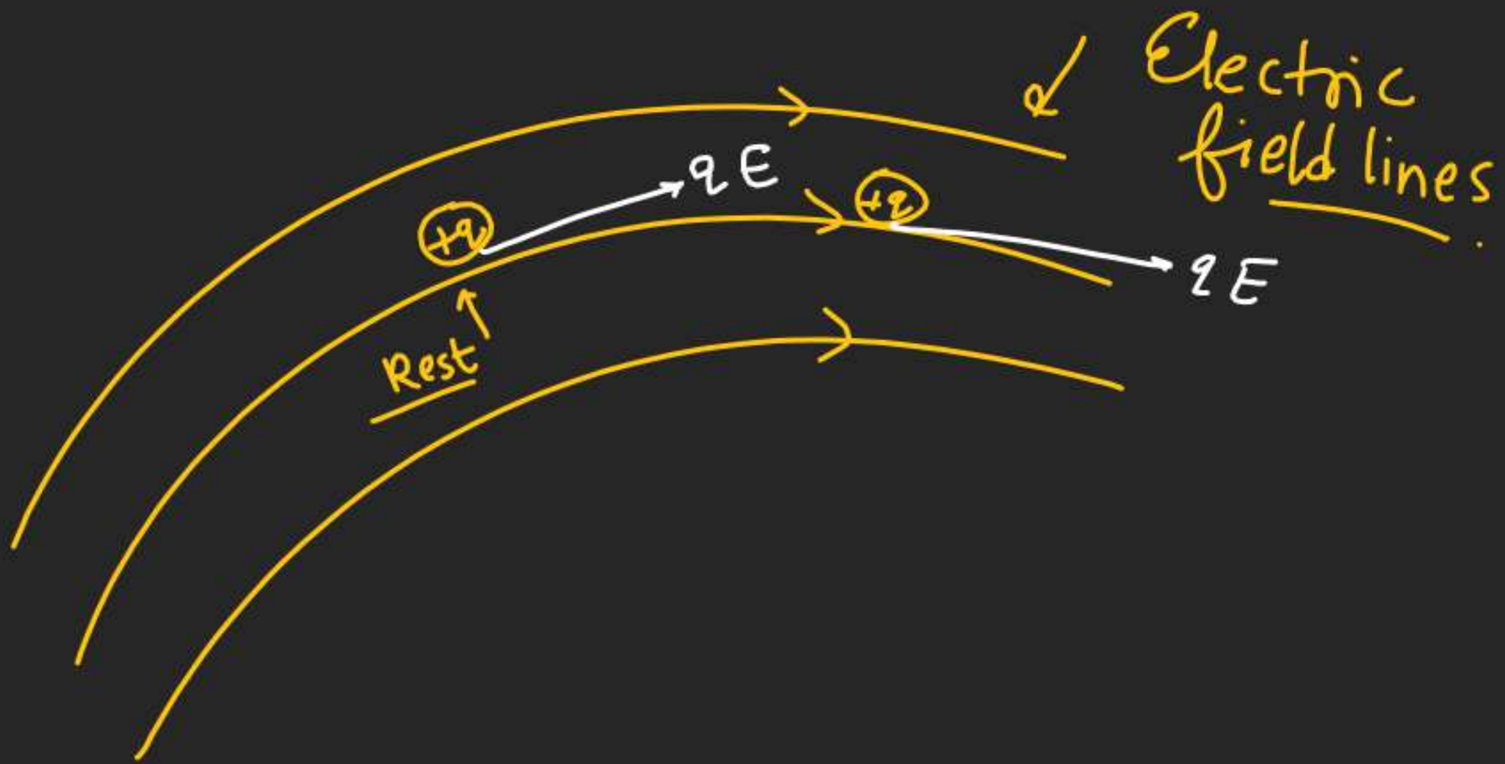
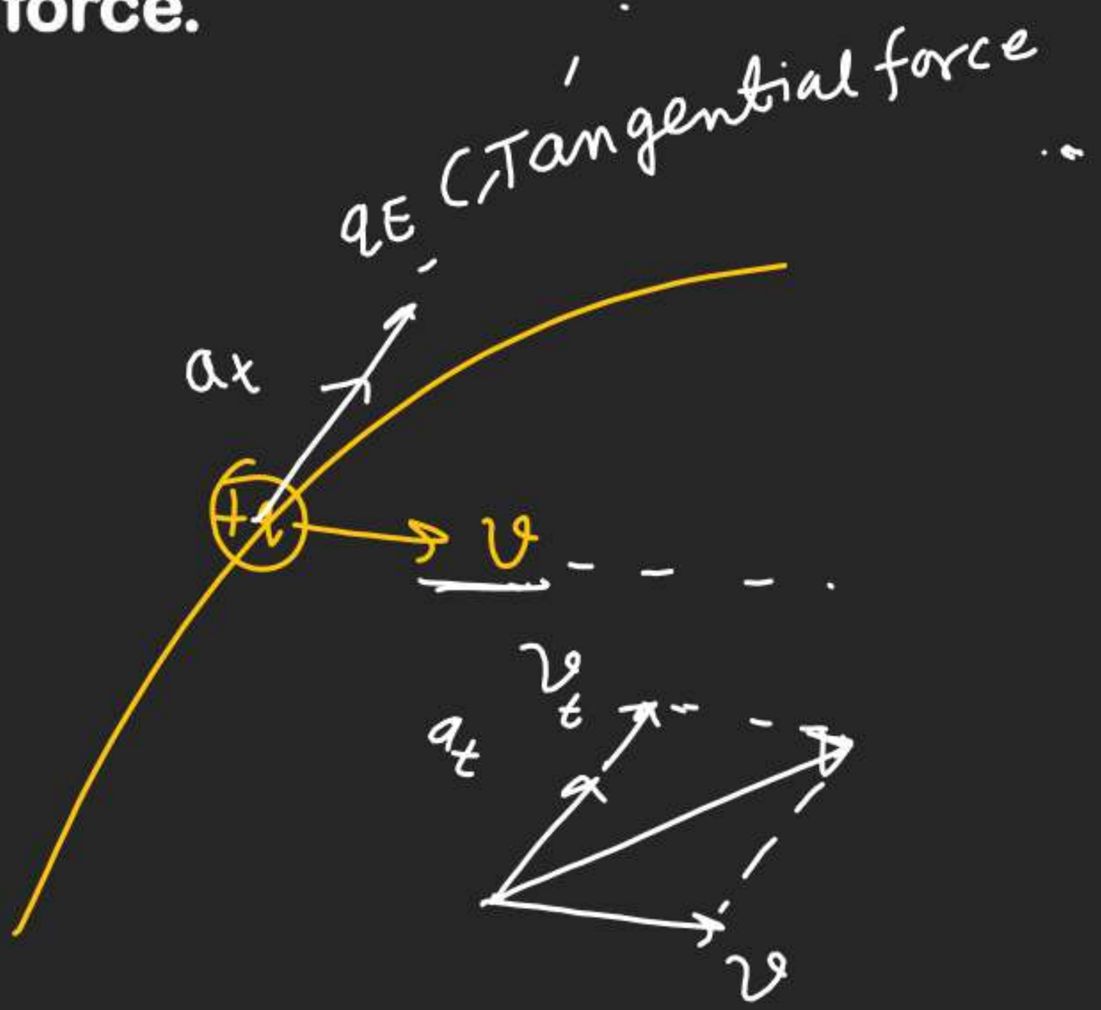
ELECTRIC FIELD LINE

If a positive point charge at rest is free to move under the influence of electric force only, then it may or may not follow the line of force.





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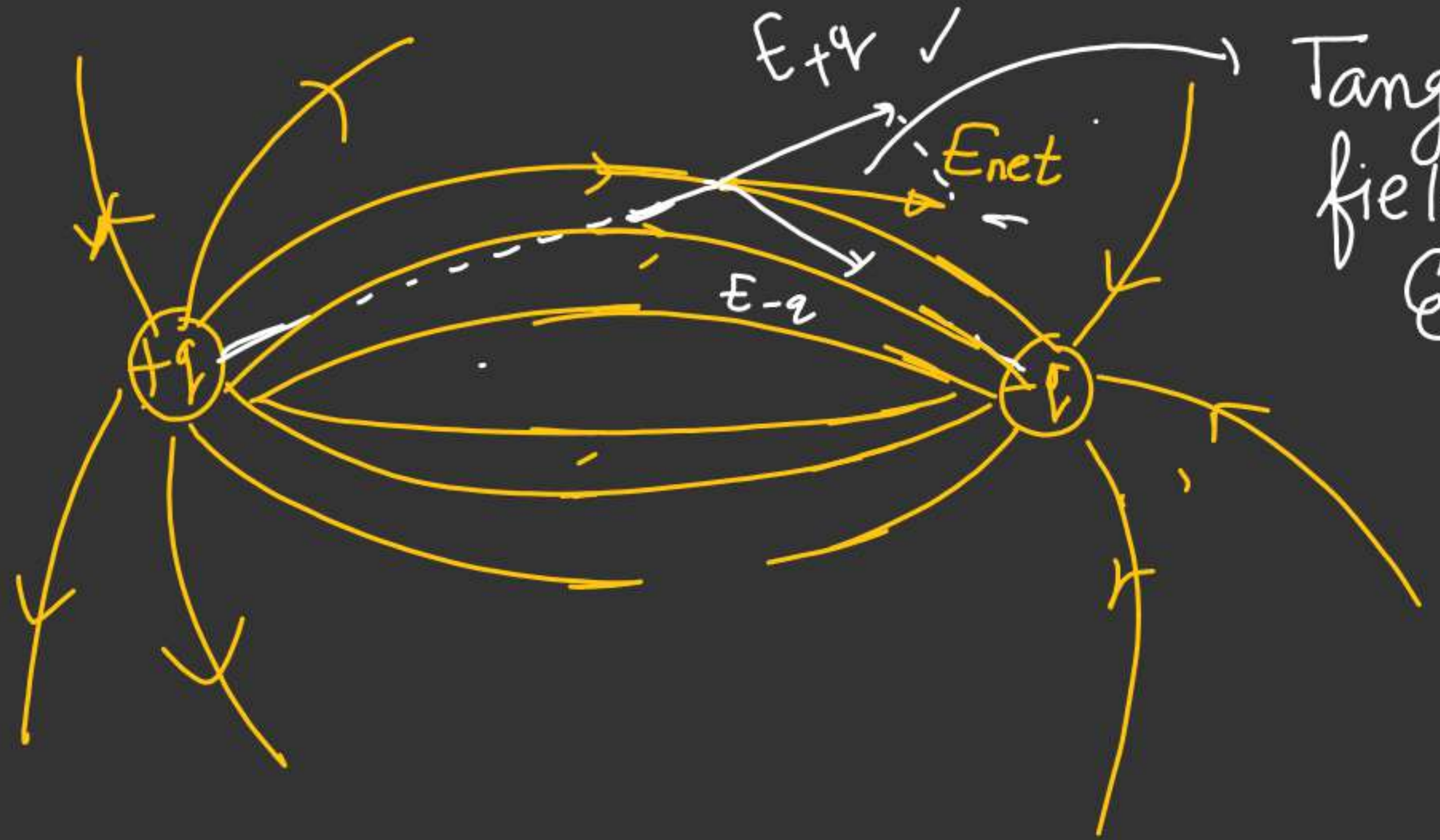

Tangent at Electric field lines given net Electric field.

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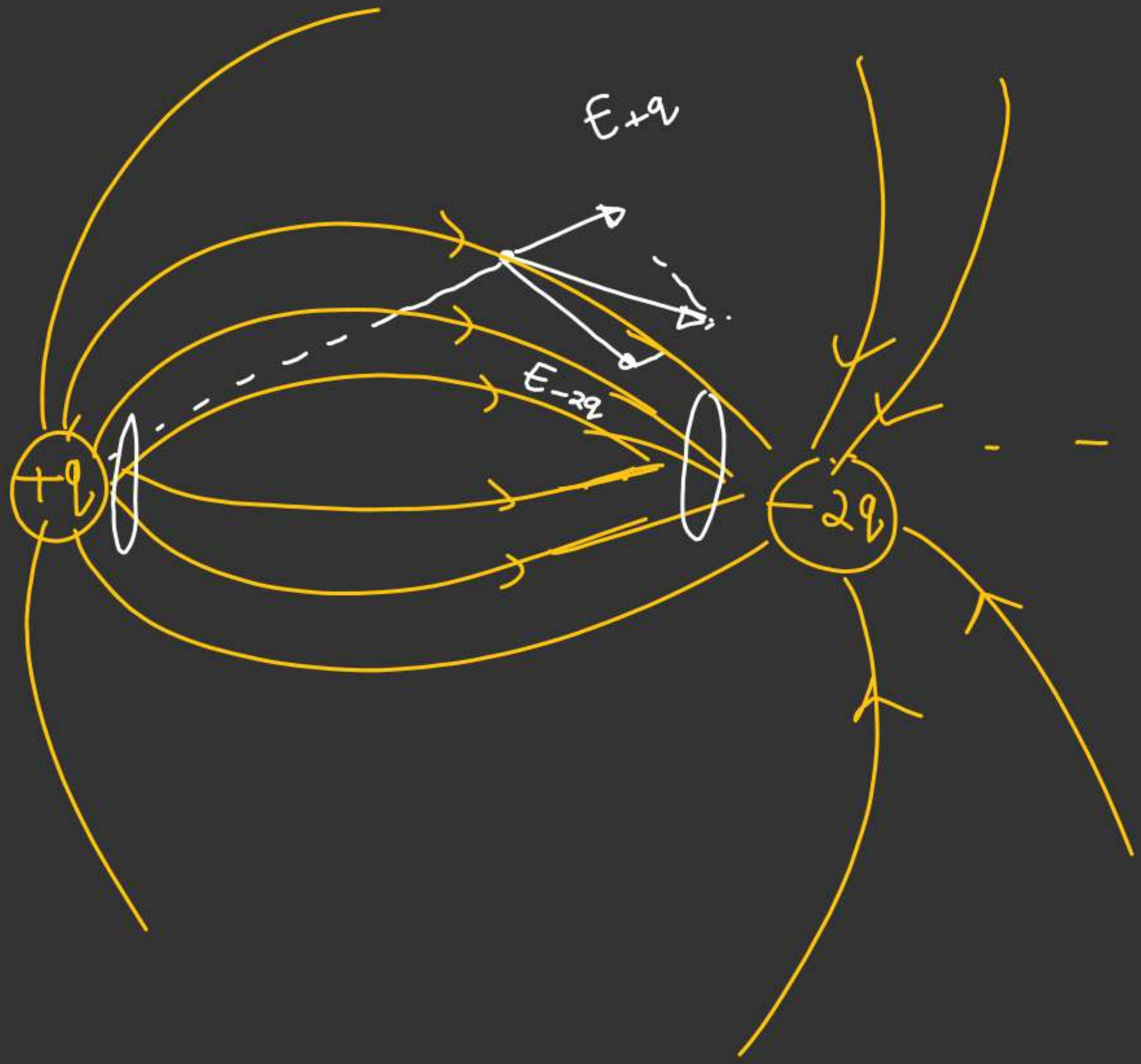

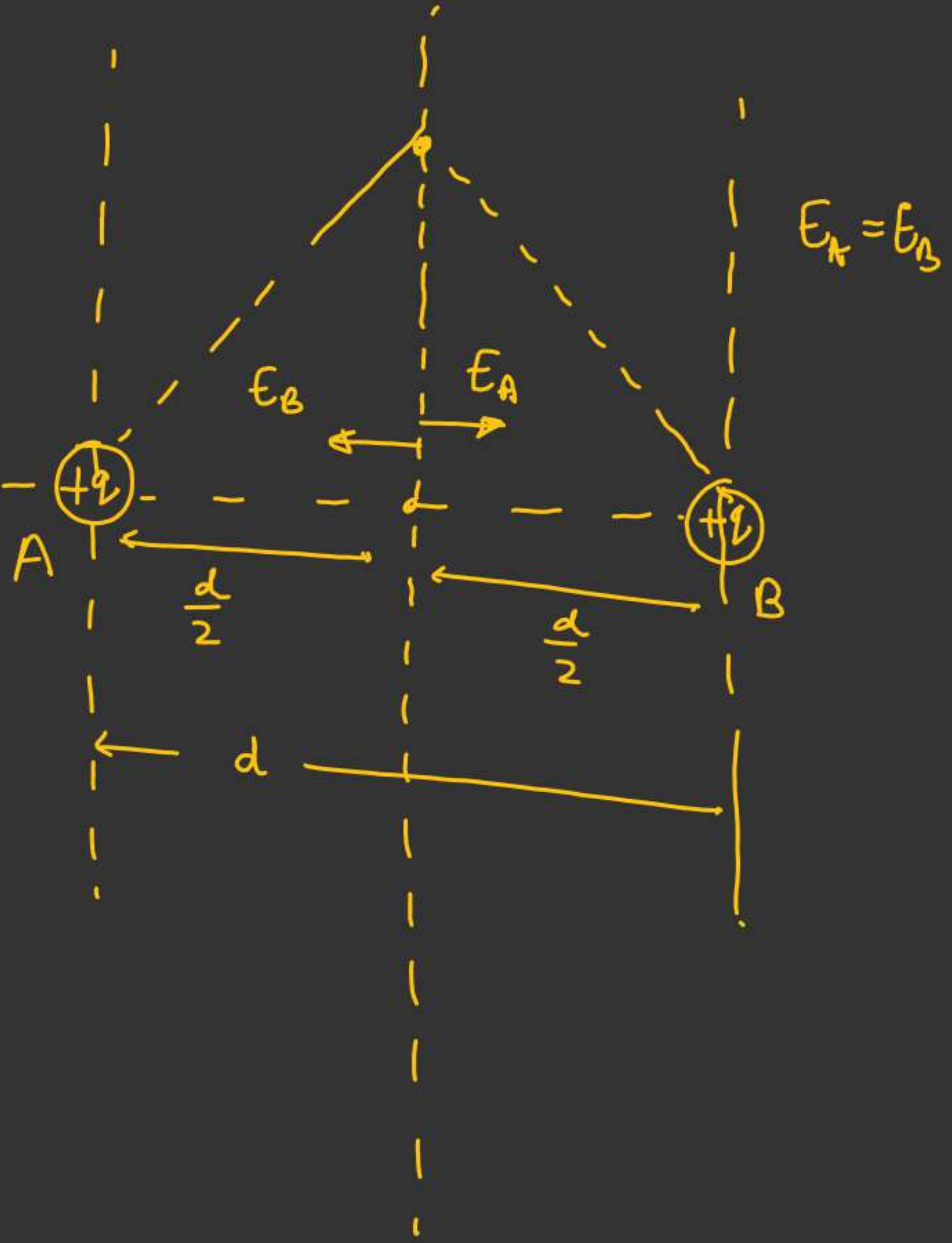

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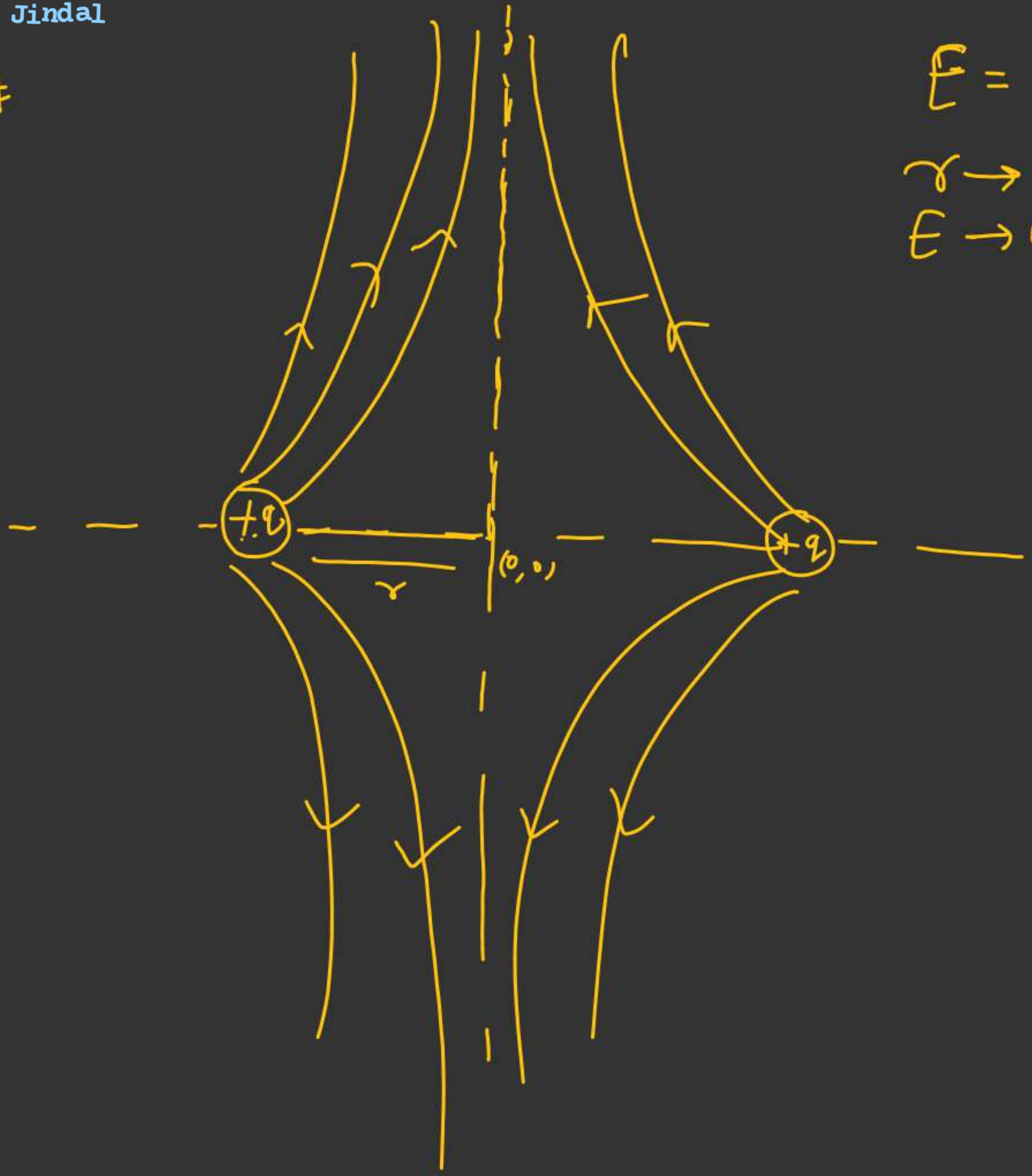

$$E = \frac{Kq}{r^2}$$

$r \to 0$

$E \to \infty$

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ELECTRIC FIELD LINE