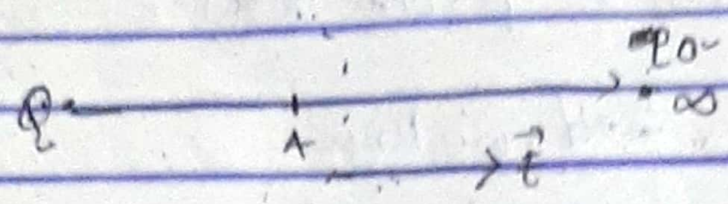
Electric potential energy:-



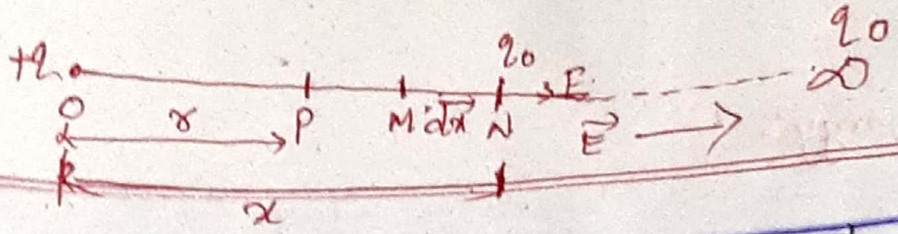
When a unit positive charge is moved from infinity to point A inside the electric field of Q : some work must be done against electrostatic repulsive force. This work done is converted in the form of potential energy which is known as E.P.E.

Relation between electric field and potential:

OR.

Prove electric field is negative of potential gradient. i.e $E = -\frac{dV}{dx}$

→ let a charge +q is at O. let the test charge is lying at an infinity. Let P be the point where net electric potential is to be calculated. Let OP = r. Initially while bringing a charge from q_0 towards +q. let it reaches upto point N. let ON = x. Let small distance between M and N be dx.



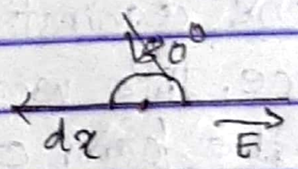
As we know, workdone $dw = \vec{F} \cdot \vec{dx}$ — (1)

By the defination of electric field, we know,

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

or, $\vec{F} = \vec{E} q_0$ — (2)

Using eq^n (2) in eq^n (1)



$$dw = q_0 \vec{E} \cdot \vec{dx}$$

$$= q_0 E dx \cos\theta$$

$$= q_0 E dx \cos 180^\circ$$

$$= -q_0 E dx \quad \text{— (3)}$$

we know, by defination of electric potential,

$$V = \frac{W}{q_0}$$

$$dv = \frac{dw}{q_0}$$

or, $dw = q_0 dv$ — (4)

from eq^ns (3) and (4)

$$-\cancel{q_0} E dx = \cancel{q_0} dv$$

or, $-E = \frac{dv}{dx}$

$$\boxed{\therefore \quad E = -\frac{dV}{dx} \quad \text{— (5)}}$$

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→ The change of potential with distance is known as potential gradient hence the electric field is equal ~~eq~~ to the negative gradient of potential.

→ The -ve sign indicates that potential decreases in the direction of electric field.

→ A/c to the expression the unit of electric field can also be expressed as V/m