Chapter 25: Electrical potential and Energy

- potential energy: the amount of work needed to put that system together

- Electrical potential energy: the amount of work/energy needed per unit of charge to move the charge from the reference point to a specific point in an electric field.

$$V = \frac{U}{Q}$$

U: the electrical potential energy of charge Q

- Two different charges placed in the same position would have different potential energies, but they would have identical electrical potentials.

- The work and Electrical potential:

→ The work done on the charge by the electric field = to the reduction in electrical potential energy.

$$\Delta U = -W_{elec}$$

example: if the charge moves to a position where its electrical potential energy is lower, the chang in ΔU is negative and the charge has a positive work done on it by the field.

→ W_{elect} = force * distance

$= F * \Delta X$

→ $F = qE$

$$\boxed{\therefore W_{elect} = qE\Delta X}$$

$$\boxed{\Delta U = Vq}$$

$\Delta U = -W_{elect}$

$\therefore \Delta V \cancel{q} = -\cancel{q} E \Delta X$

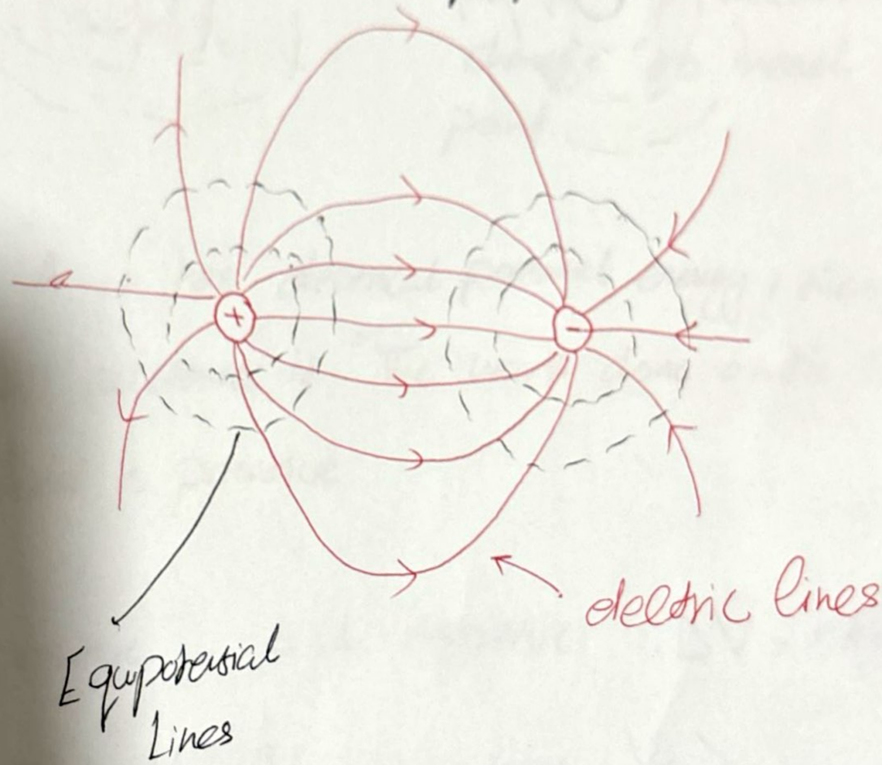
$$\boxed{\therefore \Delta V = -E\Delta X}$$

$$E = -\frac{\Delta V}{\Delta x}$$

see Example 25.1, 25.2.

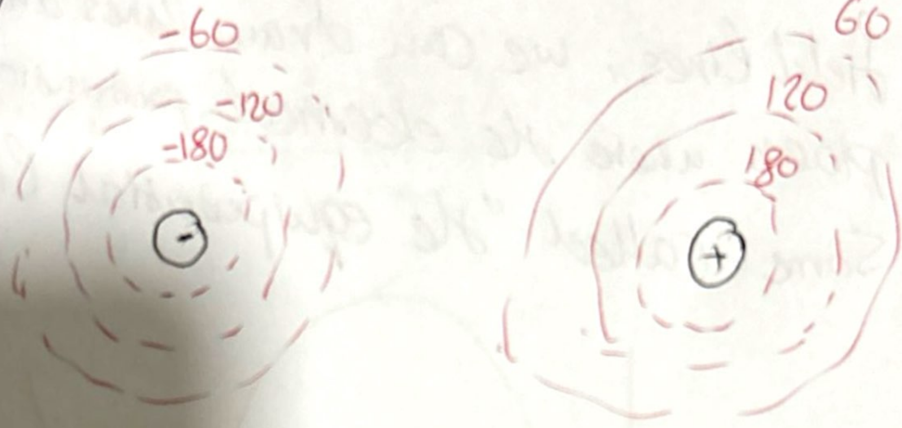
-Equipotential and field lines:

- the electrical potential is a scalar quantity, So rather than representing it with vectors or field lines, we can draw lines that show places where the electrical potential is the Same. called "the equipotential lines"

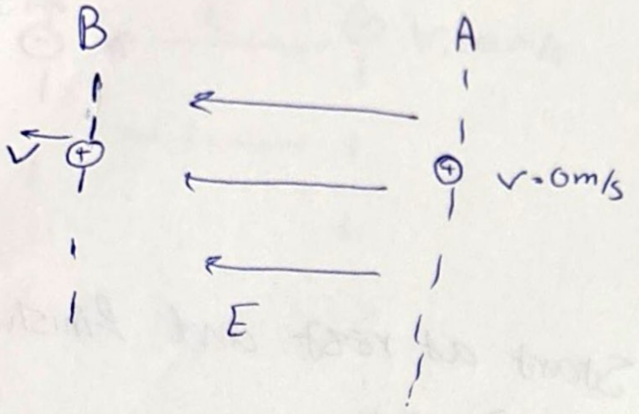


- because any change in position that has a component in the direction of the electric field will result in a change in potential ($\Delta V = E \Delta x$) equipotential lines are always perpendicular to electric field lines.

- it may help to think of the equipotential lines as being like contour lines on a topogra map.



- Positive charge, No External force



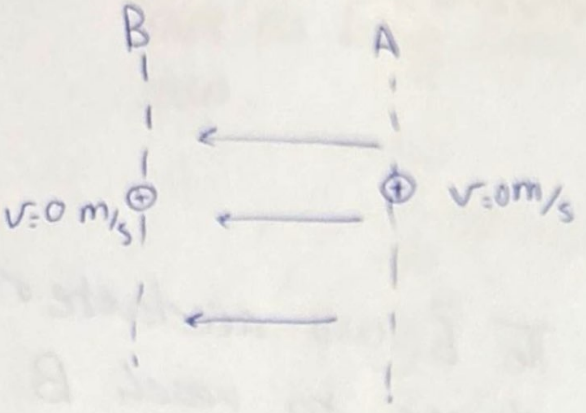
- The $\vec{E}$ will accelerate the charge to reach B point.

at point A it has electrical potential energy, then the $\vec{E}$ field will accelerate it "The work done on the charge by the field is positive"

- if W positive $\therefore \Delta U$ negative $\therefore \Delta V$ = negative

$\Delta V = V_B - V_A$ where $V_A > V_B$

* Positive charge, External force:



- Start at rest and finishes at B rest.

- So, The work done by the external force "Non-electrical" is negative and equal in magnitude to the work done by the $\vec{E}$ field.

$$K.E_f + U_f = K.E_i + U_i + W_{app}$$

W_{app} : external force

$W_{electrical} = -(U_f - U_i) = -\Delta U$: electrical force ($\vec{E}$)

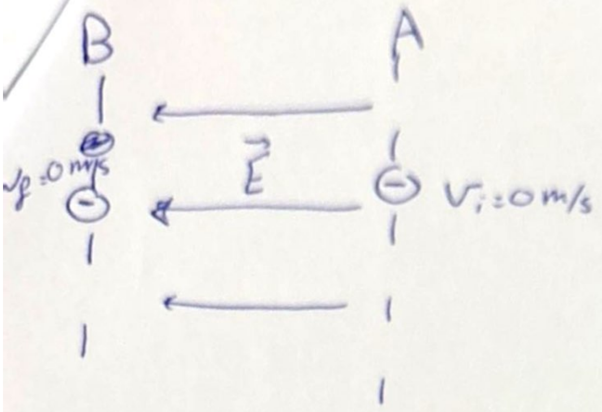
$\Delta K.E_f = $ Zero

→ To balance the equation we need to consider the W_{app}

and W_{app} should be negative

$W_{app} = W_{ele}$

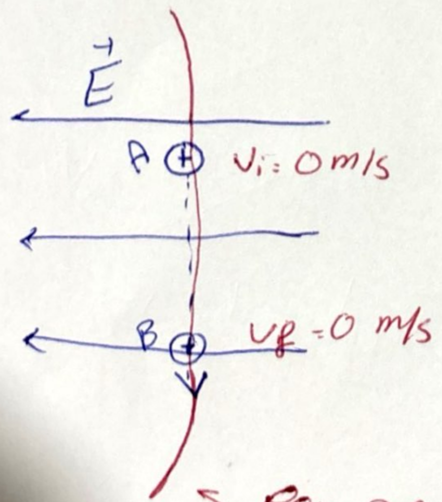
* Negative charge, External Force:



- The work done by $\vec{E}$ on the charge is negative, and equal in magnitude with W_{app}, W_{app} is positive.

$\Delta U = U_f - U_i$ $\therefore$ W_{ele} = negative.

* Charge moving perpendicular the the field



- There is no work done by the field on the charge? why.

* in this path there is no change in the electrical potential energy. where $V_B = V_A$ $\therefore$ W = zero.