The electric Potential

In this chapter we will define the electric potential (symbol V)

- Calculate V if we know the correspondig field
- Calculate the electric field if we know the electric potential
  - Determine the potential V of a
    - point charge
    - continuous charge distribution
- Define the notion of an equipotential surface
- The relationship between equipotential surface and the electric field lines

Electric potential Energy:

From 107 (ch 8) you already know that the change of potential energy (ΔU) delta is associated with a conservative force, since the work W that an external force must do on a particle to take it from position x_i to a a final position x_f

$$\Delta U = U_f - U_i = W_{ext}$$

$$= \int_{x_i}^{x_f} F_{ext}(x)\,dx$$

for the electric field
$$= - \int_{x_i}^{x_f} F_E(x)\,dx$$

where $F_E = qE$ and $F_{ext} = -F_E$

Consider an electric charge q moving from an initial position at point A to a final position at point B in an electric field $\vec{E}$.

The force exerted on the charge is

$$\vec{F} = q\vec{E}$$

$$\Delta U = \int_i^f \vec{F}_{ext} \cdot d\vec{s} = - \int_i^f \vec{F}_E \cdot d\vec{s} = -q \int_i^f \vec{E} \cdot d\vec{s}$$

The electric potential V

The change in potential energy of

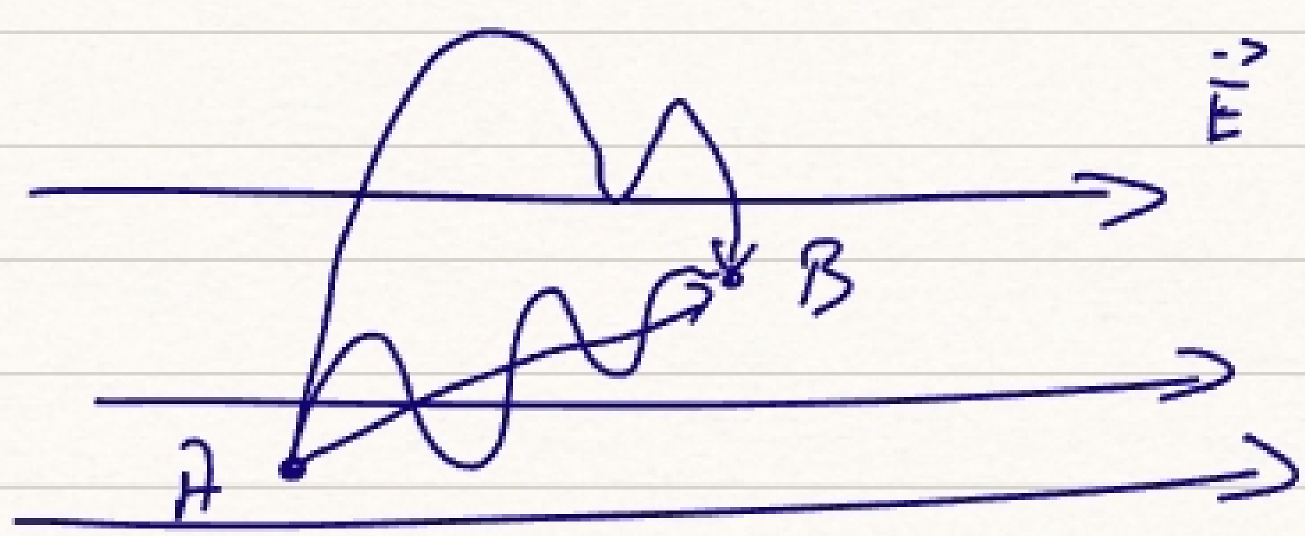
a charge q moving from A to B is

$$\Delta U = U_f - U_i = W_{Ext} = -W_E = -q\int_i^f \vec{E}\cdot d\vec{s}$$

We define the electric potential V in such a manner that it is independent of q:

$$\Delta V = \frac{\Delta U}{q} = -\frac{W_E}{q} = \frac{W_{ext}}{q}$$

Here $\Delta V = V_f - V_i \Rightarrow -\int_i^f \vec{E}\cdot d\vec{s}$



In all physical problems only changes in V are involved. Thus we can define arbitrarily the value of V at a reference point. We choose as a reference point infinity

$V_i = V_\infty = 0$ We take the initial