

PHY-112
PRINCIPLES OF PHYSICS-II
AKIFUL ISLAM (AZW)
SPRING-24 | CLASS-9

- Work done due to moving a charge q_0 in an \vec{E} -field

$$W_{i \rightarrow f} = q_0 \int_{\text{start}}^{\text{final}} \vec{E} \cdot d\vec{r}$$

- Electric Potential Energy exchanged to moving a charge q_0 in an \vec{E} -field

$$\Delta U_{\text{elec}} = -q_0 \int_{\text{start}}^{\text{final}} \vec{E} \cdot d\vec{r}$$

ELECTRIC POTENTIAL

- It is defined as

$$\Delta V = \frac{\Delta U}{q} = \frac{-W}{q} \equiv \text{Potential Difference} = \text{Voltage}$$

- Exists everywhere in space, just like \vec{E} -fields.
- Is a **scalar**, no dealings with directions.
- Causes charges to have potential energy.
- Is measured in J C^{-1} , or more commonly, **Volt** [V].

TESTING CONCEPTS (1)

Q: A proton with a speed of $2.0 \times 10^5 \text{ m s}^{-1}$ enters a region of space in which there is an electric potential. What is the proton's speed after it moves through a potential difference of 100 V? What will be the final speed if the proton is replaced by an electron?

POTENTIAL AND FIELD

Potential difference experienced by moving a charge from **starting** location to the **ending** location.

$$\Delta V = V_{\text{final}} - V_{\text{start}} = \frac{\Delta U}{q_0} = - \int_{\text{start}}^{\text{final}} \vec{E} \cdot d\vec{r}.$$

POTENTIAL DUE TO A POINT CHARGE

Physically, **Electric potential is the work done per unit charge (+1 C) to bring a charge from infinity** (where the electric field is considered to be zero) **to a particular location r in an electric field.**

$$V_{\infty} = \frac{1}{4\pi\epsilon_0} \frac{q}{r}$$

TESTING CONCEPTS (2)

Q: The electric potential at the dot is 3140 V. What is charge q ?

