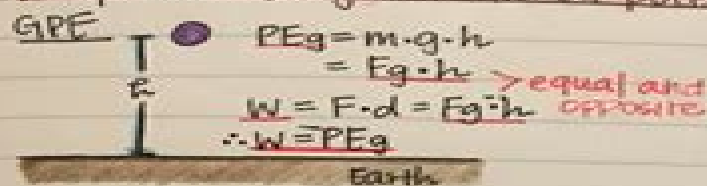


# Chapter 23: Electric Potential

## 23-1 Potential Difference

- Comparison to gravitational potential energy:



- Deriving the equation:

- $dU = -\vec{F} \cdot d\vec{r}$  change in PE for a conservative force  $F$  undergoing  $d\vec{r}$
- $\vec{F} = q_0 \vec{E}$  force exerted by electrostatic field  $\vec{E}$  on pt charge  $q_0$ .
- $dU = -q_0 \vec{E} \cdot d\vec{r}$  resulting change in electric potential energy
- $dV = \frac{dU}{q_0} = -\vec{E} \cdot d\vec{r}$  potential difference  
 → potential energy change per unit charge

For a finite displacement from point  $a \rightarrow b$

$$\Delta V = V_b - V_a = \frac{\Delta U}{q_0} = -\int_a^b \vec{E} \cdot d\vec{r}$$

This is  $-\frac{W}{q}$

scalar function unlike  $\vec{E}$

- Function  $V$  is called the electric potential/potential.

- $U = q_0 V$  relation between potential energy and potential

- $V$  is continuous at any point not occupied by a point or line of charge.

- Units

$$\text{Electric Potential} = \left[ \frac{\text{Potential energy}}{\text{unit charge}} \right] = \left[ \frac{J}{C} \right] = V \text{ or Volts/Voltage}$$

$$eV = 1.60 \times 10^{-19} \text{ C} \cdot V \text{ or J}$$

$$\text{Electric Field} = \left[ \frac{N}{C} \right] = \left[ \frac{V}{m} \right] \text{ either } \frac{\text{force}}{\text{unit charge}} \text{ or } \frac{\text{change in potential}}{\text{distance}}$$

- Potential and Electric Fields



- $\vec{E}$  points in a direction where  $V$  decreases
- positive charge accelerates in direction of  $\vec{E}$ : decreasing  $V$
- negative charge accelerates in direction opposite of  $\vec{E}$ : increasing  $V$

If released from rest, KE increases and PE decreases.

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