Electric Potential

ENGR 217

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1 Electric Potential Energy

Coulomb force is conservative (dependent only on initial and final state)

- Independent of path
- Anaogous to gravity

Work done by a conservative force can be described as the difference in potential energy

$$-\Delta U_{elec} = \Delta K$$

$$Wab = U_a - U_b = -(U_b - U_a) = -\Delta U = q_0 E d$$

Detemrine what force releative to the electric field, and the direciton of the displacement as well.

- doing work against the field (-W) is increases potential energy

Electric Potential Energy in a Uniform field

If the **positive** charge moves in the direction of the field, the field does positive work and the potential energy decreases. Thus, it's potential energy would `decrease` as it moves through the field. Moving it against the field with a force would `increase` it's potential energy.

- reverse this concept for a negative charge

$$W_{ab} = Fd = qE_0$$

Electric Potential energy of two poitn charges

$$U = k\frac{qq_0}{r}$$

- Units are joules
- It is a scalar qauntity
- Decreases as distance between charges approaches infinity

Electric Potential energy of Multiple charges

$$U = q_0 * k * \sum_i \frac{q_i}{r}$$

Total potential ENergy of a system of charges

$$U = k * \sum_{i<j} \frac{q_i q_j}{r_{ij}}$$

2 ELectric Potential

An electric potential (also called the electric field potential, potential drop, or the electrostatic potential) is the amount of work needed to move a unit of charge.

Potential

$$\frac{W_{ab}}{q_0} = -\frac{\Delta U}{q_0} = -(\frac{U_b}{q_0} - \frac{U_a}{q_0}) = -(V_b - V_a) = V_a - V_b$$

Potential and the Electric field

- if you move in the direction of the elctric field, the electric potential decreases
- In the opposite direction of the E field, the electric potential increases

Due to a single charge

$$V =$$

converting potential to electric field

$$\vec{E} = -$$