Electric Potential
and
Electric Potential Energy

We know when a force displaces an object, work has been done. $W = F\Delta d$

From our study of electric forces, an electric force that displaces a charged particle has done work on the charged particle. $W = F_e \Delta d$

As a result, the charged particle has the ability to do work, or has an increase in the Electric Potential Energy.

$$Fd \quad = W = \Delta E_e$$

$$Fed_2 - Fed_1 \quad = E_{e2} - E_{e1}$$

$$= F_e(d_2) - F_e(d_1)$$

$$= F_e\,(d_2 - d_1)$$

$$= q\Delta(d_2 - d_1)$$

$$\mathcal{E} = \frac{F_e}{q}$$

$$F_e = q\mathcal{E}$$

- The work done is dependent on the magnitude of the charge q, so the work done per unit of charge is

$$\frac{W}{q} = \frac{\Delta E_e}{q} = V$$

The electric potential energy per unit charge is "electric potential" or "potential".

$$V = \frac{E_e}{q}$$

Where V is potential (in volts)

Ee is electric potential energy (in J)

q is charge (in C)

- Electric potential energy is the energy associated with the charged object

- Electric potential is the amount of energy that <u>any</u> unit charge possesses at a point in the electric field.

- Electric Potential Energy is given by the equation:

$$Fd = W = E_e = \frac{kq_1q_2}{r}$$

$$\frac{kq_1q_2\cancel{r}}{r^{\cancel{2}}}$$

Where

E_e is the electric potential energy, in Joules (J)

k is Coulomb's constant, 9.0×10^9 Nm^2/C^2,

q_1 and q_2 are charges, in Coulomb's (C),

r is the distance between the charges

$W = \Delta E_e$

Ex. 1 3.7×10^{-5} J of work is done on a charge q (2.0×10^{-6} C) in moving it through an electric field.

a) What is the change in electric potential energy on the charge?

b) What is the potential through the electric field?

a) $\Delta E_e = ?$ $\Delta E_e = W = 3.7 \times 10^{-5}$ J

b) $V = ?$ $V = \frac{\Delta E_e}{q} = \frac{3.7 \times 10^{-5} \text{ J}}{2.0 \times 10^{-6} \text{ C}} = 18 \text{ V}$

$$qV = qEd$$

Practice Questions

- Worksheet 7.4
- p. 349 # 1 – 3
- p. 354 # 1, 2, 4