AP Physics - Electrostatics - Electrical Potential

Note Title 3/2/2008

Electrical Potential Energy

In our discussion of gravity, we talked about gravitational potential energy, or the energy associated with pulling one mass away from another, against the pull of gravity. $W_{done} = F_g \cdot d = mgh$ ← G.P.E.

Since we know that charged objects also exert forces on each other, we can define the work done for a charged object in another charged objects $\vec{E}$ field as:

$$W_{done} = F_{electrostatic} \cdot d = \text{Electrical PE}$$

From before, $\vec{F}_{electrostatic} = q\vec{E}$, so

$$W_{done} = q\vec{E}d$$

$$\therefore \boxed{\text{Electrical PE} = q\vec{E}d}$$

Electrical Potential (a.k.a. Voltage)

We also find it useful to define a term called "Electrical Potential" or "Voltage", which is the product of field strength and distance:

$$\boxed{V = \vec{E}d}$$

Therefore: $EPE = qV$

- or -

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

Voltage is therefore the energy per unit charge, and has units of Joules/Coulomb.

A voltage difference between two points in a circuit is what makes the charges flow: