Setlist L6 (90 minutes)

Introduction to electrostatics.
Prep: Charges and Fields PhET. Electric Field Hockey PhET, Noah's Demo

1. Last Class: Motion of the electric field. Noah's demo. Potential energy. Conservative forces.
2. Electric potential energy of a point charge - derive from Force
3. The electric potential of a point charge - definition similar to electric field.
4. The electric potential related to gravity
5. Introduce equipotentials.
6. Clicker question: equipotentials - B

7. Worksheet Q1 - Q4 at most

8. Alessandro Volta, lighting, and the Jacob's Ladder. It's Alive!
9. Show them the 4 electrical quantities and how they're related.
10. Clicker Questions: - Equipotentials and fields - C, B
11. Clicker Question: Equipotentials and motion - D

12. Worksheet Q6

13. Potential and conductors. We know E = 0 in a conductor (in static equilibrium) implies that the change in potential is zero. We know this isn't true if the conductor is attached to a battery.
14. Clicker Question: Different sized spheres - B
15. Kirchhoff's Law.

Potentials

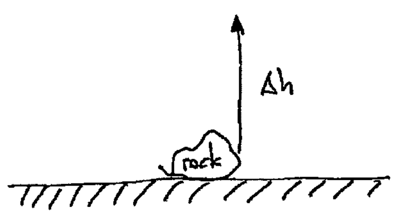
Clicker question: kinetic energy in a capacitor

We know that in a conservative field mechanical energy is conserved.

$$\Delta E = \Delta K + \Delta U = 0$$

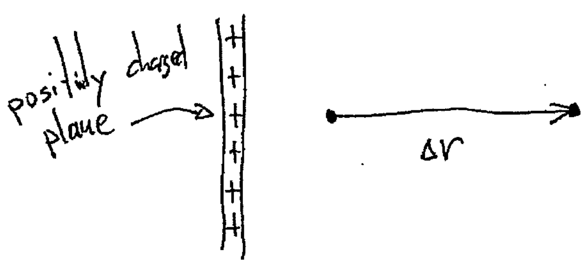
An increase in kinetic energy must be associated with a decrease in potential energy.

In a gravitational field lifting a mass is associated with an increase in potential energy.



$$\Delta U = m_{rock}\, g\, \Delta h$$

An electric field is more subtle because of the 2 charges. The change in potential energy depends on the sign of the charge.



$$\Delta U = -q\, \vec{E} \cdot \Delta \vec{r}$$ ← Be careful of which way you're going.

q can be + or −

E can be from a positive or negative source.

We know from last semester that

$$F_r = -\frac{dU}{dr}$$

for a conservative force. To find U we merely need to find the anti derivative of F. (You may be tempted to integrate. That's ok.)

$$U = \frac{kq_1q_2}{r}$$

gives us the right force.

$$F = -\frac{dU}{dr} = \frac{d}{dr} - \frac{kq_1q_2}{r}$$

$$= -kq_1q_2\left(\frac{-1}{r^2}\right)$$

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

Now, the potential energy is a quantity relating to a system of charges, similar to the force.

There is a scalar quantity that is a quality of the charge itself, similar to how the electric field is a quality of charge configurations. The <u>electric potential</u> is defined as

$$V_1 = \frac{U_{12}}{q_2},$$

Show field + potential PhET