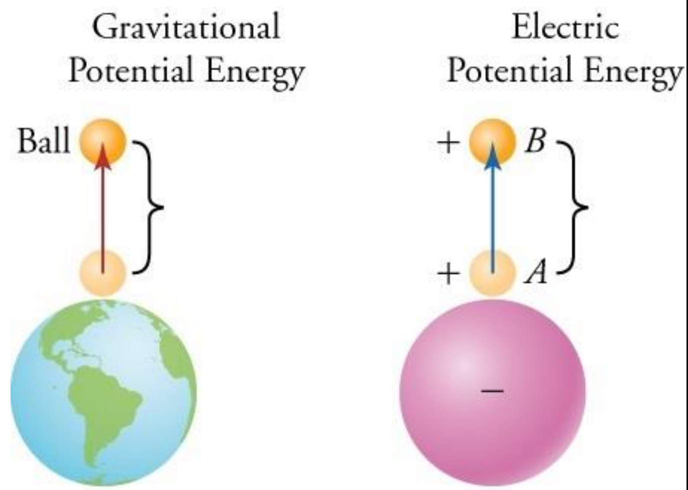
Electric Potential Energy (J) and Electric Potential (Volts)

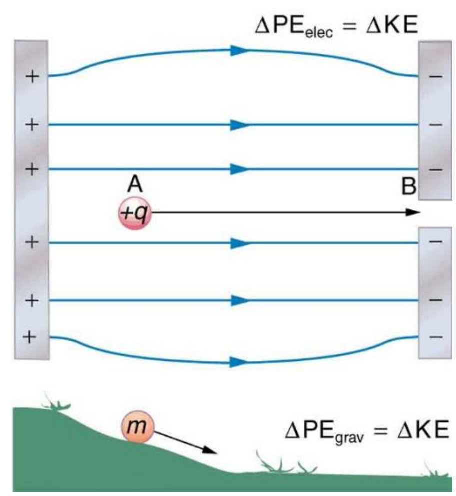
Just like a ball can be lifted up above the earth's surface to give it ***gravitational potential energy***, an electrically charged object can be put in a position so that it will also have potential energy (***the potential to move***!).



If you look at the ball to the right, if it is held a position above the earth it has the potential to fall towards the earth.

You should also see that the positive charge (shown in the diagram to the right) if held at position B, **would want to move towards the negative charge.**

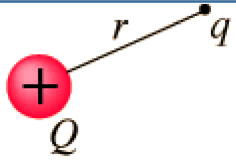
The positive charge has ***electrical potential energy***.



This idea of putting an object with electric ***charge*** near another object with ***charge*** to give it ***potential energy*** is widely used and is important. In today's world, we move charged particles around all the time. Much of our study of subatomic particles involves moving charged particles, accelerating them, or smashing them together. One way to do this is to give **particles *electric potential energy*** in the way described above.

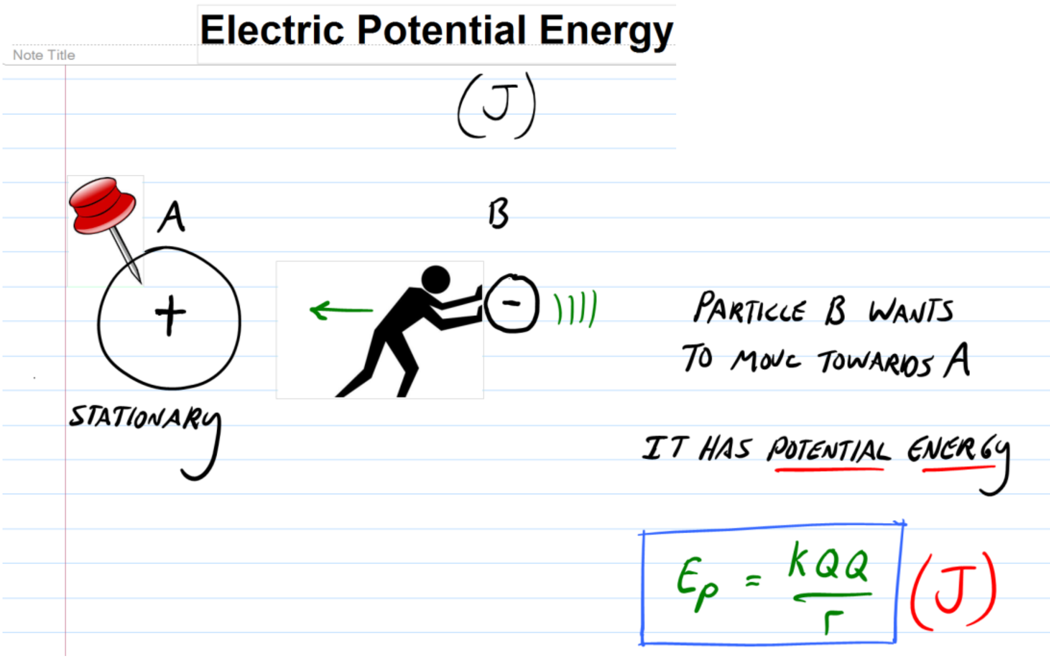
Using some clever Physics (and Calculus) you would easily be able to determine that the ***electric potential energy*** between charged can be calculated using the following formula:

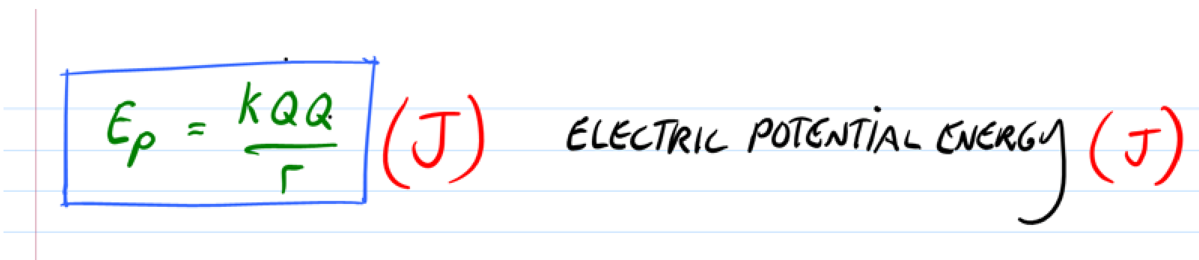
$$\text{Potential Energy} = \frac{kQq}{r}$$



This formula is used to calculate how much electrical potential ***energy*** either particle would have in ***Joules (J).*** Remember ***Joules*** is the unit for energy. Energy is also a ***Scalar quantity***. This means (unlike electric force) ***we WILL care about the (- +) signs on our charges*** in this section of the course**.**

Watch you signs!





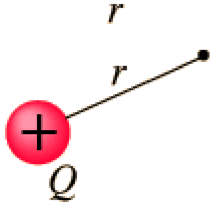
Electric Potential (V)

Now, just to make things more complicated, there is another quantity you need to know about related to charged particles and their energy. This quantity is call **Electric Potential.**

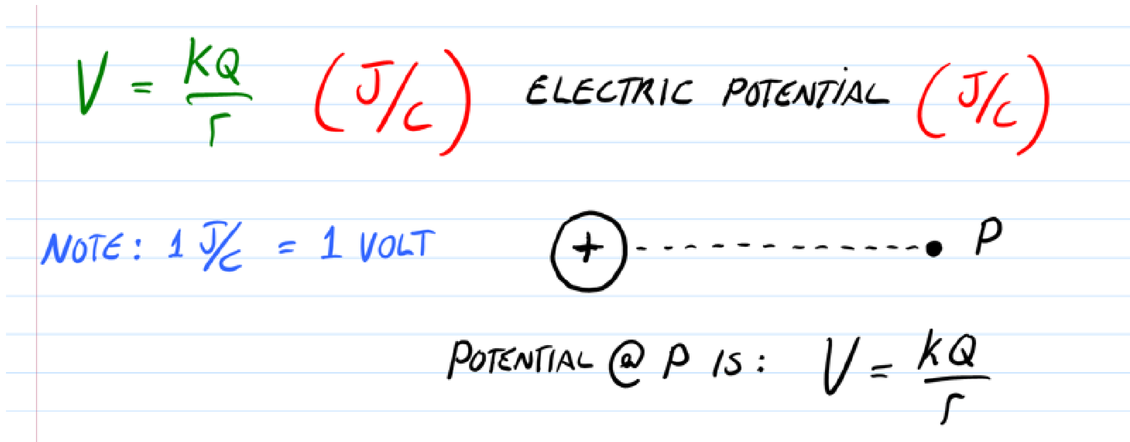
Electric Potential is defined is defined as the amount of potential energy a particle with **1 Coulomb** charge ***would*** have ***if*** it was near another charged particle.

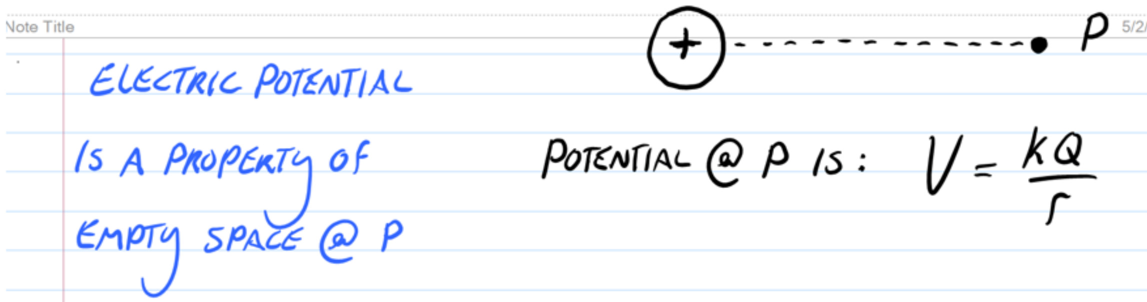
Electric Potential is a **property of empty space** measured in Joules/Coulomb (J/C).

$$V = \frac{kQ}{r}$$



In this scenario **Potential** refers to the Joules per coulomb a change **would** have **if** it was near Q. Notice only one charge exists in this scenario. Potential is also scalar with units J/C or **Volts (V).**

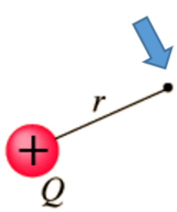




Important Notice:

The units for **Electric Potential** are Joules per Coulomb (J/C).

Placing a new charge in a particular point in space that has **Electric Potential** we can determine the **Potential Energy** of that new charge.



Point in space
that has **Potential**
due to Charge Q of 3 Joules/Coulomb
(Volts)

-9 Coulomb charge

If we place the **-9 C** charge at the point shown that has a potential of **3 Volts**

The Potential Energy the -9C Charge will have will be (**-9C**)x(**25J/C**)= -**27 Joules**

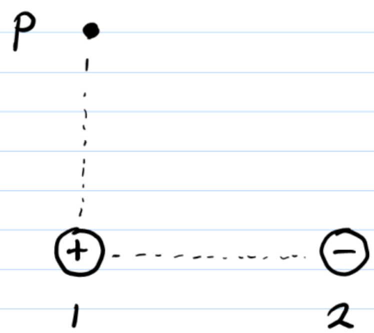
Potential Energy = (Charge) x (Potential)

Potential Energy = Charge x Potential

GREAT NEWS! ELECTRIC POTENTIAL + POTENTIAL ARE SCALAR QUANTITIES (NO DIRECTION, BUT KEEP THE SIGNS)

Example:

POTENTIAL @ P (V)



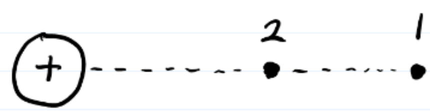
$$V_p = V_1 + V_2$$

$$V_1 = \frac{KQ}{r} \quad V_2 = \frac{KQ}{r}$$

(ADD TOGETHER, KEEP SIGNS)

ALSO....

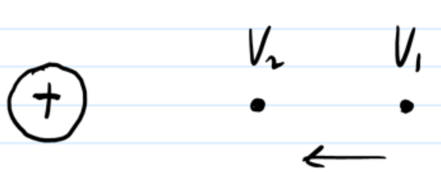
WORK TO GO FROM $1 \rightarrow 2$



$$W = \Delta E_p$$

$$W = q \Delta V$$

POTENTIAL DIFFERENCE ΔV (J/C)



$$\Delta V = V_2 - V_1$$

AMOUNT OF ENERGY TO MOVE FROM $1 \rightarrow 2$ (PER COULOMB)