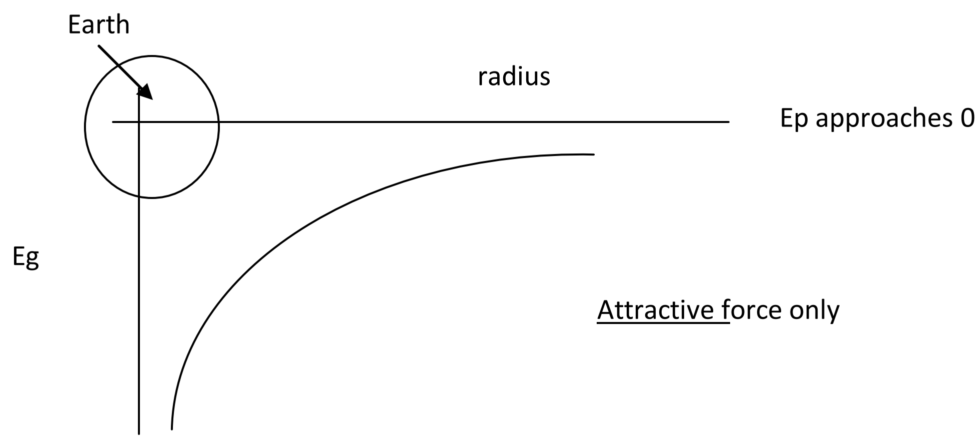
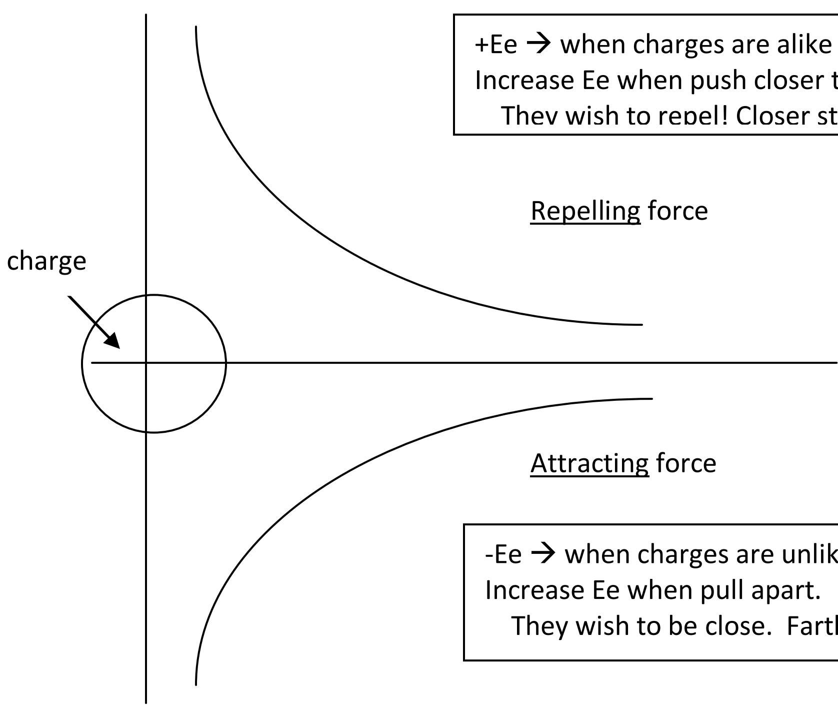
Electric Potential 8.7

Continue with our comparison of gravititational force and electric force

gravititational force	electric force
$F_g = mg$	$F_e = \varepsilon q_t$
$F_g = Gm_1m_2/r^2$	$F_e = kq_1q_2/r^2$
$E_g = -Gm_1m_2/r$	$E_e = kq_1q_2/r$



GRAVITATIONAL FORCE



+Ee → when charges are alike
Increase Ee when push closer together.
They wish to repel! Closer stores more Ee

ELECTRIC FORCES

-Ee → when charges are unlike
Increase Ee when pull apart.
They wish to be close. Farther apart stores Ee.

Ee → electric potential energy. If we let the charges go, they move and they can do work for us!

Electric Potential (V) as measured from infinitely far away

But….Electric Energy (Ee) depends on the magnitude of the test charge (qt) as well as the magnitude of the electric field strength (ε). Increasing either results in an increase of Ee logically.

So..to be systematic, we need to determine the Ee per coulomb. This will standardize our Ee.

Ee/q = electric potential = volt

V = electric potential.

V = Ee/q

where… electric potential is in volts (V)
Ee is in joules (J)
q, charge in field, is in coulombs (C)

****This formula works for charge distribution and a maste charge (qm)****

What's this mean? 1 volt of electric potential at a point in an electric field means 1 Joule of work is required to move 1 coulomb of charge from infinity to that point.

Master charge

V = Ee/q (equation 1) and Ee = kq1q2/r (equation 2)

Plug equation 2 into equation 1

Thus $V = \frac{kq1q2/r}{q\,1}$ q1 will cancel out

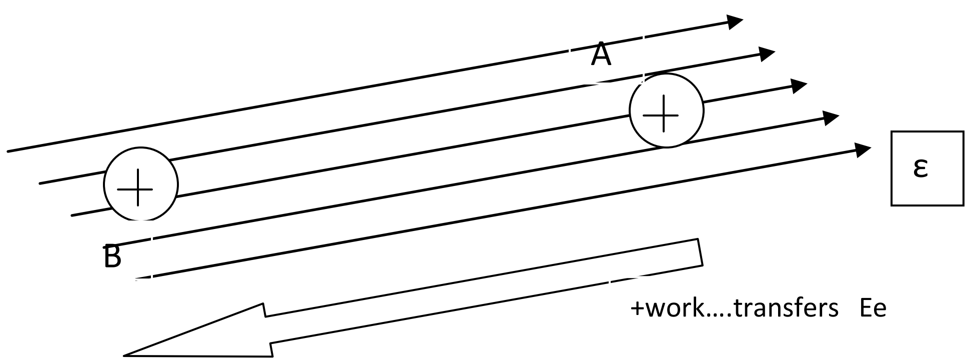
Say the 2nd charge is a master charge. Thus…q2 = qm
Therefore

V = kqm/r

**** This formula only works for a master charge ****

Electric Potential (V) as measured between 2 points (no infinity)

Most often, however, we are not moving charges from infinity. We are moving charges between 2 points ie: between the negative and positive end of the batteries around a circuit.



A positive charge would like to go in the direction of the electric force field. So…to move a positive charge from A to B would require work. (A force over a displacement). This would be positive work and it would store energy…it would store Ee!

$\Delta Ee = +\text{work done}$

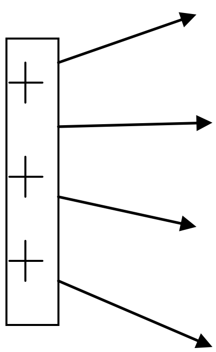
$\Delta Ee = Ee_B - Ee_A$ $\quad$ $V = Ee/q$ $\quad$ so…$Ee = Vq$

$\Delta Ee = qV_B - qV_A$

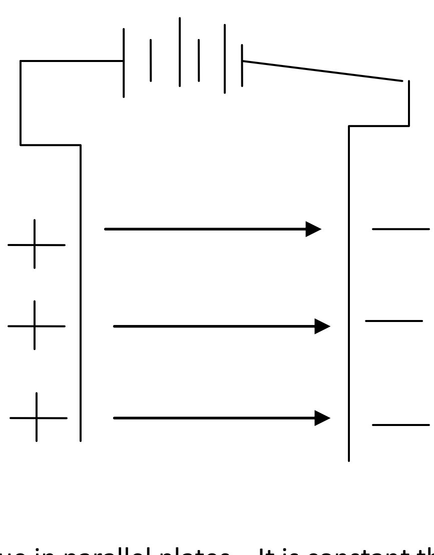
$\Delta Ee = q\Delta V$ $\quad$ ΔV = potential difference

ΔV always decreases in direction of ε. (-W so loses Ee)

Parallel Plates



Field strength weakens the farther from the plate you go.



Field strength is consistent!

Field Strength is unique in parallel plates. It is constant throughout and thus Fe is constant too!

We know…. $W = Fd$ (it takes +W to move +ve charge from right to left in this case)

$W = q\varepsilon d$ ($F_e = q\varepsilon$)

$q\Delta V = q\varepsilon d$ $E_e = qV$ so… $W = qV$

….cancel out the q's…..

$$E = \Delta V/d$$

****this is for parallel plates only****