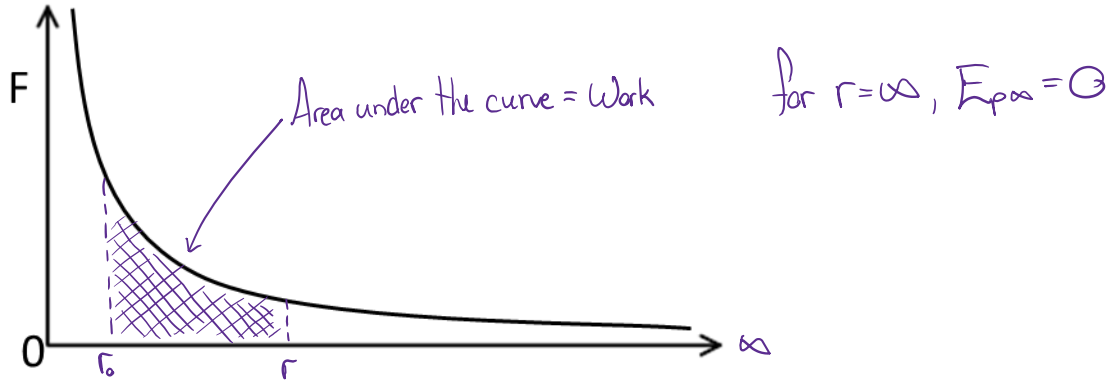
Lesson 6.3A: Electric Potential Energy

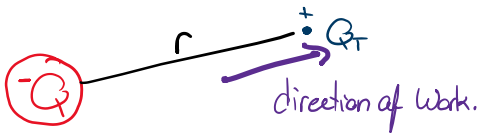
Unit 6: Electrostatics

Electric Potential Energy in Uniform Fields:

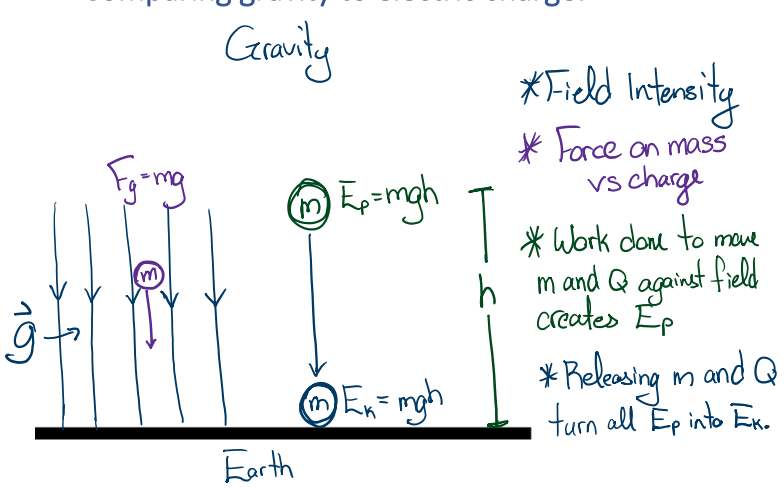
Work:

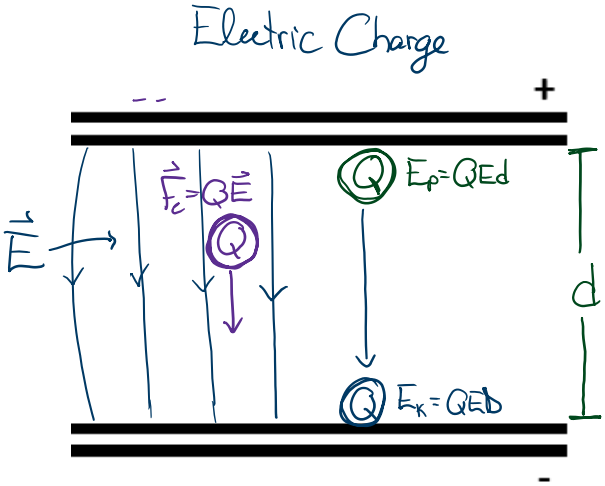
- Recall the work-energy theorem: the work done on an object is equal to the change in the object's energy.
- Work must be done to move a test charge near another charge.



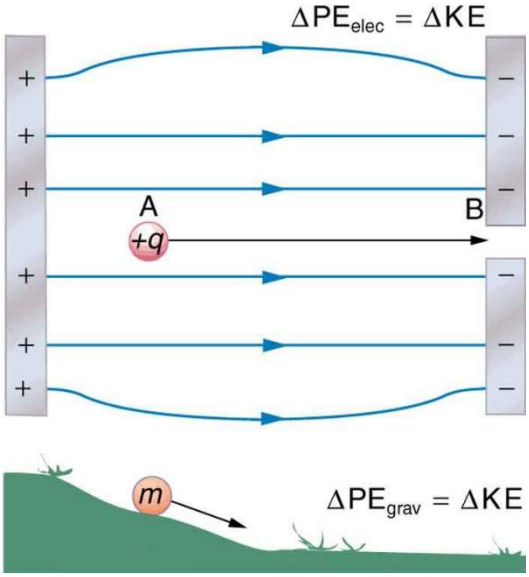
Work Case 1: Charges are the same (+/+) or (-/-)	Work Case 2: Charges are different (+/-)
	

Comparing gravity to electric charge:





Use the figure to explain, in terms of potential and kinetic energy, how accelerating a charge through an electric field is like a mass rolling down a hill.
What would happen if the electric field were doubled or halved? (describe the slope of the hill)



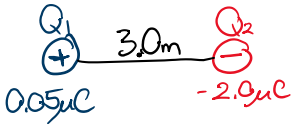
Electric Potential Energy of Multiple Charges in Non-Uniform Fields:

* With gravity, the ground is our reference at h=0 ($E_p = 0$).
* Electrostatically, $r = \infty$ is our reference point ($E_p = 0$).

$$E_p = k\frac{Q_1 Q_2}{r}$$

* Sub in signs (+/-) for charges
* Energy is a scalar, not vector
* $+E_p$ = same charges
* $-E_p$ = opposite charges.

Example 1: Find the electric potential energy of a 0.50 µC charge 3.0 m from a -2.0 µC charge.



$$E_p = \frac{kQ_1Q_2}{r} = \frac{(9.0\times10^9)(0.50\times10^{-6})(-2.0\times10^{-6})}{3.0}$$

$$= -3.0\times10^{-3}\ \text{J}$$

Example 2: Find the work required to move a -3.0 µC charge from 3.0 m to infinity from a +5.0 µC charge.

Q_1 r_0 r_∞ Q_2

$$W = \Delta E_p$$

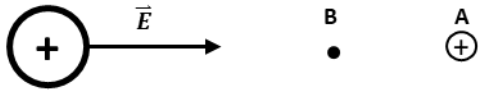
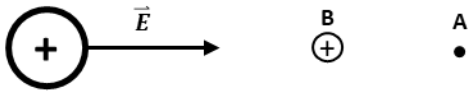
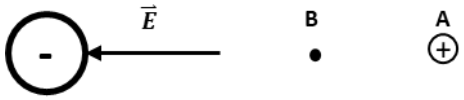
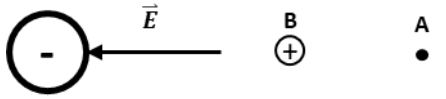
$$= E_{p\infty} - E_{p0}$$

$$= -k\frac{Q_1Q_2}{r_0}$$

$$= \frac{-(9.0\times10^9)(-3.0\times10^{-6})(5.0\times10^{-6})}{3.0}$$

$$= 4.5\times10^{-2}\ \text{J}$$

Explain what happens to the potential energy in the test charge for each scenario:

Test charge is moved from A to B 	Test charged is moved from B to A 
Test charge is moved from A to B 	Test charged is moved from B to A 

****** Stop here for the day – Do practice Problems #1-3 on page 185 and page 192 #1, 3-6***