4. (easy) A negatively charged particle (q = -2 C) moves through a 2000 v ***loss*** of electric potential. Will there a loss or gain of electric potential energy? Will there be a loss or gain of kinetic energy? (Note: Electric force is a conservative force.)

$\Delta V = \Delta U/q$

$-2000 = \Delta U/-2$

$\Delta U = 4000$ Joules

There is an increase (gain) in electric potential energy.

Since the force is conservative:

$\Delta K = -\Delta U = -4000$ J

There is a loss of kinetic energy.

5. (moderate) A negative charge moves through an electric field such that it slows down, losing 100 J of kinetic energy. The change in electric potential experienced by the charge is -10 volts.

a. What is the magnitude of the negative charge?

$\Delta V = \Delta U/q$

$-10 = 100/q$

$q = -10$ C (magnitude of 10 C)

b. If a positive charge of the double the magnitude of the first charge moved between the same two points in the field, determine the change in electric potential and the change in electric potential energy.

All charges that move between the same two points in an E-field experience the same change in electric potential which is, in this case, -10 volts.

$\Delta V = \Delta U/q$

$-10 = \Delta U/20$

$\Delta U = -200$ J

c. Would the positive charge in part b speed up or slow down?

Since the positive charge loses potential energy it must gain kinetic energy. It will speed up.

6. Assume the central charge shown below is at rest and will remain at rest. Evaluate the scenario to answer the following questions:

a. In which direction will the test charge move?

The test charge will move in the direction of the force shown below...toward the central charge.

b. Will the test charge speed up or slow down?

The test charge will accelerate under the action of the force and speed up from rest.

c. Will the kinetic energy of the particle increase or decrease?

The kinetic energy will increase due to an increase in speed.

c. Will the kinetic energy of the particle increase or decrease?

The kinetic energy will increase due to an increase in speed.

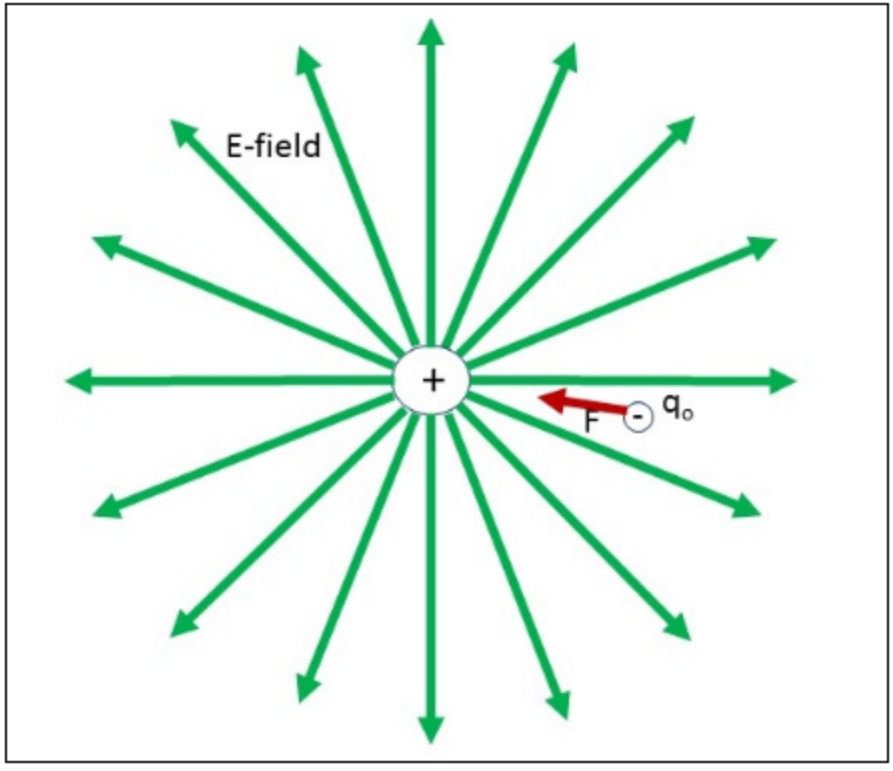
d. Will the electric potential energy increase or decrease?

Because the force is conservative, the electric potential energy will decrease.

e. Will the electric potential increase or decrease?

Since ΔU is negative and q_o is negative, the change in electric potential (ΔV) is positive since $\Delta V = \Delta U/q_o$.

The electric potential decreases when the charge "follows the field" and increases when the charge moves "against the field". This idea is true for both positive and negative charges.



7. (moderate) An E-field exists such that its components in the x and z directions are zero, but the component to the y direction is 6.0 N/C (uniform). A proton moves from the origin to the position y = 10.0 m. Determine the change in electric potential. Additionally, find the change in potential if the proton moved from the origin to x = 10.0 m.

For the motion along the y axis:

$\Delta V = -Ed$

$\Delta V = -(6.0)(10.0) = -60$ v

For the motion along the x axis:

$\Delta V = -Ed$

$\Delta V = -(0)(10.0) = 0$ v

8. (moderate) A charged particle moves along a straight line in a uniform E-field (E = 50 V/m). The field is in the same direction as the displacement. Find the change in electric potential if the object moves from x = 5.0 m to x = 100.0 m. Does the change in potential depend upon the positive or negative nature of the charge?

In the case of a uniform field: $\Delta V = -Ed$ (where d is the distance moved along the field)

$\Delta V = -50((100 - 5) = -4750$ volts

The change in potential does not depend upon the sign of the charge.

9. (moderate) A charged particle (+2.2 pC) moves along a the x axis in an E-field (22 N/m) that is also directed along the x-axis. Determine both the change in electric potential and the change in electric potential energy (in MeV) for the particle when it undergoes a displacement from x = 2 m to x = 20 m. Will this particle speed up or slow down?

$\Delta V = -Ed$

$\Delta V = -22(18) = -396$ volts

$\Delta U = q\Delta V$

$\Delta U = 2.2\times10^{-12}(-396) = -8.71\times10^{-10}$ J $(1eV/1.6\times10^{-19}J) = -5.4\times10^{9}$ eV = -5400 MeV

A loss of U means a gain of K. The particle will speed up.