Quiz 19.1A

$q = -88.2\ \mu C$

A negatively charged 244-gram puck slides across a horizontal, frictionless surface with an initial speed of 5.40 m/s in the +x direction. You can assume the only force in this problem that does any work is the electric force.

As the puck moves, it slows down and finally briefly comes to a stop after traveling a total distance of 3.75 meters in the +x direction from its initial location (much like a ball thrown upward comes to rest for an instant at its maximum height).

a) How much work is done by the electric field during this motion?
b) If the voltage at the initial location of the puck is 0.00 Volts, what is the voltage at the final location of the puck, where it briefly comes to rest?

a) $W_E = \Delta K$

$= \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2$

$= 0 - \frac{1}{2}(.244)(5.40)^2 = \boxed{-3.56\ J}$

b) $W_E = -\Delta U_E = -q\Delta V$

$-3.56 = -q\Delta V$

$\Delta V = \frac{3.56}{-88.2\times10^{-6}} = -40,335$

so $\boxed{V_F = -40,300\ Volts}$

makes sense b/c to slow down, negative charge moves in same dir as $\vec{E}$, so $\vec{E}$ points → from higher (0) to lower (-40,300) voltage.

Checking other solution paths

$|E| = \frac{\Delta V}{d} = 10,800\ \frac{V}{m}$

$W_E = |qE|\Delta s|\cos 180°$

$= (88.2\times10^{-6})(10800)(3.75)(-1)$

$= -3.57\ J$ ✓