ICE: Electric Potential 2

2a) A negative test charge $Q = -0.6 \text{C}$ was moved from point A to point B in a uniform electric field $E = 5 \text{N/C}$. (The test charge is at rest before and after the move.) The distance between A and B is 0.5m and the line connecting A and B is \textbf{perpendicular} to the electric field. How much work was done by the net external force while moving the test charge from A to B?

\[ W_{\text{ext}} = + \Delta U = q \Delta V \]
\[ \text{with } \Delta V = - \int E \cdot dx \]
\[ E = 5 \text{ N/C} \]

\text{In this case: } E \perp dx \]
\[ \text{So } \Delta V = 0 \text{ and } W_{\text{ext}} = 0 \]

2b) After moving the -0.6C test charge from A to B, it was then moved from B to C along the electric field line. (The test charge is at rest before and after the move.) The distance between B and C also is 0.5m. How much work was done by the net external force while moving the test charge from A to C?

\[ \Delta V = - \int E \cdot dx = -EDx \]
\[ W_{\text{ext}} = +q \Delta V = -qEDx \]
\[ = (+0.6C)(5 \text{N/C})(0.5 \text{m}) \]
\[ = +1.5 \text{ J} \]

2c) Suppose the charge is instead moved from A to D and then to C. How much work was done by the net external force while moving the test charge this time?

The work done is \textbf{independent of path} since the Coulomb force is conservative. Hence $W_{\text{ext}}^{A \rightarrow C} = +1.5 \text{ J}$ regardless of the route taken.

\[ \text{UST Physics, Ohmann and Lopez del Puerto} \]