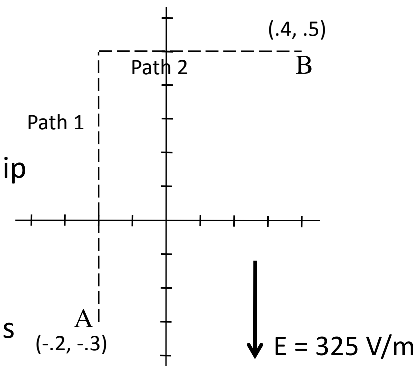
Problem 25.3

Determine $\Delta V = V_B - V_A$

As long as the electric field is constant, the relationship

$$\vec{E} \bullet \vec{d} = -\Delta V$$

$$E\ d_{1\,to\,2} \cos\theta = -(V_2 - V_1)$$

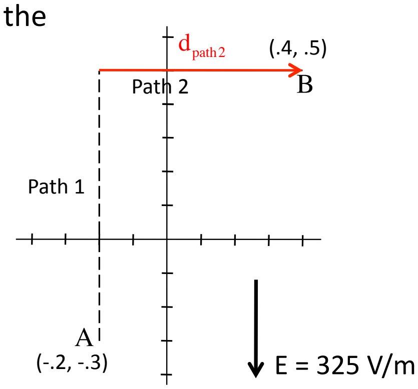


holds along any path, where the electric field vector is obvious and the *d* vector is defined as a vector that starts at a particular point and end at a second point in the field. Notice that the angle between *E* and *d* in the *dot product* will depend upon where *d* starts and where it ends.

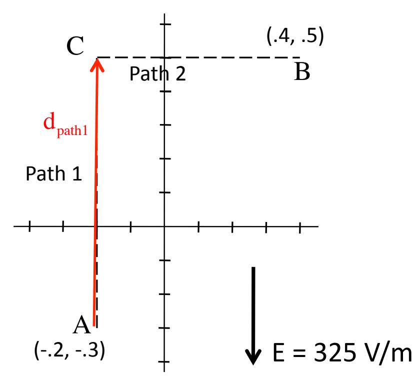
For Path 2: Defining *d* as shown in the sketch, notice that *E* and *D* are at right angles to one another. That means that

$$Ed_{path\,2} \cos 90^\circ = 0$$

and the voltage *difference* along the path is zero (or, the voltage doesn't change along the path.)



For Path 1: Defining *d* to start at Point A and terminate at Point C, notice that the angle between *E* and *d* is 180 degrees, relative to one another. That means that



$$\vec{E} \bullet \vec{d} \quad = \quad -\Delta V$$

$$E \quad d_{A\ to\ C} \quad \cos 180^\circ = -(V_C - V_A)$$

$$(325\ \text{V/m})[(.5\ \text{m}) - (-.3\ \text{m})](-1) \quad = \quad -\Delta V$$

$$\Rightarrow \quad \Delta V = 260\ \text{volts}$$

As the voltage doesn't change along Path 2, the voltage difference between A and B must be the same as the voltage difference between A and C, or 260 volts.

Notice that solution this means that traveling AGAINST the electric field, as we did above, produces a *positive* voltage difference. That means traveling WITH electric fields must produce a negative voltage difference. Apparently, electrical potentials run from HIGHER to LOWER voltage.