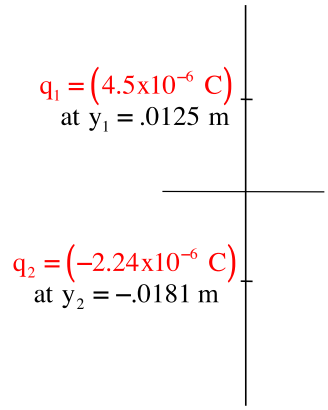
Problem 25.11

Consider the charges located as shown:



a.) Determine the net voltage V at the origin:

To begin with, voltages add like scalars such that:

$$V_{origin} = k\frac{q_1}{|y_1|} + k\frac{q_2}{|y_2|}$$

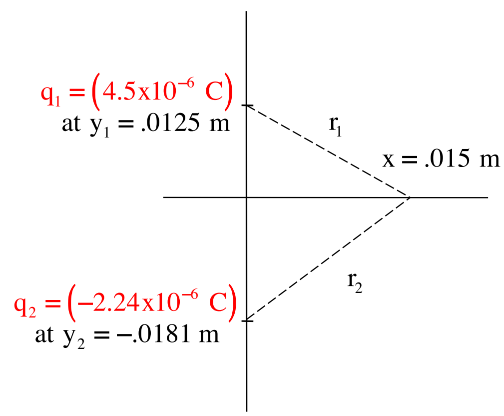
$$= (9x10^9 N\bullet m^2/C^2)\frac{(4.5x10^{-6}\ C)}{(.0125\ m)} + (9x10^9 N\bullet m^2/C^2)\frac{(-2.24x10^{-6}\ C)}{(.0181\ m)}$$

$$\Rightarrow \quad V_{origin} = 2.12x10^6 \text{ volts}$$

The two things to note about this calculation is that the distance to the point of interest is a *magnitude* (always positive) whereas the charge MUST have its sign included. That is, voltages for negative charges will always be negative, where the negative sign does NOT come from the coordinate but rather comes from the charge.

b.) Determine the net voltage V at point "x":

To begin with, we need to determine the distance between the charges and the point of interest. The Pythagorean relationship will help here:



$$r_1 = \left((.015\ m)^2 + (.0125\ m)^2\right)^{1/2}$$
$$= .0195\ m$$

$$r_1 = \left((.015\ m)^2 + (-.018\ m)^2\right)^{1/2}$$
$$= .0234\ m$$

$$V_{origin} = k\frac{q_1}{|r_1|} + k\frac{q_1}{|r_2|}$$

$$= (9x10^9 N\bullet m^2/C^2)\frac{(4.5x10^{-6}\ C)}{(.0195\ m)} + (9x10^9 N\bullet m^2/C^2)\frac{(-2.24x10^{-6}\ C)}{(.0234\ m)}$$

$$\Rightarrow \quad V_{origin} = 1.21x10^6 \text{ volts}$$