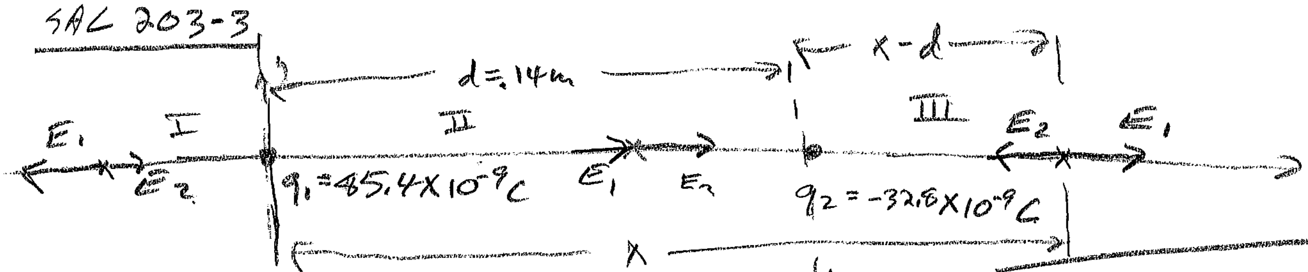
SAC 203-3



Because of the r^2 in $E = \frac{kq}{r^2}$, $\boxed{E = 0 \text{ at } x = -\infty \text{ and } E = 0 \text{ at } x = +\infty}$

Divide axis up into regions I, II, III. only other possibility for $E=0$ is in region III.

In region I $\vec{E}_1$ and $\vec{E}_2$ are in opposite directions but $E_1 > E_2$ at all points because all points are closer to q_1, and, q_1 is greater. can't have $E=0$

In II $\vec{E}_1$ & $\vec{E}_2$ both to right no cancellation can't have $E=0$

Region III. E_1 & E_2 are in opposite directions. Use + & - to chor. direction w/ + to right.

$$\vec{E}_1 + \vec{E}_2 = 0$$

$$\frac{kq_1}{x^2}\hat{\imath} + \frac{kq_2}{(x-d)^2}\hat{\imath} = 0$$

$$\left(q_1(x-d)^2 + q_2 x^2\right)\hat{\imath} = 0$$

[FOR THE VECTOR TO BE 0, IT'S x-comp must be 0]:

$$(x-d)^2 + \frac{q_2}{q_1}x^2 = 0$$

$$x^2 - 2dx + d^2 + \frac{q_2}{q_1}x^2 = 0$$

$$\left(1 + \frac{q_2}{q_1}\right)x^2 - 2dx + d^2 = 0$$

$$x = \frac{-(-2d) \pm \sqrt{(-2d)^2 - 4\left(1 + \frac{q_2}{q_1}\right)d^2}}{2\left(1 + \frac{q_2}{q_1}\right)}$$

$$x = \frac{2d \pm \sqrt{4d^2 - 4\left(1 + \frac{q_2}{q_1}\right)d^2}}{2\left(1 + \frac{q_2}{q_1}\right)}$$

$$x = \frac{d \pm \sqrt{d^2 - \left(1 + \frac{q_2}{q_1}\right)d^2}}{1 + \frac{q_2}{q_1}}$$

$$x = \frac{d \pm \sqrt{-\frac{q_2}{q_1}}\,d}{1 + \frac{q_2}{q_1}}$$

$$x = \frac{d\left(1 \pm \sqrt{-\frac{q_2}{q_1}}\right)}{1 + \frac{q_2}{q_1}}$$

$$= \frac{14\,cm\left(1 \pm \sqrt{-\frac{-32.8\,nC}{85.4\,nC}}\right)}{1 + \frac{-32.8\,nC}{85.4\,nC}}$$

$\boxed{x = 36.8\,cm}$, ~~8.64 cm~~ This is in II