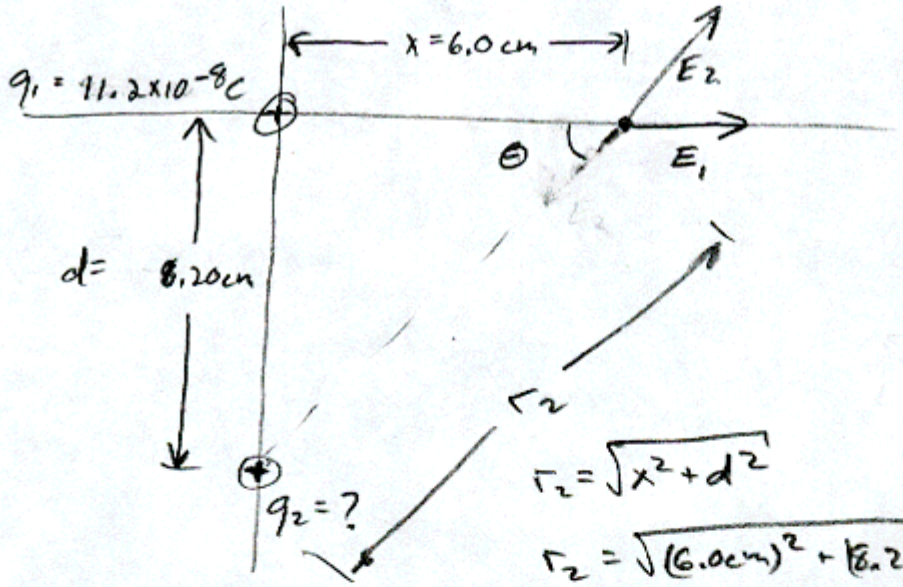
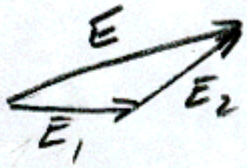
SAL 203 - 4 PAGE 1





$r_2 = \sqrt{x^2 + d^2}$

$r_2 = \sqrt{(6.0\text{cm})^2 + (8.20\text{cm})^2} = 10.16\text{cm}$

$$E_1 = \frac{kq_1}{x^2} = \frac{8.99 \times 10^9 \frac{N \cdot m^2}{c^2}\,(11.2 \times 10^{-8} C)}{(.060m)^2}$$

$$E_1 = 2.797 \times 10^5 \frac{N}{c}$$

$$E = 2E_1$$

$$E = 2\left(2.797 \times 10^5 \frac{N}{c}\right)$$

$$E = 5.594 \times 10^5 \frac{N}{c}$$

Knowing E_1 & E we just have to find E_2

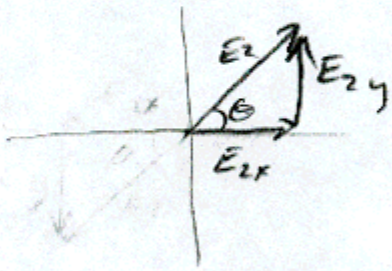
Then use $E_2 = \frac{kq_2}{r_2^2}$ to get q_2

$$\tan\theta = \frac{d}{x}$$

$$\theta = \tan^{-1}\frac{d}{x}$$

$$\theta = \tan^{-1}\frac{8.20\text{cm}}{6.0\text{cm}}$$

$$\theta = 53.81^\circ$$

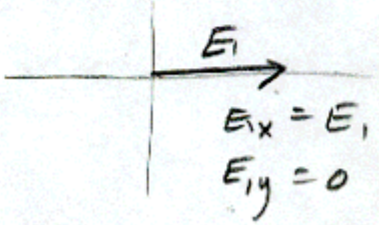


$|E_{2x}| = E_2 \cos\theta$

$E_{2x} = +E_2 \cos\theta$

$|E_{2y}| = E_2 \sin\theta$

$E_{2y} = +E_2 \sin\theta$



$E_{1x} = E_1$

$E_{1y} = 0$

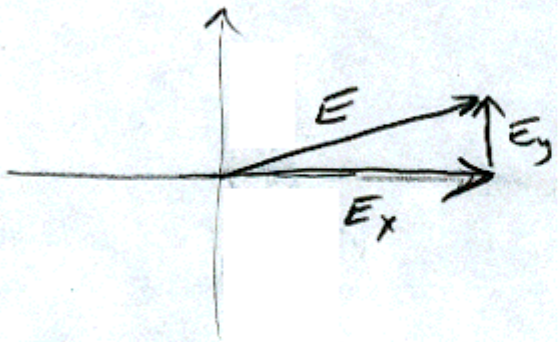
$$E_x = E_{1x} + E_{2x}$$

$$E_x = E_1 + E_2\cos\theta$$

$$E_y = E_{1y} + E_{2y}$$

$$E_y = 0 + +E_2\sin\theta$$

$$E_y = +E_2\sin\theta$$



$$E^2 = E_x^2 + E_y^2$$

$$E^2 = (E_1 + E_2\cos\theta)^2 + (+E_2\sin\theta)^2$$

$$E^2 = E_1^2 + 2E_1E_2\cos\theta + \underbrace{E_2^2(\cos\theta)^2 + E_2(\sin\theta)^2}_{E_2^2(\cos^2\theta + \sin^2\theta)}$$

$$\cos^2\theta + \sin^2\theta = 1$$

$$E^2 = E_2^2 + 2E_1(\cos\theta)E_2 + E_1^2$$

$$E_2^2 + 2E_1(\cos\theta)E_2 + (E_1^2 - E^2) = 0$$

$$E_2 = \frac{-[+2E_1\cos\theta] \pm \sqrt{(+2E_1\cos\theta)^2 - 4\cdot1\cdot(E_1^2 - E^2)}}{2}$$

$$E_2 = -E_1\cos\theta \pm \sqrt{(E_1\cos\theta)^2 + E^2 - E_1^2}$$

$$E_2 = -2.797\times10^5\,\frac{N}{C}\cos 53.81^\circ \pm \left[\left(2.797\times10^5\,\frac{N}{C}\cos 53.81^\circ\right)^2 + \left(5.594\times10^5\,\frac{N}{C}\right)^2 - \left(2.797\times10^5\,\frac{N}{C}\right)^2\right]^{1/2}$$

$$E_2 = -6.77\times10^5\,\frac{N}{C},\ +3.467\times10^5\,\frac{N}{C}$$ [ANS CAN'T BE −]

$$E_2 = \frac{k|q_2|}{r_2^2}$$

$$|q_2| = \frac{E_2 r_2^2}{k}$$

$$= \frac{3.467 \times 10^5 \frac{N}{C} (.1016\,m)^2}{8.99 \times 10^9 \frac{N \cdot m^2}{C^2}}$$

$$q_2 = 3.981 \times 10^{-7} C$$

$$\boxed{q_2 = .40 \mu C}$$

Check

$$E_2 = \frac{kq_2}{r_2^2} = \frac{8.99 \times 10^9 \frac{N \cdot m^2}{C^2} (.3981 \times 10^{-6} C)}{(.060m)^2 + (.0820m)^2}$$

$$E_2 = 3.467 \times 10^5 N/C$$

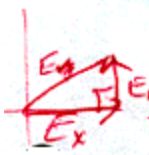
$$E_{2x} = E_2 \cos\theta = 3.467 \times 10^5 \frac{N}{C} \frac{6.0cm}{\sqrt{(6cm)^2 + 8.2cm^2}}$$

$$E_{2x} = 2.047 \times 10^5 \frac{N}{C}$$

$$E_{2y} = E_2 \sin\theta = E_2 \frac{d}{x^2 + d^2} = 3.467 \times 10^5 \frac{N}{C} \frac{8.2cm}{\sqrt{(6cm)^2 + (8.2cm)^2}}$$

$$E_{2y} = 2.798 \times 10^5 N/C$$

$$E_x = E_{1x} + E_{2x} = 2.797 \times 10^5 \frac{N}{C} + 2.047 \times 10^5 N/C = 4.844 \times 10^5 \frac{N}{C}$$



$$E_y = E_{2y} = 2.798 \times 10^5 N/C$$

$$E = \sqrt{E_x^2 + E_y^2} = \sqrt{(4.844 \times 10^5 \frac{N}{C})^2 + (2.798 \times 10^5 N/C)^2}$$

$$E = 5.594 \times 10^5 N/C \quad \text{which is indeed } 2E_1 \quad \checkmark$$