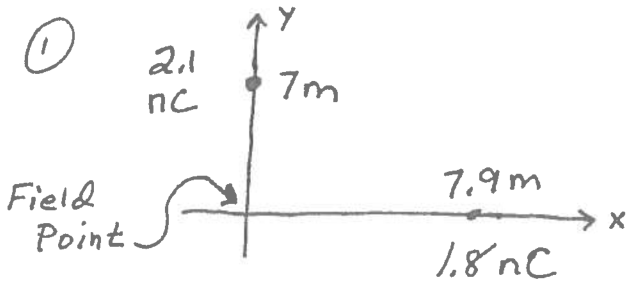
Ch 18: Find E version A

(1)




$$E_x = k\frac{Q_1}{R_1^2} = \frac{(8.99E9)(1.8E-9)}{7.9^2}$$

$$= .2593\ N/C$$

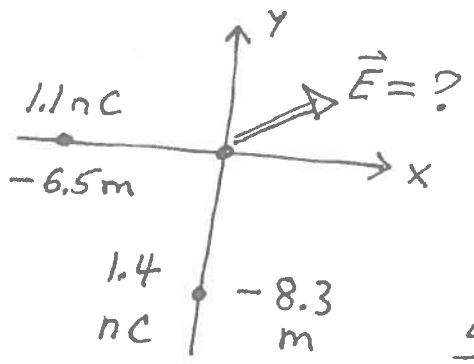
$$E_y = k\frac{Q_2}{R_2^2} = \frac{(8.99)(2.1)}{7^2}$$

$$= .3853\ N/C$$

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

$$\boxed{E = .465\ N/C}$$

(2)



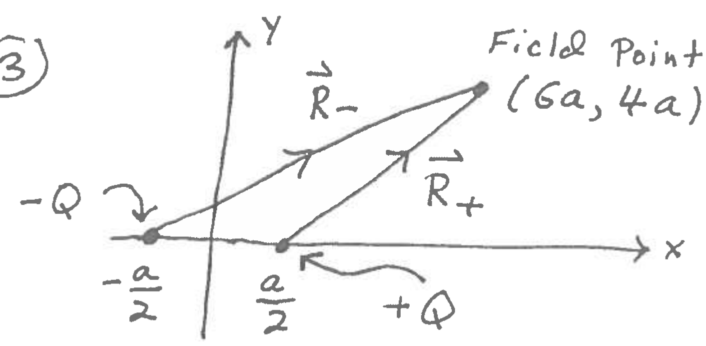

$$E_x = \frac{(8.99)(1.1)}{6.5^2}$$

$$E_y = \frac{(8.99)(1.4)}{8.3^2}$$

$$\frac{E_y}{E_x} = \frac{1.4}{8.3^2}\,\frac{6.5^2}{1.1} = \tan\theta = .7806$$

$$\theta = \tan^{-1}(.7806) = .66\text{ rad}\left(\frac{180\text{ deg}}{\pi\text{ rad}}\right) = \boxed{38^\circ = \theta}$$

(3)




$$\vec{E} = k\left(\frac{Q_+}{R_+^3}\vec{R}_+ + \frac{Q_-}{R_-^3}\vec{R}_-\right)$$

$$\vec{E} = kQ\left(\frac{\vec{R}_+}{R_+^3} - \frac{\vec{R}_-}{R_-^3}\right) \qquad \vec{R}_+ = \vec{r} - \vec{r}_+$$

$$\vec{R}_- = \vec{r} - \vec{r}_-$$

$$\vec{r} = 6a\,\hat{i} + 4a\,\hat{j} \;//\; \vec{r}_+ = \frac{a}{2}\hat{i} \;//\; \vec{r}_- = -\frac{a}{2}\hat{i}$$

$$\vec{R}_+ = (6a - .5a)\hat{\imath} + 4a\hat{\jmath} = (5.5\hat{\imath} + 4\hat{\jmath})a$$

$$\vec{R}_- = (6a - -.5a)\hat{\imath} + 4a\hat{\jmath} = (6.5\hat{\imath} + 4\hat{\jmath})a$$

$$R_+ = a\sqrt{5.5^2 + 4^2} = 6.8a \quad // \quad R_- = a\sqrt{6.5^2 + 16} = 7.632a$$

$$E_x = kQ\left\{\frac{5.5a}{(6.8a)^3} - \frac{6.5a}{(7.632a)^3}\right\} = \boxed{\frac{kQ}{a^2}\{.00287\}}$$

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$$\vec{r} = 1.1a\hat{\imath} + 1.2a\hat{\jmath}$$ Charges at $\pm .5a\hat{\imath}$

$$\vec{R}_+ = (1.1a - .5a)\hat{\imath} + 1.2a\hat{\jmath} = .6a\hat{\imath} + 1.2a\hat{\jmath}$$

$$\vec{R}_- = (1.1a + .5a)\hat{\imath} + 1.2a\hat{\jmath} = 1.6a\hat{\imath} + 1.2a\hat{\jmath}$$

$$R_+ = \sqrt{.6^2 + 1.2^2}\,a = 1.342a$$

$$R_- = \sqrt{1.6^2 + 1.2^2}\,a = 2.0a$$

$$\vec{E} = kQ\left\{\frac{\vec{R}_+}{R_+^3} - \frac{\vec{R}_-}{R_-^3}\right\}$$ we want $E_y$ so we take the y-components:

$$\vec{R}_+ \cdot \hat{\jmath} = 1.2a = \vec{R}_- \cdot \hat{\jmath}$$

$$E_y = kQ\left\{\frac{1.2a}{(1.342a)^3} - \frac{1.2a}{(2a)^3}\right\} = \boxed{\frac{kQ}{a^2}\{-.347\}}$$