4.13 Charge $q_1 = 6\ \mu$C is located at $(1\text{ cm}, 1\text{ cm}, 0)$ and charge q_2 is located at $(0, 0, 4\text{ cm})$. What should q_2 be so that **E** at (0, 2 cm, 0) has no y-component?

Solution:

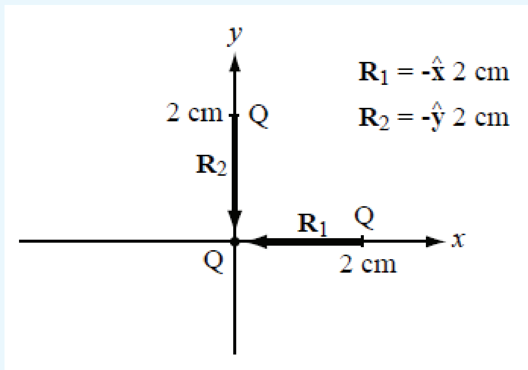

Figure P4.13 Locations of charges in Problem 4.13.

For the configuration of Fig. P4.13, use of Eq. (4.19) gives

$$\mathbf{E}(\mathbf{R} = \hat{\mathbf{y}}2\text{cm}) = \frac{1}{4\pi\varepsilon}\left[\frac{6\mu\text{C}(-\hat{\mathbf{x}}+\hat{\mathbf{y}})\times 10^{-2}}{(2\times 10^{-2})^{3/2}} + \frac{q_2(\hat{\mathbf{y}}2-\hat{\mathbf{z}}4)\times 10^{-2}}{(20\times 10^{-2})^{3/2}}\right]$$

$$= \frac{1}{4\pi\varepsilon}[-\hat{\mathbf{x}}21.21\times 10^{-6} + \hat{\mathbf{y}}(21.21\times 10^{-6} + 0.224q_2)$$

$$-\hat{\mathbf{z}}0.447q_2] \qquad \text{(V/m)}.$$

If $E_y = 0$, then $q_2 = -21.21\times 10^{-6}/0.224 \approx -94.69$ (μC).