

Problem 4.13 Charge $q_1 = 4 \mu\text{C}$ 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 \mathbf{E} at $(0, 2 \text{ cm}, 0)$ has no y-component?

Solution:

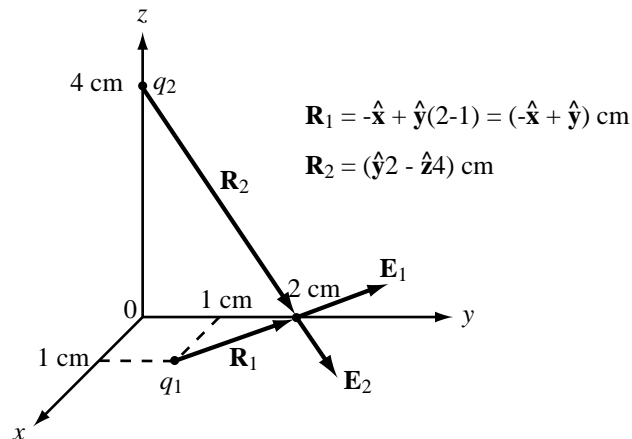


Figure P4.13: Locations of charges in Problem 4.13.

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

$$\begin{aligned} \mathbf{E}(\mathbf{R} = \hat{\mathbf{y}}2\text{cm}) &= \frac{1}{4\pi\epsilon} \left[\frac{6\mu\text{C}(-\hat{\mathbf{x}} + \hat{\mathbf{y}}) \times 10^{-2}}{(2 \times 10^{-2})^{3/2}} + \frac{q_2(\hat{\mathbf{y}}2 - \hat{\mathbf{z}}4) \times 10^{-2}}{(20 \times 10^{-2})^{3/2}} \right] \\ &= \frac{1}{4\pi\epsilon} [-\hat{\mathbf{x}}21.21 \times 10^{-6} + \hat{\mathbf{y}}(21.21 \times 10^{-6} + 0.224q_2) \\ &\quad - \hat{\mathbf{z}}0.447q_2] \quad (\text{V/m}). \end{aligned}$$

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