

44. We are looking for a charge q which, when placed at the origin, experiences $\vec{F}_{\text{net}} = 0$, where

$$\vec{F}_{\text{net}} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 \quad .$$

The magnitude of these individual forces are given by Coulomb's law, Eq. 22-1, and without loss of generality we assume $q > 0$. The charges q_1 ($+6 \mu\text{C}$), q_2 ($-4 \mu\text{C}$), and q_3 (unknown), are located on the $+x$ axis, so that we know \vec{F}_1 points towards $-x$, \vec{F}_2 points towards $+x$, and \vec{F}_3 points towards $-x$ if $q_3 > 0$ and points towards $+x$ if $q_3 < 0$. Therefore, with $r_1 = 8 \text{ m}$, $r_2 = 16 \text{ m}$ and $r_3 = 24 \text{ m}$, we have

$$0 = -k \frac{q_1 q}{r_1^2} + k \frac{|q_2| q}{r_2^2} - k \frac{q_3 q}{r_3^2} \quad .$$

Simplifying, this becomes

$$0 = -\frac{6}{8^2} + \frac{4}{16^2} - \frac{q_3}{24^2}$$

where q_3 is now understood to be in μC . Thus, we obtain $q_3 = -45 \mu\text{C}$.