41. Charge $q_1 = -80 \times 10^{-6}$ C is at the origin, and charge $q_2 = +40 \times 10^{-6}$ C is at $x = 0.20$ m. The force on $q_3 = +20 \times 10^{-6}$ C is due to the attractive and repulsive forces from q_1 and q_2, respectively. In symbols, $\vec{F}_{3\ \text{net}} = \vec{F}_{3\,1} + \vec{F}_{3\,2}$, where

$$|\vec{F}_{3\,1}| = k\,\frac{q_3\,|q_1|}{r_{3\,1}^2} \qquad \text{and} \quad |\vec{F}_{3\,2}| = k\,\frac{q_3\,q_2}{r_{3\,2}^2} \quad .$$

(a) In this case $r_{3\,1} = 0.40$ m and $r_{3\,2} = 0.20$ m, with $\vec{F}_{3\,1}$ directed towards $-x$ and $\vec{F}_{3\,2}$ directed in the $+x$ direction. Using the value of k in Eq. 22-5, we obtain $\vec{F}_{3\ \text{net}} = 89.9 \approx 90$ N in the $+x$ direction.

(b) In this case $r_{3\,1} = 0.80$ m and $r_{3\,2} = 0.60$ m, with $\vec{F}_{3\,1}$ directed towards $-x$ and $\vec{F}_{3\,2}$ towards $+x$. Now we obtain $\vec{F}_{3\ \text{net}} = 2.5$ N in the $-x$ direction.

(c) Between the locations treated in parts (a) and (b), there must be one where $\vec{F}_{3\ \text{net}} = 0$. Writing $r_{3\,1} = x$ and $r_{3\,2} = x - 0.20$ m, we equate $|\vec{F}_{3\,1}|$ and $|\vec{F}_{3\,2}|$, and after canceling common factors, arrive at

$$\frac{|q_1|}{x^2} = \frac{q_2}{(x-0.2)^2} \quad .$$

This can be further simplified to

$$\frac{(x-0.2)^2}{x^2} = \frac{q_2}{|q_1|} = \frac{1}{2} \quad .$$

Taking the (positive) square root and solving, we obtain $x = 0.68$ m. If one takes the negative root and 'solves', one finds the location where the net force *would* be zero *if* q_1 and q_2 were of like sign (which is not the case here).