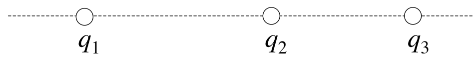
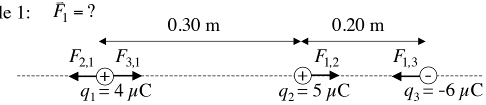


Example 1:

Three charges are fixed along a straight line as shown in the figure above with $q_1 = 4.0 \times 10^{-6}$ C, $q_2 = 5.0 \times 10^{-6}$ C, and $q_3 = -6.0 \times 10^{-6}$ C. The distance between q_1 and q_2 is 0.30 m and the distance between q_2 and q_3 is 0.20 m. Find the net force on each charge due to the other charges

Example 1: $\vec{F}_1 = ?$



$$\vec{F}_1 = \vec{F}_{2,1} + \vec{F}_{3,1}$$

$$F_{2,1} = k\left|\frac{q_2 q_1}{r_{21}^2}\right| = \left(9.0\times10^{9}\ \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}\right)\left|\frac{(5.0\times10^{-6}\ \text{C})(4.0\times10^{-6}\ \text{C})}{(0.30\ \text{m})^2}\right| = 2.0\ \text{N}$$

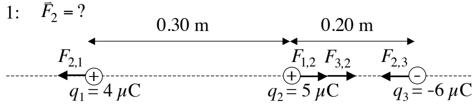
$$\vec{F}_{2,1} = -2.0\ \text{N}$$

$$F_{3,1} = k\left|\frac{q_3 q_1}{r_{31}^2}\right| = \left(9.0\times10^{9}\ \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}\right)\left|\frac{(-6.0\times10^{-6}\ \text{C})(4.0\times10^{-6}\ \text{C})}{(0.50\ \text{m})^2}\right| = 0.864\ \text{N}$$

$$\vec{F}_{3,1} = 0.864\ \text{N}$$

$$\vec{F}_1 = \vec{F}_{2,1} + \vec{F}_{3,1} = -2.0\ \text{N} + 0.864\ \text{N} = -1.136\ \text{N} \quad \text{so} \quad \boxed{\vec{F}_1 = 1.136\ \text{N}\ \angle 180°}$$

Example 1: $\vec{F}_2 = ?$



$$\vec{F}_2 = \vec{F}_{1,2} + \vec{F}_{3,2}$$

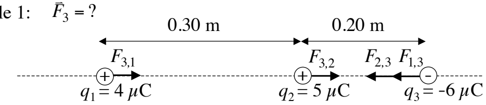
$$\vec{F}_{1,2} = -\vec{F}_{2,1} = 2.0\ \text{N}$$

$$F_{3,2} = k\left|\frac{q_3 q_2}{r_{32}^2}\right| = \left(9.0\times10^{9}\ \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}\right)\left|\frac{(-6.0\times10^{-6}\ \text{C})(5.0\times10^{-6}\ \text{C})}{(0.20\ \text{m})^2}\right| = 6.75\ \text{N}$$

$$\vec{F}_{3,2} = 6.75\ \text{N}$$

$$\vec{F}_2 = \vec{F}_{1,2} + \vec{F}_{3,2} = 2.0\ \text{N} + 6.75\ \text{N} = 8.75\ \text{N} \quad \text{so} \quad \boxed{\vec{F}_2 = 8.75\ \text{N}\ \angle 0}$$

Example 1: $\vec{F}_3 = ?$

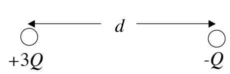


$$\vec{F}_3 = \vec{F}_{1,3} + \vec{F}_{2,3}$$

$$\vec{F}_{1,3} = -\vec{F}_{3,1} = -0.864\ \text{N}$$

$$\vec{F}_{2,3} = -\vec{F}_{3,2} = -6.75\ \text{N}$$

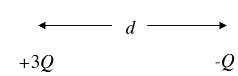
$$\vec{F}_3 = \vec{F}_{1,3} + \vec{F}_{2,3} = -0.864\ \text{N} + (-6.75)\ \text{N} = -7.61\ \text{N} \quad \text{so} \quad \boxed{\vec{F}_3 = 7.61\ \text{N}\ \angle 180°}$$



Example 2:

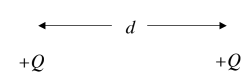
Two identical conducting spheres are charged to $+3Q$ and $-Q$, respectively, and are separated by a distance d (much greater than the radii of the spheres) as shown above. The magnitude of the force of attraction on the left sphere is F_1. After the spheres are made to touch and then are reseparated by distance d, the magnitude of the force on the left sphere is F_2. What is the relationship between F_1 and F_2?

Example 2:



$$F_1 = k\frac{(3Q)(Q)}{d^2} = k\frac{3Q^2}{d^2}$$

$$Q_{Total} = 3Q + (-Q) = 2Q$$



$$F_2 = k\frac{(Q)(Q)}{d^2} = k\frac{Q^2}{d^2} = \frac{1}{3}F_1$$