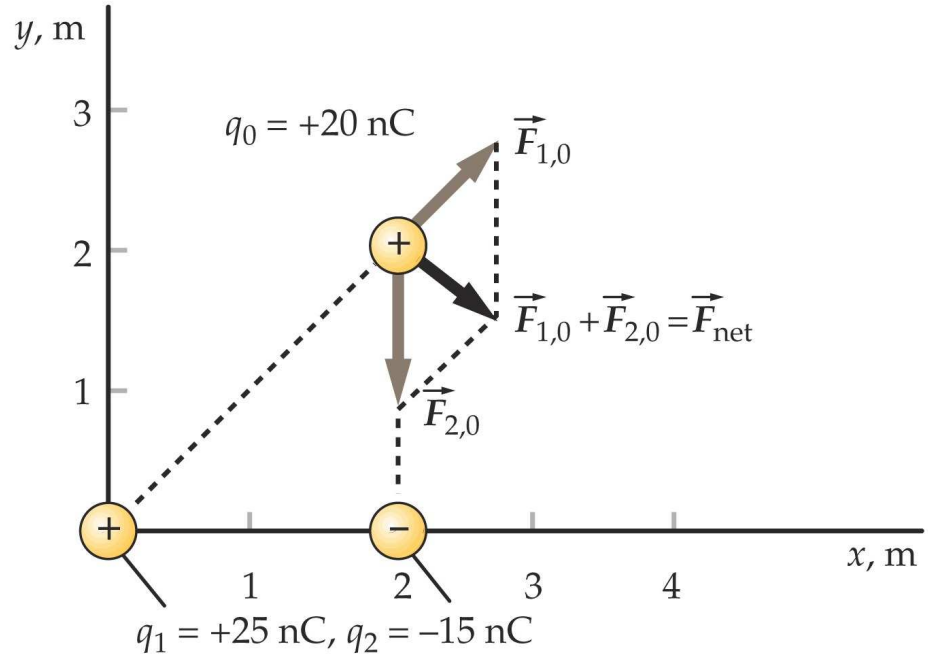
Coulomb Force in Two Dimensions (1a)



Find the magnitude and direction of the resultant force on charge q_0.

- Magnitude of individual forces:

$$F_{1,0} = k\frac{|q_1 q_0|}{r_{1,0}^2} = 5.62 \times 10^{-7}\text{N}, \quad F_{2,0} = k\frac{|q_2 q_0|}{r_{2,0}^2} = 6.74 \times 10^{-7}\text{N}.$$

- Components of individual forces:

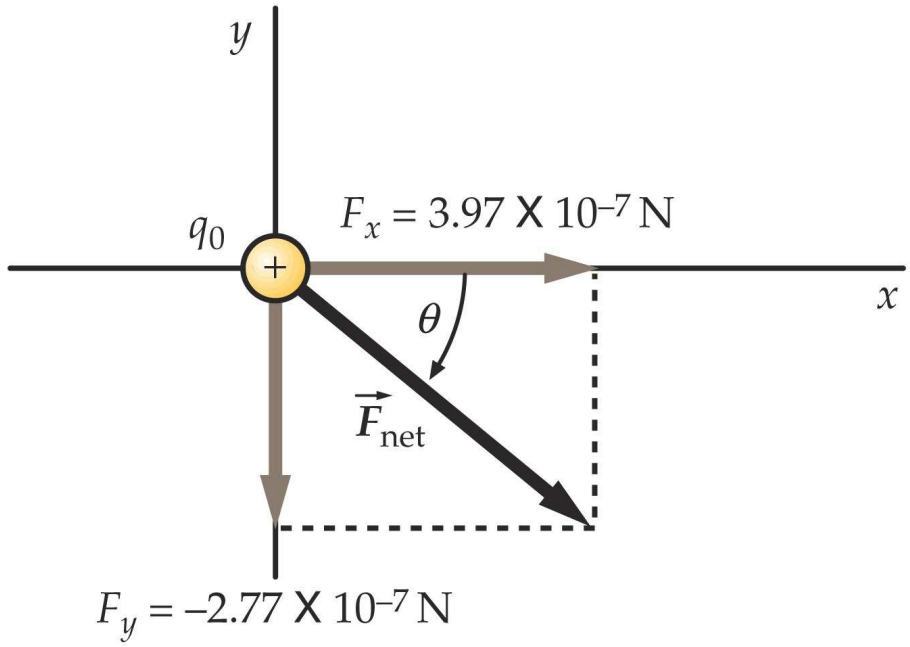
$$F_{1,0}^x = F_{1,0}\cos 45^\circ, \quad F_{1,0}^y = F_{1,0}\sin 45^\circ, \quad F_{2,0}^x = 0, \quad F_{2,0}^y = -F_{2,0}.$$

Coulomb Force in Two Dimensions (1b)

- Components of resultant force:

$$F_x = F_{1,0}^x + F_{2,0}^x = 3.97 \times 10^{-7}\mathrm{N}, \quad F_y = F_{1,0}^y + F_{2,0}^y = -2.77 \times 10^{-7}\mathrm{N}.$$

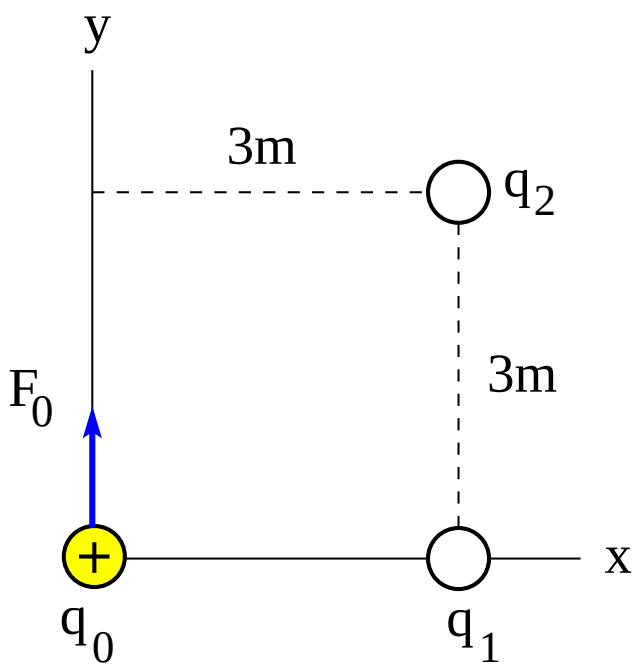
- Magnitude of resultant force: $F = \sqrt{F_x^2 + F_y^2} = 4.84 \times 10^{-7}\mathrm{N}$.
- Direction of resultant force: $\theta = \arctan\left(F_y/F_x\right) = -34.9°$.



Coulomb Force in Two Dimensions (2)

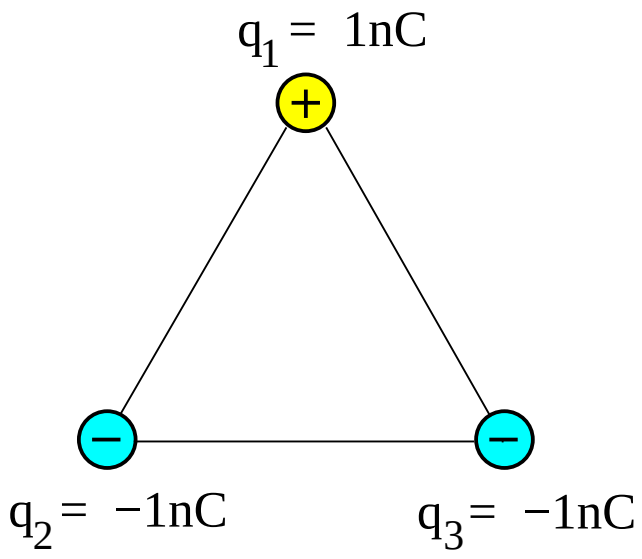
The unknwon point charges q_1, q_2 exert a force $F_0 = 2$N on the known point charge $q_0 = 1$nC. This force is directed in the positive y-direction as shown.

Determine first whether q_1, q_2 are positive or negative. Then determine the values of the two point charges.



Coulomb Force in Two Dimensions (3)

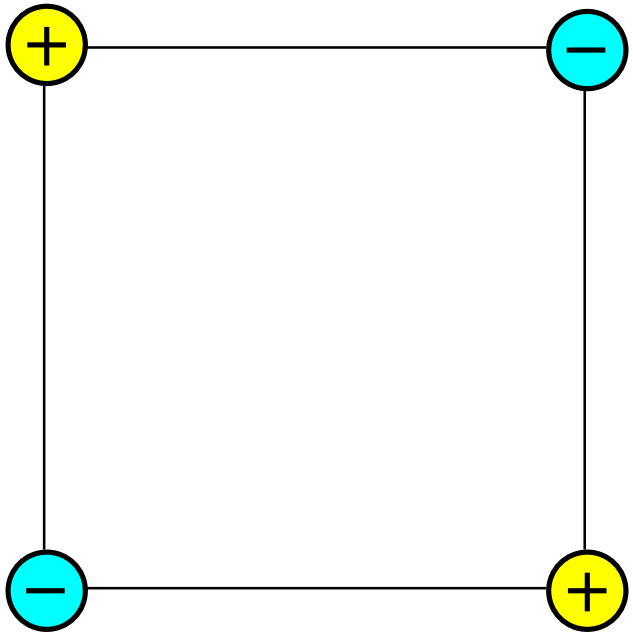
Point charges of equal magnitude are positioned at the corners of an equilateral triangle.



- Copy this configuration and indicate by arrows the direction of the resultant force on each point charge.
- Which point charge experiences the strongest force?

Coulomb Force in Two Dimensions (4)

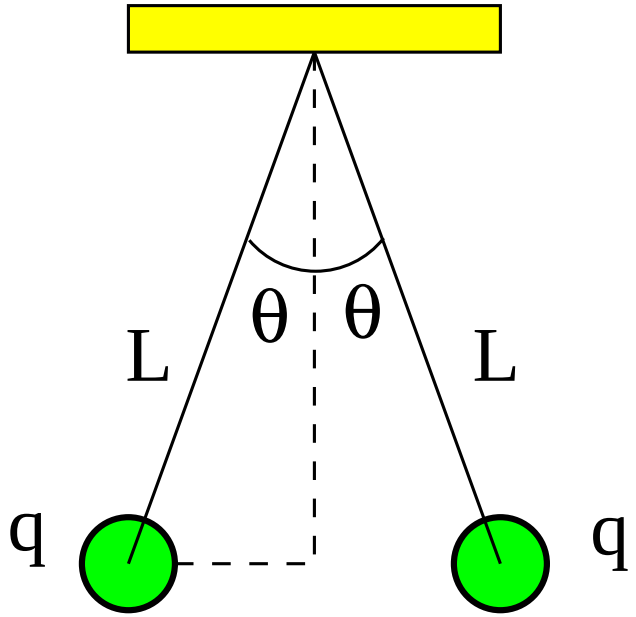
Point charges of equal magnitude are positioned at the corners of a square.



- Copy this configuration and indicate by arrows the direction of the resultant force on each point charge.
- If the force between nearest-neighbor charges is 1N, what is the strength of the resultant force on each charge?

Coulomb Force in Two Dimensions (5)

Two identical small charged spheres, each having a mass $m = 30$g, hang in equilibrium at an anlge of $\theta = 5^\circ$ from the vertical. The length of the strings is $L = 15$cm.



- Identify all forces acting on each sphere.
- Find the magnitude of the charge q on each sphere.