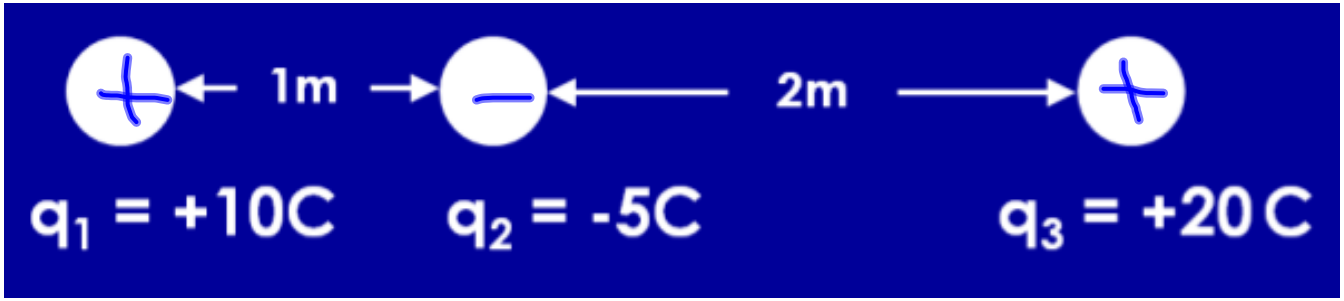
Welcome to a Couple More Coulomb's Law Problems!

Start by thinking/discussing: if 3 charges are arranged as in the figure, in what direction is the net force acting on charge 2?



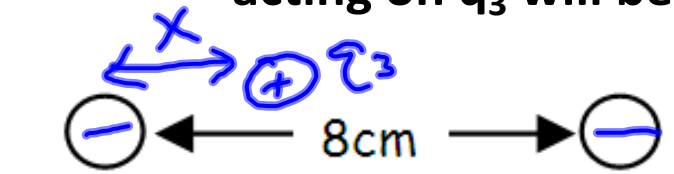
Today's Agenda

- Lesson: 2 More Kinds of Coulomb's Problems
- HW: Pg. 575-577 #15, 32, 5

(All Ch 21 HW is due tomorrow, and we've also got our 1st quiz of the year.)

Ex. #1

Two charges are arranged as in the figure. Where can a third charge $q_3 = 4\mu C$ be placed, so that the net force acting on q_3 will be zero?



$q_1 = -20nC$ $q_2 = -34nC$

$$F_{3,1} = F_{3,2}$$

$$\frac{k(20nC)(q_3)}{x^2} = \frac{k(34nC)(q_3)}{(8-x)^2}$$

$$\frac{20}{x^2} = \frac{34}{(8-x)^2}$$

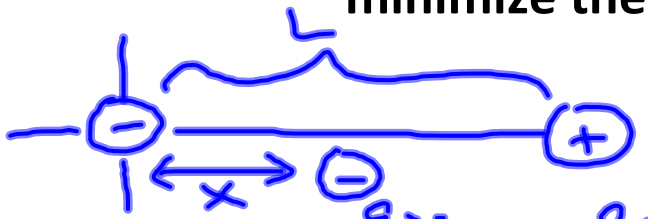
$$\frac{34x^2}{20} = 20(8-x)^2 \longrightarrow 1.7x^2 = (8-x)^2$$

$$\sqrt{1.7}\quad x = 8 - x$$

$$x = 3.47\,cm$$

Ex. #2

A charge -8Q is located at the origin, and a charge +Q is on the positive x-axis at position x=L. Where should a 3rd charge of -2Q be placed between the other charges, to minimize the net force on that 3rd charge?



$q_1 = -8Q$ $q_3 = -2Q$ $q_2 = +Q$

$$\Sigma F_3 = \vec{F}_{3,1} + \vec{F}_{3,2} = \frac{16kQ^2}{x^2} + \frac{2kQ^2}{(L-x)^2}$$

$$\frac{dF}{dx} = 2kQ^2 \frac{d}{dx}\left(8x^{-2} + (L-x)^{-2}\right)$$

$$0 = 2kQ^2\left(-16x^{-3} - 2(L-x)^{-3}(-1)\right)$$

$$0 = -\frac{16}{x^3} + \frac{2}{(L-x)^3}$$

→ to be cont...

$$\emptyset = \frac{-16}{x^3} + \frac{2}{(L-x)^3}$$

$$\frac{16}{x^3} = \frac{2}{(L-x)^3}$$

$$2x^3 = 16(L-x)^3$$

$$x^3 = 8(L-x)^3$$

$$x = 2(L-x)$$

$$x = 2L - 2x$$

$$3x = 2L$$

$$x = \frac{2L}{3}$$