Electric Force: What is the net Force on the middle charge?

\[ F_{\text{on middle due to L}} = (9 \times 10^9 \text{ N m}^2/\text{C}^2) \times (75 \times 10^{-3} \text{ C} \times 45 \times 10^{-3} \text{ C}) / (1.5 \text{ m})^2 \]
\[ F_{\text{on middle due to L}} = 1.35 \times 10^7 \text{ N}, \text{ positive, pointing to the R} \]

\[ F_{\text{on middle due to R}} = (9 \times 10^9 \text{ N m}^2/\text{C}^2) \times (-90 \times 10^{-3} \text{ C} \times 45 \times 10^{-3} \text{ C}) / (1.5 \text{ m})^2 \]
\[ F_{\text{on middle due to R}} = -1.62 \times 10^7 \text{ N}, \text{ negative, pointing to the L} \]

Net Force = \[ F_{\text{on middle due to L}} + F_{\text{on middle due to R}} \]
Net Force = \[ 1.35 \times 10^7 \text{ N} - 1.62 \times 10^7 \text{ N} \]
Net Force = \[ -0.27 \times 10^7 \text{ N}, \text{ pointing left} \]

This is the method to solve any Force or E field problem with multiple charges!
What is the magnitude and direction of the electric field at a point midway between a -20 \( \mu \text{C} \) and a +60 \( \mu \text{C} \) charge 40 cm apart?

a. 9.0 \( \times \) 10\(^6\) J (N/C)

How to solve:

Put yourself at the middle point. Look at the charge on the left. What is the E field you see due to that charge? It’s just

\[
E = k \times \frac{-20 \, \mu \text{C}}{(0.2)^2},
\]

pointing towards the left because E fields point in towards negative charges.

Look at the charge on the right. What is the E field you see due to that charge? It’s just

\[
E = k \times \frac{60 \, \mu \text{C}}{(0.2)^2},
\]

pointing towards the left because E fields point away from positive charges.
What is the magnitude and direction of the electric field at a point midway between a -20 μC and a + 60 μC charge 40 cm apart?

a. 9.0 * 10^6 N/C

\[ E_{\text{on middle due to } L} = (9 \times 10^9 \text{ N m}^2/\text{C}^2) \times (-20 \times 10^{-6} \text{ C}) / (0.2 \text{ m})^2 \]

\[ E_{\text{on middle due to } L} = -4.5 \times 10^6 \text{ N/C}, \text{ pointing left} \]

\[ E_{\text{on middle due to } R} = (9 \times 10^9 \text{ N m}^2/\text{C}^2) \times (+60 \times 10^{-6} \text{ C}) / (0.2 \text{ m})^2 \]

\[ E_{\text{on middle due to } R} = 1.34 \times 10^7 \text{ N/C}, \]

Net Field = \( E_{\text{on middle due to } L} + E_{\text{on middle due to } R} \)

Net Field = 1.35 * 10^7 N – 4.5 * 10^6 N

Net Field = 9.0* 10^6 N, pointing left: