Ch. 20 Examples

AP Physics 2

Example 1 A.) Find the magnitude and direction of the electric force on a +2μC charge in the following situation:

$$F_e = \frac{kQ_1 \cdot Q_2}{r^2} = \frac{(9\times10^9)(2\times10^{-6}\text{coul})(3\times10^{-6}\text{coul})}{(2m)^2}$$

F_e = 0.0135 Newtons to the left

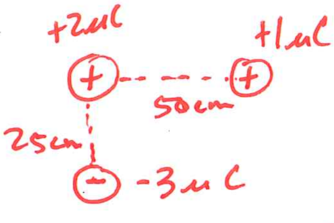
B.) Find the location that a −5μC charge would need to be placed to result in no net force on the +2μC charge.

So we need a net force of 0.0135 Newtons to the right. That means the (−) charge will be to the right of the +2μC charge.

$$0.0135N = \frac{(9\times10^9)(2\times10^{-6}\text{coul})(5\times10^{-6}\text{coul})}{(x)^2}$$

x = 2.58 meters to the right of the +2μC charge.

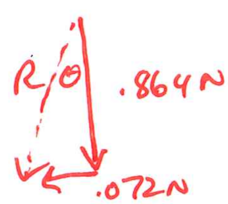
Example 2 Find the net force (and direction) on the +2 μC charge in the diagram.



$$F_{1,2} = \frac{(9\times10^9)(1\times10^{-6}\text{coul})(2\times10^{-6}\text{coul})}{(0.5m)^2} = 0.072N \text{ to the left}$$

$$F_{1,3} = \frac{(9\times10^9)(3\times10^{-6}\text{coul})(2\times10^{-6}\text{coul})}{(.25m)^2} = .864 \text{ Newtons down}$$

0.867 Newtons @ 4.76° West of South (or 85.24° South of West)



$\theta = \tan^{-1}\left(\frac{.072}{.864}\right) = 4.76°$

$R = \sqrt{(.864)^2 + (.072)^2} = 0.867N$

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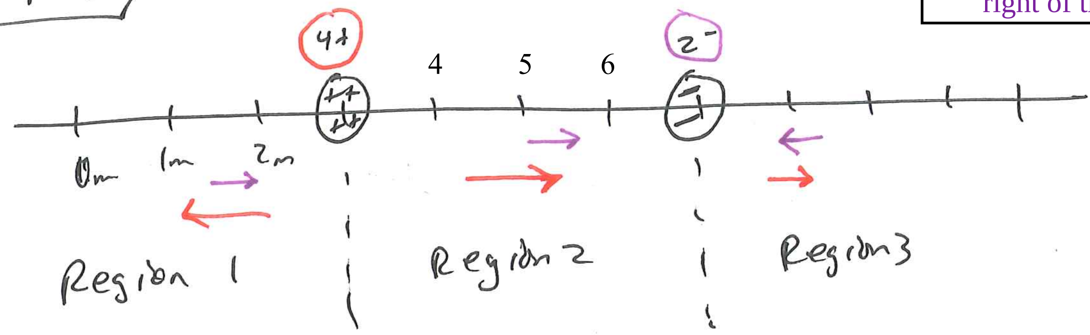
Final answer is that the electric field is zero at a position 9.66 meters to the right of the 2- charge

Example 3



Find a location where the electric field caused by the two charges is zero.

1st: Think about the direction of $\vec{E}$ cause by each charge in each region of space. I'll show this with colored arrows. Red for the 4^+ charge and purple for the 2^- charge.

In Region 1 →: The fields are going opposite directions, so they could cancel, but since the 4^+ charge is larger in magnitude AND closer in distance, the field caused by it will always be greater than the field caused by the 2^- charge.

In Region 2: The fields can't cancel since they are pointing the same direction

In Region 3: The fields can cancel because the charge 4^+ points the opposite direction as that caused by 2^-, but the 2^- charge is closer, so there will be a location where the fields cancel.

$E = \frac{KQ}{R^2}$ $\quad E_{4+} = \frac{K\,4Q}{(r+4)^2}$ $\quad E_{2-} = \frac{K\,2Q}{r^2}$

Define 'r' as the distance to the right of the 2- charge

$\frac{4}{(r+4)^2} = \frac{2}{r^2}$

$2r^2 = (r+4)^2$

$\sqrt{2}r = r+4$

$.41r = 4$

$r = 9.66m$