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Holt Physics

Problem 17A

PROBLEM

Two electrostatic point charges of $+20.0 \mu\text{C}$ and $-30.0 \mu\text{C}$ exert attractive forces on each other of -145 N . What is the distance between the two charges?

SOLUTION

Given: $q_1 = 2.00 \times 10^{-5} \text{ C}$ $q_2 = -3.00 \times 10^{-5} \text{ C}$
 $F_{\text{electric}} = -145 \text{ N}$ $k_C = 8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$

Unknown: $r = ?$

Choose the equation(s) or situation:

Use Coulomb's law, given on page 634.

$$F_{\text{electric}} = \frac{k_C q_1 q_2}{r^2}$$

Rearrange the equation(s) to solve for the unknown(s): Rearrange Coulomb's law to solve for the distance between the two charges.

$$r = \sqrt{\frac{k_C q_1 q_2}{F_{\text{electric}}}} = \sqrt{\frac{(8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2)(-3.0 \times 10^{-5} \text{ C})(2.0 \times 10^{-5} \text{ C})}{-145 \text{ N}}}$$

$r = 0.193 \text{ m} = \boxed{19.3 \text{ cm}}$

$\mu = 10^{-6}$ $n = 10^{-9}$

ADDITIONAL PRACTICE

- Two electrostatic point charges of $-13.0 \mu\text{C}$ and $-16.0 \mu\text{C}$ exert repulsive forces on each other of 12.5 N . What is the distance between the two charges?
- Two electrostatic point charges of $99.9 \mu\text{C}$ and $33.3 \mu\text{C}$ exert repulsive forces on each other of 87.3 N . What is the distance between the two charges?
- Two electrostatic point charges of $-43.2 \mu\text{C}$ and $22.4 \mu\text{C}$ exert attractive forces on each other of -6.5 N . What is the distance between the two charges?
- A glass rod rubbed against silk gains a charge of $-5.3 \mu\text{C}$. What is the electric force between the rod and the silk when the two are separated by a distance of 4.2 cm ? (Assume that the charges are located at a point.) *The other charge is $+5.3 \mu\text{C}$.*
- A glass rod rubbed against your hair gains a charge of -14.0 nC . What is the electric force between the balloon and your hair when the two are separated by a distance of 7.1 cm ? (Assume that the charges are located at a point.) *The other charge is $+14 \text{ nC}$.*

6. A dog's fur is combed and the comb gains a charge of 8.0 nC. What is the electric force between the fur and the comb when the two are separated by 2.0 cm? *The other charge is -8nC.*
7. Suppose two pions are separated by 8.3×10^{-10} m. If the magnitude of the electric force between the charges is 3.34×10^{-10} N, what is the value of q ? *$q_1 = q_2$*
8. Suppose two muons having equal but opposite charge are separated by 6.4×10^{-8} m. If the magnitude of the electric force between the charges is 5.62×10^{-14} N, what is the value of q ?
9. Suppose two delta particles are separated by 9.3×10^{-11} m. If the magnitude of the electric force between the charges is 2.66×10^{-8} N, what is the value of q ? *$q_1 = q_2$*
10. Suppose two equal charges are separated by 6.5×10^{-11} m. If the magnitude of the electric force between the charges is 9.92×10^{-4} N, what is the value of q ?

★ When $q_1 = q_2$ you can use
the equation $F_{\text{electric}} = \frac{K_c q^2}{r^2}$