

## Electric Forces and Fields

**Problem A****COULOMB'S LAW  
PROBLEM**

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

**SOLUTION**

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

**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.

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

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

**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  $12.5 \text{ N}$ . 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  $87.3 \text{ N}$ . 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  $-6.5 \text{ N}$ . 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  $4.2 \text{ cm}$ ? (Assume that the charges are located at a point.)
- A glass rod rubbed against your hair gains a charge of  $-14.0 \text{ nC}$ . What is the electric force between the balloon and your hair when the two are separated by a distance of  $7.1 \text{ cm}$ ? (Assume that the charges are located at a point.)

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?
7. Suppose two pions are separated by  $8.3 \times 10^{-10}$  m. If the magnitude of the electric force between the charges is  $3.34 \times 10^{-10}$  N, what is the value of  $q$ ?
8. Suppose two muons having equal but opposite charge are separated by  $6.4 \times 10^{-8}$  m. If the magnitude of the electric force between the charges is  $5.62 \times 10^{-14}$  N, what is the value of  $q$ ?
9. Suppose two delta particles are separated by  $9.3 \times 10^{-11}$  m. If the magnitude of the electric force between the charges is  $2.66 \times 10^{-8}$  N, what is the value of  $q$ ?
10. Suppose two equal charges are separated by  $6.5 \times 10^{-11}$  m. If the magnitude of the electric force between the charges is  $9.92 \times 10^{-4}$  N, what is the value of  $q$ ?