Electric Forces and Fields

Problem A

COULOMB'S LAW

PROBLEM

Two electrostatic point charges of +20.0 μC and −30.0 μC exert attractive forces on each other of −145 N. What is the distance between the two charges?

SOLUTION

Given: $q_1 = 2.00 \times 10^{-5}$ C $q_2 = -3.00 \times 10^{-5}$ C

$F_{electric} = -145$ N $k_C = 8.99 \times 109$ N•m^2/C^2

Unknown: $r = ?$

Choose the equation(s) or situation:
Use Coulomb's law, given on page 634.

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

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

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

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

ADDITIONAL PRACTICE

1. Two electrostatic point charges of −13.0 μC and −16.0 μC exert repulsive forces on each other of 12.5 N. What is the distance between the two charges?

2. Two electrostatic point charges of 99.9 μC and 33.3 μC exert repulsive forces on each other of 87.3 N. What is the distance between the two charges?

3. Two electrostatic point charges of −43.2 μC and 22.4 μC exert attractive forces on each other of −6.5 N. What is the distance between the two charges?

4. A glass rod rubbed against silk gains a charge of −5.3 μC. 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.)

5. A glass rod rubbed against your hair gains a charge of −14.0 nC. What is the electric force between the balloon and your hear when the two are separated by a distance of 7.1 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 8.3×10^{-10} m. If the magnitude of the electric force between the charges is 3.34×10^{-10} N, what is the value of q?

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?

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?