

CHAPTER 18 | *ELECTRIC FORCES AND ELECTRIC FIELDS*

PROBLEMS

7. **SSM** **WWW** **REASONING** Initially, the two spheres are neutral. Since negative charge is removed from the sphere which loses electrons, it then carries a net positive charge. Furthermore, the neutral sphere to which the electrons are added is then negatively charged. Once the charge is transferred, there exists an electrostatic force on each of the two spheres, the magnitude of which is given by Coulomb's law (Equation 18.1), $F = kq_1q_2/r^2$.

SOLUTION

a. Since each electron carries a charge of -1.60×10^{-19} C, the amount of negative charge removed from the first sphere is

$$(3.0 \times 10^{13} \text{ electrons}) \left(\frac{1.60 \times 10^{-19} \text{ C}}{1 \text{ electron}} \right) = 4.8 \times 10^{-6} \text{ C}$$

Thus, the first sphere carries a charge $+4.8 \times 10^{-6}$ C, while the second sphere carries a charge -4.8×10^{-6} C. The magnitude of the electrostatic force that acts on each sphere is, therefore,

$$F = \frac{kq_1q_2}{r^2} = \frac{(8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2)(4.8 \times 10^{-6} \text{ C})^2}{(0.50 \text{ m})^2} = \boxed{0.83 \text{ N}}$$

b. Since the spheres carry charges of opposite sign, the force is **attractive**.

15. **SSM** **WWW** **REASONING** Each particle will experience an electric force due to the presence of the other charge. According to Coulomb's law (Equation 18.1), the magnitude of the force felt by each particle can be calculated from $F = kq_1q_2/r^2$, where q_1 and q_2 are the respective charges on particles 1 and 2 and r is the distance between them. According to Newton's second law, the magnitude of the force experienced by each particle is given by $F = ma$, where a is the acceleration of the particle.

SOLUTION

a. Since the two particles have identical positive charges, $q_1 = q_2 = q$, and we have, using the data for particle 1,

$$\frac{kq^2}{r^2} = m_1a_1$$

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Sebastian Brünink



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