

17. **REASONING** The electrons transferred increase the magnitudes of the positive and negative charges from $2.00 \mu\text{C}$ to a greater value. We can calculate the number N of electrons by dividing the change in the magnitude of the charges by the magnitude e of the charge on an electron. The greater charge that exists after the transfer can be obtained from Coulomb's law and the value given for the magnitude of the electrostatic force.

SOLUTION The number N of electrons transferred is

$$N = \frac{|q_{\text{after}}| - |q_{\text{before}}|}{e}$$

where $|q_{\text{after}}|$ and $|q_{\text{before}}|$ are the magnitudes of the charges after and before the transfer of electrons occurs. To obtain $|q_{\text{after}}|$, we apply Coulomb's law with a value of 68.0 N for the electrostatic force:

$$F = k \frac{|q_{\text{after}}|^2}{r^2} \quad \text{or} \quad |q_{\text{after}}| = \sqrt{\frac{Fr^2}{k}}$$

Using this result in the expression for N , we find that

$$N = \frac{\sqrt{\frac{Fr^2}{k}} - |q_{\text{before}}|}{e} = \frac{\sqrt{\frac{(68.0 \text{ N})(0.0300 \text{ m})^2}{8.99 \times 10^9 \text{ N} \cdot \text{m}^2 / \text{C}^2}} - 2.00 \times 10^{-6} \text{ C}}{1.60 \times 10^{-19} \text{ C}} = \boxed{3.8 \times 10^{12}}$$