

## Section Summary

### 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

- Electric charge is a conserved quantity, which means it can be neither created nor destroyed.
- Electric charge comes in two varieties, which are called *positive* and *negative*.
- Charges with the same sign repel each other. Charges with opposite signs attract each other.
- Charges can move easily in conducting material. Charges cannot move easily in an insulating material.
- Objects can be charged in three ways: by contact, by conduction, and by induction.
- Although a polarized object may be neutral, its electrical charge is unbalanced, so one side of the object has excess negative charge and the other side has an equal magnitude of excess positive charge.

### 18.2 Coulomb's law

- Coulomb's law is an inverse square law and describes the electrostatic force between particles.
- The electrostatic force between charged objects is proportional to the charge on each object and inversely proportional to the distance squared between the objects.
- If Coulomb's law gives a negative result, the force is attractive; if the result is positive, the force is repulsive.

### 18.3 Electric Field

- The electric field defines the force per unit charge in the space around a charge distribution.
- For a point charge or a sphere of uniform charge, the electric field is inversely proportional to the distance from the point charge or from the center of the sphere.
- Electric-field lines never cross each other.
- More force is applied to a charge in a region with many electric field lines than in a region with few electric field lines.
- Electric field lines start at positive charges and point away from positive charges. They end at negative charges and point toward negative charges.

### 18.4 Electric Potential

- Electric potential energy is a concept similar to gravitational potential energy: It is the potential that charges have to do work by virtue of their positions relative to each other.

- Electric potential is the electric potential energy per unit charge.
- The potential is always measured between two points, where one point may be at infinity.
- Positive charges move from regions of high potential to regions of low potential.
- Negative charges move from regions of low potential to regions of high potential.

### **18.5 Capacitors and Dielectrics**

- The capacitance of a capacitor depends only on the geometry of the capacitor and the materials from which it is made. It does not depend on the voltage across the capacitor.
- Capacitors store electrical energy in the electric field between their plates.
- A dielectric material is an insulator that is polarized in an electric field.
- Putting a dielectric between the plates of a capacitor increases the capacitance of the capacitor.