Physics
Chapter 16: Electric Forces and Fields
Chapter 17: Electric Energy and Current

Section 16.1
Electric Charge

Electric Charge

--All matter consists of particles with electrical charges.

--The fundamental electric charge is the charge carried by a proton or electron.

--The sign of the charge carried by a proton is positive; that of an electron is negative.

--Positive and negative are simply names given to electric charges by Benjamin Franklin.

--A neutral object has equal numbers of positive and negative charges.

--Opposite electric charges attract each other; like charges repel.

--Electric charges is always conserved. (When one substance becomes positively charged by losing electrons, another substance must gain the same number of electrons.)

Quantity of Electric Charge

--The amount of electric charge is measured in <u>coulombs</u> (C):

$$1 \text{ C} = 6.25 \times 10^{18} \text{ e}$$

(e = elementary charge)

--The elementary unit charge on a proton or electron may be expressed in coulombs:

$$1 \text{ e} = 1 \text{ C}/6.25 \times 10^{18} \text{ e} = 1.6 \times 10^{-19} \text{ C}$$

Conductors and Insulators

--A conductor is a substance that electric charge can flow through.

--An insulator does not allow an electric current to pass through.

--Examples:

Conductors:	any metal (gold, copper, aluminum)	
Insulators:	rubber	plastic
	nonmetals	glass

--Conductors and insulators can obtain an electric charge by contact.

--Conductors can acquire an electric charge by <u>induction</u>.

--Insulators can acquire a surface charge by polarization.

Section 16.2
Electric Force

Electric Force

--The electric force between two charged objects depends directly upon the charge on each object and inversely on square of the distance between them.

--Greater charge = Greater force.

--Greater distance = Less force.

Coulomb's Law

--Coulomb's law gives the quantitative relationship between electrical force, charge, and distance:

$$F_e = K_c \frac{q_1 q_2}{R^2}$$

--where q_1 and q_2 are the charges on the two objects, R is the distance between their centers, and K_c is a constant:

$$K_c = 8.9875 \times 10^9 \text{ N} \times \text{m}^2/\text{C}^2$$

--Compare Coulomb’s law to Newton’s law of universal gravitation.

$$F_e = K_c \frac{q_1 q_2}{R^2} \text{ (Coulomb's Law)}$$

$$F_g = G \frac{m_1 m_2}{R^2} \text{ (Newton's Law)}$$

--Note that gravitational forces are only attractive while electrical forces are either attractive or repulsive.

Example: What is the electrical force between a proton and an electron a distance of 1.0 m apart?

$$F_e = K_c \frac{q_1 q_2}{R^2}$$

$$F_e = 8.9875 \text{ x } 10^9 \ \frac{N \times m^2}{C^2} \ \left(\frac{(+1.602 \text{ x } 10^{-19}C)(-1.602 \text{ x } 10^{-19}C)}{(1.0 \text{ m})^2}\right)$$

$$F_e = -2.307 \times 10^{-28} \text{ N}$$

--The negative sign indicates the force is attractive.