Module #13: Coulomb’s Law and the Electric Field

Introduction

* Electrostatics is the study of electric charges at rest
* There are two types of electric charges: positive and negative

The Basics of Electric Charge

* Matter is made up of atoms, which are composed of protons, neutrons, and electrons.
  + Protons have a positive change and electrons have a negative charge
  + When there is an equal number of protons and electrons, so that the charges cancel each other out, it is called electrically neutral
* When an atom gains or losses an electron it is called an ion
* Experiment 13.1 Attraction and Repulsion p.424
* Like charges repel each other while unlike charges attract one another.
* A conductor is a substance through which charge flows easily
  + Most metals are conductors
* An insulator is a substance through which charge cannot flow
  + Most nonmetals are insulators
* Semiconductors allow charge to flow only under certain conditions
* Law of Charge Conservation = the net amount of electric charge in the universe is constant
* Experiment 13.2 Making and Using an Electroscope p.426-427
* Charging by conduction = charging an object by allowing it to come into contact with an object that already has an electric charge
* Discharging = ridding an object of its charge
* Charging by induction = charging an object without direct contact between the object and a charge

Electrostatic Force and Coulomb’s Law

* A static charge is a charge that does not move
* Electrostatic force = the force that exists between two charges at rest
* The standard unit of charge is the Coulomb (C)
  + An electron’s charge is -1.6 x 10-19 Coulombs
  + A proton’s charge is +1.6 x 10-19 Coulombs
* Coulomb’s Law of electrostatic force between two charged objects is best expressed with the equation:
  + F = (kq1q2) / r2
    - F is the magnitude of the electrostatic force (unit Newtons)
    - Q1 is the charge of one object
    - Q2 is the charge of the other object
    - R is the distance between the centers of the objects
    - K represents a physical constant
      * Value of 9.0 x 109 (N\*m2)/C2
  + Measures instantaneous electrostatic force because as soon as the objects move under the influence of that force, the magnitude of that force will change
* Example 13.1 p.432-433
* OYO p.433 #13.3-13.4

Multiple Charges and the Electrostatic Force

* Skipped section!

The Electric Field

* Electric field – a representation of the electrostatic force exerted by a stationary charge on a positive test charge
  + Exerts force on any other particles that come into it
  + Arrows in an electric field diagram are called electric field lines
* The relative number of electric field lines drawn is proportional to the charge of the particle creating the field
* The arrows that form the electric field lines point out of positive charges and into negative charges.
* Electric field lines can never cross
* Figure 13.3, 13.4
* Figure 13.5
  + Identical charges – same number of electric field lines
  + Lines curve because they are not allowed to cross
* Example 13.3 p.442
* OYO p.443 #13.7