AP Physics Study Guide

Electric Charge and Electric Field

From Simple Studies, https://simplestudies.edublogs.org & @simplestudiesinc on Instagram

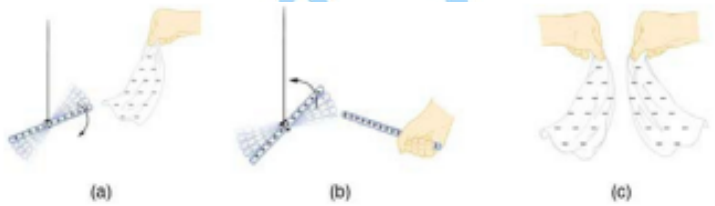
All images are from the Openstax college physics textbook

Atomic and molecular interactions are known to be manifestations of the **electromagnetic force.**

- It includes moving electricity and magnetism.

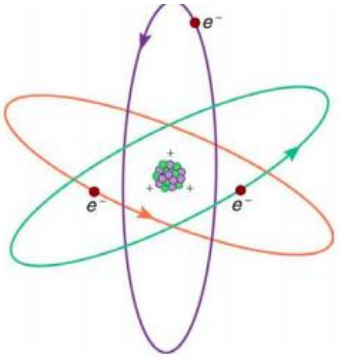
Some of the most basic characteristics of **static electricity**:

- The effects of static electricity are explained by a physical quantity not previously introduced, called **electric charge.**
- There are only two types of charge, one positive and the other negative
- Like charges repel, whereas unlike charges attract



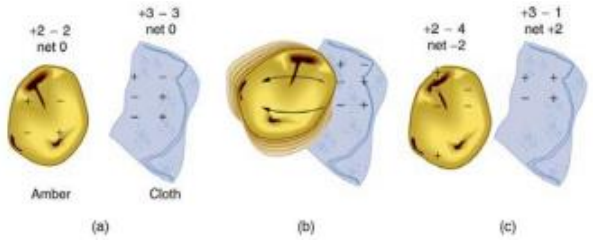
An atom includes negative **electrons** orbiting its positive nucleus

- The nucleus is positive due to the presence of positively charged **protons**
    - The charges of protons and electrons are identical in magnitude but opposite in sign



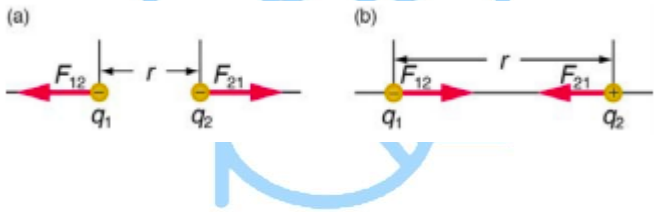
Charges in atoms and molecules can be separated

- Ex: rubbing, batteries, chemical interactions
- Some atoms and molecules have a greater affinity for electrons than others
- The **law of conservation of charge** states that total charge is constant in any process
    - No charge is actually created or destroyed when charges are separated



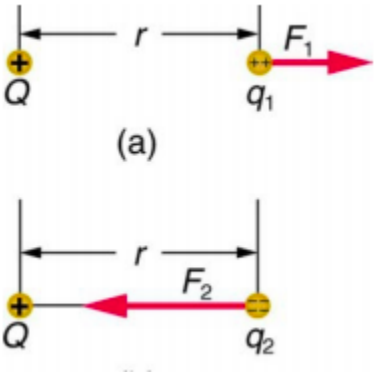
Coulomb's law calculates the magnitude of the force between two point charges separated by a distance

- $F = k\frac{|q_1 q_2|}{r^2}$
- It is the mathematical formula for **electrostatic force** - the amount and direction of attraction or repulsion between two charged bodies



A **field** is a way of conceptualizing and mapping the force that surrounds any object and acts on another object at a distance without apparent physical connection

- It includes a **point charge** (a particle having a charge) that acts on a **test charge** at a distance
- $E = F/q$
    - E is the ratio of the Coulomb force to the test change
    - F is the electrostatic force
        - E is in the same direction of F



These are steps you can take to solve electrostatics problems:

- Examine the situation to determine if static electricity is involved

    - This may concern separated stationary charges, the forces among them, and the electric fields they create
- Identify the system of interest
    - This includes noting the number, locations, and types of charges involved
- Identify exactly what needs to be determined in the problem
    - Determine whether the Coulomb force is to be considered directly
    - It may be useful to draw a free-body diagram
- Make a list of what is given or can be inferred from the problem as stated
    - Identify the knowns
- Solve the appropriate equation for the quantity to be determined
- Examine the answer to see if it is reasonable