14.1 Electrostatic Interactions

- Two objects with the same charge (positive OR negative) will exert a repulsive force on each other.
    - The magnitude of this repulsive force increases as the two objects gets closer to one another.
- Two objects with different charges (positive AND negative) will exert a attractive force on each other.
    - The magnitude of this attractive force increases as the two objects gets closer to one another.
- Objects acquire a positive or negative charge when rubbed by a material.
- An Electrostatic force is a force that occurs when charged objects are at rest.
- Charge refers to the number of electrons relative to the number of protons of an object.
    - More electrons mean that the object has a negative charge.
    - Less electrons mean that the object has a positive charge.
- An uncharged object and an object with either a positive or negative charge will attract one another.
    - The intensity of the attraction will be greater if the uncharged object was a conductor.

14.2 Explanations for Electrostatic Interactions

- Electrostatic interactions are NOT the same as magnetic interactions
- Throughout time there have been different explanations about what these interactions are and why they occur.
    - Benjamin Franklin first speculated that electric charges exist because there are “weightless electric fluids” in everything.
        - These electric fluids can be transferred from one object to another
        - These “electric fluids” are what determine if an object is positively or negatively charged.
            - If there’s more electric fluid, then the object has a positive charge.
            - If there’s less electric fluid, then the object has a negative charge.
        - So the interaction between objects was based on how much electric fluid each of the objects had.
    - J.J. Thompson disproved Franklin’s speculation through the various experiments he’s conducted.
        - As a result, Thompson was the first to correctly theorize that these charges actually come from the particles that make up matter.
        - Further experiments conducted by Robert Millikan and Harvey Fletcher.
            - Their experiments found that the charge came from electrons.

- Out of the three particles that make up atoms (proton, neutron, electron), only an electron can be transferred from one atom to another.
    - If an atom has more electrons than protons, then the atom is a negative ion or an anion.
    - If an atom has more protons than electrons, then the atom is a positive ion or a cation.
- When two objects are being rubbed together, one object will lose electrons and the other will gain the same amount.

14.3 Conducters and Nonconducters (dielectrics)

- Most conducters are metals.
    - In metals, electrons are able to move freely.
- If a positively charged object were to be put close to an uncharged metal, then the side of the metal that's closest to charged object will be be slightly more negative and the side that's further from the charged object will be slighly more positive.
- If a negatively charged object were to be put close to an uncharged metal, then the side of the metal that's closest to charged object will be be slightly more positive and the side that's further from the charged object will be slighly more negative.
- The electroscope measures the magnitude of electric charge.
    - Magnitude of charge is measured by the angle of deflection on the electroscope.
        - You can inititate it by:
            - Bringing the charged object close to the sphere of the electroscope.
            - Touching the sphere with the charged object.
            - Rubbing the charged object on the sphere.
- Most Dielectrics/Insulators are non-metals.
    - In non-metals, electrons are noat able to move as freely and stick to their atoms.
- The Earth is a conducter.
    - Because of this, objects can transfer their excessive electrons to the Earth through a process called grounding.
- Electric charge
    - Is a conserved quantity.
    - Is represented by the symbol, "q".
    - Is measured in cuolombs.
    - Charge quantization means that the smallest amount of charge an object can have is the charge of one electron.
        - The charge of one electron is -1.6 * 10^(-19) C.

14.4 Coulomb's Force Law

- From Coulomb's data we can pull the following two proportionalities:

    - $F_{(q_1 \text{ on } q_2)} \propto q_1 * q_2$
    - $F_{(q_1 \text{ on } q_2)} \propto 1/(r^2)$
- We can use these two proportionalities to get Coulomb's law:
    - $F_{(q_1 \text{ on } q_2)} = (k * |q_1| * |q_2|) / (r^2)$
        - $k = 9.0 * 10^9 \ (N*(m^2)) / (C^2)$
            - "k" is the proportionality constant that depends on the system of units used.
        - Coulomb's Law corresponds to the expression for the gravitational force hat any two objects with mass exert on each other.
            - $F_{(m_1 \text{ on } m_2)} = (G * m_1 * m_2) / (r^2)$

14.5 Electric Potential Energy

- The electric potential energy of the system will decrease as it is converted into both kinetic and gravitational potential energy.
- $\Delta U_q = U_{(q\ f)} - U_{(q\ i)} = k * q_1 * q_2 \ ((1 / r_f) - (1 / r_i))$
    - Electric potential energy uses joules as its units.
- On a graph, like charges seem to be decreasing at a decreasing rate.
- On a graph, unlink charges seem to be increasing at a decreasing rate