AP Physics C: Chapter 22

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1 Charge Model

- Two types of charge exist
  - (+): proton N_p
  - (−): proton N_e
- Unit is **Coulombs** (Q, q)
- e is the **fundamental charge**: 1.6×10^{-19}
- **neutral object**: some number of N_p and N_e
- **charged object**: an imbalance of electrons: $q = N_p e - N_e e$
- *N.B. charge is quantized: increases or decreases in discrete jumps*
- Electrons transfer to other object but charge is conserved
- Opposites attract
- Two types of electromagnetic matter
  - **conductors**: electrons are free to move

$$\begin{array}{ccccc} & (-) & (-) & (-) & \\ (-) & (+) & (+) & (+) & (-) \\ (-) & (+) & (+) & (+) & (-) \\ (-) & (+) & (+) & (+) & (-) \\ & (-) & (-) & (-) & \end{array}$$

    - **sea of electrons**
    - Valence electrons
    - Mostly metals
    - They charge by **conduction** (touching)
      - Results in a shift of the sea of electrons
      - Charge is excessive and equally distributed
      - An object with the same charge as the other

        - **electrostatic equilibrium**: charge is equally distributed, on the surface, and at rest
    - **insulators**: electrons are not free to move
        - $(+)\quad(-)\quad(+)\quad(-)\quad(+)\quad(-)$
        - valence e^- tightly bonded to proton
        - When they are rubbed together, the degree of their opposite charge depends on their measurement on the **triboelectric scale**
- **electrostatic discharge** requires contact with a conductor
    - if conductor to conductor (**grounding**) ⏚
- **polarization**: neutral object with same number of N_p and N_e, but one side is "more positive" and the other "more negative"
- **charging by induction**: only occurs in conductors
    - Occurs when a charged object is brought near a grounded conductor.
    - Electrons are lost along the grounded wire.
    - Removing ground wire results in a conductor with positive charge in electrostatic equilibrium.

2 Point Charge

- Conceptually shrinking down an object so that it has mass and charge but no size
- We can quantify how much force two charges experience with $\frac{k \cdot |q_1||q_2|}{r^2}$
    - $k = K = K_E$
    - $k = 8.99 \times 10^9$
- $+q_1 \longrightarrow \qquad \longleftarrow -q_2$
- $\longleftarrow +q_1 \qquad +q_2 \longrightarrow$

3 Electric Field

- Charge causes a change in the space around it, which becomes a vector field
- $\vec{E} = \frac{1}{4\pi t_0} \cdot \frac{Q}{r^2} \cdot \vec{r}$
- $F_{E_q} = \frac{1}{r\pi t_0} \cdot \frac{qQ}{r^2} \cdot \vec{r} = q\vec{E}$