Ch 16: Electrostatics

- Electric charges that are not moving
- Definition of new symbols
  - $e^-$ = electron
  - $p$ = proton
  - $n$ = neutron
  - $e^+$ = positron

Coulomb’s Law

$$F = \frac{k Q_1 Q_2}{r^2}$$

- $k = 9.0 \times 10^9$ N m$^2$/C$^2$
- Coulomb’s constant
- $Q_1, Q_2$ = charges
  - measured in Coulombs (C)
  - 1 C is a lot of charge!
- $r$ = distance between $Q_1$ and $Q_2$

Electric Force

- Similar form as gravitational force (weird, huh?), except
  - positive and negative charges
- Like charges repel; opposite charge attract

Charge Carriers

- The electron
  - $1 e^- = -1.602 \times 10^{-19}$ C
    - smallest unit of charge, also referred to as $e$
    - negatively charged
    - Charge of 1 e is $-1e$
- The proton
  - $1 p = 1.602 \times 10^{-19}$ C
    - positively charged
    - Charge of 1 p is $+1e$
- Charge is quantized!

Think-Pair-Share

- What is the electrostatic force between an $e^-$ and a $p$ in a Hydrogen atom, given the radius of the H atom is $0.5 \times 10^{-10}$ m?

Coulomb’s Law

with different constants

$$F = \frac{1}{4\pi \varepsilon_0} \frac{Q_1 Q_2}{r^2}$$

- $\varepsilon_0$ = permittivity of free space
- $\varepsilon_0 = \frac{1}{4\pi k} = 8.85 \times 10^{-12}$ C$^2$/N·m$^2$

(more relevant to future chapters)
Illustrations of Coulomb’s Law

- Comb & Paper
  ![Comb & Paper Illustration]

Illustrations of Coulomb’s Law

- Electroscope
  ![Electroscope Illustration]

Illustrations of Coulomb’s Law

- Van de Graaff generator & pie plates
  ![Van de Graaff generator & pie plates Illustration]

Illustrations of Coulomb’s Law

- Flowing water & charged rod
  ![Flowing water & charged rod Illustration]

Conductor versus Insulator

Conductor

- Neutral metal rod
  ![Neutral metal rod]

- Metal rod still neutral, but with a separation of charge electron’s travel
  ![Metal rod with separation of charge]

Insulator

- Nonconductor
  ![Nonconductor]

charge separation within molecules
  ![Charge separation within molecules]