 Phys 2426 2017-09-05 Lec 1

Why Study E & M?
- Our society is electric.
  - Energy
  - Info
  - Comm
- Light & Optics
- Chemistry
- Practice - Analysis & Abstraction

Electrostatics

All matter made of particles
Protons, Electrons, Neutrons,
Charge is the "value" of "how electric" a particle or object is.
Charge (Q, q) is in coulombs (C).
Charges combine by addition.
Two types of charge, and they cancel.
Protons are ⊕
Electrons are ⊖
Charge is conserved.

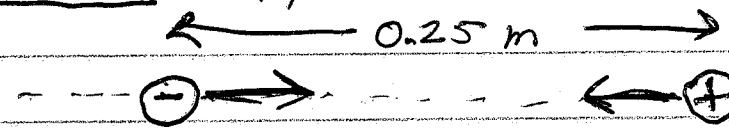
The ~~Franklin~~ SI Unit = 1.0 C is HUGE.

Note Uses of "e": e = "times ten to the power"
$e = 1.6 \times 10^{-19}$ C
$e = 2.718...$

Fundamental Interaction - Coulomb Force

Force is a vector: Magnitude & Direction

Direction Opposites Attract



$q_1 = -5\ nC$ $q_2 = +8\ nC$

Strength Coulomb's Law $k = 9\times10^9\ Nm^2/C^2$

$$F_E = \frac{k\,q\,Q}{R^2}$$

q, Q = charge magnitudes

R = center-to-center dist

$$F_E = \frac{(9\times10^9\ \frac{Nm^2}{C^2})(5\times10^{-9}\ C)(8\times10^{-9}\ C)}{(0.25\ m)^2}$$

$$= 5.76\times10^{-6}\ N = 5.76\ \mu N$$

What if one charge is zero? Zero force.

Can have "charge-induced dipole" attraction.

Accounting Methods

$$Q = q_1 + q_2 + \cdots$$

Q: Total Charge; $q_1, q_2, \ldots$: individual charges

Ex: $q_p = (+1.6 \times 10^{-19}\ C) = +e$

$q_e = (-1.6 \times 10^{-19}\ C) = -e$

$$Q = +e N_p - e N_e$$
$$= e(N_p - N_e)$$

Note $Q = 0 \longrightarrow N_p = N_e$

Charge Density

ρ = charge per volume $\quad Q = \rho_{avg} V$

$$Q = \int \rho \, dV$$

λ = charge per length $\quad Q = \lambda_{avg} \ell$

$$Q = \int \lambda \, dx$$

σ = charge per area $\quad Q = \sigma_{avg} A$

$$Q = \int \sigma \, dA$$