capa set #1
Due Sept. 16.

Physics 102

Lecture 2.

Friday. Sept. 10, 2004

- charge separation

  Normally, in an object,

  # of electrons = # of protons

  i.e., sum of charges = 0

  ∴ The object is electrically neutral.

  When we rub amber with fur, we actually transfer electrons from fur to amber. Therefore, amber is negatively charged and fur is positively charged. The carry equal amount but opposite sign charges.

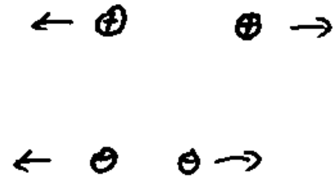
- Conservation of charge.

  The Total charge in the universe is constant.

  We can not create or destroy charge. We can transfer charge from one object to another.

- Interaction between charges (Coulomb's Law).

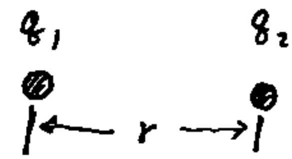
  like charges repel:



  opposite charges attract:

  The magnitude of the force

$$F = k \frac{|q_1|\,|q_2|}{r^2}$$



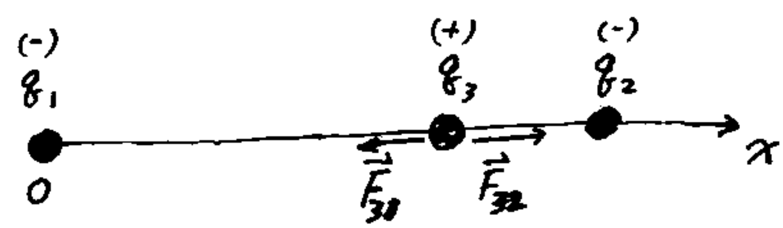
$$k = 8.99 \times 10^9 \ N \cdot m^2/C^2$$

e.g. 19-2. (p. 618)

A charge $q_1 = -5.4\ \mu C$ is at the origin, and a charge $q_2 = -2.2\ \mu C$ is on the x axis at $x = 1.00\ m$.

Find the net force acting on a charge $q_3 = 1.6\ \mu C$ at $x = 0.75\ m$

$$\vec{F}_3 = \vec{F}_{31} + \vec{F}_{32}$$



$$F_{3x} = -F_{31} + F_{32}$$

$$= -0.14N + 0.51N$$

$$= 0.37\ N.$$

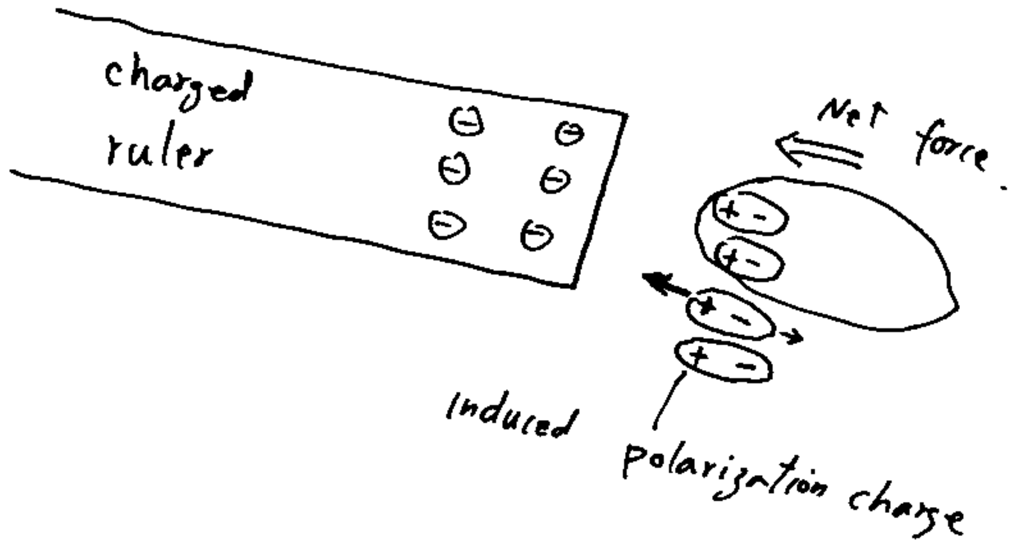
$$\therefore\ \vec{F}_3 = 0.37\ \hat{x}\ (N).$$

$$F_{31} = \frac{k\,|q_1|\,|q_3|}{(0.75)^2} = 0.14\ N$$

$$F_{32} = \frac{k\,|q_2|\,|q_3|}{(0.25)^2} = 0.51\ N$$

- Polarization.

  why can a charged ruler attract small neutral objects?



- Insulators and conductors.

  Insulators: charges are bound.
  (can not move freely).

  conductors: charges can move
  e.g.: in metals, there are free electrons

  free electrons are the ones
  in the outer most ~~orbits~~ atomic orbits.
  they can easily escape from the atom.

  semiconductors: between insulators and conductors.

- The electric field

Field —— spatial distribution of a quantity.

e.g.: Temperature field : $T(x, y, z)$

Force field : $\vec{F}(x, y, z)$

★ Definition of the electric field.

If a test charge q_0 experiences a force $\vec{F}$ at a given location, the electric field $\vec{E}$ at that location is:

$$\vec{E} = \frac{\vec{F}}{q_0} \quad \left(\text{electric force per unit charge} \right)$$

unit: N/C.

Note: Test charge q_0: $\left. \begin{array}{l} q_0 \to 0 \\ \text{size} \to 0 \end{array} \right\}$ ideally Not affect the field.