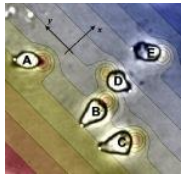
Physics 131-Physics for Biologists I



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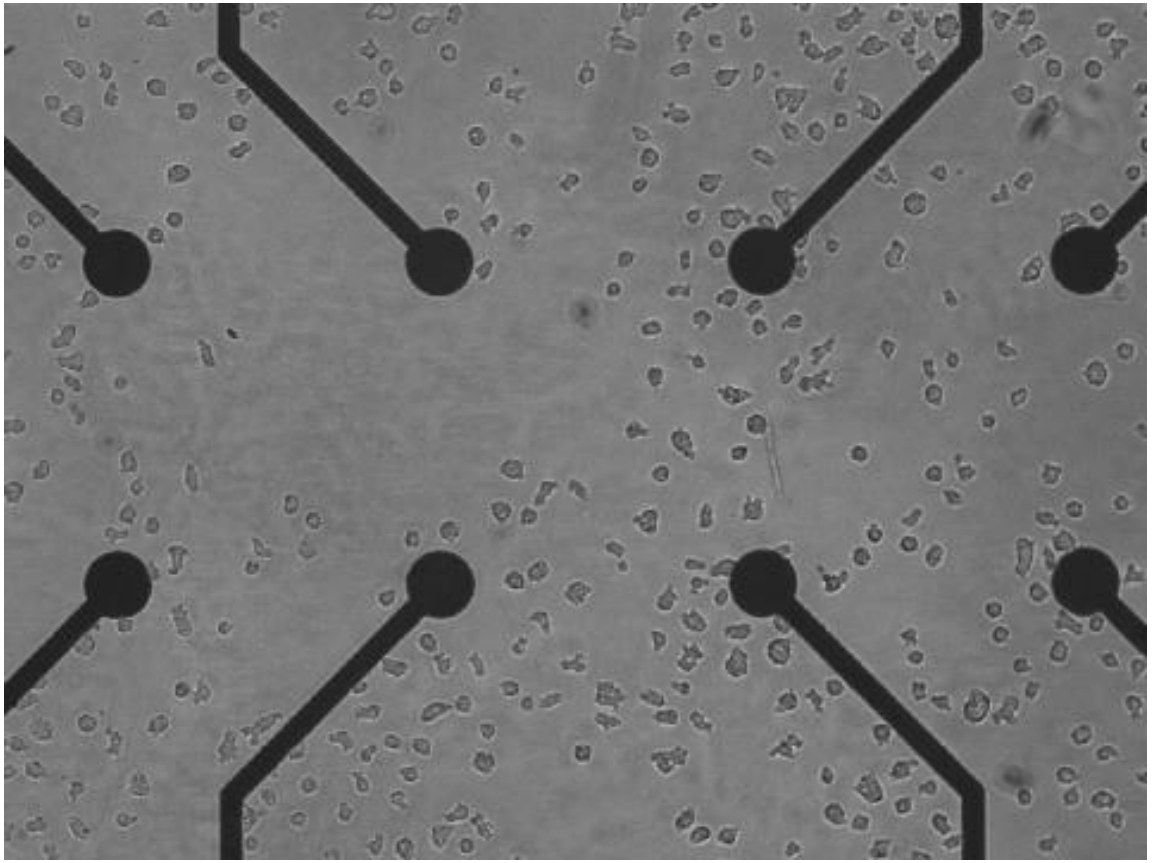
MIDTERM MAKEUP: Average change in Midterm Grade: 7 points
19 scores increased
4 scores decreased



Electric Forces

Instructors
Next Semester

Electrostatics

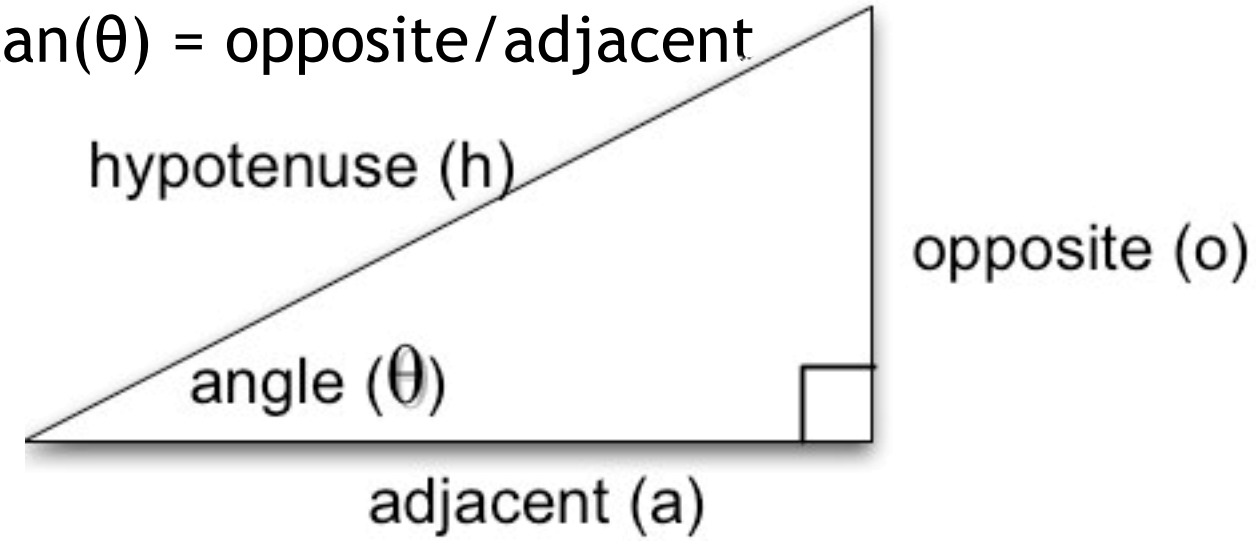
A hidden property of matter: Matter is made up of two kinds of electrical matter (positive and negative) that have equal magnitude and that cancel when they are together and hide matter's electrical nature. Matter with an equal balance is called neutral.

Charges Q and q exert forces on each other (Coulomb force):

$$\vec{F}_{Q\to q} = \frac{k_C qQ}{R^2}\hat{r}_{Q\to q} \qquad \vec{F}_{q\to Q} = \frac{k_C qQ}{R^2}\hat{r}_{q\to Q} \qquad \vec{F}_{q\to Q} = -\vec{F}_{Q\to q}$$

Trig review

- The ratios of a triangle's sides only depend on θ.
  - sin(θ) = opposite/hypotenuse
  - cos(θ) = adjacent/hypotenuse
  - tan(θ) = opposite/adjacent



Vectors with trig - by components

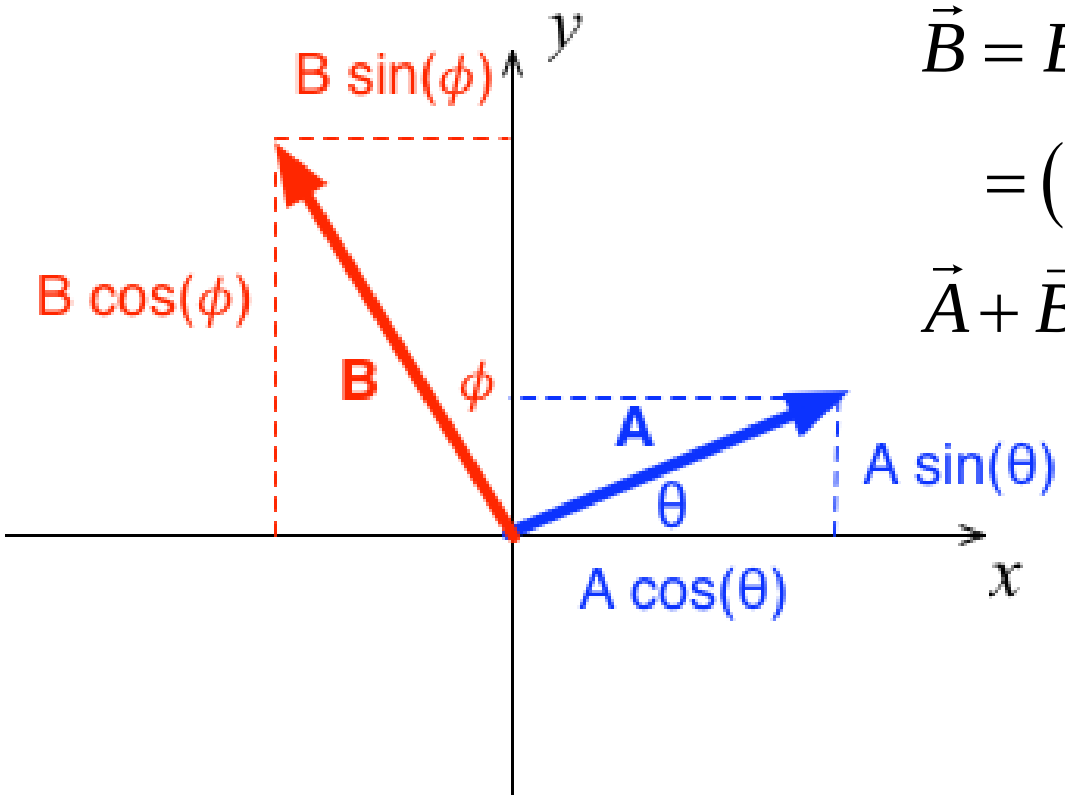
$$\vec{A} = A_x\hat{i} + A_y\hat{j}$$

$$= \left(A\cos(\theta)\right)\hat{i} + \left(A\sin(\theta)\right)\hat{j}$$

$$\vec{B} = B_x\hat{i} + B_y\hat{j}$$

$$= \left(-B\sin(\phi)\right)\hat{i} + \left(B\cos(\phi)\right)\hat{j}$$

$$\vec{A} + \vec{B} = ?$$



Conductors and Insulators

Insulators

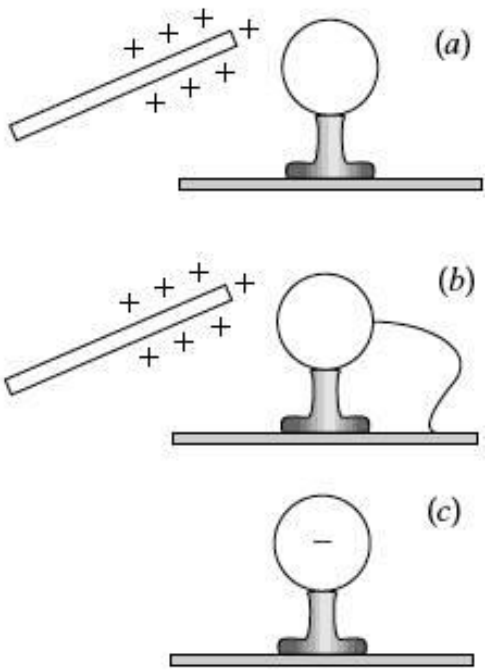
- In some matter, the charges they contain are bound and cannot move around freely.
  - Negative charges (electrons) are able to move a bit within an atom or molecule. This leads to **Polarization**
- Excess charge put onto insulators just sits there.

Conductors

- In some matter, charges in it can move around throughout the object.
- Excess charge put onto this kind of matter redistributes itself or flows off (if there is a conducting path to ground).

Example of Charging in a conductor:

A - charged object is placed near a conductor attached to an insulating pedestal (see Fig a). After the opposite side of the conductor is grounded for a short time (Fig b), the conductor becomes POSITIVELY charged (Fig c). Based on this information, we can conclude that within the conductor



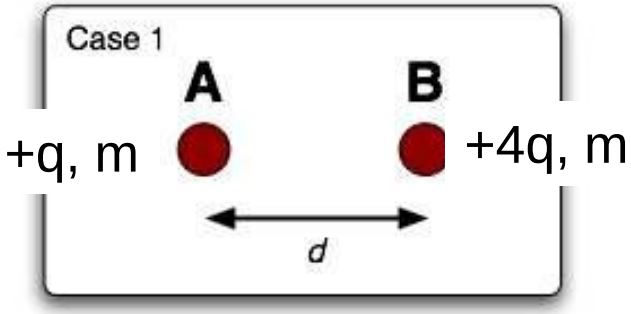
1. both + and - charges move freely
2. only - charges move freely
3. only + charges move freely
4. We can't really distinguish the three cases above

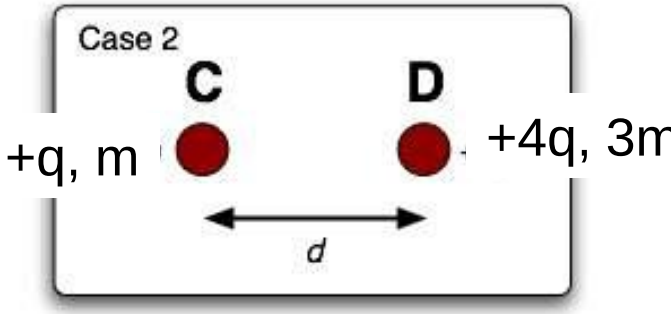
(2) Is what really happens in a metal but based on the information we cannot really distinguish between 1,2, and 3

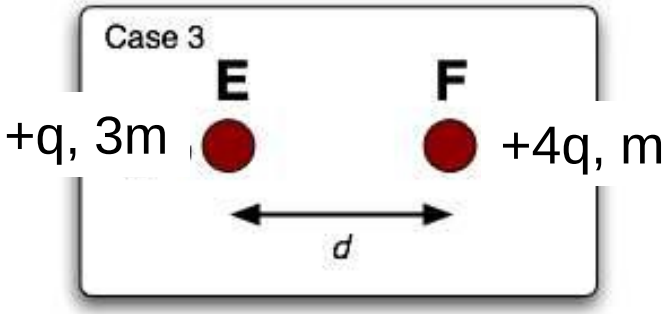
Whiteboard
TA & LA

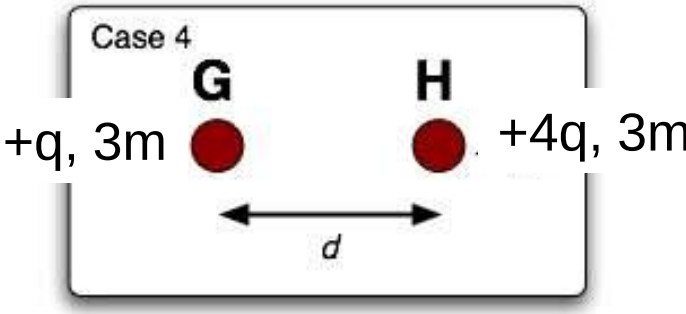
In each of the four cases shown below, a particle of charge +q is placed a distance d from a particle of charge +4q. The particles are then released simultaneously. The masses of the particles are indicated in the diagram. Which case has the largest magnitude of the acceleration of the RIGHT HAND particle just after it is released?

1. Case 1
2. Case 2
3. Case 3
4. Case 4
5. Cases 1 & 2
6. **Cases 1 & 3**
7. Cases 2 & 4
8. Cases 3 & 4









(Whiteboard, TA & LA)

Multiple charges

- Consider four objects, three with + charge of q, one with - charge of q in the system schema. Sketch system schema with electrostatic interactions for two cases:

(1) 

(2) 

All charges interact with all other charges