B-Day Due Mon., Jan 3
A-Day: Due Tues., Jan 4

2011 PreAP Electrostatics 1

At this point you should know these facts:

Opposite charges attract (− and +) and like charges repel.

Electrons move (not protons); + objects have lost electrons, etc.

Conductors allow electrons to flow; Insulators resist the flow of electrons.

Charge is quantized: there cannot be part of an electron or proton, only whole #s.

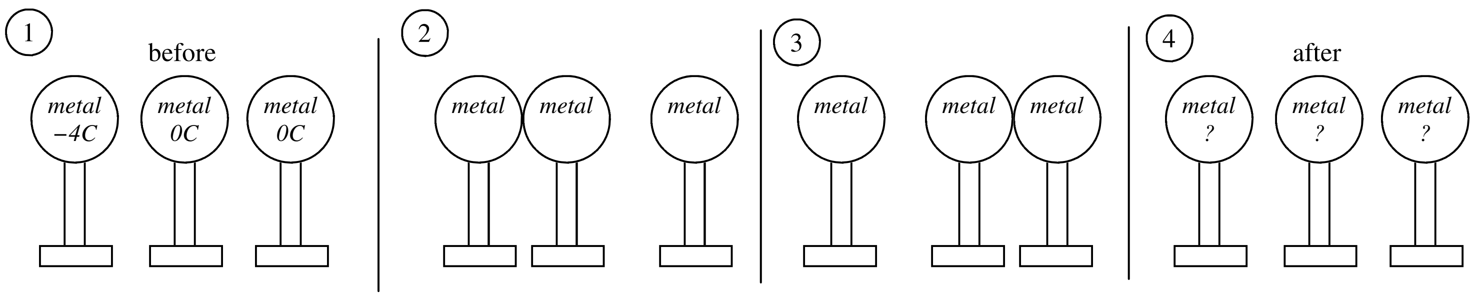
Electron Charge
1 electron = - 1.602 x 10^{-19} *C*

In case you forgot, μ means: "$\times 10^{-6}$*". So, 3μC =* 3×10^{-6} *C, a small + charge. −4.5μC =* -4.5×10^{-6} *C, a small − charge.*

1. What is the charge of 6 electrons?

2. An object has a charge of 1.7μC,
how many electrons did it gain or lose?

3. The left metal sphere is touched to the middle, neutral metal sphere. The middle sphere is then pulled away from the left sphere and touched to the right, neutral metal sphere.



A. Afterwards, what is the charge of the left metal sphere?
B. Afterwards, what is the charge of the right metal sphere?

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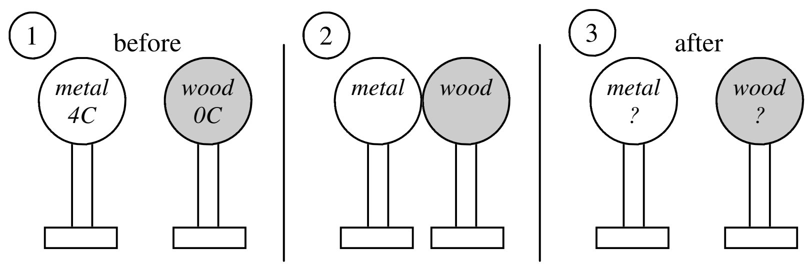
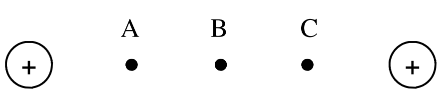
4. This time the metal sphere is touched to a neutral wood sphere.
A. What is the final charge of the metal sphere?

B. What is the final charge of the wood sphere?





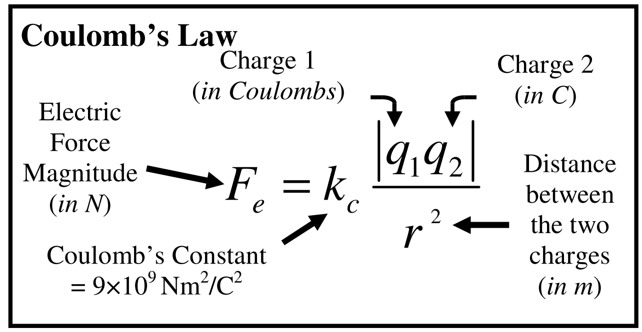
5. The 2 charges in the diagram are fixed (can't move). For the following situations decide if the charge will move to the left (L), right (R), or will stay put (S).

A. ____ * If a positive charge is put at A?
B. ____ If a negative charge is put at C?
C. ____ If a negative charge is put at B?
D. ____ If a positive charge is put at C?

E. ____ * If a 3.4μC charge is put at B?
F. ____ If a 8nC charge is put at A?
G. ____ If a –4.2C charge is put at C?
H. ____ If a –3.9μC charge is put at B?

Stable equilibrium is like in a hole: push a ball to one side, it rolls back. Unstable would be at the top of a hill: push the ball it rolls farther away.

6. In the same diagram again to answer the following. Assume that point B is exactly half way between the two charges.
A. * If a positive charge is put at point B will it be stable or unstable?
B. If a negative charge is put at point B will it be stable or unstable?



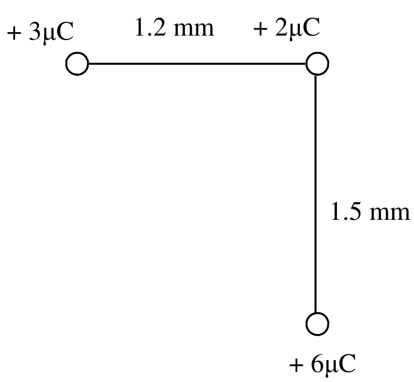
The new equation at the right looks a lot like the gravity equation. Both of them are field forces and are $1/r^2$ laws: known as inverse-square laws. Please note the absolute value symbol on top. This equation gives you the MAGNITUDE (size) of the electric force. You decide on the direction (attract; repel; left; right; 34°; etc.) by looking at the situation.

7. How does the electric force change?
   - A. * If one of the charges is doubled?
   - B. * If the distance is tripled?
   - C. If one of the charges is 1/3rd as big?
   - D. If the distance is halved?

Remember that in your calculate 4×10^{12} is 4E12. Also, there are 1000mm in a m.

8. * Calculate the force between a 4 μC charge and a 8 μC charge that are 3.2 mm apart. (*Be sure to say "attract" or "repel".)*

9. Calculate the force between a 1.2 μC charge and a −4.8 μC charge that are 2.5 mm apart.



10. Use the diagram at the left to answer the following.
   - A. * Calculate the magnitude of the force on the 2μC charge due to the 3μC charge (*put the magnitude and an arrow on the diagram*).
   - B. * Calculate the magnitude of the force on the 2μC charge due to the 6μC charge (*label the diagram*).
   - C. In which quadrant will the net force point?
   - D. You now have two vectors that are perpendicular to each other. Calculate the net electric force acting on the 2μC charge.

Q5A: R, because a + charge is more repelled by the closer charge (the left one)
Q5E: S (stays) it is equally repelled by both + charges. If it moves L or R it will be pushed back to the center.
Q6A: Stable. At the center it feels equal repulsion. On either side of B the repulsion of the closer charge increases.
Q7A: doubles (on top, no exponent); Q7B: 1/9 as much (on bottom and squared) Q8: see picture at the right.
Q10A: 3.75E4N to right 10B: 4.8E4N up

$$F_e = \frac{(9E9)(4E-6)(8E-6)}{(3.2\times10^{-3})^2} = 2.81\times10^4\text{ N repelling}$$