A-day: Due Tues., Mar 31
B-day: Due Wed., Apr 1

2009 Electricity 1

Name: _____

1. Give the three basic particles that make up all atoms, where they are located, and their charges.

Sub atomic particle name	Charge (+, –, or neutral)	Location in the atom

2. If opposites attract and like charges repel, then:

A) two protons will: Attract or Repel?

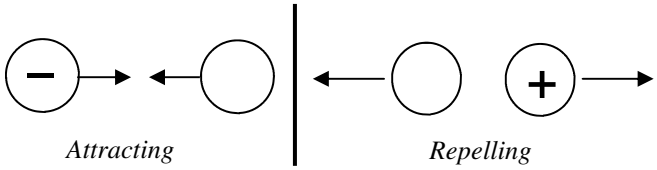
D) (+) (+)

B) two electrons will: Attract or Repel?

E) (–) (+)

C) An electron and a proton will: Attract or Repel?

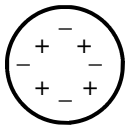
F) (–) (–)



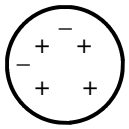
3. For each of the two sets of objects at the left decide if the unknown charge is + or –.

4. For the three objects below, count up the positives and negatives and decide if the net charge is positive, negative, or neutral.

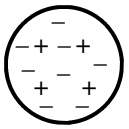
A. +, –, 0?



B. +, –, 0?



C. +, –, 0?



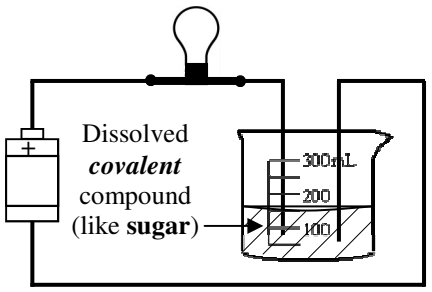
In the 20th century scientists learned that protons and neutrons are held together in the nucleus with the "strong nuclear force", the strongest force in nature. It is very difficult to remove a proton from the atom. Electrons, on the other hand, move very easily in metals, which we call electricity, or whenever atoms combine into ionic compounds. When an object has a + or – charge it is because electrons have moved, not protons.

5. Gained or lost electrons?
   A. A positively charged object?
   B. A negatively charged object?

Electrical conductors allow electricity to flow and insulators resist the flow of electricity.

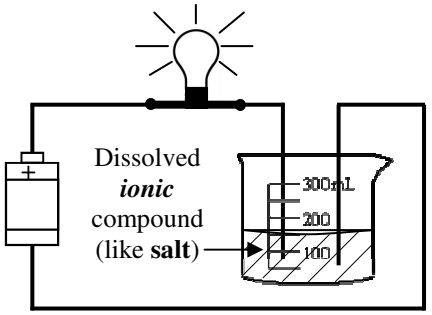
6. Electrical conductor or insulator?
   A. ____ Rubber
   B. ____ A paperclip
   C. ____ Paper
   D. ____ Aluminum

7. As seen in the diagrams at the right, sugar and salt are dumped into water and disappear (called d_____).
   A. Can the salt or sugar be filtered out of the solution (*can a filter be used to get them out*)?
   B. Which type of compound is due to atoms sharing electrons: ionic or covalent?
   C. Which of two solutions is an electrical conductor?
   D. How do you know (*look at the pictures*)?
   E. If magnesium oxide where dissolved, would it be a conductor or insulator?



Turns out that pure water is not a good conductor and salt water is.

8. A jewel thief has two fish tanks in his house, neither of which have fish in them. Supposedly the thief hide his jewels in one of the tanks. As you look, you notice that both of the tanks have little treasure chests at the bottom. Just before you each in you notice electric wires laying in the water, so you quickly pull back. Upon closer inspection you see that the right tank has residue on the sides, which turns out to be salt. The left tank has no salt in it. Which tank probably has the jewels in it and why?



Electric Charge The unit of charge is a fundamental quantity.

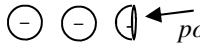
Electron Charge

$1\ electron = -1.602 \times 10^{-19}\ C$

The charge of a proton is the same as an electron, only positive:
1 proton = +1.602x10^{-19}C.

The smallest units of charge are the proton and the electron. You cannot have part of an electron, because it would lose its negative charge. Therefore, you cannot have less than -1.602 x 10^{-19}C of charge and any amount of charge must be multiples of this number. You can have 12 electrons or 13 electrons, but not 12.5 electrons!

1e 1e ½e



Not possible

Electric charge is quantized, meaning the amount of charge must always be in multiples of e. You can never have part of an electron.

Ex: What is the charge of an object that gains 1.2 x 10^{8} electrons?

Do a conversion :

$$\left(\frac{1.2 \times 10^{8}\ \text{e}}{1}\right)\left(\frac{-1.602\times10^{-19}\ \text{C}}{1\ \text{e}}\right) = -1.92\times10^{-11}\ \text{C}$$

Ex: How many electrons are gained or lost if an object has a charge of 4.6μC (microcoloumbs)?

$$\left(\frac{4.6 \times 10^{-6}\ \text{C}}{1}\right)\left(\frac{1\ \text{e}}{-1.602\times10^{-19}\ \text{C}}\right) = -2.87\times10^{13}\ \text{e}$$

The negative means it lost e's (+ object).

9. A. Can an object gain 6.5 electrons?
   B. Why or why not?

Remember conversions? Remember that the units cancel, but not the number. See the two examples at the right.

10. Using the same process, how much charge do 12 electrons have?

11. An object has a charge of –4.5 x 10^{-6} C. How many electrons did it gain?

If 1 piece of candy = 5 cents.

How many pieces can you buy for 85 cents?

Do a conversion :

$$\left(\frac{85\ \text{cents}}{1}\right)\left(\frac{1\ \text{piece}}{5\ \text{cents}}\right) = 17\ \text{pieces}$$

Notice that the cents cancel.

How much does would 115 pieces cost?

$$\left(\frac{115\ \text{pieces}}{1}\right)\left(\frac{5\ \text{cents}}{1\ \text{piece}}\right) = 115(5) = 575\ \text{cents} = \$5.75$$

Coulomb's Law

Charge 1 (*in Coulombs*) → q_1; Charge 2 (*in C*) → q_2

Electric Force (*in N*) → F_e

$$F_e = k_c \frac{q_1 q_2}{r^2}$$

Distance between the two charges (*in m*) → r

Coulomb's Constant = 8.99 x 10^{9} Nm^2/C^2 → k_c

12. Using the example above, calculate the force between a 6 C and a 4C charge that are 8 cm apart (*remember to use meters and the "EE" key*).

Ex: A 2μC charge is 3 mm from a 6μC charge. What is the electric force between them?

Variables:
$k_c = 8.99\text{x}10^{9}$
$q_1 = 2\text{x}10^{-6}\text{C}$
$q_2 = 6\text{x}10^{-6}\text{C}$
$r = 3\text{x}10^{-3}\text{m}$

$$F_e = k_c \frac{q_1 q_2}{r^2}$$

$$= 8.99\text{x}10^{9}\ \frac{(2\text{x}10^{-6})(6\text{x}10^{-6})}{(3\text{x}10^{-3})^2}$$

$$= 9\text{x}10^{9}\ \frac{1.2\text{x}10^{-11}}{9\text{x}10^{-6}} = 1.2\text{x}10^{4}\ \text{N}$$

Since they are like charges: they repel.

The electric force is like the magnetic force due to two magnets.

13. Will the electric force increase or decrease:
   A. If one of the charges is bigger?
   B. If the distance between the two charges increases.

Sorry to say, we need another page for TAKS..

14. Chemical or Physical Change*?*

A. _____Bubbles are formed.	F. ____ Changes smell	K. ____ Ripping paper
B. _____Melting wax	G. ____ Breaking glass	L. ____ Gets hot
C. _____Gets cold	H. ____ Changes temperature	M. ____ Sugar dissolves
D. _____Color changes	I. ____ Cutting up	N. ____ Burning gasoline
E. _____Boiling water	J. ____ Evaporating something	

15. Are the following parts of digestion physical or chemical changes?
    A. ____ Chewing food into smaller pieces.
    B. ____ When acids in your stomach break down your food into nutrients your body can absorb.
    C. _____When enzymes in your saliva pre-digest and soften your food in your mouth before you swallow.
    D. _____Tearing food with your teeth.

16. The complete act of digestion is this a physical or chemical change?

17. When something dissolves in water, is this a physical or chemical change?

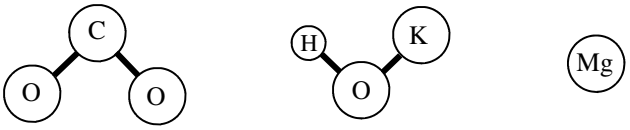
18. Given this reaction: $\_\_\_\_K_3N + \_\_\_Ca(CrO_4) \rightarrow \_\_\_Ca_3N_2 + \_\_\_K_2(CrO_4)$

    A. Balance the reaction.
    B. What is the first product?
    C. What is the first reactant?

From the notes: "Atoms, Elements, Molecules, and Compounds" [There are copies in the classroom.]

19. When atoms rearrange in chemical reactions, do the individual atoms change?

20. How do we know that the atom is most empty space?



21. From the diagrams above:
    A. How many atoms?
    B. How many molecules?
    C. How many compounds?
    D. How many elements?