

## Charge

Read from **Lesson 1** of the **Static Electricity** chapter at **The Physics Classroom**:

<http://www.physicsclassroom.com/Class/estatics/u8l1a.html>

<http://www.physicsclassroom.com/Class/estatics/u8l1b.html>

**MOP Connection:** Static Electricity: sublevel 1

### Introduction:

It all begins with atoms. An understanding of static electricity begins with an understanding of the atom. Matter is made of atoms and if any sample of matter is charged, becomes charged or loses a charge, then the explanation of what happened demands that one understands matter at the *particle level*.

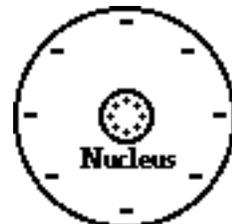
1. In the space at the right, draw a picture of your understanding of the structure of an atom. What does it look like? What is inside of it? Express what you know using a well-labeled diagram.
  2. The charged parts of the atom are the \_\_\_\_\_ and the \_\_\_\_\_. The \_\_\_\_\_ are positively charged and the \_\_\_\_\_ are negatively charged. The \_\_\_\_\_ are not charged and thus will not be of importance in this unit.
  3. An electrically neutral atom is an atom which \_\_\_\_\_.
    - a. does not have any protons or electrons
    - b. has more neutrons than the sum of all its protons and electrons
    - c. has a balance of protons and electrons (the same number of each)
    - d. has a balance of neutrons and electrons (the same number of each)
    - e. has a balance of protons, electrons and neutrons (the same number of each)
  4. An electrically charged atom (sometimes referred to as an ion) can be distinguished from an electrically neutral atom in that the charged atom (ion) \_\_\_\_\_.
    - a. does not have any neutrons
    - b. has lost one or more of its neutrons
    - c. either has a proton or an electron present somewhere within it
    - d. has a different number of neutrons than the sum of its electrons and protons
    - e. has an imbalance of protons and electrons (unequal numbers of these)

### Structure of the Atom

### Physics Fact:

Protons (and neutrons) are located in the *interior* of an atom - in the nucleus. They are tightly bound and unable to leave the atom except through nuclear processes. On the other hand, electrons are on the *exterior* of an atom. They are exposed to other atoms and to forces that are capable of *ejecting* them or *stripping* them of the atom.

5. The diagram at the right depicts the eight electrons and eight protons in an oxygen atom.
  - a. Explain what must happen in order for an oxygen atom to become negatively charged.
  - b. Explain what must happen in order for an oxygen atom to become positively charged.



## Static Electricity

6. What is true of atoms in terms of being neutral, negatively charged, and positively charged is also true of objects. An object that is negatively charged must have \_\_\_\_\_ (more, less, the same number of) electrons compared to its protons. An object that is positively charged must have \_\_\_\_\_ (more, less, the same number of) electrons compared to its protons. An object that is electrically neutral must have \_\_\_\_\_ (more, less, the same number of) electrons compared to its protons.

Summarize these verbal statements by inserting >, < or = symbols into the blanks below:

**Negatively Charged**  
# of e<sup>-</sup> \_\_\_\_\_ # of p<sup>+</sup>

**Positively Charged**  
# of e<sup>-</sup> \_\_\_\_\_ # of p<sup>+</sup>

**Electrically Neutral**  
# of e<sup>-</sup> \_\_\_\_\_ # of p<sup>+</sup>

7. An object becomes charged due to an excess or deficiency (shortage) of electrons. Knowing the exact number of excess or deficient electrons in an object allows one to determine the object's charge. The charge of one electron is  $1.6 \times 10^{-19}$  C. Use this to determine the charge of the following objects.

Object	# of Excess or Deficient Electrons	Quantity and Kind of Charge (Q) on Object in Coulombs (C)
A	$1.0 \times 10^3$ excess electrons	
B	$1.0 \times 10^6$ deficient electrons	
C	$2.0 \times 10^9$ excess electrons	
D	$2.5 \times 10^8$ deficient electrons	
E	$6.82 \times 10^{12}$ excess electrons	

8. During a physics lab, a plastic strip was rubbed with cotton and became positively charged. The correct explanation for why the plastic strip becomes positively charged is that ...
- the plastic strip acquired extra protons from the cotton.
  - the plastic strip acquired extra protons from the charging process.
  - protons were created as the result of the charging process.
  - the plastic strip lost electrons to the cotton during the charging process.
9. Miss Chiff, the seventh-grade science teacher, greets her students in an unusual manner. She stands at the door of her classroom, scuffing her feet back and forth on the carpet. As she does so, electrons move from the carpet to her shoes to her body. Miss Chiff is now charged with a \_\_\_\_\_ (positive, negative) type of charge.
- Then, Miss Chiff reaches out and touches her students on the nose as they enter the classroom. As she does, some electrons leave Miss Chiff and move onto her students. Miss Chiff is now \_\_\_\_\_ (more, less) negatively charged than before the contact with the student. And the student is now charged with a \_\_\_\_\_ (positive, negative) type of charge.
10. In a lab report during the Static Electricity unit, Aaron Agin suggests that a sample of wool became positively charged by gaining protons from the rubber balloon that it rubbed. Explain what is wrong with Aaron's statement.