

## Charging by Friction

Read from **Lesson 2** of the **Static Electricity** chapter at **The Physics Classroom**:

<http://www.physicsclassroom.com/Class/estatics/u8l2a.html>

<http://www.physicsclassroom.com/Class/estatics/u8l1d.html>

**MOP Connection:** Static Electricity: sublevel 3

### Review:

1. Fill in the following blanks with the word **electrons** or **protons**.

\_\_\_\_\_ are negatively charged and \_\_\_\_\_ are positively charged. The \_\_\_\_\_ reside in the nucleus of atoms and are tightly bound; they will never leave an atom as a result of electrostatic procedures. On the other hand, \_\_\_\_\_ are located outside the nucleus and are easily removed from or added to atoms. As an object begins to gain or lose \_\_\_\_\_ from its atoms, it becomes positively or negatively charged. A negatively charged object has more \_\_\_\_\_ than \_\_\_\_\_. A positively charged object has more \_\_\_\_\_ than \_\_\_\_\_.

2. 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.

3. Objects differ from one another in terms of their relative tendency to draw electrons towards themselves. Some materials are more *electron-greedy* than others. A **triboelectric series** is a listing of a variety of materials in order of their relative attraction for the electrons of another material. The listing at the right is an example of a triboelectric series. Materials listed near the top of the table have a stronger affinity for electrons than those located below them. When two materials are rubbed together, electrons are transferred from the material that has the lesser affinity for electrons to the material that has the greater affinity for electrons. The object that gains the electrons acquires a \_\_\_\_\_ (+ or -) charge and the object that loses the electrons acquires a \_\_\_\_\_ (+ or -).

### Triboelectric Series

Celluloid
Sulfur
Rubber
Copper, Brass
Amber
Wood
Cotton
Human Skin
Silk
Cat Fur
Wool
Glass
Rabbit Fur

Use the triboelectric series to answer the following questions:

- When you pull a **cotton** sweater off your **skin**, electrons are transferred from the \_\_\_\_\_ (cotton, skin) to the \_\_\_\_\_ (cotton, skin). As a result, your body acquires a \_\_\_\_\_ (+, -, ) charge and the cotton sweater acquires a \_\_\_\_\_ (+, -, ) charge.
- When you rub a **glass** rod with a **silk** cloth, electrons are transferred from the \_\_\_\_\_ (glass, silk) to the \_\_\_\_\_ (glass, silk). As a result, the glass rod acquires a \_\_\_\_\_ (+, -, ) charge and the silk cloth acquires a \_\_\_\_\_ (+, -, ) charge.
- Suppose you rub a rubber rod with a silk cloth and a second rubber rod with a wool sweater. The silk cloth will acquire a \_\_\_\_\_ (+, -, ) charge; the wool sweater will acquire a \_\_\_\_\_ (+, -, ) charge. The sweater and the cloth will then be observed to \_\_\_\_\_ (attract, repel, not interact with) each other.
- Suppose you rub a glass rod with a silk cloth and a second glass rod with rabbit fur. The silk cloth will acquire a \_\_\_\_\_ (+, -, ) charge; the rabbit fur will acquire a \_\_\_\_\_ (+, -, ) charge. The rabbit fur and the silk cloth will then be observed to \_\_\_\_\_ (attract, repel, not interact with) each other.

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8. Consider the statements below. Identify them as being either True or False.

T or F?	Statement
_____	a. When two objects made of different materials are rubbed together, they each acquire a charge.
_____	b. When two objects made of different materials are rubbed together, they will either be both charged-positively or both charged negatively.
_____	c. When two objects made of different materials are rubbed together, they will attract each other after the charging process.
_____	d. When two objects made of different materials are rubbed together, one object gains electrons and the other objects gains protons.
_____	e. When two objects made of different materials are rubbed together, the total amount of charge among the two objects remains unchanged.

9. Saran Wrap has a larger electron affinity than Nylon. If Nylon is rubbed against Saran Wrap, which would end up with the excess negative charge? \_\_\_\_\_ Explain.

10. Object A is rubbed with object B. Object C is rubbed with object D. Objects A and D are observed to repel each other. Object B is observed to repel a negatively charged balloon. This is conclusive evidence that ...

... object A acquired a \_\_\_\_\_ (+ , -) charge.

... object B acquired a \_\_\_\_\_ (+ , -) charge.

... object C acquired a \_\_\_\_\_ (+ , -) charge.

... object D acquired a \_\_\_\_\_ (+ , -) charge.



11. A teacher rubs a glass object and a felt cloth together and the glass becomes positively charged. Which of the following statements are true? Circle all that apply.
- The glass gained protons during the rubbing process.
  - The felt became charged negatively during this rubbing process.
  - Charge is created during the rubbing process; it is grabbed by the more *charge-hungry* object.
  - If the glass acquired a charge of +5 units, then the felt acquires a charge of -5 units.
  - This event violates the law of conservation of charge.
  - Electrons are transferred from glass to felt; protons are transferred from felt to glass.
  - Once charged in this manner, the glass object and the felt cloth should attract each other.
  - In general, glass materials must have a greater affinity for electrons than felt materials.

12. Balloons A and B are suspended from the ceiling by light threads; each balloon is made of rubber. Balloon A was rubbed with animal fur. Balloon B was rubbed with animal fur. If a negatively charged plastic tube were inserted between the two balloons, then one would observe that the two balloons \_\_\_\_\_. (Refer to the triboelectric series.)
- would deflect even more from a vertical orientation
  - would relax to a more vertical orientation
  - would not be affected at all by the presence of the plastic tube.

