

## Triboelectric Charging Lesson Notes

### Focus Questions:

- What is triboelectric charging and how does it occur?
- How can the results of triboelectric charging be predicted?

### What is Triboelectric Charging?

Involves bringing the particles of one object in *close* contact with the particles of a second object, and then separating them from each other.

**The Result:** The two objects become charged with opposite type of charge.

### How Does Triboelectric Charging Work?

- Electrons are transferred from the object that loves them the least to the object that loves them the most.
- The object that gains the e<sup>-</sup>s becomes negatively-charged. The object that loses the e<sup>-</sup>s becomes positively-charged.

**Example:** Vinyl balloons love e<sup>-</sup>s more than human hair. When rubbed, e<sup>-</sup>s transfer from hair to balloon. The balloon becomes - and the hair +.

### Electron Affinity

**Definition:** a property of a materials that describes the relative amount of affinity (or love) that its atoms have for electrons.

During triboelectric charging, **e<sup>-</sup>s are transferred** from the material with the least e<sup>-</sup> affinity (making it +) to the material with the greatest e<sup>-</sup> affinity (making it -).

**Example Question:** Glass is rubbed with a silk cloth and the glass becomes +. Which material - glass or silk - has the greatest affinity for e<sup>-</sup>s?

**Answer:** Silk, because after being rubbed with glass, it was the material that gained e<sup>-</sup>s to become -.

### Triboelectric Series

A triboelectric series (shown at right) is a listing of a collection of materials, ranked in order of their electron affinity (their relative love for e<sup>-</sup>s).

For the series at the right, materials ranked higher in this series will become - when rubbed with materials below them.

For instance, **vinyl** (near top) will become - when rubbed with **rabbit fur**.

<b>Most e<sup>-</sup> Loving</b>	Teflon
	Vinyl
	Polyethylene
	Polyester
	Acrylic
	Natural Rubber
	Wood
	Cotton
	Paper
	Aluminum
	Silk
	Wool
	Glass
	Acetate
<b>Least e<sup>-</sup> Loving</b>	Rabbit Fur

### Example Questions

1. Rub Teflon and Rabbit Fur. Which becomes + and which becomes -?
2. Rub Vinyl and Paper. Which becomes + and which becomes -?
3. Rub Material X with cotton and it becomes +. What charge will X acquire when rubbed with wool?  
a. Positive    b. Negative    c. Can't tell.

Most e<sup>-</sup>  
Loving

Teflon
Vinyl
Polyethylene
Polyester
Acrylic
Natural Rubber
Wood
Cotton
Paper
Aluminum
Silk
Wool
Glass
Acetate
Rabbit Fur

Least e<sup>-</sup>  
Loving

### Law of Conservation of Charge

During electrostatic processes, the total amount of charge is conserved. In other words:

*Charge is neither created nor destroyed, but only transferred from one object to another in the form of electrons.*

So when a vinyl balloon is given several vigorous rubs with animal fur, there may be approximately 2 trillion ( $10^{12}$  electrons).

	Before Rubbing	After Rubbing
Vinyl Balloon	0	-300 nC
Human Hair	0	+300 nC
Total for System	0	0