

**Science 9**  
Unit 3: Static Electricity  
Worksheet 3: Measuring and Creating Charge



**MEASURING CHARGE:**

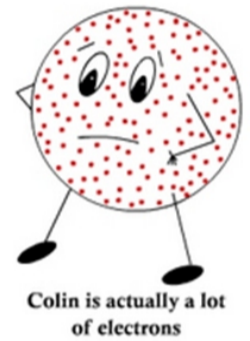
**Coulomb (C)**, is the unit of electric charge. It is named after the French physicist Charles Augustin de Coulomb (1736–1806)

$$1 \text{ Coulomb} = 6\,250\,000\,000\,000\,000\,000 \text{ electrons}$$

or

$$1 \text{ Coulomb} = 6.25 \times 10^{18}$$

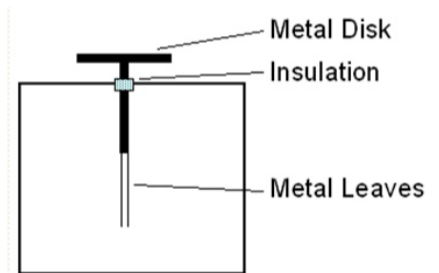
**Colin Coulomb**



**DETECTING CHARGE:**

An **electroscope** is used to detect the presence of a net charge on an object.

- When the electroscope is neutral, the leaves hang vertically.
- When charged, the leaves repel each other and diverge. A larger divergence indicates a larger net charge



**CREATING CHARGE:**

**Insulators:**

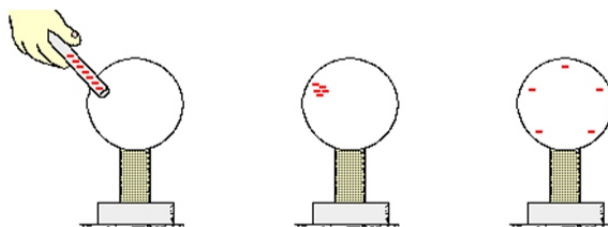
- Materials that do not allow charges to move easily.
- Examples: Plastic, Glass, Ceramics, Dry Wood
- A charge on an insulator will stay in one region and will not be distribute. Therefore, only insulators can retain a static charge



**Charged Insulator**

**Conductors :**

- Conductors Materials that allow electrons to travel freely
- Examples Copper, Gold, Aluminum
- Conductors can not retain static charge



Static electricity occurs due to friction. **Friction** occurs when objects rub against each other. The friction between two objects can result in one object losing electrons and the other object gaining electrons.



Basically, it is the stripping of electrons from one neutral object to another to make two oppositely charged objects. For example the man in the picture to the right rubs a rubber rod with some wool. The wool loses electrons to hard rubber rod. The picture below illustrates what happens

The rod is negatively charged



Wool is now positively charged

*Note: Conductors CANNOT be easily charged by friction as the extra electrons gained can easily escape.*



The **Van de Graaff generator** uses friction to produce a large static charge on a metal dome. A moving belt produces a static charge at the base of the generator. The belt carries this charge to the top where it collects on the dome

### PART A: MULTIPLE CHOICE

- Which of the following is a measure of electric charge?
  - Coulomb
  - Joule
  - Newton
  - Volts
- How many electrons are in 1 coulomb of charge?
  - 1
  - 625
  - 6 250 000 000 000 000
  - 6 250 000 000 000 000 000 electrons
- Which of the following is used to detect electric charge?
  - Electroscope
  - Ebonite Rod
  - Van der Graaff generator
  - Voltmeter
- Which of the following best characterizes electrical insulators?
  - charges on the surface don't move
  - high tensile strength
  - electric charges move freely
  - good heat conductors

5. When performing an experiment with electricity, which material would act as an insulator?
- (A) staple
  - (B) popsicle stick
  - (C) wire
  - (D) paper clip
6. Objects that don't allow electrons to flow easily through them are called \_\_\_\_\_.
- (A) protons
  - (B) insulators
  - (C) conductors
  - (D) neutrons
7. Which of the following best characterizes electrical conductors?
- (A) low mass density D. poor heat conductors
  - (B) high tensile strength
  - (C) electric charges move freely
  - (E) total electric charge is zero
8. Electrons can move the easiest through which of the following materials
- (A) Bread
  - (B) Copper
  - (C) Hair
  - (D) Plastic
9. Which of these materials is the best conductor?
- (A) aluminum
  - (B) styrofoam
  - (C) wool
  - (D) glass
10. Which of the following would help cause a charge to be placed on an object?
- (A) Friction
  - (B) Current
  - (C) Radiation
  - (D) Static
11. What does an object that is charged by rubbing acquire?
- (A) a balanced charge
  - (B) a static charge
  - (C) an unbalanced charge
  - (D) electrical current
12. When charging two objects by rubbing them together:
- (A) neither may be a conductor.
  - (B) they must have different temperature.
  - (C) they will sometimes end up with both being positively charged.
  - (D) the heat produced by friction is a necessary part of this process.
13. When a glass rod is rubbed with silk, which of the following statements best describes what happens?
- (A) the silk remains neutral
  - (B) both will have positive charges
  - (C) both will have negative charges
  - (D) They will be oppositely charged

14. A cotton T-shirt is placed in a clothes dryer with another piece of clothing. Which material would the other piece of clothing have to be made of to ensure that no static cling would result?
- (A) cotton
  - (B) nylon
  - (C) polyester
  - (D) wool

PART B: TRUE AND FALSE

15. Friction can result in the transfer of protons from one object to another as the objects rub against each other. **TRUE AND FALSE**
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16. A quantity of electric charge is measured in coulombs. **TRUE AND FALSE**
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17. Conductors allow electric charges to move easily through them. **TRUE AND FALSE**
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PART C: WRITTEN RESPONSE

1. In terms of the motion of electrons, what is the difference between an insulator and a conductor?
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2. Explain why clothes dried in the clothes dryer have more static electricity than those dried on a clothesline.
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3. You have seen how a Van de Graaff generator affects the hair of anyone touching it. Assume that the dome of the generator is negatively charged. Since a person's hair is initially neutral, why does the hair "stand on end" after the person touches the dome for a period of time? Your explanation should include a discussion of electron transfer and the laws of static charge.

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4. Ebonite rubbed with fur acquires a negative charge. A glass rod rubbed with silk is suspended from an insulating thread. When the ebonite rod is brought near the glass rod, there is an attraction. When the fur is brought near the glass rod, there is a repulsion. Describe the transfer of charges that occurred when the glass rod and silk were rubbed together.
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