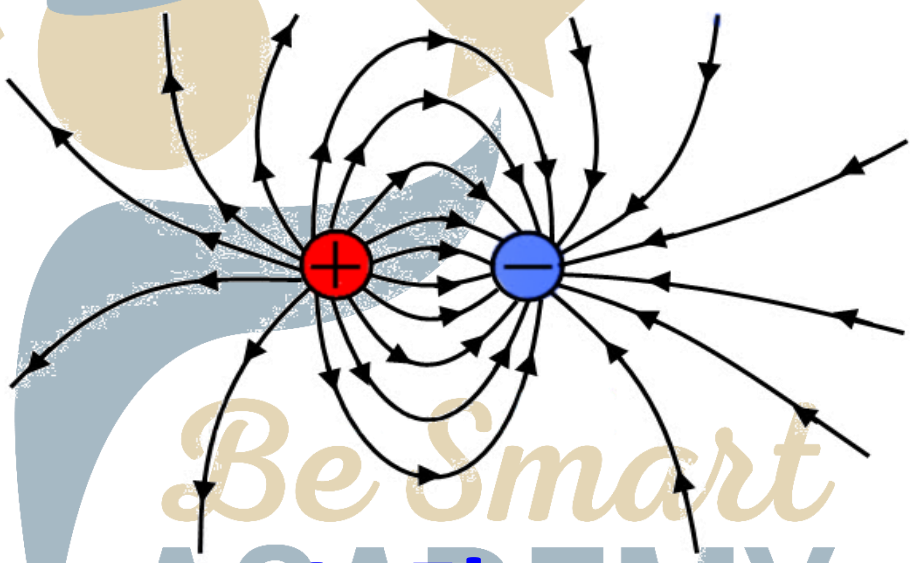
Physics – Grade 10
Unit 1: Electricity



Chapter 1: Electrostatic

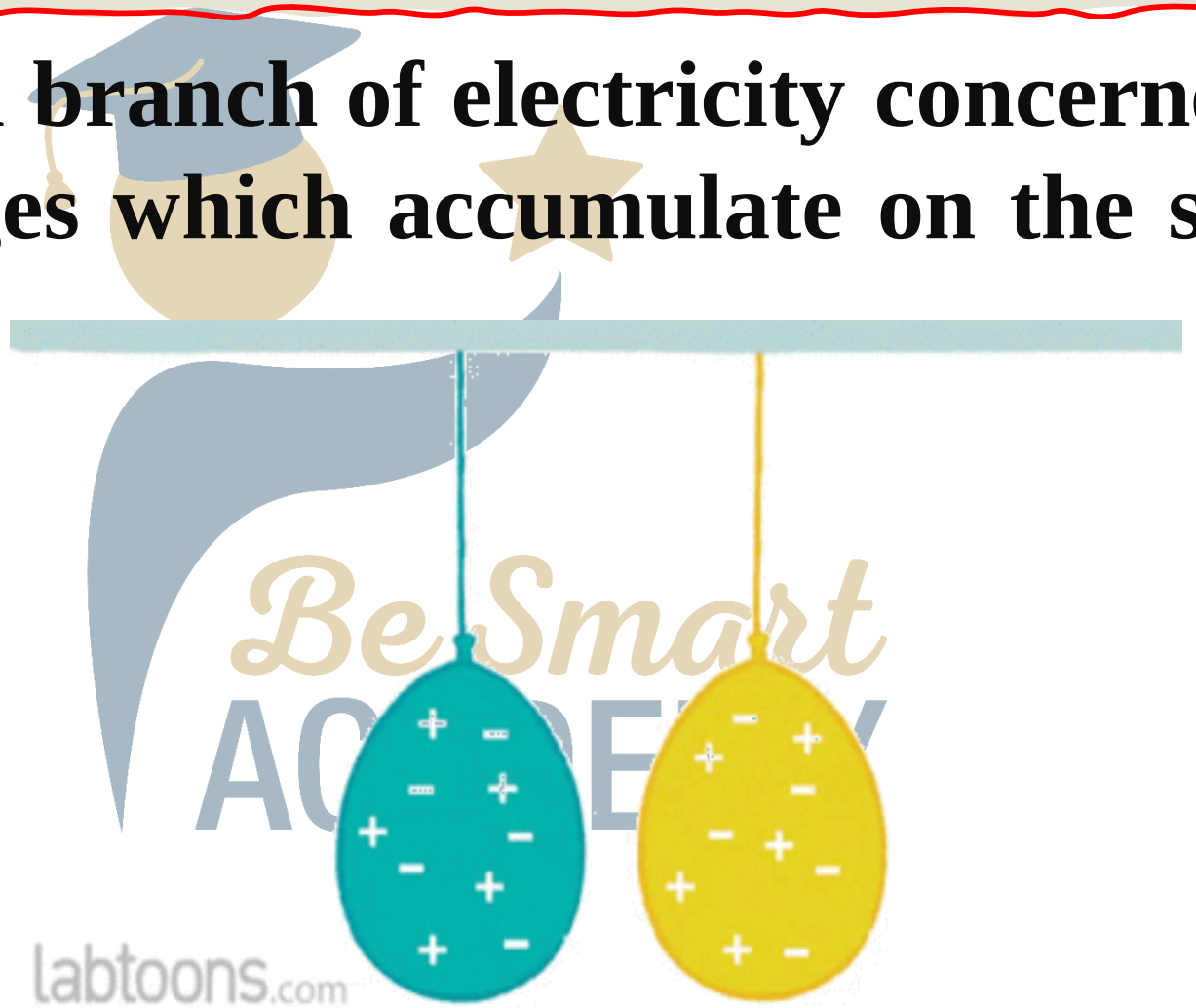
Prepared and presented by: Mr. Mohamad Seif

OBJECTIVES

1. Definition of electrostatic
2. Structure of atom
3. Charge of a body

Definition of electrostatic

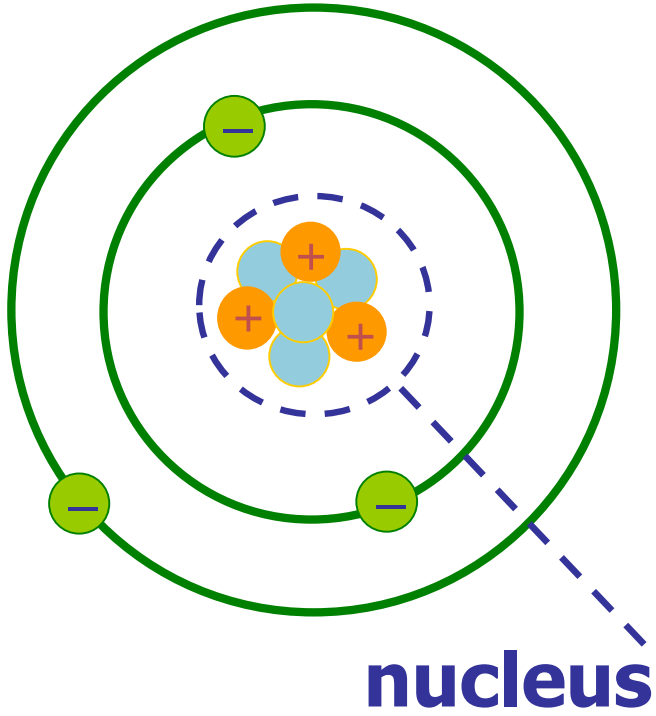
Electrostatics: is a branch of electricity concerned with static (stationary) charges which accumulate on the surface of the materials



Structure of atom

Matter is composed of atoms

- **Each atom consists of a nucleus and electron cloud.**
- **The nucleus consists of two types of particles: protons which have a positive charge and neutrons which are neutral.**
- **The electrons are negatively charged and spread in the electron cloud around the nucleus.**



Charge of a body

- The charge of an electron is $-e = -1.6 \times 10^{-19} C$ and the charge of a proton is $e = 1.6 \times 10^{-19} C$.
- In neutral bodies, the number of electrons in each atom is equal to the number of protons.
- If an object loses electrons, it has a deficit of electrons. So, it becomes positively charged object.
- If an object gains electrons, it has an excess number of electrons. So, it becomes negatively charged object.

Charge of a body

Total Charge (Q) of a body:

If an object has an excess or deficit of N electrons, its total charge is given by:

$$Q = N \times e$$

Where e is charge of one electron

Charge of a body

Application 1:

Consider a body containing 5.2×10^5 electrons. Calculate the total charge of the body.

$$|Q| = N \times e \Rightarrow |Q| = (5.2 \times 10^5) \times (1.6 \times 10^{-19} C)$$

$$|Q| = 8.32 \times 10^{-14} C$$

Law of electric charges

Unlike charges attract each other.

Like charges repel each other

OBJECTIVES

1. Types of Electrifications
2. Electrification of friction
3. Electrification by contact

Types of electrification

Electrification: is the process of charging objects by adding or removing electrons.

Electrification is of three types:

1. **Electrification (Charging) by friction.**
2. **Electrification (Charging) by contact (conduction).**
3. **Electrification (Charging) by induction**

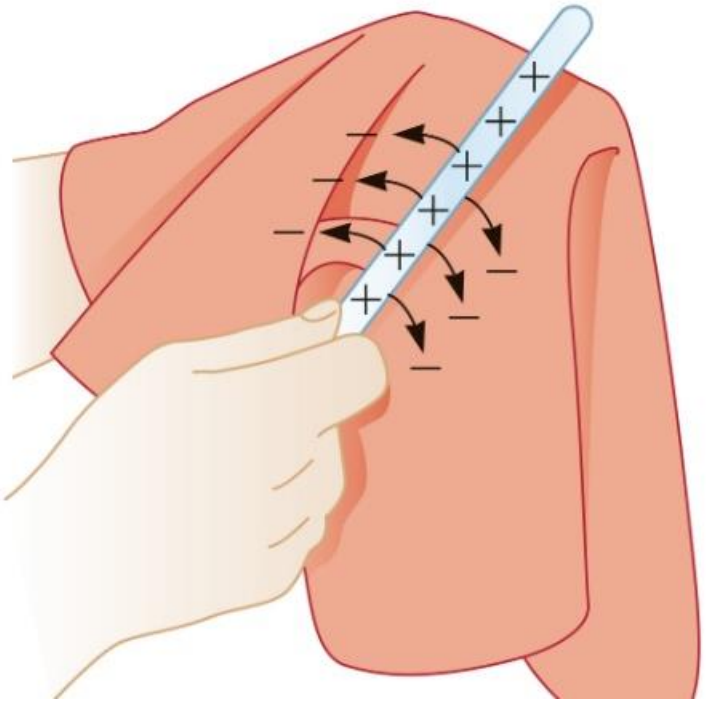
Types of electrification

Electrification by friction:

If we rub an object (A) with another object (B), then:

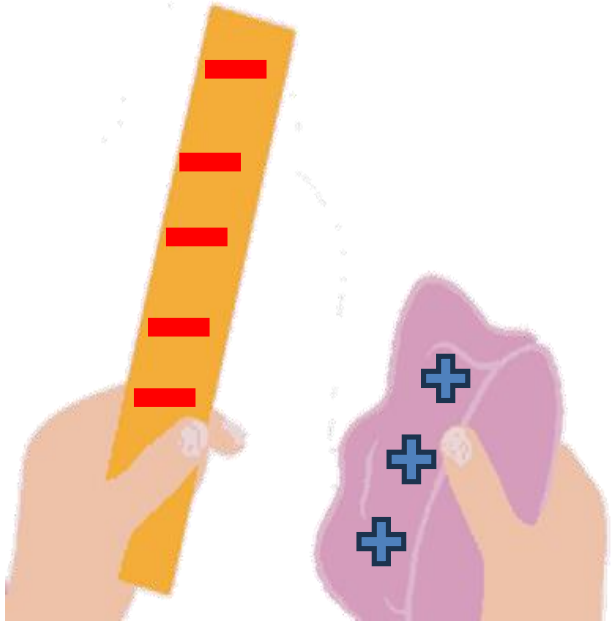
Electrons transfer from one of them to the other:

The two bodies to become charged with opposite charges.



Types of electrification

If the electrons move from A to B, then:



Body (A) loses electrons (A has deficit of electrons) to become positively charged.
Body (B) gains electrons (B has excess in electrons) to become negatively charged.

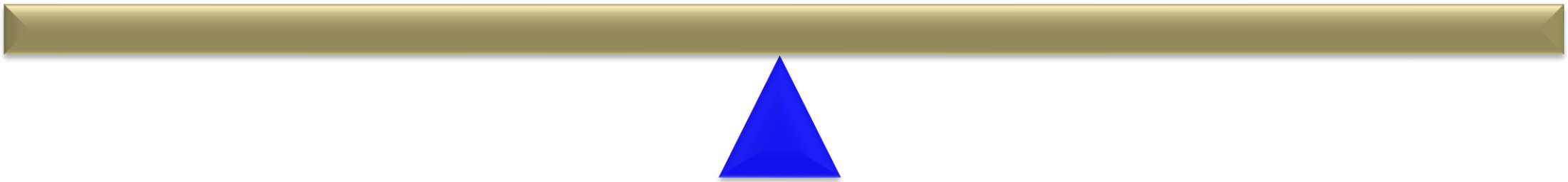
At the end of electrification by friction the two bodies (A) and (B) attract each other, since they are of unlike charges

Types of electrification

Notes

During rubbing a piece of glass with a piece of silk, electrons transfer from the glass to silk

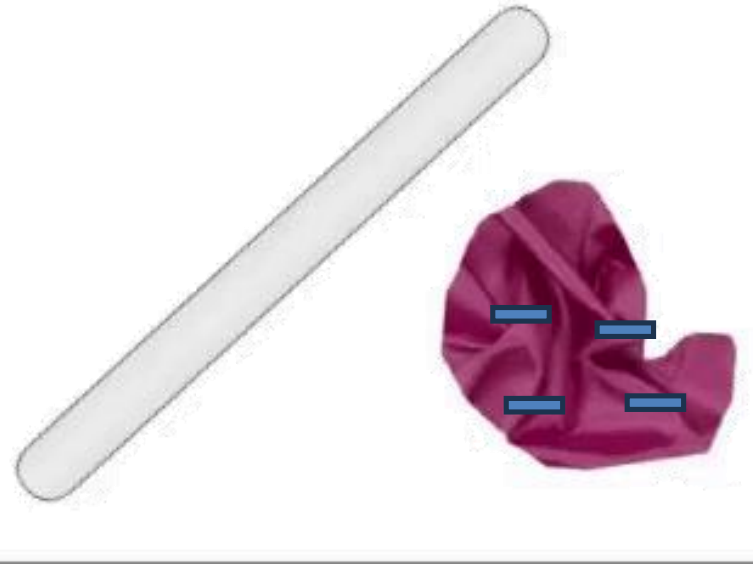
During rubbing a piece of plastic with a piece of fur, electrons transfer from the fur to plastic



Types of electrification

Application 2:

An ebonite rod (Kind of rubber) is rubbed with a piece of fur. Explain what happens ?



After rubbing, the ebonite rod with fur, some electrons moves from the fur to the ebonite rod, then:

The ebonite rod acquires an excess of electrons (negatively charged).

The fur acquires a deficit of electrons. (positively charged)

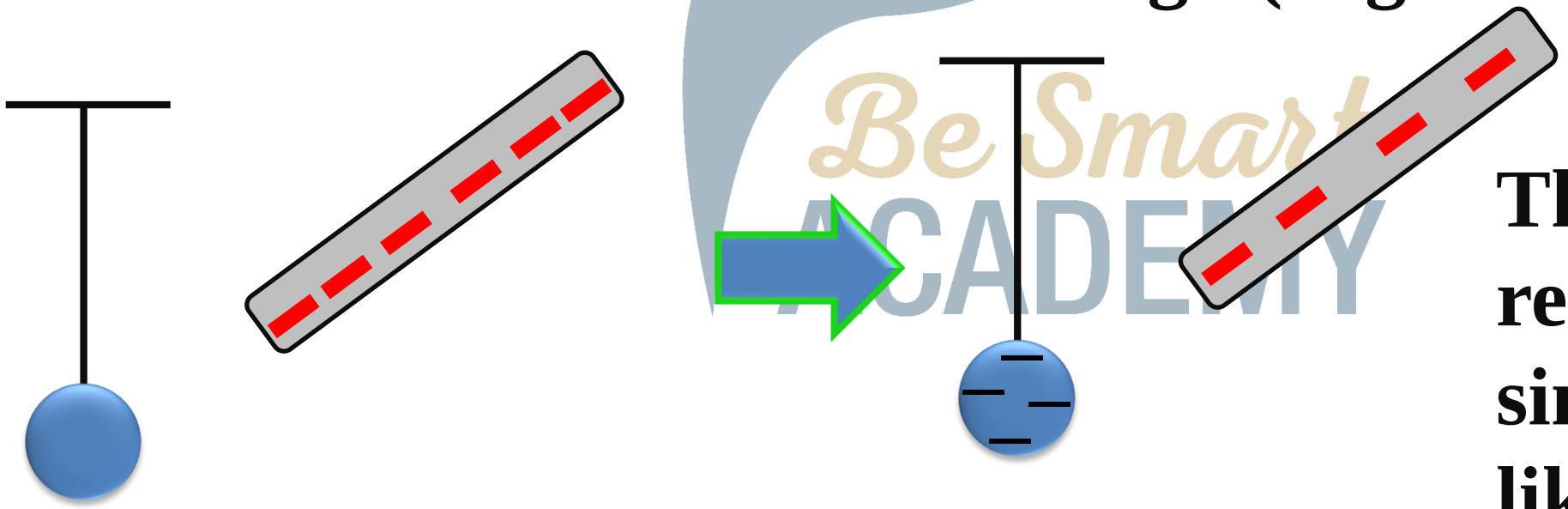
Types of electrification

Electrification by contact (Conduction):

When a negatively charged rod comes in contact with a neutral ball:

Some electrons transfer from the rod to the neutral ball.

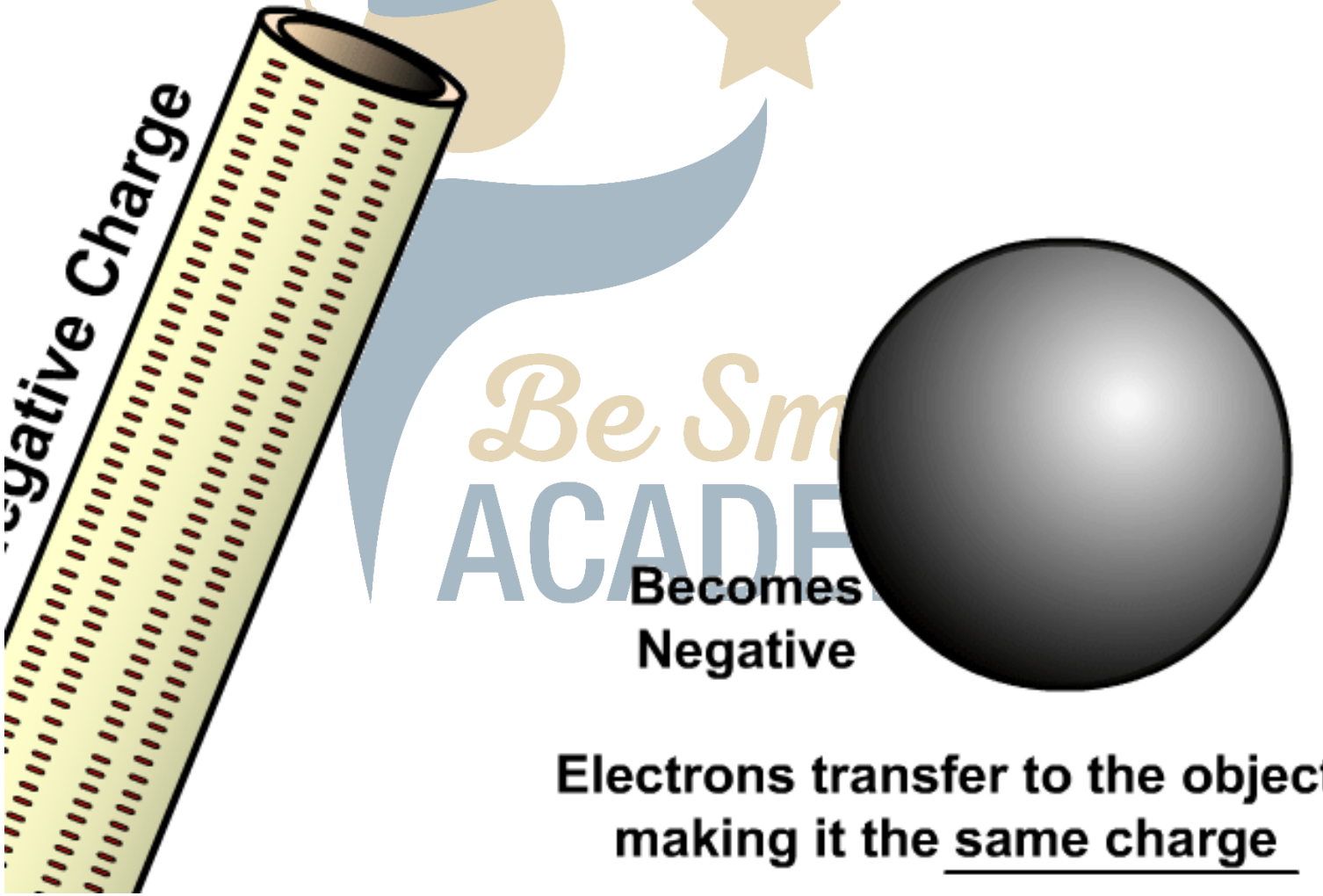
The two bodies become of same sign (negatively charged)



The two bodies repel each other since they are of like charges

Types of electrification

Conduction



Electrons transfer to the object
making it the same charge

Types of electrification

Application 3:

A positively charged glass rod in contact with the neutral ball Explain what happens?

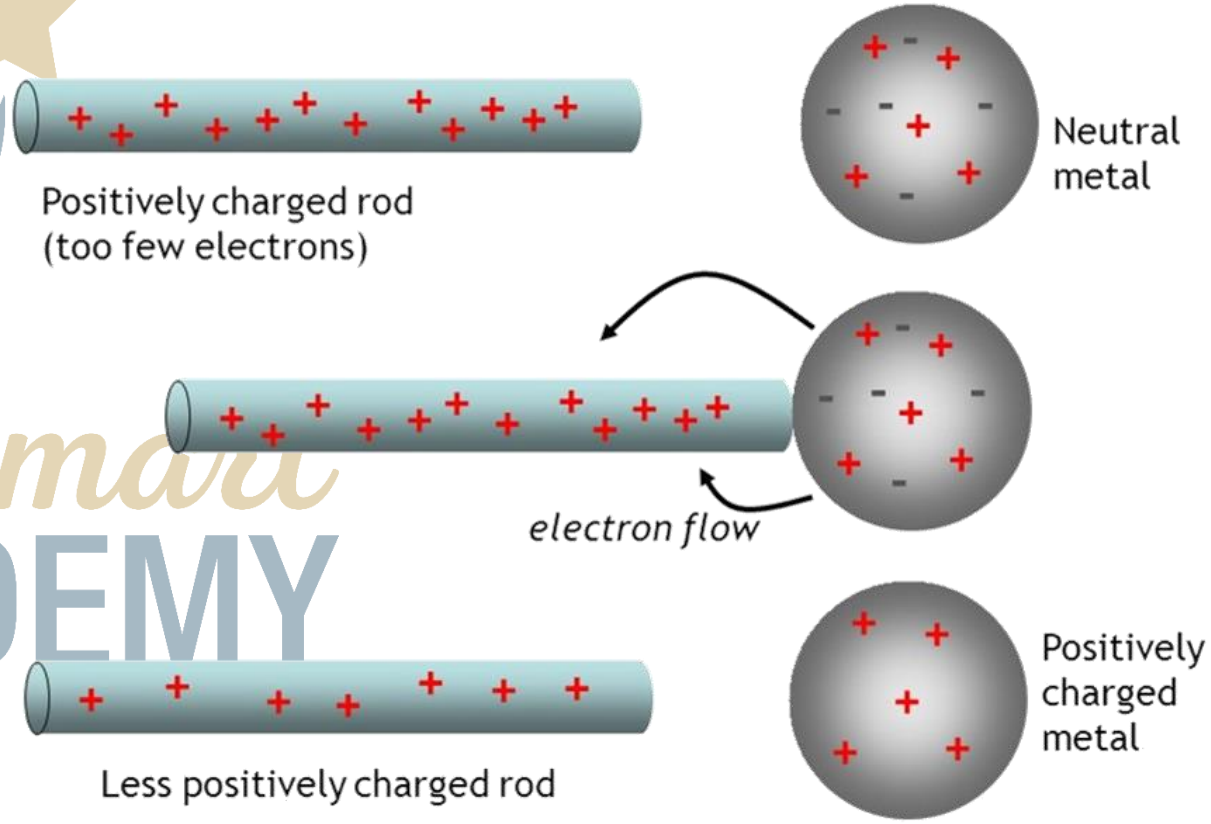
After contact, some electrons move from the neutral ball to the glass rod.

Types of electrification

For both the rod and the ball, the number of positive charges is greater than negative charges

Both are positively charged.

They repel each other, since they have same charge



OBJECTIVES

1. Electrification by Induction
2. Grounding

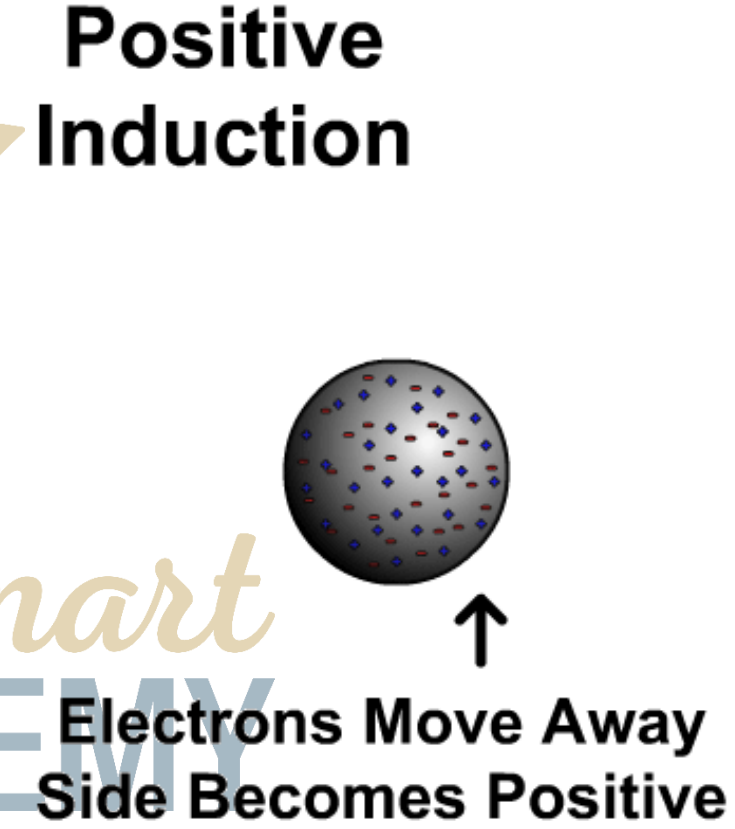
Types of electrification

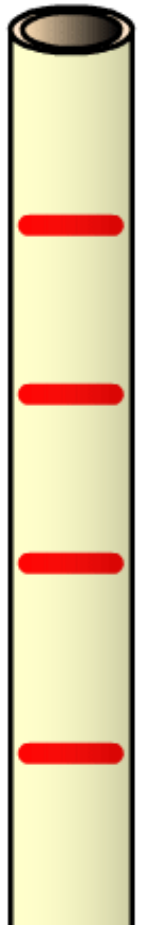
Electrification by Induction:

No contact occurs between the two objects.

The charged object influences a neutral object.

A Redistribution of charges occur in the induced body



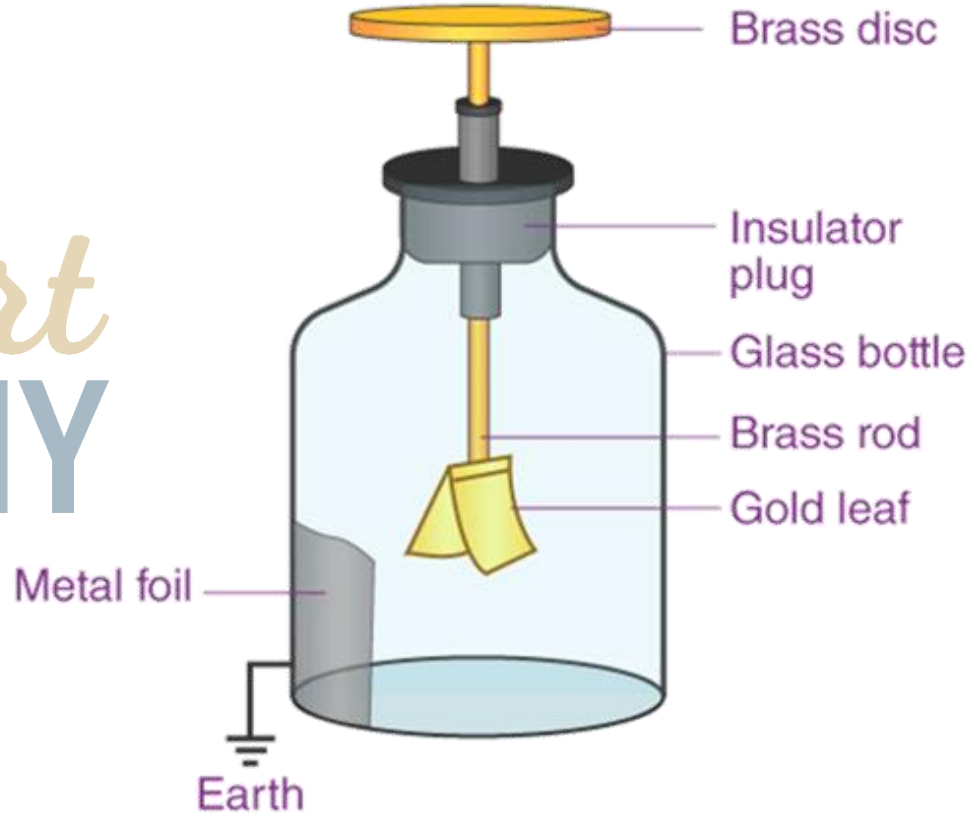


Types of electrification

Note:

An electroscope is used in different methods of electrifications.

The electroscope is an <u>instrument</u> used to detect the presence of <u>electric charge</u> on a body.

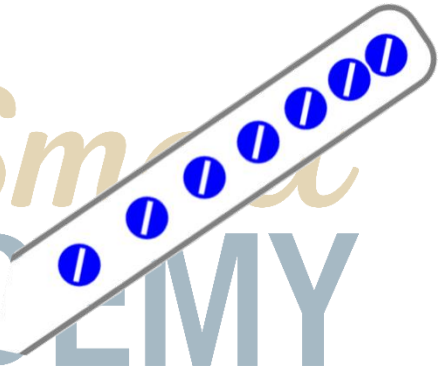


Types of electrification

Application 4:

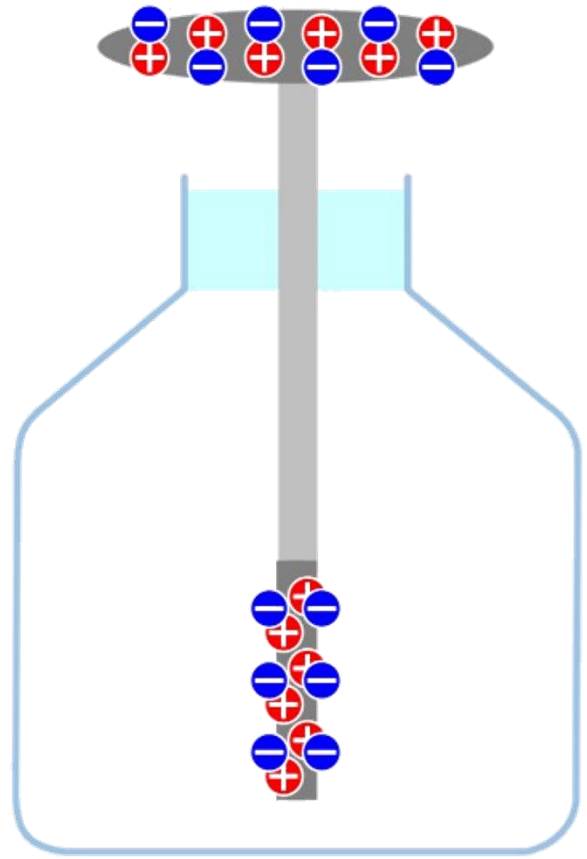
A negatively charged rod is set close to a neutral ball of the electroscope).

Explain what happens?



The electrons of the negatively charged rod repel the electrons on the neutral disc

Redistribution of charges occurs on the electroscope.



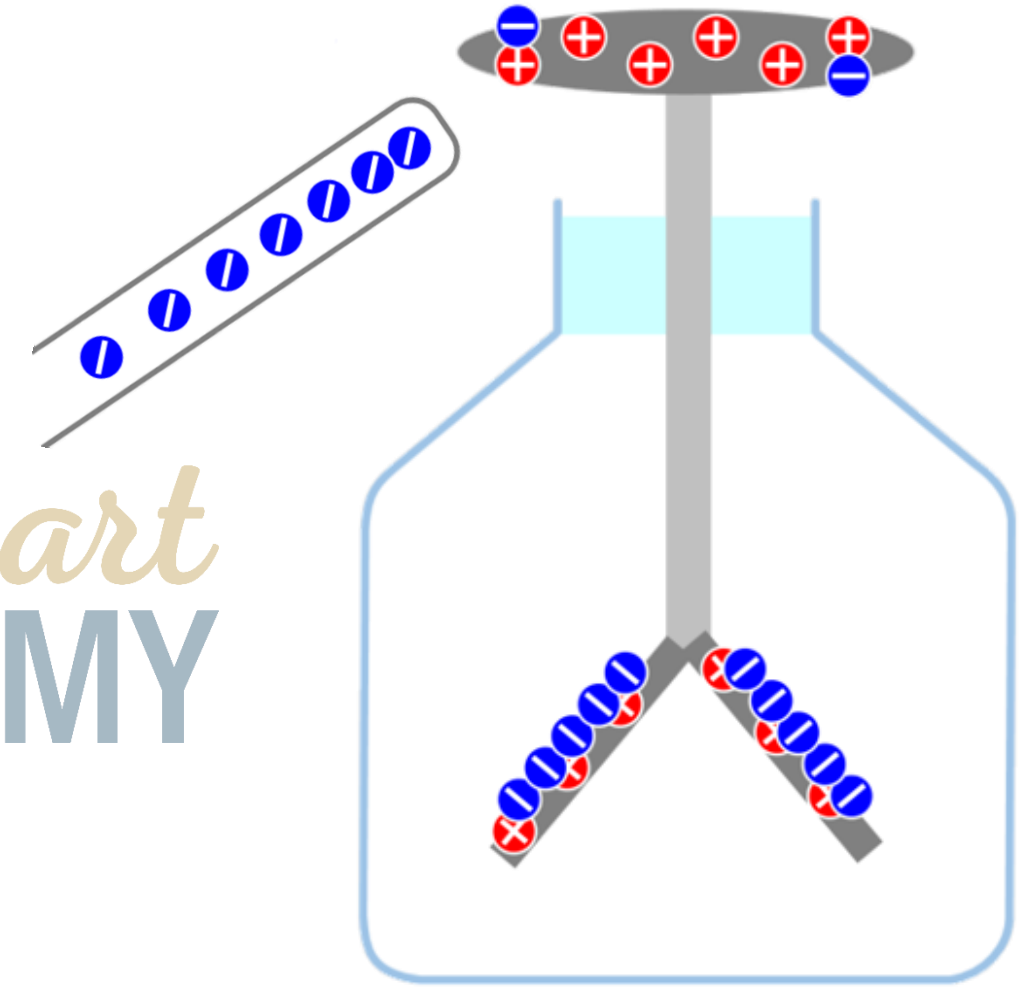
Types of electrification

Some electrons move from the disc towards the leaves

The disc become positively charged, while the leaves become negatively charged.

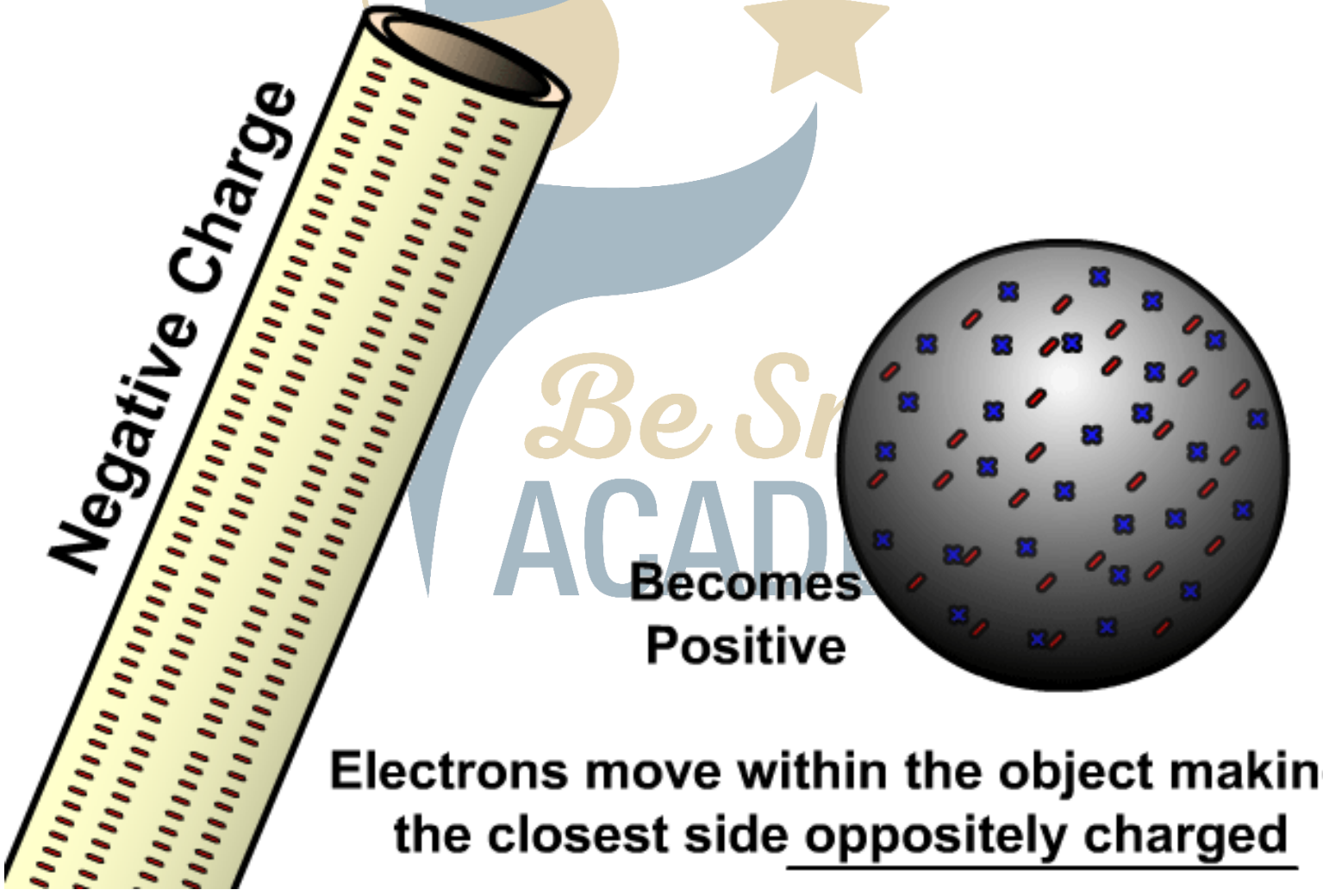
The leaves then diverge.

If the rod is moved away, the electroscope returns neutral by redistribution of charges.



Types of electrification

Induction

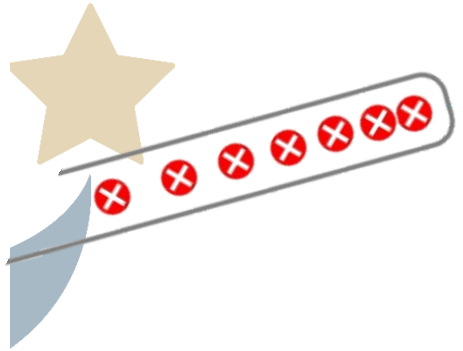


Electrons move within the object making the closest side oppositely charged

Types of electrification

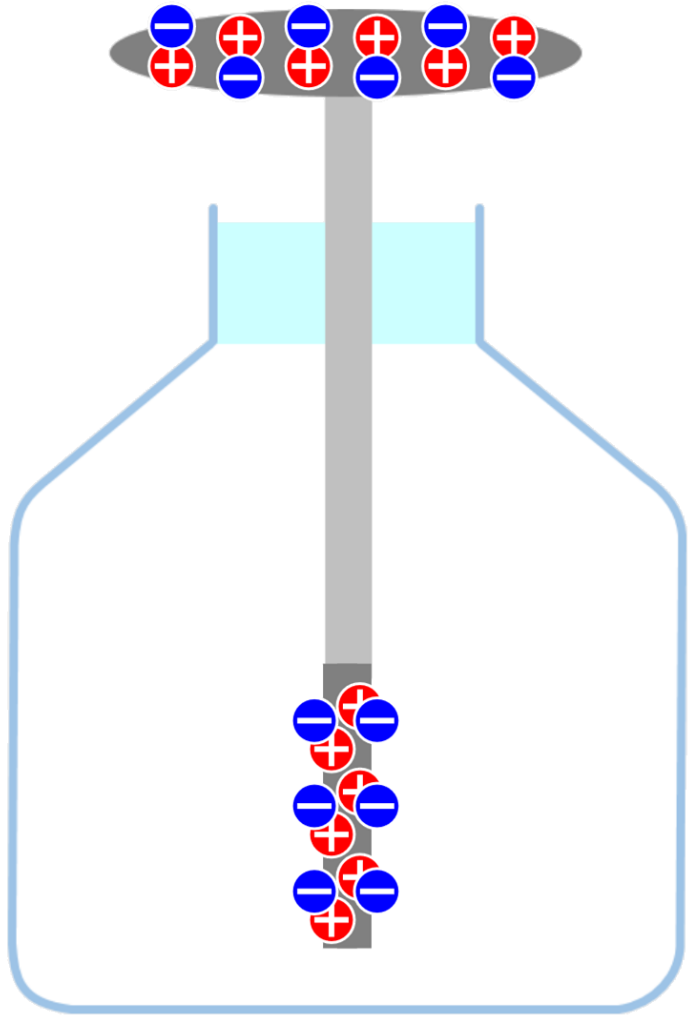
Application 5:

A positively charged rod is brought close to a neutral ball of the electroscope. Explain what happens?



The positive charges of the rod attract the electrons in the neutral disc & leaves.

The electrons move from the leaves to disc.



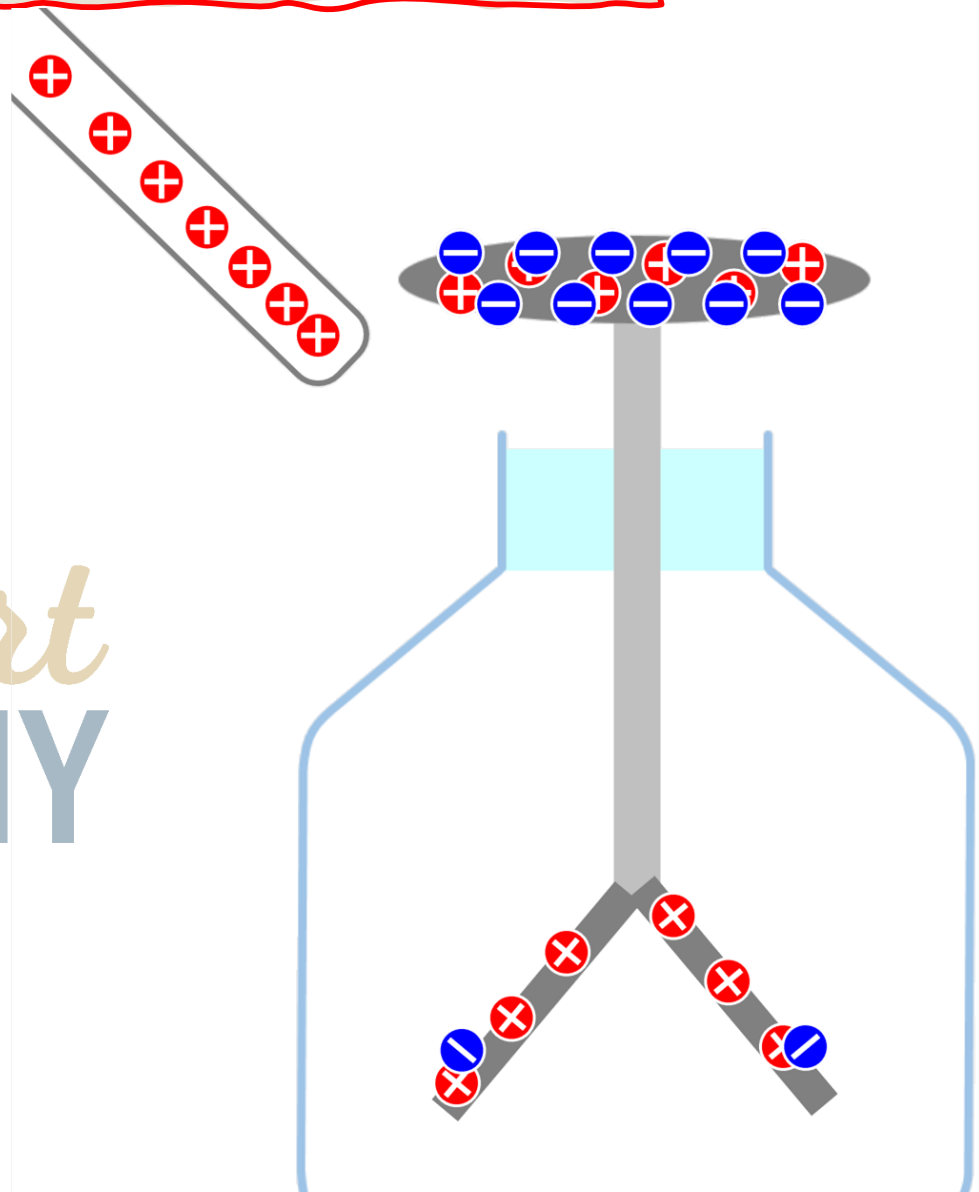
Types of electrification

The negative charges arrange on the surface of the ball (Redistribution of charges).

The disc becomes negatively charged, while the leaves become positively charged

The leaves then diverge

If the rod is moved away, the electroscope returns neutral by redistribution of charges



Grounding

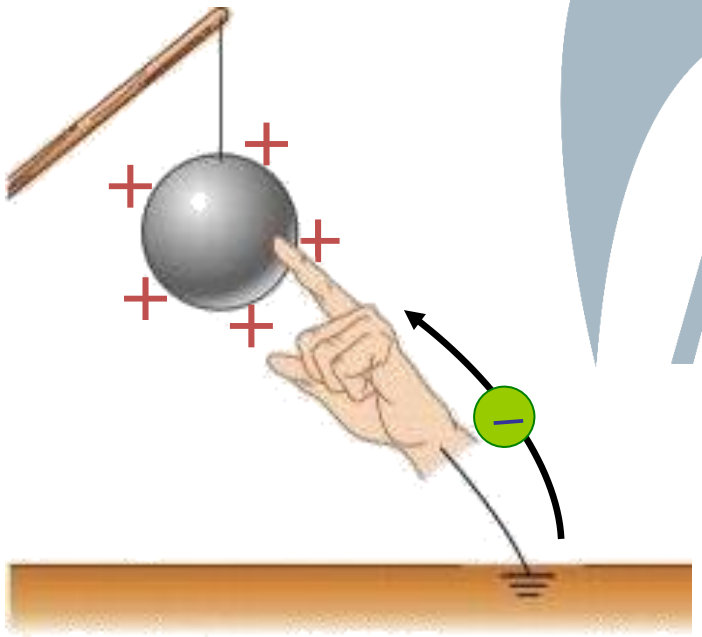
A charged object is grounded when it is connected to the earth through a connecting wire.

When a body is grounded, it return neutral body.

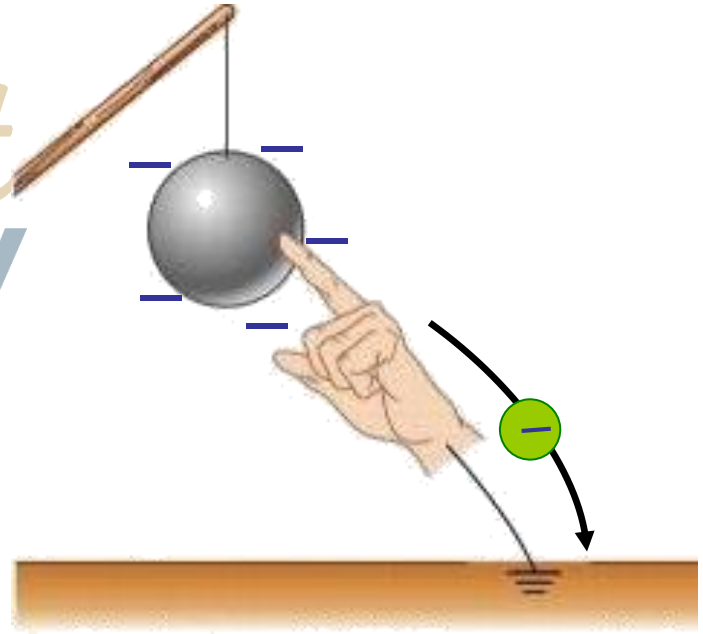
Grounding occurs by adding or removing electrons from the body.

Grounding

electrons flow from the earth to the metal ball to make it neutral.



electrons flow from the earth to the metal ball to make it neutral



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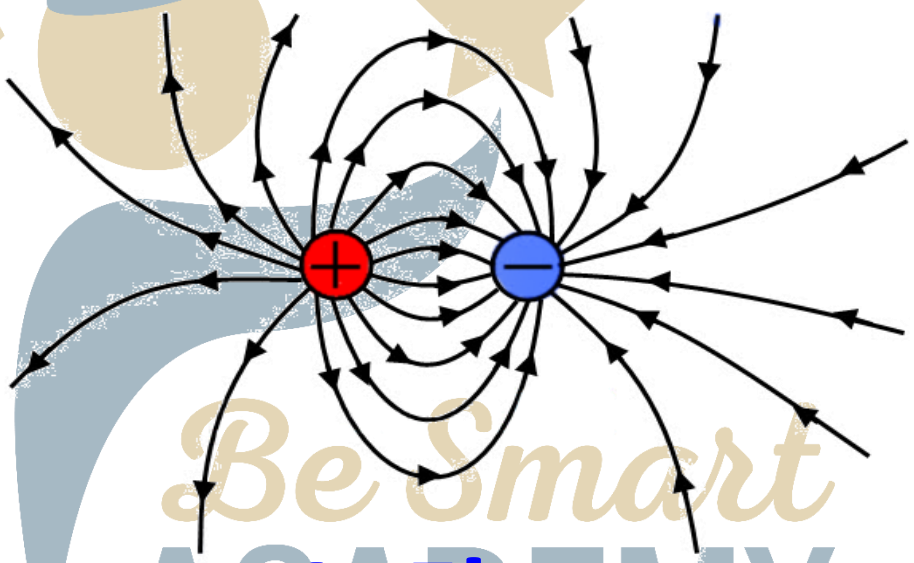
Unit 1: Electricity



Chapter 1: Electrostatic

Prepared and presented by: Mr. Mohamad Seif

OBJECTIVES

1. Law of conservation of charges
2. Coulomb’s law

Law of conservation of charges

Charge is never created or destroyed it is only transferred from one object to another.

The total number of charges of a body is conserved.

$$q_1 + q_2 = q_1' + q_2'$$

Law of conservation of charges

Application 6:

Two identical charges A and B of charges $q_1 = -8 \times 10^{-6} C$ and $q_2 = 5 \times 10^{-6} C$ respectively.

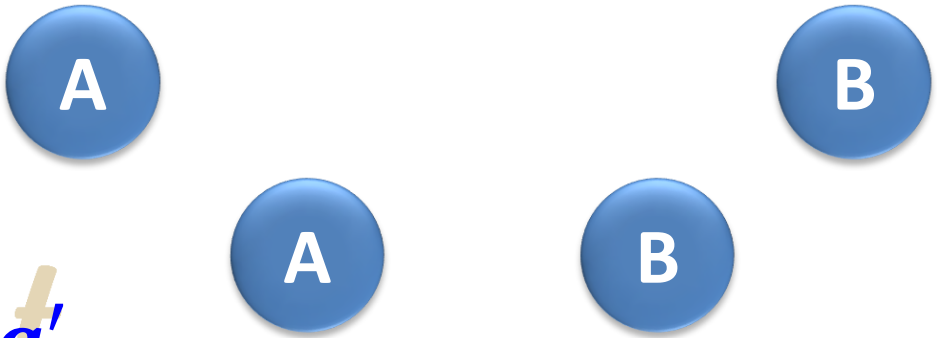
The two charges are placed in contact then separated after a short time.

Calculate the charges of A and B after contact using law of conservation of charges

Law of conservation of charges

$q_1 = -8 \times 10^{-6} C;\ q_2 = 5 \times 10^{-6} C$

Calculate the charges of A and B after contact the using law of conservation of charges



$$q_1 + q_2 = q'_1 + q'_2$$

But the two bodies are identical then: $q'_1 = q'_2$

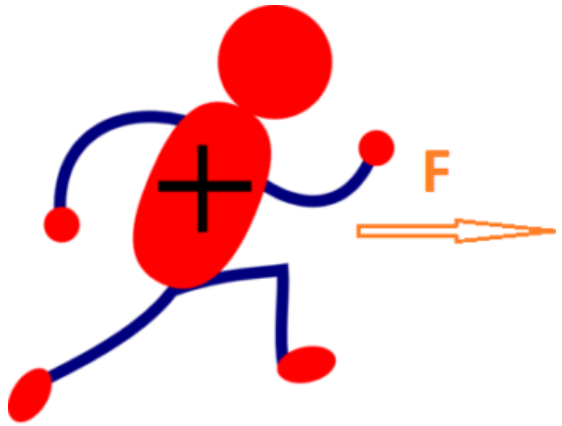
$$q_1 + q_2 = q'_1 + q'_1 \Rightarrow q_1 + q_2 = q'_1 + q'_1 \Rightarrow q_1 + q_2 = 2q'_1$$

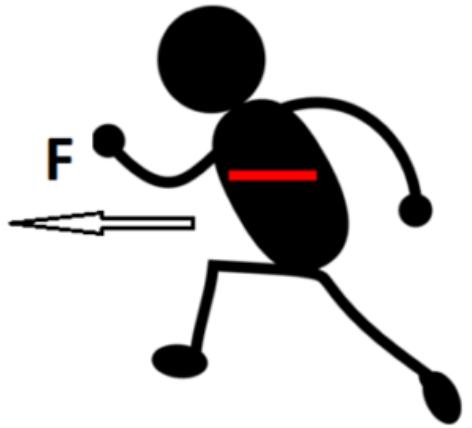
$$q'_1 = q'_2 = \frac{q_1 + q_2}{2} = \frac{-8 \times 10^{-6} + 5 \times 10^{-6}}{2} = -1.5 \times 10^{-6} C$$

Coulomb's law

Statement of Coulomb's law:

The force of interaction between the two charges is proportional to the product of absolute values of the charges and inversely proportional to the square of the distance.





$$F = \frac{K|q_1|.|q_2|}{d^2}$$

Coulomb's law

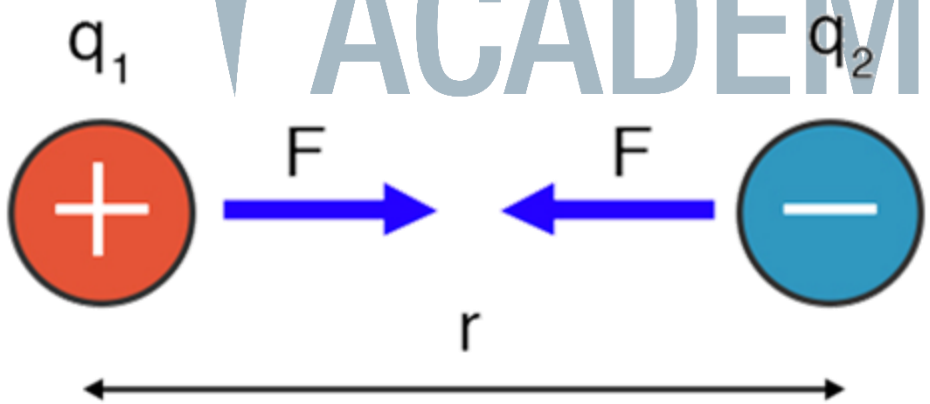
Application 7:

Given: Two-point charges (A) and B of charges $q_1 = 2 \times 10^{-5} C$ and $q_2 = -4 \times 10^{-5} C$ respectively.

The two-point charges are separated by 30 cm.

Given $K = 9 \times 10^9 S.I.$

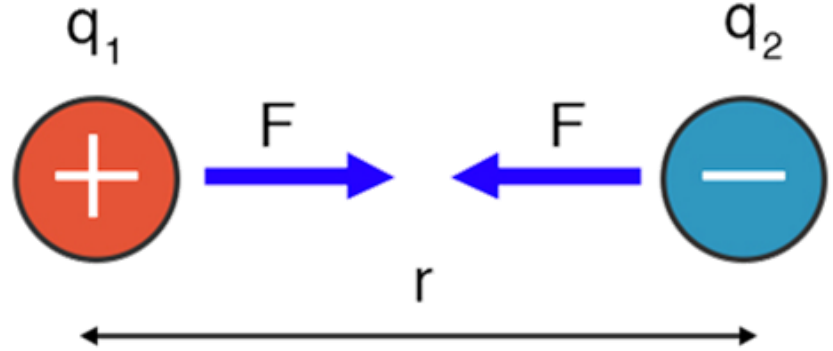
Calculate the attractive force between the two charges.



Coulomb's law

$q_1 = 2 \times 10^{-5} C$; $q_2 = -4 \times 10^{-5} C$; $d = 0.3m$; $K = 9 \times 10^9 S.I$

Calculate the attractive force between the two charges.

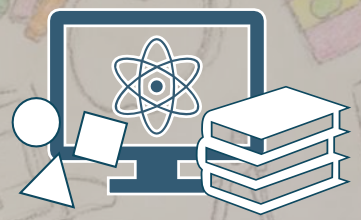


$$F = \frac{K|q_1|.|q_2|}{d^2}$$

$$F = \frac{9 \times 10^9 |2 \times 10^{-5}|.|-4 \times 10^{-5} C|}{(0.3)^2}$$

$$F = 80N$$

The End



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