Chapter I
Electrostatics

Course 1

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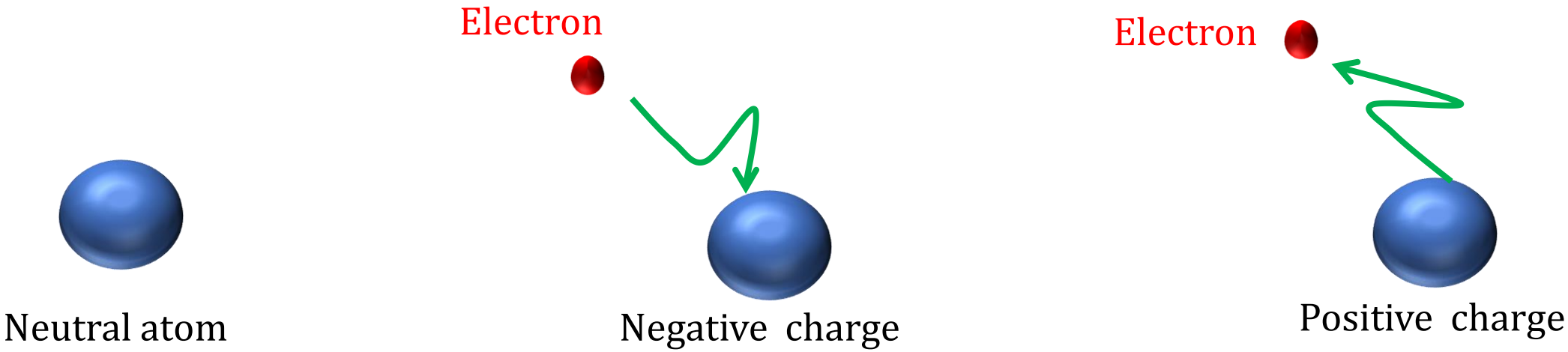
General Overview:

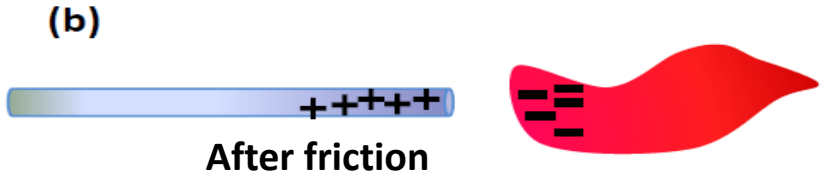
1. Electrification of Bodies

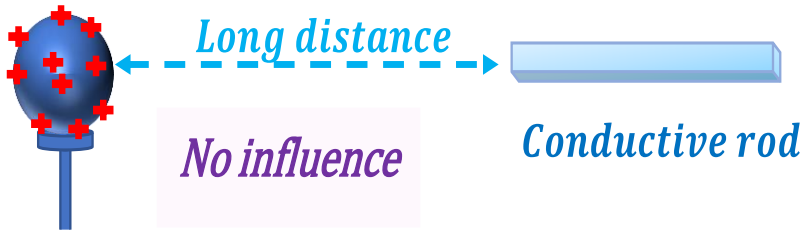
The atom, obviously, is an electrically neutral(متعادل كهربائيا) system . By losing an electron, it becomes a cation (أيون), which is a positively charged ion, and by capturing an electron, it becomes an anion, which is a negatively charged ion.



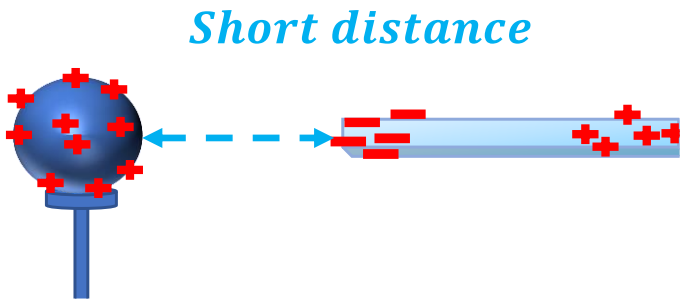
All bodies become charged through several means:

By friction

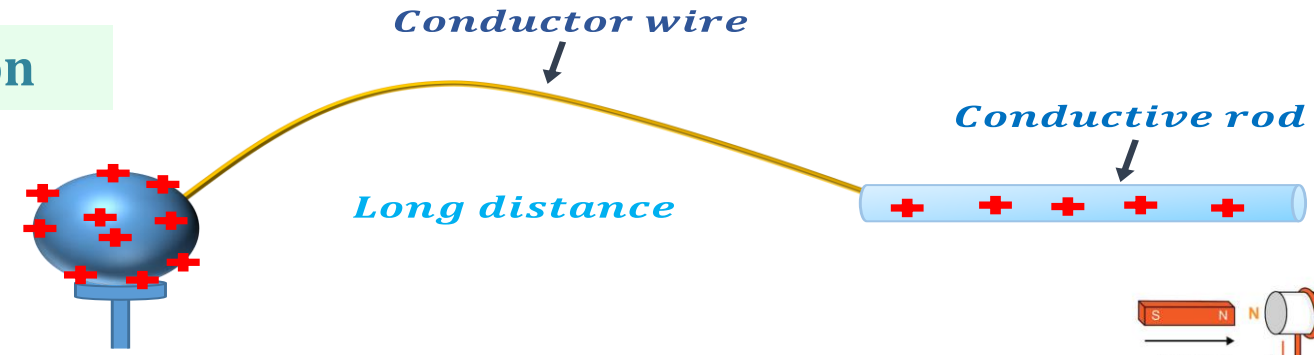




Electrification by Induction



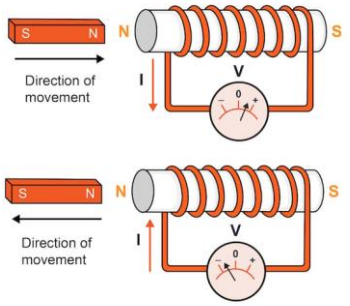
Electrification by Conduction



radiation

photovoltaic solar panel

magnetic induction



2 Types of Bodies

Plastic rod

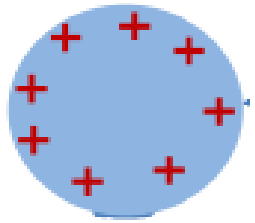
The charge remains localized (does not move)

Insulators or dielectrics (العوازل)

Examples : glass, sulfur, paraffin, plastic, … (الزجاج والكبريت والبا رافين والبلاستيك)

Conductors (الموصلات,النواقل) charge moves freely within conductors.

Examples : metals, alloys, the human body, water, soil…. (المعادن والسبائك وجسم الإنسان، الماء، التربة....)



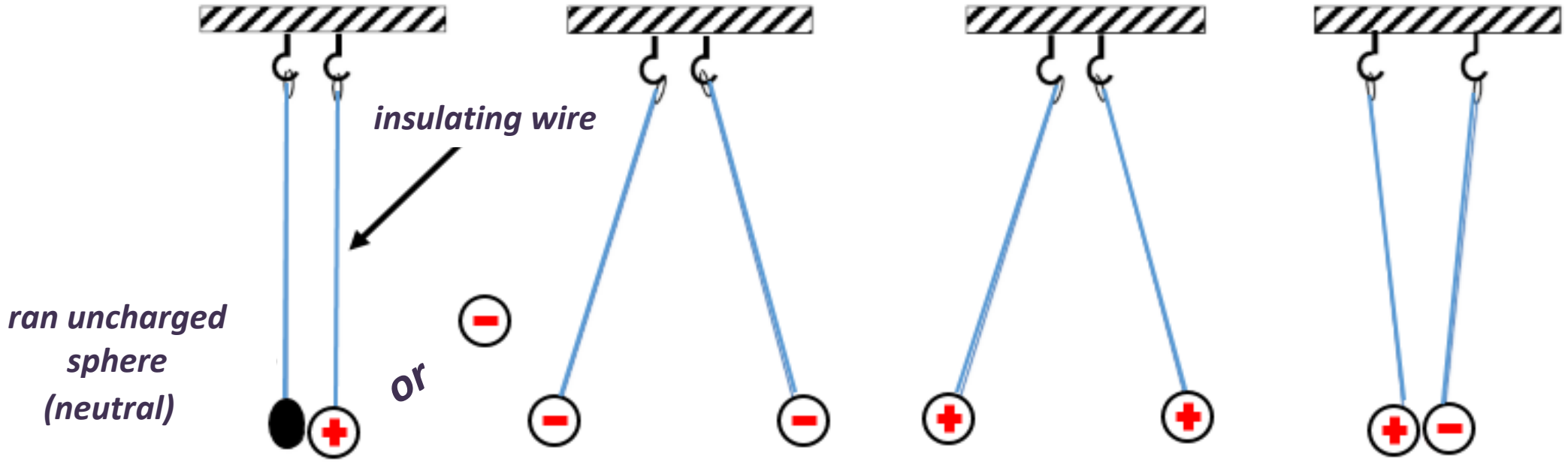
The charge distributes over the surface of the conductor(case of isolate system)

Semiconductor (أشباه الموصلات, اشباه النواقل)

The semiconductor is a material that is neither a perfect conductor of electricity nor a perfect insulator.

Examples : Silicon, germanium, gallium arsenide, gallium nitride, graphene.

3 Electric Charge: The electrical charge may be positive or negative



No effect | *Repulsion* | *Repulsion* | *Attraction*

4 Quantification of Charge

The smallest quantity of charge that can be isolated is called the elementary charge. This elementary charge is the electric charge of a proton or an electron, which is equal to $\mathbf{e = 1.602176634 \times 10^{-19}\ C}$. Any electric charge q can exist only as multiples of the elementary charge *e*, that is $\boldsymbol{q = Ne}$, it is said that electric charge is quantized.

Example:

- If $\mathbf{q = 8\ 10^{-3}\ C}$, then it consists of $\mathbf{4.993\ 10^{16}}$ protons $\left(\boldsymbol{N = \frac{q}{e}}\right)$.
- If $\mathbf{q = -2.15\ 10^{-8}\ C}$, then it consists of $\mathbf{1.342\ 10^{9}}$ electrons $\left(\boldsymbol{N = \frac{q}{e}}\right)$

Note: The elementary charge *e* is also called the quantum of electric charge.

5 Conservation of Electric Charge

This is a principle which means that charge cannot be destroyed nor created.

Therefore, The net electric charge of any isolated system is always conserved.

Example :

Two identical conductive spheres carry charges q_1 and q_2 respective. They are brought into contact and then separated.

Calculate the new charges q_1' and q_2' of the two spheres after contact. Specify the direction of electron transfer each case and calculate numbers of electron transfered.

Given : $q_1 = 310^{-8}C \; and \;\; q_2 = 810^{-8}C$

solution

$\boldsymbol{q'_1 = q'_2 = 5.510^{-8}C}$ The direction of transfer (S_1 to S_2) $\boldsymbol{N} = 1.562510^{11}$electrons