**1. Electrification experiments**

Electrification represents a charge transfer phenomenon. There are three types of electrification of an object: by friction, by contact and by influence.

**a. Electrification by friction**

**b. Contact electrification**

**c. Electrification by influence**

**2. The electrical charge**

**a. Definition of electric charge**

The electric charge is a scalar quantity, like mass, represents a fundamental property of matter, it is denoted ***q*** and its unit in SI is the Coulomb (C). There are two types of electrical charges, *positive* and *negative.*

**b. The elementary charge**

It is the smallest amount of charge **e = 1.602176634x10 -19 C** , the electric charge of an: electron: q e = -e = -1.602176634x10 -19 C and proton: q p = +e = 1.602176634x10 - 19 C.

**c. The point charge**

Is an electric charge localized at a dimensionless [point](https://fr.wikipedia.org/wiki/Point_(g%C3%A9om%C3%A9trie)) .

**3. Conductive materials, insulating materials**

From an electrical point of view, there are two main families of materials: conductors and insulators.

**a. Conductive materials**

**b. Insulating materials (dielectric) المواد العازلة**

**4. Coulomb's law**

**a. interaction between two point charges q 1 and q 2 التفاعل بين شحنتين نقطيتين**

, we will often use the value: 9.10 9 Nm 2 C -2 .

=8.8542.10 -12 C 2 /Nm 2 is the vacuum permittivity.

Noticed In a medium other than a vacuum, ε

0

will be replaced by ε

=

ε

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ε

r

where ε

r

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**Note** : In a medium other than vacuum, ε0 will be replaced by ε= ε0 εr where εr represents the relative permittivity :

**b. Principle of superposition**

Assuming that there exist n immobile electric charges in a vacuum. The electrostatic force exerted by the n charges on a charge q located at a point M is:

**5. The electrostatic field**

**a. Definition**

The unit of ***E*** in SI is Volt/meter (V/m)

**b. Electrostatic field created by a set of point charges**

**c. Field lines**

Field lines are curves where the electrostatic field is tangent to each point.

**6. The electrostatic potential**

The electrostatic potential is a scalar physical quantity which defines the electrical state of a point in space. It corresponds to the electrostatic potential energy of a charged particle at this point divided by the charge of the particle.

* The potential is expressed in Volt (V) (i.e. in J/C).

**a. Relationship between field and electrostatic potential**

In an O,x,y,z coordinate system:

and

by identification:

**b. Principle of superposition**

Consider n fixed point charges qi,placed at points Mi in a vacuum. The electrical potential created by the whole of these charges at a point M is written:

**c. Equipotential surfaces**

The equipotential surface is the set of points in space having the same value of electric potential. It is therefore defined by: V(x, y, z) = V 0 = Cste

The equipotential surfaces are therefore perpendicular to the field lines.

**d. Work and potential energy of moving a charge in**

* The work of the electrostatic force , and the potential energy, when moving a charge q from point A to point B in an electrostatic field , are given by the following formulas:

***W AB ( = q.(V A -V B )***

**V(A)-V(B)** is the electrostatic potential difference between points A and B and is equal **to:**

***E p (A) - E p (B) = - ∆E p = W AB***

**7.** **electric dipole**

The electric dipoleis a system made up of two equal charges and opposite signs, *+q* and *–q* , separated by a distance *a* .:

**a. Electric potential produced by an electric dipole:**

We will calculate the electric potential produced by the two charges (+q) and (-q), at the point M located at the distance r 1 from the charge (+q) and at the distance r 2 from the charge (-q) . The distance a is very small compared to the distances r 1 and r 2

The electrostatic potential *V* created in M by the two electric charges is equal to

**b. Dipole Electrostatic Field**

The electrostatic field vector at point M is written in polar coordinates:

We also have

**7. Electric field created by a continuous distribution of charges**

* **Linear charge density λ:**
* **Surface charge density σ:**
* **Volume charge density ρ** :

**a. The electrostatic field produced by a fine wire carrying a positive linear charge of density** **constant**

Consider a finished wire AB of length L and uniform positive linear chargeλ

1- Calculate the field vector and the potential V created by the entire wire AB at any point M located at distance x from the wire.

2 - Deduce and V when M is in the mediating plane of wire AB.

3- Deduce when the wire AB is of infinite length.

**Solution :**

**1.b-Calculation of potential**

**2.a** - **Deduce and V when *M* is in the mediating plane of wire AB:**

**2.b** - **Deduce the potential V created at point M which is located in the mediating plane of wire AB:**

**3-** **Deduce when the wire AB is of infinite length:**

**1°) a) Determination of the field created by the disk at point M of the axis Ox, located at a distance x from the center O of the disk:**

**b) Calculate the electric potential V created at point M:**

**2°) Let's check the relationship between the potential and the field:**

**3) let us distinguish the field 𝐸 when the radius of the disk R tends towards infinity**

**8. Gauss's theorem**

**a. Gauss's theorem نظرية غوص**

The field flux across a closed surface created by a charge distribution is equal to the algebraic sum of the charges present within that surface (S G ) divided by

**a) Calculation of the electrostatic field created by a wire of infinite length and constant linear density λ positive by application of Gauss' theorem.**

A wire, of infinite length, is uniformly charged by a positive linear density λ.

1)-By application of Gauss's Theorem calculate the electrostatic field created by this distribution at a point located at distance x from the wire.