BADJI MOKHTAR ANNABA UNIVERSITY
FACULTY OF SCIENCES
DEPARTMENT OF MATHEMATICS 1st year /2024–2025
Transversal Teaching Unit
Responsible for the electricity module (Coefficient: 2, Credit: 3): Professor A. GASMI
Evaluation Mode: EMD Rating 60% and TD Rating 40%

Série de TD N° 1 : **Electrostatics** (du 02 /02/2025 au 16/02/2025)

Exercice à traiter obligatoirement : 1, 3, 4, 5 et 8

Exercise 1 :

After to modern physics the hydrogen atom is essentially made up of an electron, with charge $q_e = -1.6\ 10^{-19}$ C and mass $M_e = 0.91\ 10^{-30}$ Kg and a proton, with charge $q_p = 1.16\ 10^{-19}$ C and mass Mp = 1.872 10-27 Kg. Suppose that the electron turned around the proton at a distancer= $5.3\ 10^{-11}$ m.

a- a- What is the nature of force.
b- b- Calculate this force.
c- c- Calculate the speed of the electron.

Exercise 2

At the tops of the angles of a triangle with sides a = 8cm,
b = 10cm and c = 12cm, we place three charges.
$q_1 = 210^{-6}$C, $q_2 = -310^{-6}$C and $q_3 = 10^{-6}$C. (Figure 1).
a) Calculate the resultant force acting on the charge q_3.
b) Calculate the electric potential at the center of gravity of triangle.
c) Calculate the electric field at the center of gravity of triangle.

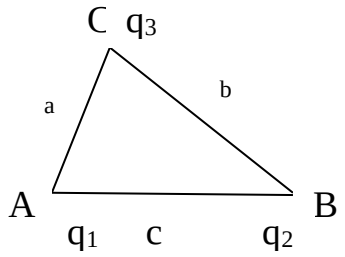

figure1

We give the dielectric constant in vacuum $\varepsilon_0 = 8{,}8510^{-12}$ C^2/Nm^2

Exercise 3:

Two point charges, $q_1 = 40.\ 10^{-9}$ C and $q_2 = -30.\ 10^{-9}$ C, are at a distance $A_1 A_2 = 10$ cm from each other.
1- Calculate the potential:
a) At a point A located halfway between the charges.
b) At a point B located 8 cm from the charge q_1 and 6 cm from the charge q_2.
2- Calculate the electric field in A and B.
3- What is the work necessary to transfer a charge $q = 25.\ 10^{-9}$ C from B to A?

Exercise 4:

We consider the uniform electrostatic distribution λ on the segment $x \in [-\frac{a}{2}, +\frac{a}{2}]$.

Calculate E and V on the OX axis $x > \frac{a}{2}$.

Exercise 5:

Consider a circular distribution, with center O and radius R, uniformly charged with a linear density λ.

a) Determine the electric field E created at the distance z from the axis of the circle.

b) Determine the potential V created at the distance z from the axis of the circle.

Exercise 6:

Two positive point charges, of value q, are fixed on the Y axis at the coordinates y=+a and y=-a.

a) Show that the potential at any point on the X axis is given by:

$V(x)=K\times 2q\times (a^2+x^2)^{-1/2}$ avec $K=9\times 10^9$SI

b) What is the expression for the electric field E on the X axis, compare with dV(x)/dx. Comment

c) What is the work done by the electric force to move a charge +6C from the point $x_a=3a$ to point $x_B=4a$, knowing that $q=+e=1.6\times 10^{-19}$C et a=1A

Exercise 7

An electric dipole is made up of two charges –q and +q placed at A and B.

Its dipole moment is defined by: $\vec{p} = q.\overrightarrow{AB}$

a) Determine the electric field E, created by this dipole, at a point M located on the axis AB at a distance r from its center.

b) If this dipole is subjected to an electric field E', show that its electric potential energy is given by:

$W_p=-p\times E'\times cos(\vec{P},\vec{E'})$

Exercise 8

We consider the electrostatic distribution of linear and uniform charge density λ on an infinitely long wire.

a) Calculate the electric field E at a distance a from the wire by the direct method and by applying Gauss' theorem.

b) Apply the result to calculate the electric field created by two perpendicular wires, charged with linear charge densities λ and 2λ.