University Center of Mila **Academic year :2024/2025**
Institute of Sciences and Technology **Module : structure of matter**
First Year TS

Series N° 2

Exercise 1:

The electron package of the cathode tube is deviated under the influence of an electric field E. The deviation of this package (after measuring the amount of deviation Y_S) resulting from the electric field $E = 3{,}6 \cdot 10^4 V/m$ is abolished by the opposite of the magnetic field B = 9.10^{-4} Tesla, which affects in the same electric field vacuum.

1 . Find the expression for the e/m_e ratio of electrons in terms of E, B, L, Ys.
2. determine the speed and kinetic energy of the electrons.
3. What is the value of the U voltage accelerator U that can be applied between the cathode and the anode so that the electrons acquire this Kinetic energy?

e = $1{,}6.10^{-19}$ C, me = $9{,}1.10^{-31}$ Kg

Exercise 2 :

Using the device used in ***Millikan's*** experiment, we observe the free fall of a spherical oil droplet in the air at a constant speed equal to $v_1 = 3.\ 10^{-4}$ m/s.

1. with negligent the Archimedes thruster. Calculate the radius of this droplet, its size and mass.

In the presence of the electric field E_1, the droplet rises toward the positive pole of the capacitor (upward) at a new speed $V_2 = 15{,}097.\ 10^{-4}$ m/s

2. What is the q_1 charge value that the droplet acquires if you know that the electric field value is $E_1 = 3.106$ v/m.

3. The electric charge of the droplet changes to q2. the droplet stabilizes between the two capacitor plates, when the value of the electric field $E_2 = 331554.6$ V/m . Calculate the value of the new electric charge q_2.

g = 9,81 $m.s^{-2}$, ρ_h = 900K g/m^3, $\eta = 17{,}3.10^{-6}$ $Kg.m^{-1}.s^{-1}$

Exercise 3:

Inside the mass spectrometer of ***Bainbridge*** observed that element X has 3 isotopes
The ions collide with the photographic board at a distance of: 41,50 cm; 45,65 cm and 37, cm from the collision point of the ions $^{12}C^+$ where the inside of the speed filter is applied electric field E = 5.104 $V.m^{-1}$.

1. Calculate the value of the appropriate magnetic field that allows ions with a speed of 2.10^5 $m.s^{-1}$ pass to the filter without deviation.
2. Calculate the magnetic field inside the analyser knowing that the distance between the exit point from the speed filter and the point of collision of $^{12}C^+$ ions is 49.80 cm.
3. Select the X element and its isotopes knowing they are lighter than carbon

$N_A = 6{,}023.10^{23}$; e=$1.6 .10^{-19}$C