University Kasdi Merbah Ouargla

Faculty of Mathematics & Matter Sciences

Department of Chemistry

Year: 2023\2024 ***Course:*** Chemistry 1 ***Level:*** First year

TD N2: Structure of atom

Exercise 1:

A beam of electrons undergoes a deviation y_0 under the action of an electric field of intensity $E = 2.10^4$ V/m in J.J. Thomson's experiment. This deviation is eliminated by applying a magnetic field of intensity $B = 10^{-3}$ Tesla, acting in the same space as the electric field.

1-Determine the velocity of the electrons and their kinetic energy.

2-Find the relation expressing the deviation y_0.

3- Calculate the deviation y_0 experienced by the beam at the exit of the capacitor, knowing that the length of the capacitor is L = 10 cm. me = 9.1 x 10^{-31} kg, e = 1.6 x 10^{-19} C.

Exercise 2:

In Millikan's experiment, an oil droplet of mass m and radius r is found between the plates of a capacitor.

1.The drop falls in free fall from a distance of 4 mm after 12.8 seconds.

a-Calculate the radius and mass of the droplet (we will neglect the Archimedes thrus).

2-The droplet charges when we apply an electric field E= 1.8 10^7 $V.m^{-1}$, it rises with a speed of 4mm after 16 seconds.

a- Calculate the total charge q, deduce the number of charges?

$\rho = 1.26 g.cm^{-3}$, $\eta = 1.80. 10^{-4}$ $kg.s^{-1}.m^{-1}$, $g = 9.81 m. s^{-2}$, $e = 1.6. 10^{-19}$ C.

Exercise 3:

The $^{20}Ne^+$ and $^{21}Ne^+$ ions are separated using a Bainbridge mass spectrograph.

What is the speed of these ions at the exit of the speed filter, if the distance d between the impact pins on the photographic plate is 3cm, the magnetic induction being 0.2 Tesla.

Exercise N 4:

The masses of the proton, neutron and electron are respectively $1.6723842.10^{-24}$g, $1.6746887.10^{-24}$g and $9.109534.10^{-28}$g.

1- Define the atomic mass unit (u.m.a). Give its value in gram.
2- Calculate in U.M.A. and to within 10^{-4}, the masses of the proton, neutron and of the electron.
3- Calculate according to Einstein's relation (mass-energy equivalence), the energy content of an a.u. expressed in MeV.
(1eV=$1.6.10^{-19}$ Jouls)

Exercise 5:

Consider the element phosphorus P (Z=15) (isotopically pure, nuclide $^{31}_{15}P$)

1. Determine, in a.u.m.a and with the same precision as the exercise preceding, the mass of the nucleus, then that of the phosphorus atom.

2. Is it reasonable to consider that the mass of the atom is localized in the nuclei?

3. Calculate the molar atomic mass of this element.

4. The actual value is 30.9738 g. mol^{-1}. What can we conclude from this?

Exercise 6:

The natural silicon element Si (Z=14) is a mixture of three stable isotopes: $_{28}$Si, $_{29}$Si and $_{30}$Si.

The natural abundance of the most abundant isotope is 92.23%.

The atomic molar mass of natural silicon is 28.085 $g.mol^{-1}$.

1. What is the most abundant isotope of silicon?

2. Calculate the natural abundance of the other two isotopes.