University of Mohamed Khider, Biskra
Faculty of Exact Sciences, Natural and Life Sciences
Department: Materials Science
First Year - Common Trunk

Academic Year: 2023/2024
Course: Chemistry 1

Series N° :2

Exercise 1:

In Thomson's experiment, an electron moves at a speed of 36 km/s and passes through an electric field with a magnitude of 5800 V/m. What is the magnitude of the magnetic field that the electron should experience in order not to deviate from its path, and what is its direction?

Exercise 2:

Using a (Millikan) apparatus, we study the motion of a single droplet of oil with a negative charge.

1. In the absence of an electric field, the droplet falls a distance of 2.61 mm in 12 seconds. Calculate the radius and mass of the droplet while neglecting the air resistance.
2. We apply an electric field to the droplet until its motion comes to a stop. If the distance between the capacitor plates is d = 2cm and the voltage difference is v= 4320V, calculate the charge of the droplet. What can you conclude?

ρ =900 Kg/m^3, g=9.81 m/s^2, η=$18.10^{-6} kg/m.s$

Exercise 3:

Consider the element aluminum ${}^{27}_{13}Al$, assuming that both the nucleus and the atom have a spherical shape.

1. Calculate the density of both the nucleus ${}^{27}_{13}Al$ and the atom of aluminum ${}^{27}_{13}Al$ in relation to water, assuming that the nucleus and the atom are spherical in shape. Given that the nuclear radius (R_N) is 10^{-5}Å and the atomic radius (R_A) is 1.25Å where ρ_{H_2O}=1 g/cm^3
2. What can you conclude? Mention the atomic model that aligns with these results and the scientist who proposed it.
3. You have a piece of ${}^{27}_{13}Al$ with a volume of 5 cm^3 and a mass of 13.5 g.
   - Find the volume occupied by the atoms in this piece.
   - Compare this volume to the volume of the piece itself. What can you conclude?

Exercise 4:

1- Silicon ${}_{14}Si$ has three stable isotopes with the following atomic masses, respectively: 27.977 u, 28.976 u, 29.974 u. Provide the nuclear structure for each isotope.

2- If the average atomic mass of silicon is 28.086 u and 1g of the isotope mixture contains 30.9 mg of the heaviest isotope, what are the percentage abundances of each isotope?

Exercise 5:

The mass spectrometer of Banbridge is used to separate natural boron from its isotope using carbon $^{12}C^{+}$ as a reference. In the velocity filter, the charges $^{+a}B^{+}$، ^{b}B and $^{12}C^{+}$, where $^{12}C^{+}$ is the heaviest, are subjected to electric fields $\vec{E}$ and $\vec{B}$ so that $\frac{E}{B} = 4.10^5$ (S.I). These charges are then separated using a second magnetic field B_1 = 0.2 tesla in the analyzer. The radius of the $^{12}C^{+}$ ion is 24.92 cm on the photographic plate, while the collision points for boron appear at distances of 4.17 cm and 8.34 cm relative to carbon.

1- Calculate the atomic masses of the two boron isotopes.
2- The ratio of the heavier isotope of boron to the lighter one is 4.3. Calculate the average atomic mass of natural boron.

Exercise 6:

The masses of the proton, neutron, and electron are as follows, respectively:
$1.6723842 \times 10^{-24}$ g, $1.6746887 \times 10\text{-}^{24}$ g, and 9.109534×10^{-28} g.

1- Calculate the mass of each of the proton, neutron, and electron in unified atomic mass units (u.m.a).
2- Calculate the energy equivalent of the atomic mass unit (u.m.a) in MeV.
3- Calculate the binding energy for each nucleon in a nucleus: proton and neutron. Which one is more stable?

$$^{235}_{92}U = 234.9934\ uma;\ ^{210}_{84}Po = 210.0482\ uma$$