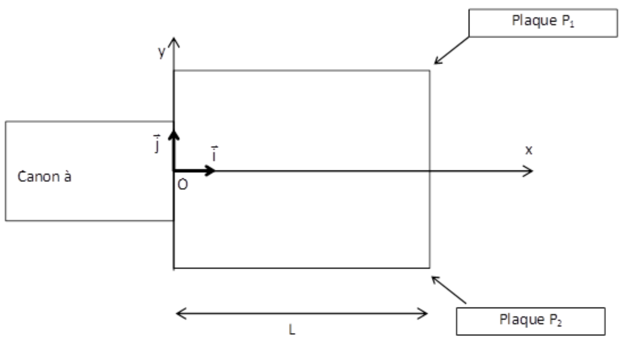
Exercise: 1

J.J. Thomson's experiment consists in passing an electron between two plates of a condenser in order to deflect it.

1. On the following diagram, represent the electric field force vectors of velocity and acceleration for an electron, a proton and a neutron.



2. These three particles are subjected to a magnetic field. Show the movement of each particle when it is deflected by a magnetic field.

Exercise: 2 (Charged particle subjected to electric and magnetic fields)

A- An electron with a velocity $v_0=10^7$ m/s enters between two plates of a condenser with a length x=50, separated by a distance l=20 cm. The electric field is perpendicular to the electron's displacement.

a. Write the relation to calculate the deviation of the electron in terms of mm, e, x, v_0, l, and V (where V is the potential difference and l is the distance between the two plates).

b. With a potential difference of 100 V between the plates, calculate the deviation of the electron at the exit of the capacitor in centimeters.

B- The electron with a velocity v_0 is subjected to a magnetic field of 10^{-2} T.

a. Determine the value of the magnetic force. What is the unit of magnetic force, and how did you obtain it?

b. Find the radius of the circle described by the electron.

: $m_e = 9{,}1 \times 10^{-31}$ kg, $e = 1{,}6 \times 10^{-19}$ C, $g = 9{,}81$ m/s^2

E=V/l , 1 Ampere = 1 Coulomb/second, 1 Tesla = 1 Newton/Meter* Ampere

Exercise: 3

An electron is placed in a uniform electric field with E=500 V/m. The mass of the electron is $m=9.11\times10^{-31}$ kg, and its charge is $e=1.6\times10^{-19}$ C. The electron moves a distance of x=0.02 m, and under the influence of the electric field.

1. Calculate the initial velocity of the electron, its electrostatic force and acceleration
2. If the electron's kinetic energy is 8×10^{-20} J, calculate its deviation.
3. In the case of proton, repeat question 1 ($m_p=1.67\times10^{-27}$ kg).
4. Let's consider the proton placed in equilibrium under the simultaneous influence of a uniform electric field and a magnetic field. The electric and magnetic forces act on the proton in a way that maintains its equilibrium state in both fields.
   Calculate the magnetic field strength required for this condition. Deducted and calculated the value of the magnetic force.

Exercise: 4

1. Assume the viscosity of air (η) is 1.8×10^{-5} Ns/m², the fall speed (v) is 3×10^{-4} m/s, the air volume mass (ρ) is 900 kg/m^3, and gravity (g) is 9.8 m/s². Calculate the radius of the oil drop.
2. Suppose an oil drop with a mass of 9.8×10^{-15} kg is suspended in an electric field of 1000 N/C. Calculate the charge of the drop.
3. Determine the number of elementary charges.

Exercise: 5

Given an oil drop of mass 1.2×10^{-14} kg, calculate the gravitational force acting on the drop.
Use the formula P = mg, where P is the gravitational force, m is the mass of the oil drop, and g is the acceleration due to gravity (9.8 m/s^2).

Exercise: 6

1. When the droplet falls in the absence of an electric field, write the vector relationship between the friction force and the weight when the constant velocity v_1 is reached. Derive the expression for v_1 as a function of η, r, m and g.

2. The above relationship can also be written as : $v_1 = \frac{2}{9}.\frac{\rho.g.r^2}{\eta}$ where ρ is the volume mass of the oil.

Determine the radius r of the droplet, given that it travels a distance of 2.11 mm over a period of time Δt =10 s.

3. To facilitate measurement under the microscope, the droplet should not be too fast. Decide whether a large droplet or a small droplet is preferable. ρ = 890 kg.m^{-3}, g = 9,8 N.kg^{-1}, η = 1,8´10^{-5} kg.m^{-1}.s^{-1}.

Exercise: 7

1)- Natural chlorine (Cl) is a mixture of two isotopes, ${}^{35}_{17}Cl$ ${}^{37}_{17}Cl$. The atomic molar mass of natural chlorine is 35.453 g/mol, and the molar masses of the isotopes are 34.9688 g/mol for ${}^{35}_{17}Cl$ et 36,9659 g/mol pour ${}^{37}_{17}Cl$. Provide the proportions of these isotopes in natural chlorine.

2)- To separate these isotopes, a Bainbridge-type mass spectrometer is used. In the ionization chamber, Cl^{2+} ions are formed.

2.a)- What should be the velocity of the ions at the exit of the velocity filter if we want to achieve a separation of their impact point by 1 cm after passing through a magnetic field with an intensity of 0.15 Tesla.

2.b)- What is the intensity of the electric field in the velocity filter if the magnetic field in the velocity selector has an intensity of 0.2 Tesla.

Exercise: 8

Consider the radioelement of ${}^{235}_{92}U$

2- Calculate the mass defect, in atomic mass units and kilograms.

mass of Uranium 235 nucleus =234.9934 a.m.u

Mass of neutron mn = 1.00865 a.m.u

Proton mass mp = 1.00727 a.m.u

1 amu = $1.66054.10^{-27}$ kg

4- Calculate, in joules and then in MeV, the binding energy of this nucleus

1 eV= $1.6.10^{-19}$ J

C = 3.10^{8} m. s^{-1}

5- Calculate the binding energy per nucleon of this nucleus.

6- Compare the stability of the uranium 235 nucleus with that of radium 226, whose binding energy is 7.66 MeV per nucleon

x

Exercise: 9

Calculate the binding energy per nucleon of ${}^{20}_{10}Ne$, ${}^{14}_{6}C$, ${}^{238}_{92}U$, ${}^{4}_{2}He$

- m_C = 14.00324 a.m.u
- m_{Ne} =19.9867 a.m.u
- m_U = 238.050 79 a.m.u
- m_{He} = 4,0015 a.m.u
- m_p = 1.007276 a.m.u
- m_n = 1.008665 a.m.u

Compare the stability of radioelements and Indicate their position in the Aston curve