SET 1

Exercise 1

1. What is the physical dimension of the following quantities?

- Velocity (v)
- Acceleration (a)
- Force (F)
- Work (W) / Energy (E)
- Pressure (p)
- Power (P)
- Electric charge (Q)
- Electric potential (V)

2. Deduce the SI units of these quantities.

Exercise 2

A **1.00 dm³** sample of liquid water (H_2O) is available. Using the data below, calculate the following quantities and **show all your work, including units**:

Given Data:

- $\rho(H_2O) = 1.00\ g\cdot cm^{-3}$
- $M(H_2O) = 18.0\ g\cdot mol^{-1}$
- $N_A = 6.023 \times 10^{23}\ mol^{-1}$

Questions:

1. The **mass** of the water sample (in grams)
2. The **number of moles** of H_2O molecules
3. The **number of H_2O molecules**
4. The **number of moles of hydrogen atoms** in the sample
5. The **number of moles of oxygen atoms** in the sample
6. The **total number of hydrogen atoms**
7. The **total number of oxygen atoms**

Exercise 3:

For each of the following chemical species, determine:

- the number of **protons (p^+)**,
- the number of **neutrons (n^0)**,
- the number of **electrons (e^-)**.

Then, among these species, identify which are **cations**, which are **anions**, and which pairs (or sets) are **isotopes**.

Exercise 4:

Silicon (Si), with atomic number Z = 14, exists in three isotopic forms.

A	Atomic mass	**Natural abundance**
28	27,977	92,23
29	28,976	
30	29,974	

1/ Give the nuclear composition (number of protons, neutrons, and electrons) of the three stable isotopes of silicon.

2 /Knowing that the average atomic mass of natural silicon is 28.085 u, and that one isotope of silicon is an unstable artificial isotope, complete the table above.

Exercise 5

1/ Express, in MeV, the energy equivalent of **one atomic mass unit (1 u)**.

2/ Calculate the binding energy associated with the formation of the helium nucleus (He) and the carbon nucleus (^{12}C). For each nucleus compute:

a/ the mass defect Δm (in atomic mass units u),

b/ the total binding energy E_b(in MeV), and

c/ the binding energy per nucleon (in MeV·nucleon ^{1}).

d/ Which nucleus is the more stable?

Data:

$1u=1,6606.10^{-27}kg$; $N_A=6,022.10^{23}$; $c=3.10^{8} m.s^{-1}$; $1MeV=10^{6}$ eV; $1eV= 1,602.10^{-19}$ C ;
m_P = 1,0073 u ; m_n= 1,0087 u ; m(^{12}C). = 12,011u et m(He) =4,0026 u.