TD Sheet N°01 of Chemistry 1

Exercise 1

Which of the following samples has the greatest mass of iron (Fe)?

0.2 Moles $Fe_2(SO_4)_3$ **;** 38g of iron **;** 0.3 atom-gram iron **;** 7 x10^{23} iron atoms ; 3.8 mols of iron

Data: M(Fe) = 56 g.mol^{-1} ; M(S) = 32g.mol^{-1} ; Avogadro number N_A = 6.022. 10^{23} mol^{-1}

Exercise 2

We completely dissolve 3.5 g of NaCl in 125 mL of water with a mass density of 0.998 g/ml. This produces an aqueous solution of sodium chloride of 126.5 mL.

1- What is the mass percentage of NaCl in this solution?
2- What is the mole fraction of NaCl in this solution?
3- What is the molality of NaCl?
4- What is the molar concentration of NaCl?
M(Na): 23g/mole; M(Cl): 35.5g/mole.

Exercise 3 .

What do A, Z, and q mean for the element ${}^{A}_{Z}X^{q}$?
What are the numbers of neutrons, protons, and electrons present in each of the following atoms or ions?
${}^{55}_{25}Mn$; ${}^{40}_{18}Ar$; ${}^{96}_{42}Mo$; ${}^{48}_{22}Ti$; ${}^{19}_{9}F$; ${}^{207}_{82}Pb^{2+}$; ${}^{80}_{35}Br^{-}$; ${}^{122}_{51}Sb^{3+}$; ${}^{31}_{15}P^{3-}$; ${}^{24}_{12}Mg^{2+}$; ${}^{79}_{34}Se^{2-}$
Are there any isotopes, isotones, or isobars among these 11 nuclides? (Isobars = elements with the same A and a different Z. Isotones = elements having the same number of neutrons).

Exercise 4

1- An oxide sample of copper CuO has a mass m = 1.59 g. How many moles and molecules of CuO, and atoms of Cu and O are there in this sample? M(Cu)= 63.54g.mol-1; M(O) = 16 g.mol.
a) How many moles are there in 40.1 g of $MgSO_4$.
b) How many grams are there in 0.4 moles of $CaCO_3$.
c) Calculate the mass in grams of 3,62 10^{24} zinc atoms and 6,02 10^{21} water molecules.
d) In 0.6 moles of CO_2, how many grams and molecules of CO_2 are there?
Deduce the number of carbon and oxygen atoms.
Data: Mg = 24, S = 32, O = 16, Ca = 40, Zn = 65.37, C = 12; H = 1.

Exercise 5

The naturally occurring element silicon 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. Which is the most abundant silicon isotope?
2. Calculate the natural abundance of the other two isotopes.

Exercise 6

Consider a monoatomic ion made up of 8 protons, 8 neutrons and 10 electrons.
1°) Is this ion an anion or a cation? **2°)** What is the charge of this ion? **3°)** Deduce this ion's symbol.
4°) Deduce the symbol of the corresponding atom.
5°) Repeat the previous questions for an ion made up of 13 protons, 14 neutrons and 10 electrons.

Exercise 7

The masses of the proton, neutron and electron are 1, 6726485.10^{-24} g , 1.6749543.10^{-24} g and 9.109534.10^{-28} g respectively. a) Define the atomic mass unit (a.m.u.). Give its value in g to the same significant figures as the masses of particles of the same order of magnitude. b) Calculate in a.m.u., and to the nearest 10^{-4}, the masses of the proton, neutron and electron. c) Calculate from Einstein's relation (mass-energy equivalence) the energy content of one a.m.u. expressed in MeV. (Avogadro number: 6.022045.10^{23})

Exercise 8

1- Specify the composition of a nucleus of the uranium isotope 235 with symbol $^{235}_{92}U$

2- Calculate the mass defect of this nucleus, in atomic mass units and then in kilograms.

Mass of the uranium 235 nucleus: m ($^{235}_{92}U$) = 234.99332 amu; Mass of the neutron mn = 1.00866 amu

Mass of proton mp = 1.00728 amu; 1 amu = 1.66 10^{-27} kg.

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

1 eV = 1.6 10^{-19} J ; c = 2,9979. 10^{8} m / s

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

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