TD Sheet N°02 of Chemistry 1

Exercise 1

Complete the following nuclear reactions:

$^{30}_{15}P \longrightarrow {}^{30}_{14}S + \ldots\ldots$; $^{3}_{1}H \longrightarrow {}^{3}_{2}He + \ldots\ldots$; $^{232}_{90}Th \longrightarrow {}^{228}_{88}Ra + \ldots\ldots\ldots$

$^{55}_{25}Mn + \ldots \longrightarrow n + {}^{55}_{26}Fe$; $^{14}_{7}N + {}^{4}_{2}He \longrightarrow {}^{17}_{8}O + \ldots\ldots$; $^{241}_{95}Am + \ldots \longrightarrow$ 4 neutrons + $^{248}_{100}Fm$

$^{44}_{22}Ti$ + electron $\longrightarrow$ positon + ……. ; *Data* : $_{5}B$; $_{20}Ca$

Exercise 2

The isotope $^{11}_{6}C$ has a period T (half-life) equal to 20.4 minutes.

1- What is meant by radioactive period?
2- Calculate its radioactive decay constant λ for $^{11}_{6}C$.

A sample of this radioactive substance has an activity of 16.7 .10^7 disintegrations per second (dps). Calculate the average number of radioactive nuclei present in the sample at this moment (Nt).

Exercise 3

The polonium nucleus is radioactive $^{210}_{84}Po$, its half-life is $t_{1/2}$ = 138 days. This element initially emits 5x 10^7 particles α per second.

1. Calculate the decay constant of the substance.
2. What is the activity of this substance?
3. On average, how many radioactive nuclei are there initially?
4. Calculate the number of radioactive nuclei remaining after 414 days?
5. What will be the activity of the substance then?

Exercise 4

Consider one of the possible fission reactions for the uranium 235 nucleus.

$$^{1}_{0}n + {}^{235}_{92}U \longrightarrow {}^{94}_{38}Sr + {}^{140}_{54}Xe + 2\,{}^{1}_{0}n$$

During this transformation, determine:

1- The energy released ΔE
2- The energy released ΔE_m by one mole of uranium nucleus (in J.mol-1).

Nucleus	$^{235}_{92}U$	$^{94}_{38}Sr$	$^{140}_{54}Xe$	n
Mass in amu	234,9935	93,8945	139,8920	1,0087

Exercise 5

We consider a mass m_0 of radon at time t = 0. The radon's half-life is 3.825 days.

1. Determine the mass of radon remaining after 1, 2, ..., n periods. Deduce the mass of radon decayed after n periods.
2. Calculate the durations required to decay 3/7 and 4/5 of the mass m_0 of radon.

Exercise 6

1. Cesium-137 is a β- radioactive element. Write the conservation laws involved in this reaction and the balanced equation for decay(disintegrate), specifying the resulting products.
2. The half-life of cesium-137 is T = 30 years. Deduce the radioactive constant λ. After how much time will 70% of the released cesium-137 have disappeared?