Faculty of technology

Common base/renewable energies

Tutorial series N 3

Exercice 1

Calculation of the cohesion energy of a mole of uranium-235 nuclei (Z = 92) knowing that the mass of a nucleus is 235.044 u. This atom can undergo a fission reaction providing lanthanum 146 (Z = 57) and bromine 87 (Z = 35). Write the fission reaction and then calculate the energy released in J/kg of uranium-235. The calorific value of coal is 33400 kJ/kg. What is the mass of coal that must be burned to produce energy equivalent to that of the fission of one kg of uranium-235. Given: 146 La = 145.943 u, 87 Br = 86.912 u

Exercise 2

In 1989, the GALILEO satellite began its journey to Jupiter, which it finally reached on December 7, 1995. Jupiter being too far from the sun, solar energy cannot be used to power scientific instruments. Instead, the satellite uses the energy produced by the decay of plutonium (_94^238)Pu, which is transformed into electricity. 238Pu decays into Uranium (U) by emitting α particles. Write the corresponding nuclear equation. The half-life of 238Pu is T = 86.6 years. The GALILEO satellite took off with 19 kg of 238Pu, what is the mass of 238Pu remaining after the 7 years needed to reach Jupiter?

Exercise 3

1- A piece of sarcophagus isolated from the air until today contains 60% of C(14) relative to the current ambient air. What is its age?

2- A piece of charred wood found in a cave and originating from an ancient campfire has a carbon 14 activity of 0.0125 Bq, while a similar current sample has an activity of 0.1 Bq. When was the cave inhabited? $t_{1/2}$(C14) = 5760 years.

Exercise 4

The thyroid gland produces hormones essential for various functions of the body from dietary iodine. To check the shape or functioning of this gland, a thyroid scintigraphy is performed using isotopes $^{131}_{53}I$ ou $^{123}_{53}I$ of iodine. Iodine 131 (Z = 53) is a β^- emitter and its half-life $t_{½}$ is 8.1 days. On August 25, 2007, a hospital receives a package of radioactive iodine with an activity A = 2.6×10^9 Bq.

1. Write the decay equation
2. What radiation does radioactive iodine emit in the human body?
4. Calculate the mass of radioactive iodine contained in the package on August 25, 2007.
5. Using the curve plotted above, determine the activity of the unused iodine package 30 days after receipt; find the exact value by calculation.
6. During a medical examination, a patient is injected with a quantity of radioactive iodine with an activity of around 4,106 Bq. How many injections can be made from the unused sample on September 25, 2007?