Radioisotope and Radiation Applications

EXERCISES

Week 1: Additional Problems

Problem A1:

A radionuclide ${}^{62}_{29}Cu$ emits β^+ radiation with a half-life $T_{1/2}$ =9.76 min. Determine the particle composition of the daughter's nuclide atom coming from this decay and determine a decay constant λ.

Problem A2:

A uranium nucleus ${}^{238}_{92}U$ is gradually changing to other nuclei (the decay series). This uranium series consist of eight alpha decays and six beta decays. What is the final product of this decay series?

Problem A3:

Determine ${}^{A}_{Z}X$ in the following nuclear reactions:

a) ${}^{2}_{1}H + {}^{A}_{Z}X \rightarrow {}^{4}_{2}He + {}^{4}_{2}He$

b) ${}^{14}_{7}N + {}^{A}_{Z}X \rightarrow {}^{17}_{8}O + {}^{1}_{1}H$

c) ${}^{A}_{Z}X \rightarrow {}^{60}_{27}Co + \gamma$

d) ${}^{A}_{Z}X + {}^{4}_{2}He \rightarrow {}^{12}_{6}C + {}^{1}_{0}n$

Problem A4:

During bombardment of carbon nucleus ${}^{12}_{6}C$ by deuterons ${}^{2}_{1}H$ a nuclear reaction in which the emergence of a radioactive nucleus of nitrogen and emission of neutron take place.(a) Write down this nuclear reaction by using the symbols of chemical elements. (b) The nitrogen nucleus is further transformed while a positron is emitted. Which nucleus is formed from this transformation?

Problem A5:

The half-life $T_{1/2}$ is defined as the time at which half of the nuclei from the original amount N_0 will decay. Does that mean that over $2T_{1/2}$ all nuclei N_0 will decay?

Problem A6:

The RaA element arises from ${}^{238}_{92}U$ by emitting five successive alpha and two beta particles. Identify the RaA element.

Problem A7:

An alpha emitter contains 10^{12} radioactive nuclei with a half-life $T_{1/2}$ =3 min. How many nuclei decay in 1 s, in 1 min., in 3 min. and in 6 min.?

Problem A8:

A radioactive isotope with a half-life $T_{1/2}$ emits one particle in each nucleus decay. There are N_0 nuclei at the beginning. How many particles were emitted in time $3T_{1/2}$?

Problem A9:

A thermal neutron beam with a kinetic energy $E_{thermal}$ = 0.025 eV is brought out from a nuclear reactor. In length of one meter, what fraction of the total number of neutrons N_0 will decay? The neutron half-life is 10.37 min.

Problem A10:

A solution with a radioisotope ^{24}Na of activity A_0 = 2 kBq was injected into the blood of a man. Volume activity a_v of the blood was measured 5 hours after the injection and it was determined to be 265 kBq/m^3. Determine a volume of the man's blood in liters. The half-life of ^{24}Na is 15 hours.