Modern physics Exercises Chapter 11-12

11.1.1 ^{212}Po has a half-life of 0.30 μs. How long does it take until only 1/16 of the original nuclei of a sample remains?

Answer: 1,2 μs

11.1.2 Calculate the number of atoms in 1.0 g of ^{226}Ra.
The Avogadro's number is 6.026 x 10^{26} atoms/kg.

Answer:26.7 x 10^{20} atoms.

11.1.3 The half-life for radium 226 is 1620 years. Use the problem above to calcualte the activity of 1,0 gram radium.

Answer: 3.6 x 10^{10} decay/s.
This is the equal to 1,0 Curie that earlier was the definition of activity, i.e.1 Ci.

11.1.4 One measures a deacay rate of 735 α-particles/minute from 1,0 mg ^{238}U.
Determine the half-life of ^{238}U.

Answer: 4.5 x 10^{9} years

11.2.1 α–particles from ^{210}Po has an measured kinetic energy of 5.3 MeV.
How large is the decay energy Q?
Answer: 0.122 MeV

11.3.1 One studies a free neutron that decays to a proton The half-life is 12,8 minutes. One measures the maximum kinetic energy for the electron to 781 keV.
Determine the mass of the neutron.

Answer: 1,008663 u

11.4.1 ^{60}Co decays through β^{-}-decay to an excited state of nickel, (^{60}Ni). After that a γ-photon with the energy 1.173 MeV is ejected and thereafter a new γ-photon is ejected with the energy 1.333 MeV down to the ground state of ^{60}Ni.
Determine how big the power is, that 1.0 g ^{60}Co generates.

Answer: 16 W

11.4.2. One wants to perform an age determination with the Carbon-14 method on a sample containing 1,0 gram carbon. One measures the activity to 0.415 decays/minute performed during 24 hours. The original activity was 0.233 decays per gram and second.
Determine the age of the sample.

Answer: 2.9 x 10^{4} years

11.5.1 One achieves a fusion between deuterium and tritium, i.e. between ^{2}H and ^{3}H and gets ^{4}He and a neutron.
Calculate how much kinetic energy that is achieved in the reaction.

Answer: 17.6 Mev

11.6.1 We shoot neutrons onto ^{235}U in order to create ^{236}U. The potential barrier of 5,3 MeV has to overcome in order to make the fission to occur.
Investigate if fission is possible with slow neutrons.

Answer: The mass difference gives the energy 6.1 MeV which is larger than the barrier, why it is enough with slow neutrons with $E_k = 0$