

Problems:

1. Radon $^{222}\text{Rn}_{86}$ is a radioactive gas produced when radium $^{226}\text{Ra}_{88}$ undergoes α decay. There is a growing concern about radon as a health hazard, because it can become trapped in houses, entering primarily through cracks in walls and floors. Suppose $3.0 \cdot 10^7$ radon atoms are trapped in a basement at the time the basement is sealed against further entry of the gas. The half-life of radon is 3.83 days.

How many radon atoms remain after 31 days?

2. On September 19, 1991, a German tourist made a startling discovery during a walking trip in the Italian Alps. He found the Iceman, a Stone Age traveler whose body had become trapped in the ice of a glacier. A remarkably well-preserved remains, which were dated using radiocarbon method. Material found with the body had a $^{14}\text{C}_6$ activity of about 0.121 Bq per gram of carbon.

Determine the age of the Iceman's remains.

Info.: Initial activity of carbon is $A_0 = 0.23$ Bq and the decay constant $\lambda = 1.21 \cdot 10^{-4} \text{yr}^{-1}$

3. By which factor the nucleon number of a nucleus has to increase in order for the nuclear radius to double?

4. Electron with energy E scatters on a proton at an angle Θ . The proton is excited to the $\Delta(1232)$ resonance state. Find the energy of scattered electron as a function of E , Θ and the mass of Δ resonance.

5. The observed Δ resonances are Δ^0 , Δ^- , Δ^+ and Δ^{++} . Write the quark content of these states. What is the isospin of the Δ resonance? Explain why?

6. The π^- meson in the rest decays to the electron and anti-neutrino. Find the energy of electron from this decay.

8. Explain what is meaning of the Bjorken scaling. What is the meaning of variable $x = Q^2/2M\nu$ in the lab system, - in the infinite momentum frame?

9. Write the spin decomposition of nucleon. Explain what each term presents.

10. Pentaquark is exotic state with 5-quark content (uudd \bar{s}). It can be produced via reaction

$$\gamma + p = \bar{K}^0 + \Theta^+ \quad (1)$$

Write possible decay channels of the Θ^+ . Write a reaction for production of the Θ^+ on the neutron.

$$\gamma + n = \quad (2)$$