



Test

DataSheets/Factsheets

1. What is the total energy released (Q-value) in the spontaneous transformation of Po-210 to Pb-206 by alpha emission?
2. What is the a) average, and b) maximum alpha particle energy for the spontaneous transformation of Pu-239?
3. What is the maximum kinetic energy of the betas released in the spontaneous transformation of Sr-89 to Y-89?

What is the average beta kinetic energy? Note that the average kinetic energy is approximately 1/3 of the maximum value.

4. The decay of Fe-55 by electron capture to Mn-55 can be written $\text{Fe-55} \rightarrow \text{Mn-55}^* + \nu$ in which an inner shell electron in Fe-55 is captured by the nucleus and combines with a proton (i.e. $e^- + p \rightarrow n + \nu$) in the nucleus to form a neutron and a neutrino ν . The process of electron capture leaves a vacancy in an electron shell that is then filled immediately by electrons from higher levels cascading down. The process is characterised by the emission of x-rays and associated Auger electrons.
 - a). What is the total decay energy (Q-value) for this reaction?
 - b). What is the energy of the mono-energetic neutrino created in this reaction?
 - c). What percentage of the total decay energy is carried away by the neutrino?
 - d). What is the isotopic (heat) power of Fe-55?
 - e). What is the total power (per gram) emitted?

Nuclear Reactions

5. Consider the reaction ${}^{60}\text{Co}(p,n)$. What's the product of the reaction?

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Decay Engine

6. The activity of Sr-90 is 18,000 transformations per minute. What is the mass of Sr-90?
7. What is the time required for the activity of Na-24 to diminish to 1% of its initial value?
8. What mass of Ra-226 will yield the same activity as one milligram of Po-210?
9. What initial mass of F-18 is required in order that there are 3 mg remaining after 16 hours?
10. At $t=0$, there are 10 Ci of Sr-90. What will be the activity of Y-90 after 5 years?
11. At $t=0$, there are 10 Ci of Ra-226. What will be the activity of Rn-222 after 2 days?

Dosimetry and Shielding

12. What is the gamma dose rate at 1 m due to a 1 Ci uncollimated isotropic source of I-131?
13. Calculate the approximate dose rate at a distance of 2m from a 240 MBq cobalt-60 source.
14. Calculate the activity of a Na-22 source which gives a dose rate of 64 $\mu\text{Sv/h}$ at 1m.
15. The dose rate at 1 m from a source is 160 $\mu\text{Sv/h}$. If this is due to cobalt-60, how much lead shielding must be used to reduce the dose rate to 10 $\mu\text{Sv/h}$?
16. A cobalt-60 source gives a dose rate of 400 $\mu\text{Sv/h}$ at 1m. At what distance from the source is the dose rate 25 $\mu\text{Sv/h}$? What thickness of lead would give the same protection at the original distance?

Range

17. The radon daughter Po-214, which emits a 7.69 MeV alpha particle, is present in the atmosphere of uranium mines.

What is the range of this particle in soft tissue?

Can the alpha particle penetrate the 70 μm minimum epidermal thickness of skin tissue?

Does inhalation of this nuclide present a radiological hazard?
18. What is the range of 1 GeV protons in a lead spallation target?