

Nuclear Key

1. Radon-222 undergoes alpha emission with a half-life of 3.823 days.
a. Write the balanced alpha emission reaction.

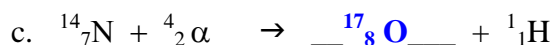
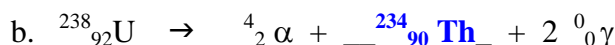


- b. If 50.0 grams of radon gas were in a closed basement, how much would be left after 19.00 hours?

$$\begin{aligned} 3.823 \text{ d} &= 0.693 / k \quad \text{so } k = 0.18127 \text{ d}^{-1} \\ \ln (A_t / 50.0) &= -0.18127 \text{ d}^{-1} (19.00 \text{ h}) (1 \text{ d} / 24 \text{ h}) \\ \ln A_t - \ln 50.0 &= -0.1435 \\ A_t &= 43.3 \text{ grams} \end{aligned}$$

2. True or False regarding atom stability?
- a. In general, calcium and smaller atoms are likely to be stable if their number of protons and neutrons are equal. True
- b. Above uranium all isotopes are unstable AND below uranium all atoms have at least one stable isotope. False
- c. In general, an even number of protons and even number of neutrons is far more likely to be stable than an odd number of protons and odd number of neutrons. True

3. Balance the following transmutation reactions:



4. What is the decay constant (k) for the radioactive isotope carbon-14 which has a half life of 5730 years? How old is a bone that has only 77.2% of its carbon-14 remaining?

$$\begin{aligned} 5730 \text{ y} &= 0.693 / k \quad \text{so } k = 0.000121 \text{ y}^{-1} \\ \ln (77.2 / 100.0) &= -0.000121 \text{ y}^{-1} (t) \\ t &= 2140 \text{ years old} \end{aligned}$$