

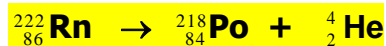
NUCLEAR CHEMISTRY PROBLEMS KEY

1. Complete the following nuclear reactions:



2. Write equations for the following nuclear reactions:

A) Radon-222 decays by alpha emission.



B) The carbon-14 isotope undergoes beta decay.



3. A radioisotope decays to give an alpha particle and Rn-222. What was the original isotope?

a) Po-218 b) Th-224 c) Pb-220 **d) Ra-226** e) none of these

4. Plutonium-239 has a half life of 2.41×10^4 yr. If you have a 10.00 mg sample how much will remain after 4 half-lives have passed?

$$10.00 \text{ mg} \left(\frac{1}{2}\right)^4 = 0.625 \text{ mg}$$

5. If you ingest a sample containing Iodine-131, how much time is required for a 75.0 mg sample to decay to 12.5 mg? The half-life for I-131 is 8.05 days.

$$k t_{1/2} = 0.693 \qquad k = \frac{0.693}{8.05 \text{ d}} = 0.0861 \text{ d}^{-1} \qquad A_0 = 75.0 \text{ mg} \qquad A_t = 12.5 \text{ mg}$$

$$\ln\left(\frac{A_t}{A_0}\right) = -kt \Rightarrow \ln\left(\frac{12.5}{75.0}\right) = -(0.0861 \text{ d}^{-1})t \Rightarrow \ln 0.167 = -(0.0861 \text{ d}^{-1})t$$

$$-1.79 = -(0.0861 \text{ d}^{-1})t \Rightarrow t = \frac{-1.79}{-0.0861 \text{ d}^{-1}} = 20.8 \text{ days}$$

6. The half-life of ${}^{98}\text{Au}$ is 2.7 days. If you begin with 5.6 mg of this gold isotope, what mass remains after 9.5 days?

$$k t_{1/2} = 0.693 \qquad k = \frac{0.693}{2.7 \text{ day}} = 0.26 \text{ d}^{-1}$$

$$\ln\left(\frac{A_t}{A_0}\right) = -kt \Rightarrow \ln\left(\frac{Au_t}{5.6 \text{ mg}}\right) = -(0.26 \text{ d}^{-1})(9.5 \text{ day})$$

$$\ln\left(\frac{Au_t}{5.6 \text{ mg}}\right) = -2.47$$

$$\text{Take anti ln both sides: } \frac{A_t}{5.6 \text{ mg}} = e^{-2.47} = 0.0846$$

$$A_t = 0.0846 \times 5.6 \text{ mg} = 0.47 \text{ mg}$$