1. Write the number of protons and neutrons for each nuclide:

   (a) $^{4}_{2}\mathrm{He}$ 2 protons, 2 neutrons

   (b) $^{20}_{10}\mathrm{Ne}$ 10 protons, 10 neutrons

   (c) $^{234}_{92}\mathrm{U}$ 92 protons, 142 neutrons

   (d) Cr – 51 24 protons, 27 neutrons

   (e) Pb – 214 82 protons, 132 neutrons

   (f) Po – 210 84 protons, 126 neutrons

2. Write a nuclear equation for the indicated decay of each nuclide:

   (a) U-234 (alpha) $^{234}_{92}\mathrm{U} \longrightarrow {}^{4}_{2}\mathrm{He} + {}^{230}_{90}\mathrm{Th}$

   (b) Th-230 (alpha) $^{230}_{90}\mathrm{Th} \longrightarrow {}^{4}_{2}\mathrm{He} + {}^{226}_{88}\mathrm{Ra}$

   (c) Pb-214 (beta) $^{214}_{82}\mathrm{Pb} \longrightarrow {}^{0}_{-1}\mathrm{e} + {}^{214}_{83}\mathrm{Bi}$

   (d) N-13 (positron emission) $^{13}_{7}\mathrm{N} \longrightarrow {}^{0}_{+1}\mathrm{e} + {}^{13}_{6}\mathrm{C}$

   (e) Cr-51 (electron capture) $^{51}_{24}\mathrm{Cr} + {}^{0}_{-1}\mathrm{e} \longrightarrow {}^{51}_{23}\mathrm{V}$

3. One of the nuclides in spent nuclear fuel is U-235, an alpha emitter with a half-life of 703 million years. How long will it take for the amount of U-235 to reach 10.0% of its initial amount?

   $t_{1/2} = \frac{0.693}{k} = 703 \times 10^6\ yr \Rightarrow k = 9.858 \times 10^{-10}\ yr^{-1}$

   Then, $ln\left(\frac{N_t}{N_0}\right) = -kt$

   $t = \frac{-ln(0.10)}{k} = 2.34 \times 10^9\ yr$

4. A wooden boat discovered just south of the Great Pyramid in Egypt has a carbon-14/carbon-12 ratio that is 72.5% of that found in living organisms. How old is the boat?

   $t_{1/2} = 5730\ yr = \frac{0.693}{k} \Rightarrow k = 1.209 \times 10^{-4}\ yr$

   $ln\left(\frac{72.5}{100}\right) = -kt$

   $t = 2659\ yr$