

1) Suppose that an alien spacecraft has impacted on the earth and you are part of a team sent to investigate. You find that a part inside of the spacecraft is a bit radioactive, and you isolate the bit that is making all the decays. The stuff is a mixture (in number of atoms present) of ${}^{99}_{43}\text{Tc}$ 0.012% (not found in nature), ${}^{197}_{79}\text{Au}$ (28%), ${}^{93}_{41}\text{Nb}$ (8%), ${}^{99}_{44}\text{Ru}$ (2.2%), ${}^{57}_{26}\text{Fe}$ (1%), and the rest is ${}^{56}_{26}\text{Fe}$. The only stable isotopes of gold and niobium are the ones you found, and the iron isotopes are in the correct abundance for what you'd expect naturally. ${}^{99}_{44}\text{Ru}$ though is only supposed to be about 13% of naturally occurring Ru. You are trying to be thorough and you find that a purified sample of $1\mu\text{g}$ ${}^{99}_{43}\text{Tc}$ has an activity of 1200 Bq. State your assumptions, but please estimate how long ago this piece of the spacecraft was fabricated. (p.s. you shouldn't need to look anything up to figure this out beyond maybe the definition of activity and what a mole of nucleons weighs.)

2) Krane Chapter 12, problem 10

3) Krane Chapter 12, problem 29

4) Krane Chapter 12, problem 38