

8. The problem with Web-based services is that there are no guarantees of accuracy or that the webpage addresses will not change from the time this solution is written to the time someone reads this. Still, it is worth mentioning that a very accessible website for a wide variety of periodic table and isotope-related information is <http://www.webelements.com>. Two websites aimed more towards the nuclear professional are <http://nucleardata.nuclear.lu.se/nucleardata> and <http://www.nndc.bnl.gov/nndc/ensdf>, which are where some of the information mentioned below was obtained.

- (a) According to Appendix F, the atomic number 60 corresponds to the element Neodymium (Nd). The first website mentioned above gives  $^{142}\text{Nd}$ ,  $^{143}\text{Nd}$ ,  $^{144}\text{Nd}$ ,  $^{145}\text{Nd}$ ,  $^{146}\text{Nd}$ ,  $^{148}\text{Nd}$ , and  $^{150}\text{Nd}$  in its list of naturally occurring isotopes. Two of these,  $^{144}\text{Nd}$  and  $^{150}\text{Nd}$ , are not perfectly stable, but their half-lives are much longer than the age of the universe (detailed information on their half-lives, modes of decay, etc are available at the last two websites referred to, above).
- (b) In this list, we are asked to put the nuclides which contain 60 neutrons and which are recognized to exist but not stable nuclei (this is why, for example,  $^{108}\text{Cd}$  is not included here). Although the problem does not ask for it, we include the half-lives of the nuclides in our list, though it must be admitted that not all reference sources agree on those values (we picked the ones we regarded as “most reliable”). Thus, we have  $^{97}\text{Rb}$  (0.2 s),  $^{98}\text{Sr}$  (0.7 s),  $^{99}\text{Y}$  (2 s),  $^{100}\text{Zr}$  (7 s),  $^{101}\text{Nb}$  (7 s),  $^{102}\text{Mo}$  (11 minutes),  $^{103}\text{Tc}$  (54 s),  $^{105}\text{Rh}$  (35 hours),  $^{109}\text{In}$  (4 hours),  $^{110}\text{Sn}$  (4 hours),  $^{111}\text{Sb}$  (75 s),  $^{112}\text{Te}$  (2 minutes),  $^{113}\text{I}$  (7 s),  $^{114}\text{Xe}$  (10 s),  $^{115}\text{Cs}$  (1.4 s), and  $^{116}\text{Ba}$  (1.4 s).
- (c) We would include in this list:  $^{60}\text{Zn}$ ,  $^{60}\text{Cu}$ ,  $^{60}\text{Ni}$ ,  $^{60}\text{Co}$ ,  $^{60}\text{Fe}$ ,  $^{60}\text{Mn}$ ,  $^{60}\text{Cr}$ , and  $^{60}\text{V}$ .