NUCLEAR DECAY SERIES

If the product of a nuclear decay is stable, the decay process ends. In other cases, the decay product—the daughter nucleus—is itself unstable. The daughter nucleus then becomes the parent nucleus for an additional decay process. Such a sequence is called a *decay series*.

Figure 6(a) depicts the number of protons versus neutrons for all stable nuclei. A small portion of this graph is enlarged in **Figure 6(b),** which shows a naturally occurring decay series. This decay series begins with thorium, Th, and ends with lead, Pb.

Each square in **Figure 6(b)** corresponds to a possible nucleus. The black dots represent stable nuclei, and the red dots represent unstable nuclei. Thus, each black dot in **Figure 6(b)** corresponds to a data point in the circled portion of **Figure 6(a).** The decay series continues until a stable nucleus is reached, in this case ^{208}Pb. Notice that there is a branch in the decay path; there are actually two ways that thorium can decay into lead.

The entire series in **Figure 6(b)** consists of 10 decays: 6 alpha decays and 4 beta decays. When α decay occurs, the nucleus moves down two squares and to the left two squares because it loses two protons and two neutrons. When β^- decay occurs, the nucleus moves down one square and to the right one square because it loses one neutron and gains one proton. Gamma decays are not represented in this series because they do not alter the ratio of protons to neutrons. In other words, gamma decays do not change the atomic number (Z) or the neutron number (N). Note that the result of the decay series is to lighten the nucleus.

extension

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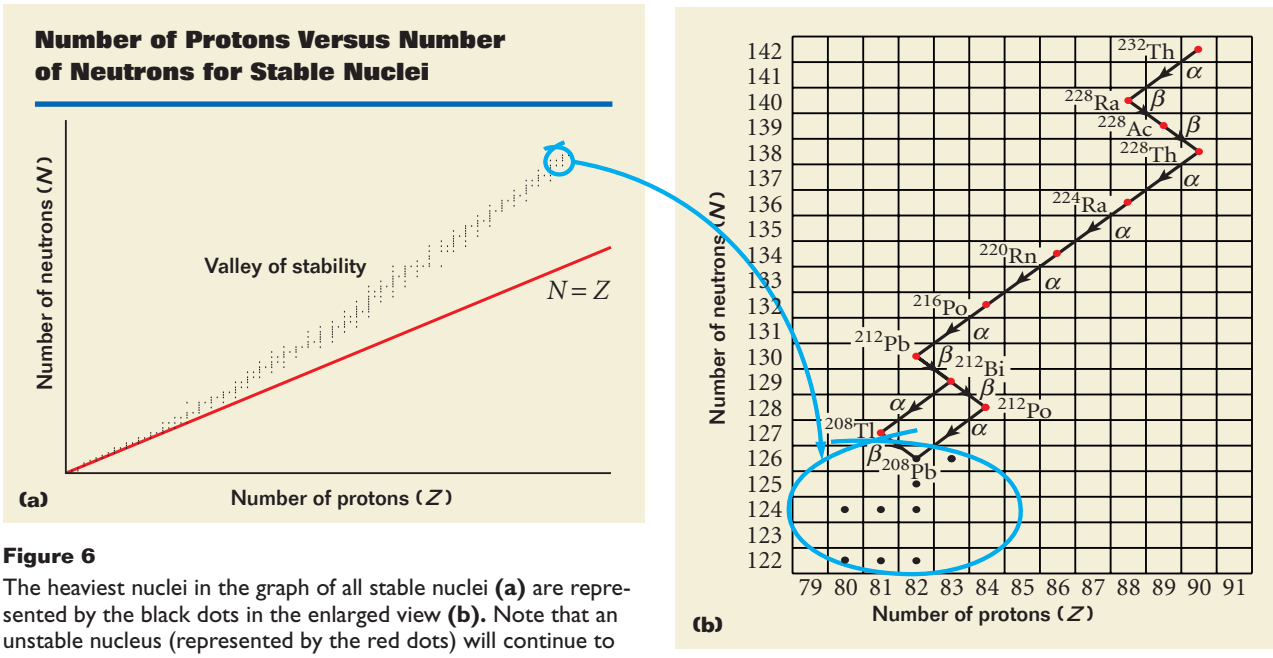

Figure 6

The heaviest nuclei in the graph of all stable nuclei **(a)** are represented by the black dots in the enlarged view **(b).** Note that an unstable nucleus (represented by the red dots) will continue to decay until the daughter nucleus is stable.