

CHAPTER 19 LEARNING OBJECTIVES

Learning Objectives

You should be able to:

1. Recognize the characteristics of the three types of radioactive emissions (α - and β -particles and γ rays).
2. Write balanced equations for radioactive decay processes (α -, β -, γ -, and positron emission and electron capture), identifying the types of radiation and nuclides involved.
3. Determine the effect of different types of decay on the neutron/proton ratio and predict the mode of decay for a particular nucleus based on its composition relative to the “band of stability” (Figure 19.1).
4. Use Einstein’s relation, $\Delta E = \Delta mc^2$, to calculate the “mass defect” (Δm) and nuclear binding energy for a given nuclide, or to calculate the energy changes in nuclear reactions. Interpret the plot of binding energy per nucleon in terms of nuclear stability and the energy changes associated with fission and fusion reactions.
5. Explain how radioactivity is detected, including a simplified description of the basic design of a Geiger counter.
6. Use first-order kinetics to examine the rates of disintegration reactions. Be able to calculate half-life, the age of an object (radiochemical dating), or the remaining amount of radioisotope, given the appropriate data.
7. Recognize and write balanced equations for nuclear transmutation, nuclear fission and nuclear fusion reactions.
8. Understand the concepts of fission reactions relating to self-sustaining chain reactions and critical mass.
9. Explain the functions of the major components of a nuclear reactor (fuel elements, control rods, moderator, and cooling liquid).
10. Explain the fundamental concepts involved in nuclear fission weapons (including chain reaction and critical mass).
11. Explain the fundamental concepts involved in nuclear fusion weapons.
12. Recognize basic features associated with exposure to radiation, including background exposure, common sources of radiation, penetrating power of radioactive emissions, and possible biological effects of exposure.
13. Define the units used to describe the level of radioactivity and to measure the effects of radiation on biological systems.
14. Recognize some medical applications of radioactivity.