

CHAPTER 23 LEARNING OBJECTIVES

To satisfy the minimum requirements for this course, you should master the following learning objectives.

Know the physical properties of and be able to recognize and use the symbols for protons, neutrons, electrons, positrons, alpha particles, beta particles and gamma rays.

Write balanced equations for radioactive decay processes (alpha, beta, gamma and positron emission and electron capture), identifying the types of radiation and nuclides involved.

Determine the effect of different types of decay on the neutron/proton ratio and predict the type of decay that a nucleus will undergo based on its composition relative to the band of stability.

Know the rules of nuclear stability that are determined by even and odd numbers of protons and neutrons.

Understand the relationship between nuclear stability and radioactivity and be able to

- use Einstein's relation, $\Delta E = \Delta mc^2$, to calculate mass defects, energy changes in nuclear reactions, and nuclear binding energies.
- interpret the plot of binding energy per nucleon (Fig. 23.2) in terms of nuclear stability and the energy changes associated with fission and fusion reactions.

Be able to interpret a decay series.

Use first-order kinetics to examine the rates of disintegration reactions and be able to calculate the half-life, the age of an object (radiochemical dating), and the remaining amount of radioisotope, given the appropriate data.

Recognize and write balanced equations for nuclear transmutation and nuclear fission reactions.

Explain how radioactivity is detected, including a simplified description of the basic design of a Geiger counter.

Explain how nuclear reactions can be used to produce energy or weapons and be able to

- describe the relationship between critical mass and chain reactions.
- explain the functions of the major components of a nuclear reactor (fuel elements, control rods, moderator, and cooling liquid).
- explain the fundamental concepts involved in nuclear weapons.
- recognize and write balanced equations for nuclear fusion reactions.
- explain the fundamental concepts involved in nuclear fusion weapons.

Understand the factors that determine the biological effects of radiation.

Be able to use units of Ci, rads, RBE and rems in calculations.

Understand the meaning of the Key Words on page 1016.