Introduction: Atomic and Nuclear Physics

Unit: Atomic and Nuclear Physics

Topics covered in this chapter:

This chapter discusses the particles that atoms and other matter are made of, how those particles interact, and the process by which radioactive decay can change the composition of a substance from one element into another.

- *Radioactive Decay* and *Nuclear Equations* describe the process of radioactive decay and how to predict the results.
- *Mass Defect & Binding Energy* uses Einstein's equation $E = mc^2$ to determine the energy that was converted to mass in order to hold the nucleus of an atom together.
- *Half-Life* explains how to calculate the rate at which radioactive decay happens and the amount of material remaining.
- *Nuclear Fission & Fusion* and *Practical Uses for Nuclear Radiation* describe ways that radioactive materials are used to produce energy or otherwise provide benefits to society.

One of the challenges of this chapter is remembering concepts from chemistry, including numbers of protons, neutrons and electrons, and how to use the Periodic Table of the Elements.

Standards addressed in this chapter:

Massachusetts Curriculum Frameworks (2016):

HS-PS1-8: Develop a model to illustrate the energy released or absorbed during the processes of fission, fusion, and radioactive decay.

AP® only

AP® Physics 2 Learning Objectives/Essential Knowledge (2024):

5.C.1.1: The student is able to analyze electric charge conservation for nuclear and elementary particle reactions and make predictions related to such reactions based upon conservation of charge. [**SP 6.4**, **7.2**]

5.G.1.1: The student is able to apply conservation of nucleon number and conservation of electric charge to make predictions about nuclear reactions and decays such as fission, fusion, alpha decay, beta decay, or gamma decay. [**SP 6.4**]

7.C.3.1: The student is able to predict the number of radioactive nuclei remaining in a sample after a certain period of time, and also predict the missing species (alpha, beta, gamma) in a radioactive decay. [**SP 6.4**]