CHAPTER 22 *Highlights*

KEY IDEAS

Section 1 The Nucleus

- The nucleus, which consists of protons and neutrons, is the small, dense core of an atom.
- A nucleus can be characterized by a mass number, A, an atomic number, Z, and a neutron number, N.
- The binding energy of a nucleus is the difference in energy between its nucleons when bound and its nucleons when unbound.

Section 2 Nuclear Decay

- An unstable nucleus can decay in three ways: alpha (α) decay, beta (β) decay, or gamma (γ) decay.
- The decay constant, λ, indicates the rate of radioactive decay.
- The half-life, $T_{1/2}$, is the time required for half the original nuclei of a radioactive substance to undergo radioactive decay.

Section 3 Nuclear Reactions

- Nuclear reactions involve a change in the nucleus of an atom.
- In fission, a heavy nucleus splits into two lighter nuclei. In fusion, two light nuclei combine to form a heavier nucleus.

Section 4 Particle Physics

- There are four fundamental interactions in nature: strong, weak, gravitational, and electromagnetic.
- The constituents of matter can be classified as leptons or hadrons, and hadrons can be further divided into mesons and baryons. Electrons and neutrinos are leptons. Protons and neutrons are baryons.
- Mesons consist of a quark-antiquark pair; baryons consist of three quarks.

Variable Symbols

Quantities		Units		Conversions
m	mass	u	unified mass unit or atomic mass unit	$= 1.660\,539 \times 10^{-27}$ kg $= 931.49$ MeV/c^2
λN	activity or decay rate	Bq Ci	becquerel curie	$= 1$ decay/s $= 3.7 \times 10^{10}$ Bq
$T_{1/2}$	half-life	s	seconds	

KEY TERMS

isotope (p. 791)

strong force (p. 792)

binding energy (p. 794)

half-life (p. 803)

PROBLEM SOLVING

See **Appendix D: Equations** for a summary of the equations introduced in this chapter. If you need more problem-solving practice, see **Appendix I: Additional Problems.**

Particle Symbols

Particle name	Symbol
alpha particle (helium nucleus)	α ($^4_2$He)
beta particle (electron)	β^- ($^0_{-1}$e)
beta particle (positron)	β^+ ($^0_{+1}$e)
gamma ray	γ
neutron	n (^1_0n)
proton	p (^1_1p)
neutrino	ν
antineutrino	$\overline{\nu}$