Sections 1.2–1.3 Questions

Understanding Concepts

1. (a) What are the relationships among the number of protons, number of neutrons, and number of electrons in an atom?
   (b) Which of the numbers in (a) is/are related to the atomic number?
   (c) Which of the numbers in (a) is/are related to the mass number?
   (d) If the atomic mass of an element is not the same as the mass number of one atom of the element, what conclusions can you draw about that element?
2. Construct a graphic organizer to indicate the relationships among atomic number, mass number, atomic mass, isotopes, and radioisotopes.
3. Two atoms respectively have $Z = 12$, $A = 26$ and $Z = 14$, $A = 26$.
   (a) Can these two atoms be classified as isotopes of the same element? Give reasons for your answer.
   (b) Suggest an alternative classification for these atoms. Justify your choice.
4. Isotopes are classified as radioisotopes because they demonstrate the property of radioactivity. How does this property differ from other properties that we have used to classify elements?

Applying Inquiry Skills

5. When a sample of uranium-238 decays, alpha particles are emitted and the uranium nuclei are converted to thorium nuclei. Thorium-234 has a half-life of 24.10 d.
   (a) Plot a graph to predict the radioactive decay of 700.0 g of thorium-234.
   (b) Use your graph to determine how much time must pass before only 24.0 g of the sample will remain as thorium-234.

Making Connections

6. (a) Give at least three examples of ways in which radioisotopes are useful.
   (b) Suggest at least two safety precautions that may be used when handling radioisotopes.

1.4 Toward a Modern Atomic Theory

Rutherford's model of the atom raised some difficult questions. If the nucleus of an atom contained several positive protons that repelled each other, how did it stay together? Why didn't the negatively charged electrons rush toward and crash into the positively charged nucleus? In response to the first question, Rutherford suggested the idea of a nuclear force—an attractive force within the nucleus—that was much stronger than the electrostatic force of repulsion. The answer to the second question—why the electrons did not fall in to be "captured" by the nucleus—required a bold new theory created by a young Danish physicist named Niels Bohr (**Figure 1**).

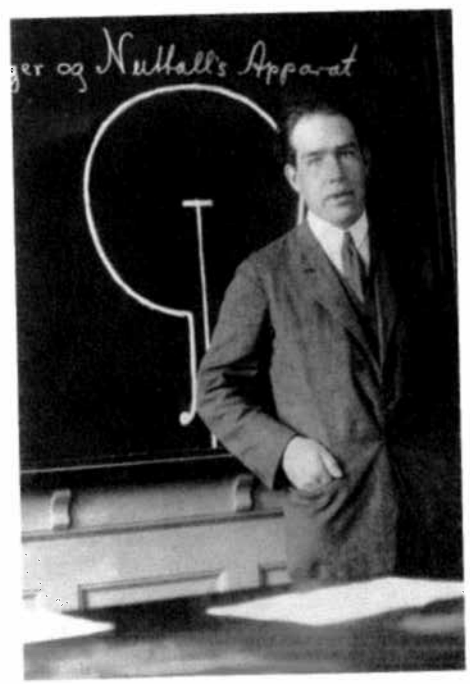

Figure 1
Niels Bohr (1885–1962) developed a new theory of atomic structure and communicated this theory with an innovative model of the atom. For this work he won the Nobel Prize for Physics in 1922.