Section 7.1
Atomic Theory, Isotopes, and Radioactive Decay
Check Your Understanding

Checking Concepts

1. What did Henri Becquerel discover about radiation emitted from uranium salts?

2. Distinguish between the terms “mass number” and “atomic number.”

3. How do various isotopes of an element differ?

4. How many protons and neutrons are in the nuclei of each of the following isotopes?

   (a) $^{11}_{5}B$

   (b) $^{20}_{10}Ne$

   (c) $^{31}_{15}P$

   (d) $^{7}_{3}Li$

   (e) magnesium-26

   (f) nitrogen-15

   (g) silicon-28

   (h) chlorine-37

5. What two rules relate to mass numbers and atomic numbers in a nuclear equation?

6. Explain the changes that occur in the nucleus during each of the following.

   (a) alpha decay

   (b) beta decay

   (c) gamma decay

Understanding Key Ideas

7. Give the name and nuclear symbol for each of the following.

   (a) an element with 9 protons and 10 neutrons

   (b) an element with 8 protons and 10 neutrons

   (c) an element with 26 protons and 30 neutrons

8. Explain the composition of alpha and beta particles in terms of subatomic particles.

9. How is gamma radiation different from alpha and beta radiation?

10. Draw a Bohr model showing the number of protons and neutrons and the electron arrangement (including pairs and single electrons) for these atoms.

    (a) hydrogen-1

    (b) hydrogen-2

(c) beryllium-9

(d) magnesium-26

(e) sulphur-36

11. Classify each of the following as alpha, beta, or gamma decay:

(a) $^{201}_{80}Hg \rightarrow {}^{201}_{81}Tl + {}^{0}_{-1}\beta$

(b) $^{231}_{91}Pa \rightarrow {}^{227}_{89}Ac + {}^{4}_{2}He$

(c) $^{225}_{89}Ac \rightarrow {}^{221}_{87}Fr + {}^{4}_{2}\alpha$

(d) $^{60}_{28}Ni^{*} \rightarrow {}^{60}_{28}Ni + {}^{0}_{0}\gamma$

(e) $^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

(f) $^{24}_{11}Na \rightarrow {}^{24}_{12}Mg + {}^{0}_{-1}e$

12. Provide the symbol for the particle or nucleus that correctly completes the equation. For alpha decay, use either $^{4}_{2}\alpha$ or $^{4}_{2}He$. For beta decay, use $^{0}_{-1}\beta$ as needed.

(a) $^{212}_{84}Po \rightarrow {}^{208}_{82}Pb +$ ____

(b) $^{90}_{38}Sr \rightarrow {}^{90}_{39}Y +$ ____

(c) $^{239}_{93}Np \rightarrow$ ____ $+ {}^{0}_{-1}\beta$

(d) $^{144}_{60}Nd \rightarrow$ ____ $+ {}^{4}_{2}\alpha$

(e) $^{42}_{19}K^{*} \rightarrow$ ____ + $^{0}_{0}\gamma$

(f) $^{146}_{62}Sm \rightarrow {}^{142}_{60}Nd$ + ____

13. Complete the following radioactive decay equations.

(a) $^{257}_{104}Rf^{*} \rightarrow$ (gamma decay)

(b) $^{8}_{3}Li \rightarrow$ (beta decay)

(c) $^{255}_{103}Lr \rightarrow$ (alpha decay)

(d) $^{254}_{98}Cf^{*} \rightarrow$ (gamma decay)

(e) $^{13}_{5}B \rightarrow$ (beta decay)

(f) $^{233}_{91}Pa \rightarrow$ (alpha decay)

Pause and Reflect

Both radioactivity and chemical reactions involve changes in matter. What do you think are the main differences between these two kinds of changes?