Understanding Key Ideas

19. Explain how gamma radiation and visible light are:
    (a) similar to each other
    (b) different from each other
20. What are two medical applications of radioactivity?
21. What is meant by the phrase "natural background radiation"?
22. How can you use atomic number and mass number to determine the number of protons and neutrons in an atom?
23. Provide the nuclear symbol for each daughter nucleus in the following list. You can refer to the periodic table in Figure 4.3 on page 172.
    (a) $^{201}_{80}\text{Hg} \rightarrow \_\_\_\_ + {}^{0}_{-1}\beta$
    (b) $^{231}_{91}\text{Pa} \rightarrow \_\_\_\_ + {}^{4}_{2}\text{He}$
    (c) $^{225}_{89}\text{Ac} \rightarrow \_\_\_\_ + {}^{4}_{2}\alpha$
    (d) $^{60}_{28}\text{Ni}^{*} \rightarrow \_\_\_\_ + {}^{0}_{0}\gamma$
    (e) $^{238}_{92}\text{U} \rightarrow \_\_\_\_ + {}^{4}_{2}\text{He}$
    (f) $^{24}_{11}\text{Na} \rightarrow \_\_\_\_ + {}^{0}_{-1}e$
24. Complete the following radioactive decay equations.
    (a) $\_\_\_\_ \rightarrow {}^{46}_{21}\text{Sc}$ (alpha decay)
    (b) $\_\_\_\_ \rightarrow {}^{40}_{19}\text{K}$ (beta decay)
    (c) $\_\_\_\_ \rightarrow {}^{3}_{2}\text{He}$ (gamma decay)
    (d) $\_\_\_\_ \rightarrow {}^{28}_{12}\text{Mg}$ (alpha decay)
    (e) $^{26}_{13}\text{Al}^{*} \rightarrow \_\_\_\_$ (gamma decay)
    (f) $^{36}_{17}\text{Cl} \rightarrow \_\_\_\_$ (beta decay)
    (g) $^{33}_{15}\text{P} \rightarrow \_\_\_\_$ (alpha decay)

Refer to Table 7.6, Common Isotope Pairs Chart, on page 307, to answer questions 25 to 27.

25. What is the daughter isotope that forms when carbon-14 undergoes radioactive decay?
26. How many years would it take for half of a sample of carbon-14 to decay?
27. If 100 micrograms (or 100 millionths of a gram) of carbon-14 were present in a sample of bone, state how many grams would be left after:
    (a) 5730 years
    (b) 11 460 years
    (c) 17 190 years
28. Find the indicated daughter nucleus.
    (a) $^{1}_{0}n + {}^{235}_{92}\text{U} \rightarrow \_\_\_\_ + {}^{77}_{34}\text{Se} + 3\,{}^{1}_{0}n +$ energy
    (b) $^{1}_{0}n + {}^{235}_{92}\text{U} \rightarrow \_\_\_\_ + {}^{93}_{40}\text{Zr} + 3\,{}^{1}_{0}n +$ energy
    (c) $^{1}_{0}n + {}^{235}_{92}\text{U} \rightarrow \_\_\_\_ + {}^{105}_{46}\text{Pd} + 3\,{}^{1}_{0}n +$ energy
29. For each item, decide whether it applies mainly to fusion, fission, or both.
    (a) used to produce electrical energy
    (b) used in atomic weapons
    (c) reactions produce radioactive daughter products
    (d) heavy nuclei split to release energy
    (e) involves the combining of two light-weight atoms into a heavier one
    (f) happens at the core of our Sun

Applying Your Understanding

30. It is not possible to predict which specific nuclei in a given sample of nuclei will decay over the course of one half-life, even if the chance of it decaying in one half-life is 50 percent. How does this compare with a coin toss, in which the likelihood of it landing heads up is very difficult to predict, even though the probability of it landing heads up is 50 percent?

Pause and Reflect

Reflect on what you have learned about radioactivity and fission. How are radioactivity and fission similar to each other? How are they different from each other?