**37.** Natural gold has only one stable isotope, ${}^{197}_{79}Au$. If gold is bombarded with slow neutrons, $\beta^-$ particles are emitted.

**a.** Write the appropriate reaction equation.

**b.** Calculate the maximum energy of the emitted beta particles.

**38.** Two ways ${}^{235}U$ can undergo fission when bombarded with a neutron are described below. In each case, neutrons are also released. Find the number of neutrons released in each of the following:

**a.** ${}^{140}Xe$ and ${}^{94}Sr$ released as fission fragments

**b.** ${}^{132}Sn$ and ${}^{101}Mo$ released as fission fragments

**39.** When a ${}^{6}_{3}Li$ nucleus is struck by a proton, an alpha particle and a product nucleus are released. What is the product nucleus?

**40.** Suppose ${}^{10}_{5}B$ is struck by an alpha particle, releasing a proton and a product nucleus in the reaction. What is the product nucleus?

**41.** An all-electric home uses about $2.0 \times 10^3$ kW•h of electrical energy per month. How many ${}^{235}U$ atoms would be required to provide this house with its energy needs for one year? Assume 100.0 percent conversion efficiency and 208 MeV released per fission.

**42.** When ${}^{18}O$ is struck by a proton, ${}^{18}F$ and another particle are produced. What is the other particle?

**43.** When a star has exhausted its hydrogen fuel, it may fuse other nuclear fuels, such as helium. At temperatures above $1.0 \times 10^8$ K, helium fusion can occur.

**a.** Two alpha particles fuse to produce a nucleus, A, and a gamma ray. What is nucleus A?

**b.** Nucleus A absorbs an alpha particle to produce a nucleus, B, and a gamma ray. What is nucleus B?

**44.** A sample of a radioactive isotope is measured to have an activity of 240.0 mCi. If the sample has a half-life of 14 days, how many nuclei of the isotope are there at this time?

## Graphing Calculator Practice

**Nuclear Decay**

In nuclear decay, a radioactive substance is transformed into another substance that may or may not be radioactive. The amount of radioactive material remaining is given by the following equation:

$$m = m_0 e^{-\lambda t}$$

In this nuclear decay equation, $m_0$ is the initial mass and $\lambda$ is the decay constant. As you learned earlier in this chapter, the decay constant is related to the half-life by the following equation:

$$T_{1/2} = \frac{0.693}{\lambda}$$

One of the interesting aspects of nuclear decay is that radioactive substances have a wide range of half-lives—from femtoseconds to billions of years. And all of these radioactive substances obey both of these equations.

In this graphing calculator activity, the calculator will use these equations to make graphs of the amount of remaining mass versus time. By analyzing these graphs, you will be able to make predictions about radioactive substances that have various initial masses and various half-lives.

Visit go.hrw.com and type in the keyword **HF6SUBX** to find this graphing calculator activity. Refer to **Appendix B** for instructions on downloading the program for this activity.