NAME: _____

DATE TURNED IN: _____

Assignment #4: Radioisotopes & Half-Lives

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ⓘ <u>Half-life</u> = is the time necessary for one half of a radioactive material to decay

> *Example: The half-life of carbon-14 is 5,730 years.*
>
> *Consequently, after 5.730 years, 1/2 of the radioactive C atoms in a sample remain not decayed. The other half (50%) decayed into N atoms.*
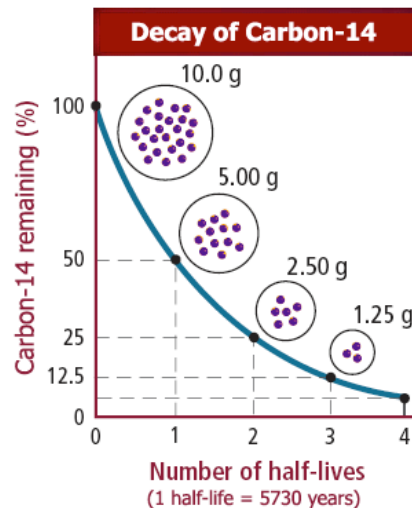>
> *After 11,460 years (2 x 5,730) half of 1/2 remains or 1/4 of the original amount of C-14 is left.*
>
> *After 17,190 years (3 x 5,730) only 1/8 of the original amount of C-14 remains.*

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1. A 200 g sample of lawrencium is left in a container from 8:00 AM one morning until 2:00 PM the next afternoon. If the mass of the sample of lawrencium was 25 g, what is the half-life of lawrencium??

      a.   1 day
      b.   10 hours
      c.   5 hours
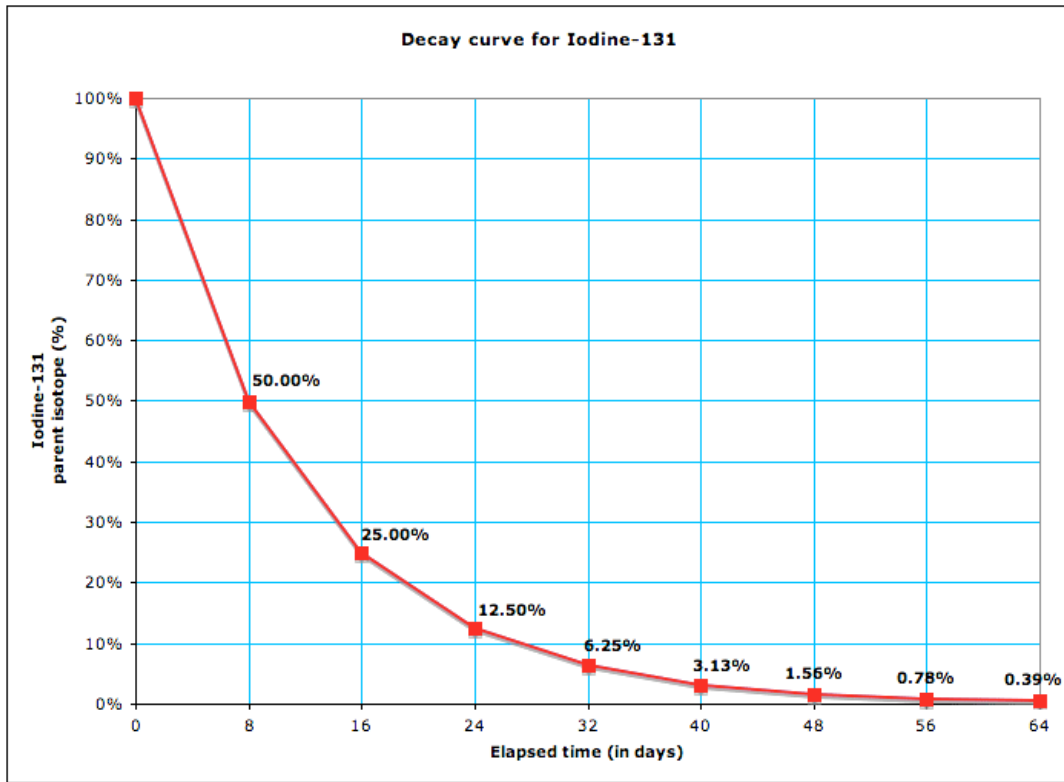   d.   30 hours

2. The following decay curve shows the isotope carbon-14.

Decay of Carbon-14

If it was determined that a fossil contained a little over 3% of the original amount of carbon-14 it once was composed of, what would be an approximate age for the fossil?
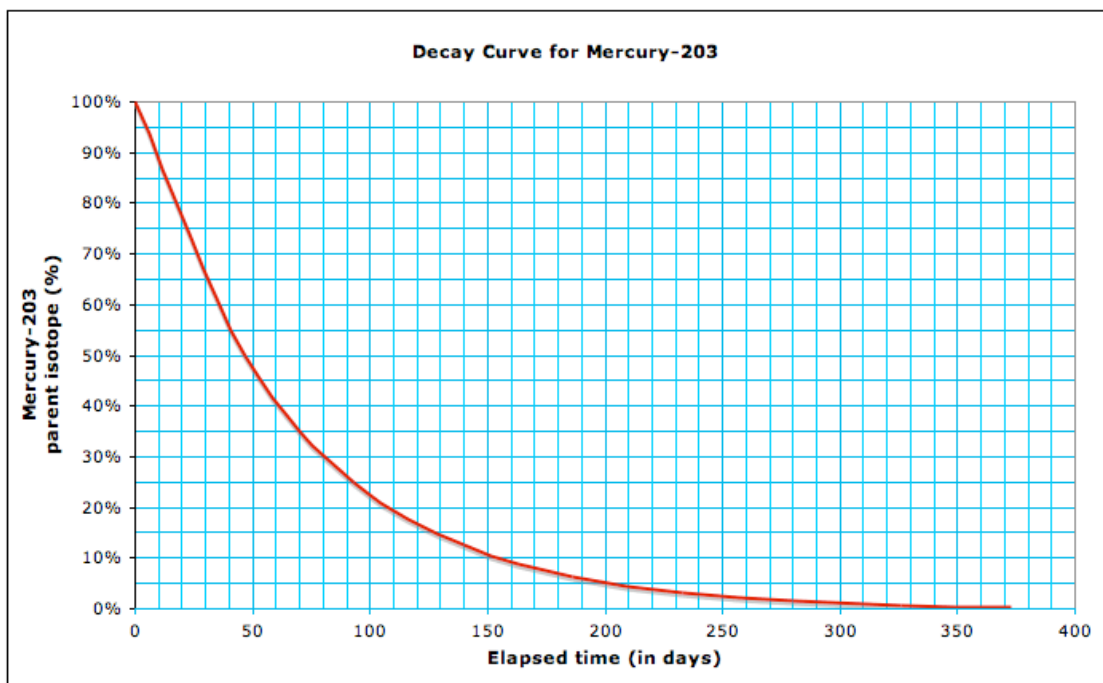
      a. 35,000 years old
      b. 29,000 years old
      c. 22,000 years old
      d. 17,000 years old

3. The following decay curve shows the isotope iodine-131, which is used in the treatment of thyroid cancer. It is important that the radioactive iodine does not remain in the body at high levels.

Decay curve for Iodine-131

If 2 g or less of iodine-131 should remain in the body after 24 days, what is the largest mass of iodine-131 that should be used for treatment?
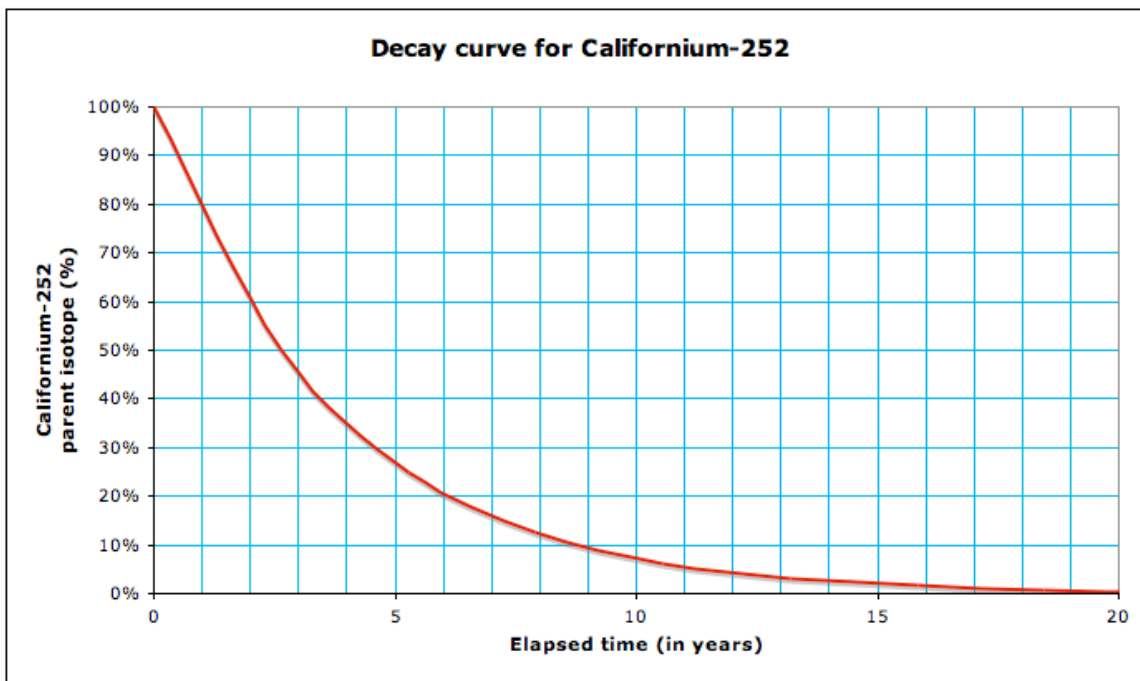
    a. 24 g
    b. 32 g
    c.   8 g
    d. 16 g
    e. None of the above

4. The following decay curve shows the isotope mercury-203.

Decay Curve for Mercury-203

If the initial amount of mercury-203 was 120 g on January 1, approximately how much would be left on June 30, six months later?

   a. 15 g
   b. 7.5 g
   c. 60 g
   d. 30 g
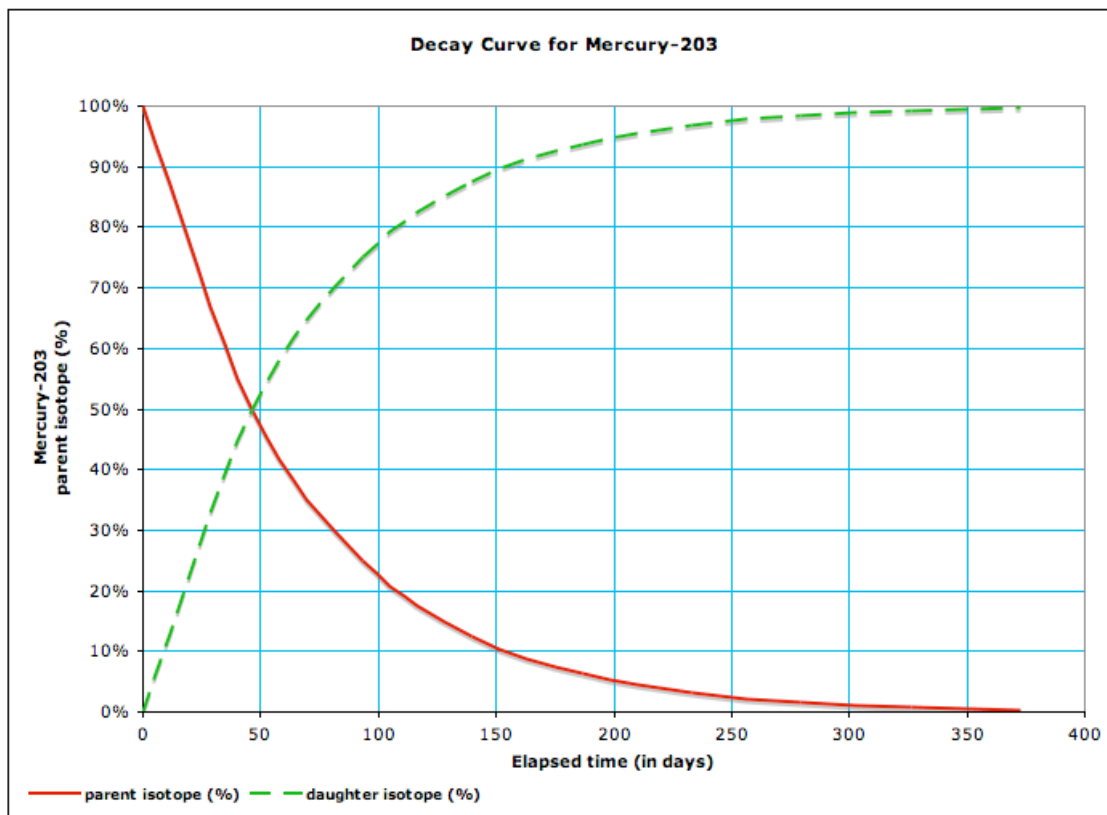
5. The following decay curve shows the isotope californium-252.

Decay curve for Californium-252

What is the half life of californium-252?

   a. 2.5 days
   b. 5 years
   c. 2.6 years
   d. 133 days

6. Potassium-40, a radioactive isotope with a half life of 1.3 billion years, has the daughter isotope argon-40. When potassium-40 is found in volcanic rock, geologists know that they can use the ratio of potassium-40: argon-40 in order to determine the age of the rock. Heat from the molten rock causes all gases, including argon-40, to evaporate as the rock forms.

Assuming that all gases produced during radioactive decay are trapped in the rock, how old is a rock that is found to contain 0.45 g of potassium-40 and 1.35 g of argon-40?

   a. 1.3 billion years old
   b. 2.6 billion years old
   c. 0.65 billion years old
   d 3.9 billion years old

7. All isotopes decay in the same pattern. What is the main difference in the graphs showing the rate of decay for different radioactive isotopes?

   a. The atomic mass of each daughter isotope
   b. The atomic mass of each parent isotope
   c. The percentages of the parent isotope that remain after each half life
   d. The time it takes for a half life to occur

8. The following decay curve shows the isotope mercury-203.

Decay Curve for Mercury-203

The daughter isotope produced by the decay of mercury-203 is thalium-203. Approximately what percentage of the total possible amount of thalium-203 has been produced after 135 days?

   a. 25%
   b. 13%
   c. 50%
   d. 88%

9. Which of the following isotopes would be best to examine if an archeologist claimed to have found an artifact from the early bronze age in Egypt, around the year 3000 BC?

Isotope		Half-Life of Parent (y)	Effective Dating Range (y)
Parent	Daughter		
uranium-235	lead-207	710 million	> 10 million
potassium-40	argon-40	1.3 billion	10 000 to 3 billion
carbon-14	nitrogen-14	5730	up to 50 000

   a. Uranium-235
   b. All three isotopes would be equally effective for dating the artifact
   c. Carbon-14
   d. Potassium-40

10. Protactinium-231 is a radioactive isotope with a half life of 32,760 years. Protactinium-231 decays into the daughter isotope actinium-227. What type of decay does protactinium-231 undergo?

   a. Alpha decay   c. There is not enough information to determine the type of decay
   b. Gamma decay   d. Beta decay