1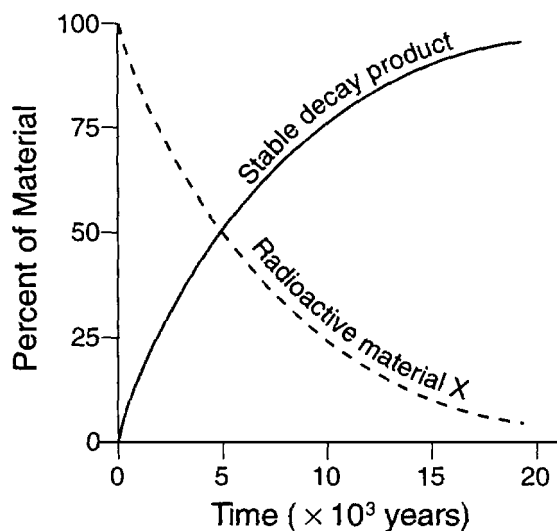. Which radioactive isotope is most useful for determining the age of mastodont bones found in late Pleistocene sediments?

   (1) uranium-238   (3) potassium-40

   (2) carbon-14   (4) rubidium-87

2. Why are radioactive substances useful for measuring geologic time?

   (1) The ratio of decay products to radioactive substances remains constant in rocks.

   (2) The half-lives of radioactive substances are short.

   (3) Samples of radioactive substances are easy to collect from rocks.

   (4) Radioactive substances undergo decay at a predictable rate.

3. Base your answer to the following question on the *Earth Science Reference Tables*, the graph below, and your knowledge of Earth science. The graph represents the decay of radioactive material *X* into a stable decay product.

   If radioactive material *X* were heated, the length of its half-life period would

   (1) decrease   (3) remain the same

   (2) increase

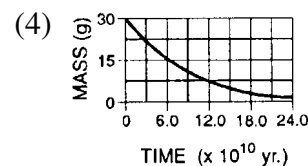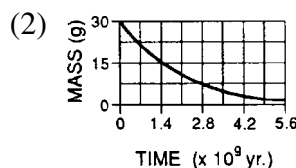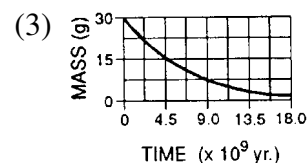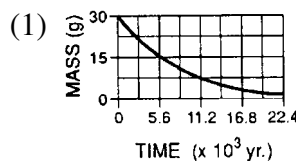4. Which process could be indicated by the expression below?
$$U^{238} \rightarrow Pb^{206}$$

   (1) crystallization of minerals in basalt

   (2) chemical weathering of marble

   (3) radioactive decay in granite

   (4) ozone depletion in the atmosphere

5. Which statement best explains why geologic materials from the Quarternary Period must be dated by using radioactive isotopes different from the isotopes used to date materials from the Cambrian Period?

   (1) All rocks contain radioactive substances.

   (2) Some isotopes decay faster than others.

   (3) Not all isotopes form stable decay products.

   (4) The decay of atoms occurs as a random event.

6. According to the *Earth Science Reference Tables*, the half-life of uranium-238 is
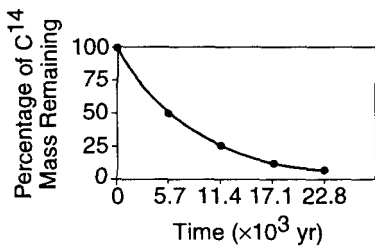
   (1) 4,500 years   (3) 4,500,000,000 years

   (2) 4,500,000 years   (4) 45,000,000,000 years

7. According to the *Earth Science Reference Tables*, which graph best represents the decay rate of potassium-40?
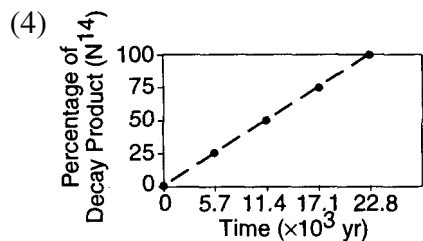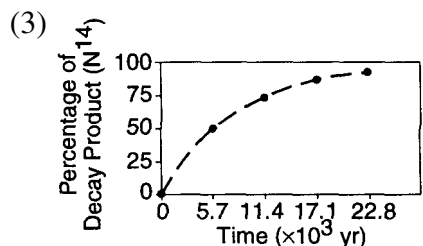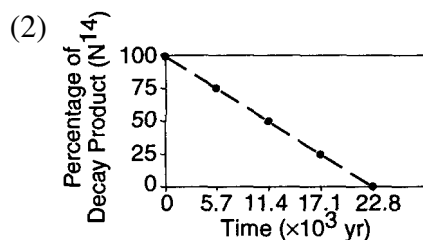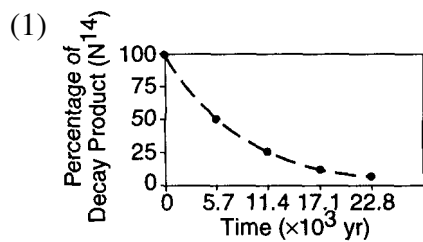

8. Carbon-14, an isotope used to date recent organic remains, would most likely be useful in determining the age of a fossil

   (1) trilobite   (3) *Kluge*

   (2) *Coelophysis*   (4) Beluga whale

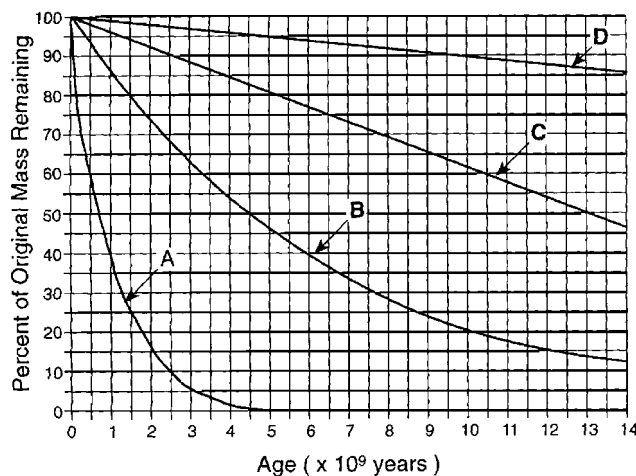9. A graph of the radioactive decay of carbon-14 is shown below.

Which graph correctly shows the accumulation of nitrogen-14, the decay product of carbon-14, over the same period?

(1)

(2)

(3)

(4)

10. A sample of wood found in an ancient tomb contains 25% of its original carbon-14. The age of this wood sample is approximately
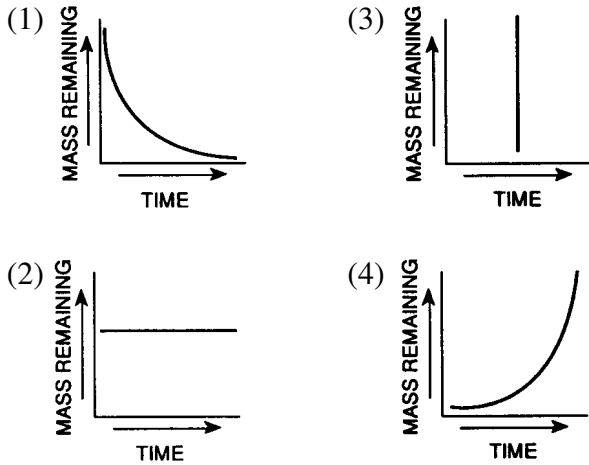
(1) 2,800 years   (3) 11,400 years

(2) 5,700 years   (4) 17,100 years

Base your answers to questions **11** through **14** on the *Earth Science Reference Tables* and the graph below. The graph shows the decay rates of four radioactive substances, *A*, *B*, *C*, and *D*.

11. Decay rates of radioactive substances such as these can be used to determine the age of rocks and fossils because radioactive decay occurs

(1) at a steady, predictable rate

(2) in all types of sedimentary rock

(3) only when a living organism dies

(4) in all organic and mineral substances

12. The radioactive substance uranium-238 is represented by

(1) *A*   (3) *C*

(2) *B*   (4) *D*

13. Which radioactive substance has a half-life of 13 billion years?

(1) *A*   (3) *C*

(2) *B*   (4) *D*

14. When 90 percent of the original mass of isotope *D* remains, what total percent of the original mass of isotope *B* remains?

(1) 10%   (3) 63%

(2) 22%   (4) 90%

15. A bone sample contains only $\frac{1}{4}$ of its original radioactive C^{14} content. How old is the bone sample?

(1) 1 C^{14} half-life   (3) 9 C^{14} half-lives

(2) 2 C^{14} half-lives   (4) 4 C^{14} half-lives

16. Which graph best represents the relationship between the remaining mass of a radioactive element and time?

(1)

(3)

(2)

(4)

17. The table below gives information about the radioactive decay of carbon-14. Part of the table has been deliberately left blank for student use.

Half-life	Mass of Original Carbon-14 Remaining (grams)	Number of Years
0	1	0
1	$\frac{1}{2}$	5,700
2	$\frac{1}{4}$	11,400
3	$\frac{1}{8}$	17,100
4	$\frac{1}{16}$	
5		
6		
7		

After how many years will $\frac{1}{128}$ gram of the original carbon-14 reamin?

(1) 22,800 yr   (3) 34,200 yr
(2) 28,500 yr   (4) 39,900 yr

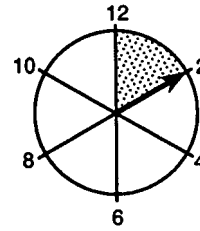18. Base your answer to the following question on the *Earth Science Reference Tables*.

What is the approximate age of an igneous rock that contains only one-fourth of its original potassium-40 content due to radioactive decay?

(1) 1.3×10^9 years   (3) 3.9×10^9 years
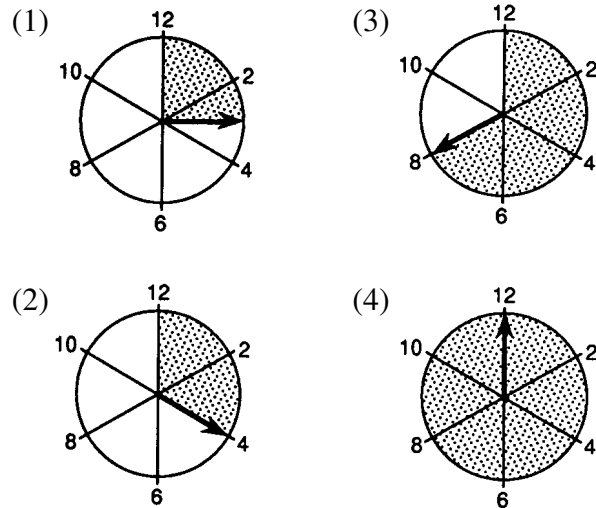(2) 2.6×10^9 years   (4) 5.2×10^9 years

19. Using radioactive dating methods and mathematical inferences, scientists have estimated the date of Earth's formation to be approximately

(1) 1.1×10^6 years ago   (3) 3.3×10^9 years ago
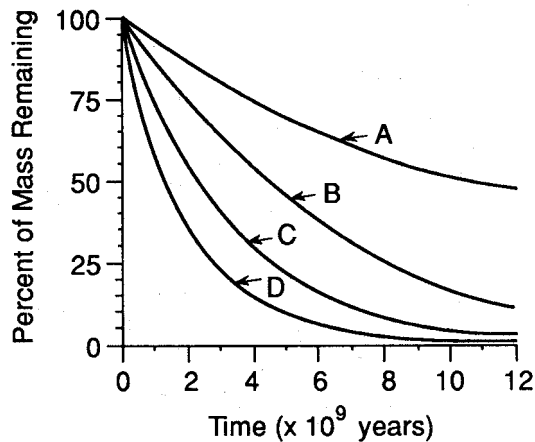(2) 2.4×10^6 years ago   (4) 4.6×10^9 years ago

20. The diagram below represents a clock used to time the half-life of a particular radioactive substance. The clock was started at 12:00. The shaded portion on the clock represents the number of hours one-half of this radioactive substance took to disintegrate.

Which diagram best represents the clock at the end of the next half-life of this radioactive substance?
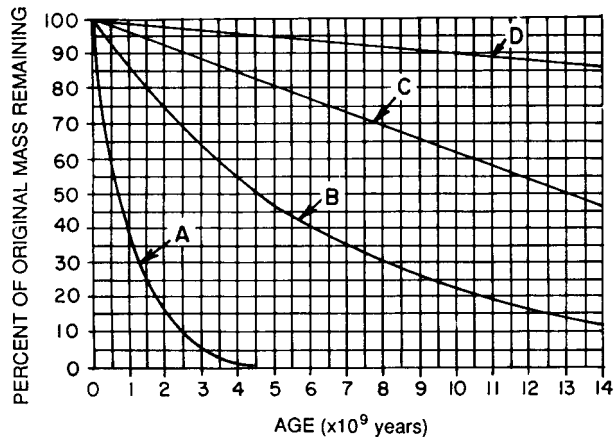
(1)

(3)

(2)

(4)

21. The graph below shows the relationship between mass and time for four radioactive elements during radioactive decay.

Which line best represents the decay curve for potassium -40? [Refer to the *Earth Science Reference Tables*.]
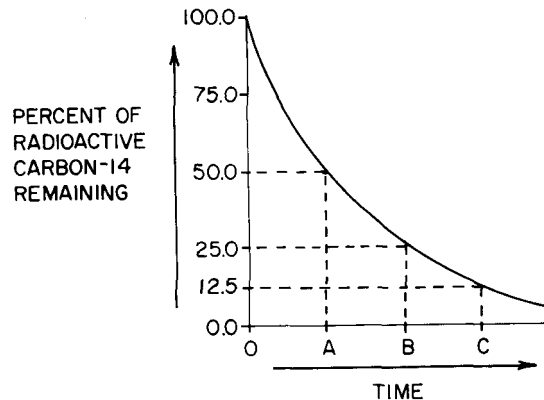
(1) *A*   (3) *C*
(2) *B*   (4) *D*

22. Which radioactive substance shown on the graph below has the longest half-life?
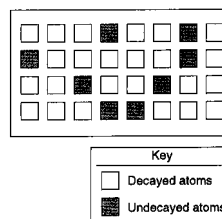

(1) *A*   (3) *C*
(2) *B*   (4) *D*

23. The graph below shows the percent remaining (not decayed) of the original amount of carbon-14 at different times (*A*, *B*, and *C*) during radioactive decay. How many half-lives of time are represented by point *B* along the time axis?

(1) 1 half-life   (3) 3 half-lives
(2) 2 half-lives   (4) 4 half-lives

24. The diagram below represents the present number of decayed and undecayed atoms in a sample that was originally 100% radioactive material.

If the half-life of the radioactive material is 1,000 years, what is the age of the sample represented by the diagram?

(1) 1,000 yr   (3) 3,000 yr
(2) 2,000 yr   (4) 4,000 yr

25. The absolute age of a rock is the approximate number of years ago that the rock formed. The absolute age of an igneous rock can best be determined by
    (1) comparing the amounts of decayed and undecayed radioactive isotopes in the rock
    (2) comparing the sizes of the crystals found in the upper and lower parts of the rock
    (3) examining the rock's relative position in a rock outcrop
    (4) examining the environment in which the rock is found

Answer Key

1. ___2___   25. ___1___

2. ___4___

3. ___3___

4. ___3___

5. ___2___

6. ___3___

7. ___2___

8. ___4___

9. ___3___

10. ___3___

11. ___1___

12. ___2___

13. ___3___

14. ___2___

15. ___2___

16. ___1___

17. ___4___

18. ___2___

19. ___4___

20. ___2___

21. ___4___

22. ___4___

23. ___2___

24. ___2___