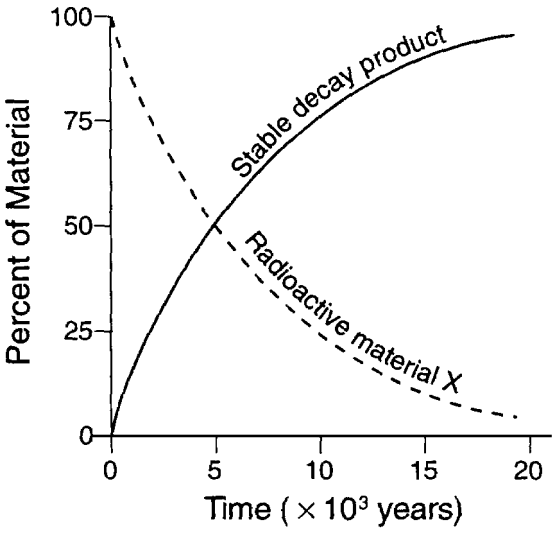
Base your answers to questions **1** through **5** on the *Earth Science Reference Tables*, the graph below, and your knowledge of Earth science. The graph represents the decay of radioactive material *X* into a stable decay product.

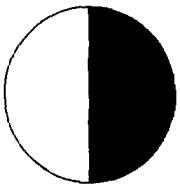


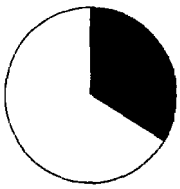

1. What is the approximate half-life of radioactive material *X*?
   (1) 5,000 yr (3) 50,000 yr
   (2) 10,000 yr (4) 100,000 yr

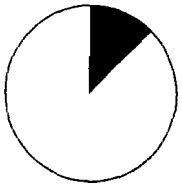
2. Radioactive material *X* can only be used to date young geologic material because radioactive material *X*
   (1) has only recently become radioactive
   (2) has a relatively short half-life
   (3) never existed in older rocks
   (4) has only recently been discovered

3. Which graph best represents the relative percentages of radioactive material *X* and its stable decay product after 15,000 years?(**The shaded region represents radioactive material while the non-shaded region represents stable decay products**.)

(1) 

(3) 

(2) 

(4) 

4. Each of the objects below has different amounts remaining of the original radioactive material *X*. Which object is most likely the oldest?

(1) 
Rock
10% of the radioactive material remains

(3) 
Shell
41% of the radioactive material remains

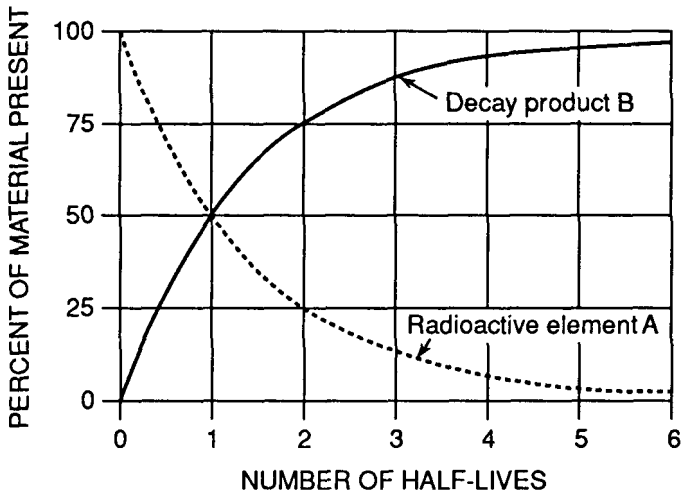
(2) 
Wood
33% of the radioactive material remains

(4) 
Bone
52% of the radioactive material remains

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

(1) decrease
(2) increase
(3) remain the same

Base your answers to questions **6** through **10** on the *Earth Science Reference Tables* and the graph below. The graph shows the rate of radioactive decay of element *A* and the rate at which decay product *B* is formed.




6. According to the graph, what is the total percentage of radioactive element *A* present after 3 half-lives?
   (1) 12.5%
   (2) 25.0%
   (3) 75.0 %
   (4) 87.5%

7. An igneous rock contains 2 grams of radioactive element *A* and 2 grams of decay product *B*. How old is the rock sample?
   (1) 1 half-life
   (2) 2 half-lives
   (3) 3 half-lives
   (4) less than 1 half-life

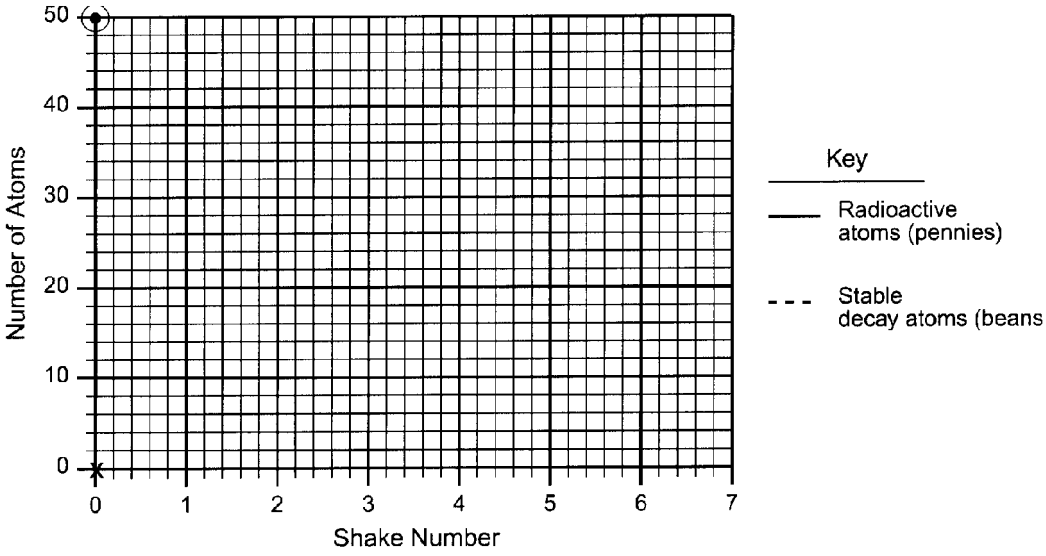
8. If the half-life of radioactive element *A* is 10,000 years, for which time interval would this element be most useful in determining the age of rock?
   (1) Precambrian
   (2) Devonian
   (3) Mississippian
   (4) Pleistocene

9. If the radioactive element in a rock sample is potassium-40, which resulting decay product would be present?
   (1) $Sr^{87}$
   (2) $Ar^{40}$
   (3) $N^{14}$
   (4) $C^{12}$

10. Two rocks containing radioactive element *A* were taken from a mine. One had a mass of 2 grams; the other had a mass of 4 grams. Compared to the half-life of element *A* in the 4-gram sample, the half-life of element *A* in the 2-gram sample will be
    (1) shorter
    (2) longer
    (3) the same

Base your answers to questions **11** and **12** on the table below, which shows the results of a student's demonstration modeling radioactive decay. To begin, the student put 50 pennies heads up in a container. Each penny represented one radioactive atom. The student placed a top on the box and shook the box. Each penny that had flipped over to the tails up side was replaced with a bean that represented the stable decay product. The student continued the process until all of the pennies had been replaced by beans.

| Shake Number | Number of Radioactive Atoms (pennies) | Number of Stable Decay Atoms (beans) |
|---|---|---|
| 0 | 50 | 0 |
| 1 | 25 | 25 |
| 2 | 14 | 36 |
| 3 | 7 | 43 |
| 4 | 5 | 45 |
| 5 | 2 | 48 |
| 6 | 1 | 49 |
| 7 | 0 | 50 |




11. On the grid provided on your answer paper, graph the data shown on the table by following the steps below.

    *a* Mark with a dot each number of radioactive atoms (pennies) after each shake. Surround each dot with a small circle. The zero shake has been plotted for you.
    *b* Connect all the dots with a solid line.
    *c* Mark with an **X** the number of stable decay atoms (beans) after each shake. The zero shake has been plotted for you.
    *d* Connect all the **X**'s with a dashed line.

12. Assume that each shake number represents an additional 100 years. State the half-life of the radioactive material in this model.