LESSON MAKER PRO

Rock Age Detectives

Use isotope ratios to date Earth materials.

HIGH SCHOOL · ESS.2B

ESS.2B "Students will develop an understanding of the history and evolution of the earth. Research, analyze, and evaluate the contributions of William Smith, James Hutton, Nicolaus Steno, Charles Lyell, and others to physical geology..."

NAME _____ DATE _____

COUNT THE HALF-LIVES

In these models, parent atoms change into daughter atoms. Assume each sample began with no daughter atoms and has not gained or lost either type. Find the fraction of parent atoms left by dividing parent atoms by the total, then count how many times that fraction was halved.

WORKED EXAMPLE

A model rock contains the atoms shown. The isotope's half-life is 7 million years. How old is the rock?

MODEL ROCK

Atom type	Count
Parent	5
Daughter	35

1. Total atoms: 5 + 35 = 40.
2. Parent fraction: 5/40 = 1/8.
3. Three halvings leave 1/8.
4. Age: 3 × 7 = 21 million years.

Answer: 21 million years

PRACTICE 4 problems

1 A rock has 1/2 of its parent isotope left. Its half-life is 2 million years. How old is it?

ANSWER _____

2 A rock has 1/4 of its parent isotope left. Its half-life is 6 million years. How old is it?

ANSWER _____

3 A rock has 1/16 of its parent isotope left. Its half-life is 9 million years. How old is it?

ANSWER _____

4 A rock has 1/32 of its parent isotope left. Its half-life is 11 million years. How old is it?

ANSWER _____

APPLY IT Show your work

1 A hiking trail crosses volcanic ash. A model of the ash has the atom counts shown. If the half-life is 10 million years, how old is the ash?

VOLCANIC ASH MODEL

Atom type	Count
Parent	12
Daughter	36

ANSWER _____

2 A model of rock from a battery-metal mine has 6 parent atoms and 90 daughter atoms. If the half-life is 13 million years, how old is the rock?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Two isotopes in one rock are measured. Isotope A has 1/16 of its parent atoms left and a half-life of 4 million years. Isotope B has 1/4 left and a half-life of 8 million years. Do the two ages agree? Explain.

WORK SPACE AND ANSWER

Rock Age Detectives

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A rock has 1/2 of its parent isotope left. Its half-life is 2 million years. How old is it?	**2 million years**
2	A rock has 1/4 of its parent isotope left. Its half-life is 6 million years. How old is it?	**12 million years**
3	A rock has 1/16 of its parent isotope left. Its half-life is 9 million years. How old is it?	**36 million years**
4	A rock has 1/32 of its parent isotope left. Its half-life is 11 million years. How old is it?	**55 million years**

PART 2 · APPLY IT

1. **20 million years** The parent fraction is 12/(12 + 36) = 1/4. Two half-lives of 10 million years have passed.
2. **52 million years** The parent fraction is 6/(6 + 90) = 1/16. Four half-lives of 13 million years have passed.

CHALLENGE

Yes. Isotope A gives 4 × 4 = 16 million years, and isotope B gives 2 × 8 = 16 million years.

Accept ages written as numbers with the unit “million years.” For the challenge, accept any explanation that correctly shows both isotopes give 16 million years.