

SAMPLE PROBLEM B

For more help, go to the *Math Tutor* at the end of the chapter.

Phosphorus-32 has a half-life of 14.3 days. How many milligrams of phosphorus-32 remain after 57.2 days if you start with 4.0 mg of the isotope?

SOLUTION

- 1 ANALYZE** Given: original mass of phosphorus-32 = 4.0 mg
half-life of phosphorus-32 = 14.3 days
time elapsed = 57.2 days
Unknown: mass of phosphorus-32 remaining after 57.2 days
- 2 PLAN** To determine the number of milligrams of phosphorus-32 remaining, we must first find the number of half-lives that have passed in the time elapsed. Then the amount of phosphorus-32 is determined by reducing the original amount by half for every half-life that has passed.
- $$\text{number of half-lives} = \text{time elapsed (days)} \times \frac{1 \text{ half-life}}{14.3 \text{ days}}$$
- $$\text{amount of phosphorus-32 remaining} = \text{original amount of phosphorus-32} \times \frac{1}{2} \text{ for each half-life}$$
- 3 COMPUTE**
$$\text{number of half-lives} = 57.2 \text{ days} \times \frac{1 \text{ half-life}}{14.3 \text{ days}} = 4 \text{ half-lives}$$
$$\text{amount of phosphorus-32 remaining} = 4.0 \text{ mg} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 0.25 \text{ mg}$$
- 4 EVALUATE** A period of 57.2 days is four half-lives for phosphorus-32. At the end of one half-life, 2.0 mg of phosphorus-32 remains; 1.0 mg remains at the end of two half-lives; 0.50 mg remains at the end of three half-lives; and 0.25 mg remains at the end of four half-lives.

PRACTICE

Answers in Appendix E

1. The half-life of polonium-210 is 138.4 days. How many milligrams of polonium-210 remain after 415.2 days if you start with 2.0 mg of the isotope?
2. Assuming a half-life of 1599 years, how many years will be needed for the decay of $\frac{15}{16}$ of a given amount of radium-226?
3. The half-life of radon-222 is 3.824 days. After what time will one-fourth of a given amount of radon remain?
4. The half-life of cobalt-60 is 5.27 years. How many milligrams of cobalt-60 remain after 52.7 years if you start with 10.0 mg?
5. A sample contains 4.0 mg of uranium-238. After 4.46×10^9 years, the sample will contain 2.0 mg of uranium-238. What is the half-life of uranium-238?

extension

Go to go.hrw.com for more practice problems that ask you to calculate the half-life or amount of sample remaining.



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