

Half-Life Problems Worksheet

1. A 2.5-gram sample of radium-226 has a half-life of 1600 years. How many grams of the sample will decay in 800 years?
2. If 20 grams of a radioactive isotope is initially present and 5 grams remains after an hour, what is the isotope's half-life?
3. Fluorine-21 has a half-life of about 5 seconds. How much of the original nuclei remains after a minute?
4. If 1 gram of sodium-24 (half-life = 15 hours) has decayed from a sample that was originally 2 grams, how old is the original sample?
5. After 6 half-lives, what fraction of a sample of chromium-48 would remain?
6. A sample of 100 grams of nitrogen-16 decays to 12.5 grams after 21.6 seconds. What is the half-life of nitrogen-16?

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Answers

1. A 2.5-gram sample of radium-226 has a half-life of 1600 years. How many grams of the sample will decay in 800 years?

0.625 grams

The half-life of radium-226 is 1600 years. After 800 years, it will only decay by a quarter, i.e., 0.25. So, of a 2.5 gram sample, $2.5 \times 0.25 = 0.625$ gram will decay.

2. If 20 grams of a radioactive isotope is initially present and 5 grams remains after an hour, what is the isotope's half-life?

30 minutes

Since the radioactive isotope became a $\frac{1}{4}$ th of its initial mass after an hour, two of its half-lives must have passed. Thus, a single half-life of this isotope is half an hour, i.e., 30 minutes.

3. Fluorine-21 has a half-life of about 5 seconds. How much of the original nuclei remains after a minute?

$1/4096$

If fluorine-21 has a half-life of 5 seconds, in a minute, i.e., 60 seconds, it has passed through $60/5 = 12$ half-lives.

So, after 12 half-lives, $1/2^{12} = 1/4096$ of the original nuclei is left.

4. If 1 gram of sodium-24 (half-life = 15 hours) has decayed from a sample that was originally 2 grams, how old is the original sample?

15 hours

As half of the sample has decayed, we know that one half-life has passed, which is 15 hours.

5. After 6 half-lives, what fraction of a sample of chromium-48 would remain?

$1/64$

After 6 half-lives, $1/2^6 = 1/64$ of the sample is left.

6. A sample of 100 grams of nitrogen-16 decays to 12.5 grams after 21.6 seconds. What is the half-life of nitrogen-16?

7.2 seconds

As 100 grams of the sample have decayed to 12.5 grams, it has gone through 3 half-lives ($12.5/100 = 0.125 = \frac{1}{8} = 1/2^3$).

So the half-life of nitrogen-16 is $21.6 / 3$ seconds = 7.2 seconds.