

Carbon-14 Q/A Half-life Worksheet

Carbon-14 is a radioactive isotope in small amounts in all living things. When an organism dies, the carbon-14 in them begins to decay steadily at a half-life of 5,730 years. This means that for every 5,730 years, exactly half of the original amount of carbon-14 has decayed. Scientists measure the amount of carbon-14 left in a dead organism and use the half-life to determine the time since the organism died.

With the help of the information provided in the above paragraph, answer the following questions.

1. Paleontologists have unearthed the skeleton of a woolly mammoth that now has 10 grams of carbon-14 left. If the woolly mammoth originally had 80 grams of carbon-14, how long ago did it die?
2. How old is a bone if it presently contains 0.3125 grams of carbon-14, but it was estimated to have originally contained 80 grams of carbon-14?
3. Scientists determined from the remains of an ancient caveman that the level of carbon-14 in them is about 25% of the original amount. How long ago did he die?
4. A sample of carbon-14 has been decaying for 22,920 years and is now 35 grams. What was the size of the original?

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Answers

Carbon-14 is a radioactive isotope in small amounts in all living things. When an organism dies, the carbon-14 in them begins to decay steadily at a half-life of 5,730 years. This means that for every 5,730 years, exactly half of the original amount of carbon-14 has decayed. Scientists measure the amount of carbon-14 left in a dead organism and use the half-life to determine the time since the organism died.

With the help of the information provided in the above paragraph, answer the following questions.

1. Paleontologists have unearthed the skeleton of a woolly mammoth that now has 10 grams of carbon-14 left. If the woolly mammoth originally had 80 grams of carbon-14, how long ago did it die?

17,190 years

For the carbon-14 to decay from 80 grams to 10 grams, it has to pass through 3 half-lives ($80 \times \frac{1}{2} = 40 \rightarrow 40 \times \frac{1}{2} = 20 \rightarrow 20 \times \frac{1}{2} = 10$). So, the woolly mammoth died $3 \times 5730 = 17190$ years ago.

2. How old is a bone if it presently contains 0.3125 grams of carbon-14, but it was estimated to have originally contained 80 grams of carbon-14?

45,840 years

For the carbon-14 in the bone to decay from 80 grams to 0.3125 grams, it has to go through 8 half-lives [$(\frac{1}{2})^8 \times 80 = 0.3125$]. So the age of the bone is $= 8 \times 5730 = 45840$ years.

3. Scientists determined from the remains of an ancient caveman that the level of carbon-14 in them is about 25% of the original amount. How long ago did he die?

11,460 years

For the amount of carbon-14 to decay by 25%, it has to pass through 2 half-lives. So the ancient caveman, most likely, died $= 2 \times 5730 = 11460$ years ago.

4. A sample of carbon-14 has been decaying for 22,920 years and is now 35 grams. What was the size of the original?

560 grams

As the sample has been decaying for 22920 years and carbon-14 has a half-life of 5730 years, the number of half-lives the sample has passed through is $= 22920/5730 = 4$.

So, the original sample weighed $= 35 \times 2^4 = 35 \times 16 = 560$ grams.