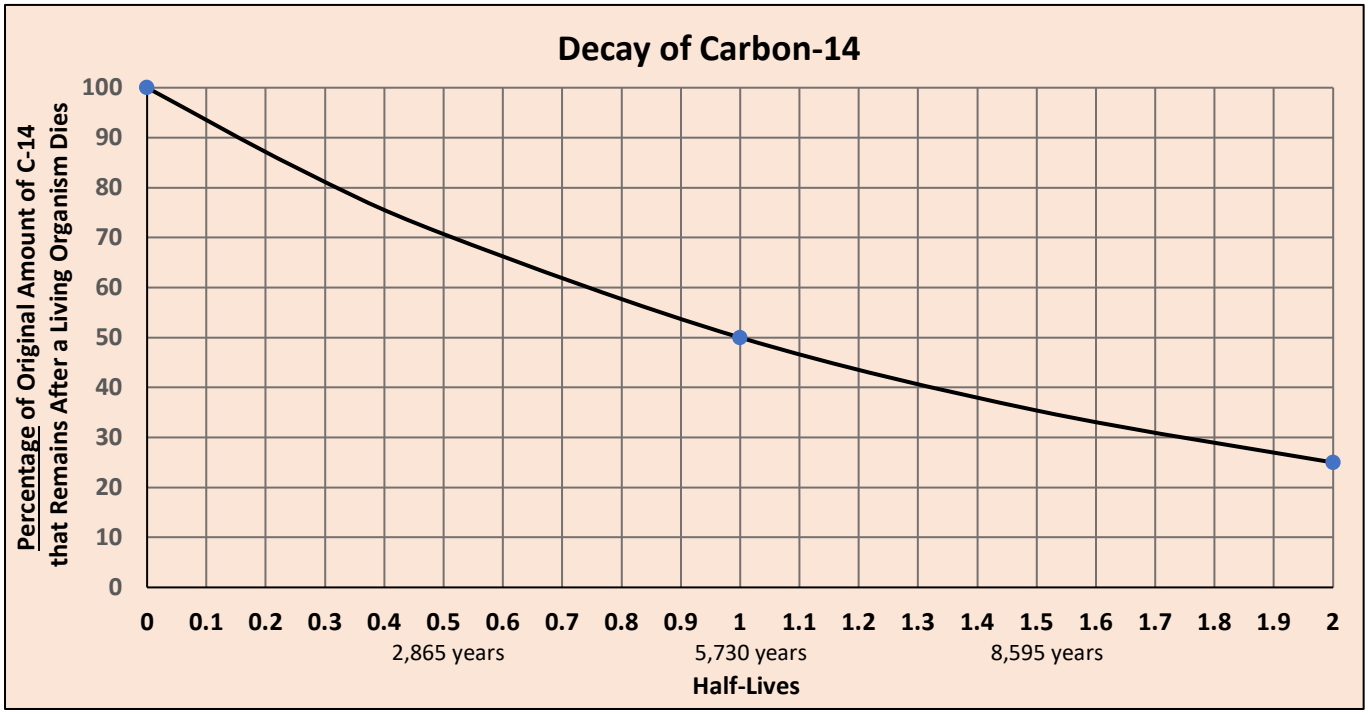
Shedding Light on Nuclear Radiation Episode 6: Radiocarbon Dating Name: _____

Part A:

1. What is radiocarbon dating? _____
_____

Part B:

2. Carbon-14 nuclei are made of _____ protons and _____ neutrons.
3. What proportion of carbon atoms on Earth are carbon-14 atoms? _____
4. What is the half-life of carbon-14? _____
5. Write the nuclear equation for the decay of carbon-14 atoms.
_____
6. The proportion of carbon-14 in our bodies stays more or less the same throughout our lives. How do carbon atoms come into our bodies and how do they leave? _____
_____
_____
_____
_____
_____
7. Below is a graph showing the percentage of carbon-14 that remains (in a preserved bone, for example) as time passes.



(a) A human bone found in an ancient Greek cemetery is found to have only 50% of the carbon-14 content of living creatures that are alive today. When did the person die (approximately)?
_____

(b) Some woolen clothing found preserved in an ancient Mesopotamian tomb is found to have only 71% of the carbon-14 content of living creatures that are alive today. Approximately how many years ago was the sheep that produced the wool alive? _____

(c) The wood that a medieval painting was painted on is found to have only about 87% of the carbon-14 content of living things that are alive today.
(i) how many half-lives have passed since the tree was cut down? _____
(ii) Approximately how many years ago was the tree cut down? (Hint: you'll need to do some simple mathematics.) _____
_____

(d) The preserved skin (found in ice) of a dead mammoth is found to have only about 31% of the carbon-14 content of living things that are alive today.
(i) how many half-lives have passed since the mammoth died? _____
(ii) Approximately how many years ago did the mammoth die?
_____

8. Briefly describe how radiocarbon dating works. _____
_____
_____
_____
_____

9. How do plants acquire carbon-14 atoms? _____
_____
_____

Part C:

10. What are cosmic rays and where do they come from? _____
_____
_____

11. If a high-speed proton crashes into an oxygen-16 atom's nucleus, the oxygen-16 atom's nucleus can fragment into pieces that may include _____
_____

12. If a high-speed neutron crashes into the nucleus of a nitrogen-14 atom, a proton can be knocked out of it while the neutron can stick onto it. This turns the N-14 atom into a C-14 atom. Write the nuclear equation for this nuclear reaction.
_____

13. What can be said about the rate of carbon-14 production in the atmosphere compared to the rate of carbon-14 radioactive decay?
    A. It is greater.
    B. It is more or less the same.
    C. It is less.

Part D:

14. Who came up with the idea of radiocarbon dating and when did it happen? _____
_____

15. Why does the wood at the centre of a tree have less carbon-14 in it than the wood closer to the bark?
_____
_____

16. Finds like the body of Otzi and the Dead Sea Scrolls are fairly uncommon because most living things decompose. How did Otzi's body and the Dead Sea Scrolls stay preserved? _____
_____
_____
_____

Nuclear Reactions Skill Building Exercises

More than 99% of carbon-14 atoms produced in the atmosphere come from the nuclear reaction that is described in the video (and in Q12). However, carbon-14 atoms can also be produced in other ways. You will likely need a periodic table to help you answer these questions.

A: mass number: number of protons + number of neutrons
Z: atomic number: number or protons

$${}^{A}_{Z}X$$

In atomic notation, carbon-13 can be written as ${}^{13}_{6}C$

17. A neutron can slam into a carbon-13 atom's nucleus and stick to it, which creates a carbon-14 nucleus. A gamma ray is also emitted. Write the nuclear equation for this nuclear reaction.
_____

18. A neutron can slam into an oxygen-17 atom's nucleus resulting in the formation of an alpha particle (a Helium-4 nucleus) and a carbon-14 atom. Write the nuclear equation for this nuclear reaction.
_____

19. A neutron can slam into an oxygen-16 atom's nucleus resulting in the formation of a helium-3 nucleus and a carbon-14 nucleus. Write the nuclear equation for this nuclear reaction.
_____