Charcoal's Nuclear Clues

Compare the nuclei of carbon isotopes

PHY.6.2 "Explore the mass number and atomic number of the nucleus of an isotope of a given chemical element."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle each atomic number in the table, underline each mass number, and number the isotope rows from 1 to 3 in order of fewest to most neutrons to show how their nuclei differ.

What Is in Ancient Charcoal?

1. A tiny piece of charcoal from an ancient campfire contains carbon atoms. Some are carbon-12, some are carbon-13, and a small fraction may be carbon-14. The number after carbon is its mass number, the total number of protons and neutrons in its nucleus. Even when their mass numbers differ, these atoms are all carbon because each nucleus has six protons.

2. An element's atomic number is its number of protons. For carbon, that number is always 6, no matter which isotope you inspect. To find the number of neutrons, subtract the atomic number from the mass number. The table lists three carbon isotopes in no particular order. Its numbers describe nuclei, not the weights of whole atoms in grams.

CARBON ISOTOPES IN CHARCOAL

Isotope	Atomic number	Mass number
carbon-14	6	14
carbon-12	6	12
carbon-13	6	13

3. A scientist can compare isotopes to investigate the charcoal's history. Carbon-14 is radioactive, so its amount decreases over time as nuclei decay. Carbon-12 and carbon-13 are stable. By counting neutrons, you can see what differs among these nuclei. The proton count stays fixed, so changing the neutron count alone does not make a different element.

2 ANSWER WITH EVIDENCE

Use the passage

1. How many neutrons are in a carbon-14 nucleus? Show your subtraction.

2. Compare carbon-12 and carbon-13. How do their proton counts and neutron counts differ?

3. Which isotope in the table has 7 neutrons? Use its atomic and mass numbers to explain.

4. Suppose one neutron were removed from a carbon-14 nucleus, but its protons stayed the same. Which isotope in the table would result? State its atomic and mass numbers.

3 YOUR TURN

Your own words

Imagine a carbon nucleus with 9 neutrons. In two sentences, name its isotope, state its atomic and mass numbers, and compare its proton and neutron counts with carbon-12.

ANSWER KEY

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PART 1 · READ AND MARK

Circle each atomic number in the table, underline each mass number, and number the isotope rows from 1 to 3 in order of fewest to most neutrons to show how their nuclei differ. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How many neutrons are in a carbon-14 nucleus? Show your subtraction.	**14 − 6 = 8 neutrons.**
2	Compare carbon-12 and carbon-13. How do their proton counts and neutron counts differ?	**Both have 6 protons. Carbon-12 has 6 neutrons, and carbon-13 has 7.**
3	Which isotope in the table has 7 neutrons? Use its atomic and mass numbers to explain.	**Carbon-13, because 13 − 6 = 7 neutrons.**
4	Suppose one neutron were removed from a carbon-14 nucleus, but its protons stayed the same. Which isotope in the table would result? State its atomic and mass numbers.	**Carbon-13 would result. Its atomic number is 6, and its mass number is 13.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The nucleus is carbon-15, with atomic number 6 and mass number 15. It has the same 6 protons as carbon-12 but has 9 neutrons instead of 6.

Accept answers that correctly subtract the atomic number from the mass number. Removing a neutron in question 4 is hypothetical, not the usual decay of carbon-14.