Nuclear Number Check

Use two conserved totals to balance decay equations.

PHY.6.3 "Investigate the conservation of mass and the conservation of charge by writing and balancing nuclear decay equations for alpha and beta decay."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the four starting isotopes in paragraphs 2 and 3, and circle the words that identify each emitted particle. Beside each starting isotope, write how its mass number and atomic number change.

What the Detector Records

1. Inside a radiation detector, an unstable nucleus can change into a different nucleus and send out a particle. A nuclear equation tracks each nucleus by mass number, the count of protons and neutrons, and atomic number, the count of protons. Write each isotope with its mass number above its atomic number. An alpha particle is $^{4}_{2}He^{2+}$, while a beta-minus particle is $^{0}_{-1}e^{-}$. In each equation, the mass numbers on the left and right must add to the same total. The atomic numbers must also add to the same total, counting the beta particle's negative value.

2. In one detector sample, radon-222, written $^{222}_{86}Rn$, undergoes alpha decay and leaves a polonium nucleus, Po. The escaping alpha particle may strike the detector before it travels far. In another sample, radium-226, $^{226}_{88}Ra$, also undergoes alpha decay and produces radon, Rn. To write either equation, place the original nucleus on the left, then the new nucleus and the alpha particle on the right. Use the two conserved totals to work out the missing numbers beside the new symbol. For an alpha event, four nucleons and two protons leave with the particle.

3. A different detector records beta-minus decay from carbon-14, $^{14}_{6}C$, leaving nitrogen, N. A second record starts with phosphorus-32, $^{32}_{15}P$, and ends with sulfur, S, plus a beta-minus particle. In beta-minus decay, a neutron becomes a proton in the nucleus, so its mass number stays the same while its atomic number rises by one. The electron carries atomic number negative one in the equation. Beta-minus decay also releases an antineutrino, left out of these simplified equations because its mass number and electric charge are zero. The totals still match even when the new nucleus has more protons.

2 ANSWER WITH EVIDENCE

Use the passage

1. Write the balanced equation for the radon-222 decay in the passage. Show the mass-number and atomic-number sums.

2. Write the balanced equation for the radium-226 decay in the passage. Show the mass-number and atomic-number sums.

3. Write the balanced equation for the carbon-14 decay in the passage. Show the mass-number and atomic-number sums.

4. Write the balanced equation for the phosphorus-32 decay in the passage. Show the mass-number and atomic-number sums.

3 YOUR TURN

Your own words

An iodine-131 nucleus, $^{131}_{53}\mathrm{I}$, undergoes beta-minus decay and forms xenon, Xe. Write its balanced equation, then show the mass-number and atomic-number sums on both sides.

ANSWER KEY

Nuclear Number Check

PART 1 · READ AND MARK

Underline the four starting isotopes in paragraphs 2 and 3, and circle the words that identify each emitted particle. Beside each starting isotope, write how its mass number and atomic number change. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Write the balanced equation for the radon-222 decay in the passage. Show the mass-number and atomic-number sums.	**$^{222}_{86}Rn \rightarrow {}^{218}_{84}Po + {}^{4}_{2}He^{2+}$. Mass: 222 = 218 + 4. Atomic: 86 = 84 + 2.**
2	Write the balanced equation for the radium-226 decay in the passage. Show the mass-number and atomic-number sums.	**$^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}He^{2+}$. Mass: 226 = 222 + 4. Atomic: 88 = 86 + 2.**
3	Write the balanced equation for the carbon-14 decay in the passage. Show the mass-number and atomic-number sums.	**$^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e^{-}$. Mass: 14 = 14 + 0. Atomic: 6 = 7 + (-1).**
4	Write the balanced equation for the phosphorus-32 decay in the passage. Show the mass-number and atomic-number sums.	**$^{32}_{15}P \rightarrow {}^{32}_{16}S + {}^{0}_{-1}e^{-}$. Mass: 32 = 32 + 0. Atomic: 15 = 16 + (-1).**

PART 3 · YOUR TURN (SAMPLE ANSWER)

$^{131}_{53}I \rightarrow {}^{131}_{54}Xe + {}^{0}_{-1}e^{-}$. Mass: 131 = 131 + 0. Atomic: 53 = 54 + (-1).

Accept equations that omit the antineutrino, as the passage does. Check that each response balances both mass numbers and atomic numbers.