# Nuclear Notation and Model Evidence

Student Worksheet | g10_u08_w29

**I can:** read nuclear notation and use mass-number/atomic-number conservation in supplied alpha, beta-minus, and gamma model cards.
**Scope card:** In ${}^{A}_{Z}\mathrm{X}$, $A$ is mass number (protons + neutrons) and $Z$ is atomic number (protons). These paper models track only printed nuclear notation and conservation. They do not give a decay probability, exposure level, safety assessment, medical application, energy-policy conclusion, or experimental procedure. Do not use radiation sources, experiments, or measurements.

| notation / model card | conservation focus |
|---|---|
| ${}^{14}_{6}\mathrm{C}$; ${}^{14}_{7}\mathrm{N}$; ${}^{4}_{2}\mathrm{He}$ | $n = A - Z$ for a printed nuclide |
| ${}^{238}_{92}\mathrm{U} \rightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\mathrm{He}$ | alpha model: $A - 4$, $Z - 2$ |
| ${}^{14}_{6}\mathrm{C} \rightarrow {}^{14}_{7}\mathrm{N} + {}^{0}_{-1}\mathrm{e} + \bar{\nu}_{\mathrm{e}}$ | beta-minus model: $A$ unchanged, $Z + 1$ in daughter |
| gamma card: emitted $\gamma$ has $A = 0$, $Z = 0$ | no change to printed parent $A$ or $Z$ |

1. In ${}^{14}_{6}\mathrm{C}$, state the mass number and atomic number.

2. Calculate the number of protons in ${}^{14}_{6}\mathrm{C}$.

3. Calculate the number of neutrons in ${}^{14}_{6}\mathrm{C}$.

4. Calculate the number of protons and neutrons in ${}^{14}_{7}\mathrm{N}$.

5. Why are ${}^{14}_{6}\mathrm{C}$ and ${}^{14}_{7}\mathrm{N}$ different elements in this model?

6. Identify the emitted particle in the supplied alpha model.

7. In the alpha model, how does the daughter mass number change from the parent?

8. In the alpha model, how does the daughter atomic number change from the parent?

9. Verify mass-number conservation for the supplied alpha model.

10. Verify atomic-number conservation for the supplied alpha model.

11. Identify the printed charged particle in the beta-minus model.

12. In the beta-minus model, how does the daughter mass number compare with the parent?

13. In the beta-minus model, how does the daughter atomic number compare with the parent?

14. Verify mass-number conservation for the supplied beta-minus model.

15. Verify atomic-number conservation for the supplied beta-minus model.

16. What change does the gamma card assign to the parent mass number and atomic number?

17. Why does nuclear notation not by itself give a decay probability or time scale?

18. Critique: "A balanced nuclear notation card is a radiation safety assessment or an experimental procedure."

19. Critique: “A nuclear model card proves a medical application or an energy-policy conclusion.”

20. Write a cautious CER statement using one conservation calculation and one decay-model pattern. Include a model/safety boundary.