

Nuclear Equations

GCSE Physics · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

Uranium-238 (atomic number 92) decays by emitting an alpha particle. Find the mass number and atomic number of the new nucleus. (2 marks)

Step 1 · Alpha particle

${}^4_2\text{He}$: mass number 4, atomic number 2

Step 2 · Mass number

$$238 - 4 = 234$$

Step 3 · Atomic number

$$92 - 2 = 90 \text{ (thorium)}$$

Answer: ${}^{234}_{90}\text{Th}$

Check: $238 = 234 + 4$ and $92 = 90 + 2$ ✓

2. Now try one with the steps

Complete the equation for the beta decay of carbon-14: ${}^{14}_6\text{C} \rightarrow ? + {}^0_{-1}\text{e}$ (2 marks)

Step 1 · Mass numbers must balance

Step 2 · Atomic numbers must balance

Step 3 · Identify

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. State how the mass number and atomic number of a nucleus change when it emits an alpha particle. [2]

2. State how the mass number and atomic number of a nucleus change when it emits a beta particle. [2]

3. State how gamma emission changes the mass and charge of a nucleus. [1]

4. Uranium-238 (atomic number 92) emits an alpha particle. State the mass number of the new nucleus. [1]
- _____
- _____
5. For the decay in question 4, state the atomic number of the new nucleus. [1]
- _____
- _____
6. Carbon-14 (atomic number 6) decays by beta emission. State the atomic number of the new nucleus. [1]
- _____
- _____
7. Write the symbol used for an alpha particle in a nuclear equation. [1]
- _____
- _____
8. Write the symbol used for a beta particle in a nuclear equation. [1]
- _____
- _____
9. Polonium-210 (atomic number 84) emits an alpha particle and becomes lead. State the mass number of the lead nucleus. [2]
- _____
- _____
10. Explain why beta decay increases the atomic number of a nucleus. [2]
- _____
- _____
11. Strontium-90 (atomic number 38) decays by beta emission to yttrium. Describe the yttrium nucleus. [2]
- _____
- _____
12. Radium-226 (atomic number 88) emits an alpha particle, and the new nucleus then emits another alpha particle. State the mass number of the final nucleus. [2]
- _____
- _____
13. A decay chain goes from uranium-238 to lead-206. Calculate the number of alpha decays in the chain. [2]
- _____
- _____

14. Explain why gamma rays are often emitted straight after an alpha or beta decay.

[2]

4. Before you hand it in

Beta decay: $^{14}_6\text{C} \rightarrow ^{14}_7\text{B} + ^0_{-1}\text{e}$

Balance the bottom numbers: $6 = Z + (-1)$, so $Z = 7$. Beta decay increases the atomic number.

Alpha decay: mass number down by 2

Alpha: mass number -4 , atomic number -2 .

Keeping the same element symbol after alpha or beta decay

Always look up the element with the new atomic number.

Writing gamma with a mass number of 1

Gamma: $^0_0\gamma$. Nothing changes except the energy.