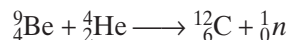


Nuclear Reactions

Unstable nuclei undergo spontaneous changes that change their number of protons and neutrons. In this process, they give off large amounts of energy and increase their stability. These changes are a type of nuclear reaction. A **nuclear reaction** is a reaction that affects the nucleus of an atom. In equations representing nuclear reactions, the total of the atomic numbers and the total of the mass numbers must be equal on both sides of the equation. An example is shown below.



Notice that when the atomic number changes, the identity of the element changes. A **transmutation** is a change in the identity of a nucleus as a result of a change in the number of its protons.

SAMPLE PROBLEM A

Identify the product that balances the following nuclear reaction: ${}^{212}_{84}\text{Po} \longrightarrow {}^4_2\text{He} + \underline{\hspace{1cm}}?$

SOLUTION

1. The total mass number and atomic number must be equal on both sides of the equation.

$$\begin{array}{lcl} {}^{212}_{84}\text{Po} \longrightarrow {}^4_2\text{He} + \underline{\hspace{1cm}}? & & \\ \text{mass number:} & 212 - 4 = 208 & \text{atomic number:} \quad 84 - 2 = 82 \end{array}$$

2. The nuclide has a mass number of 208 and an atomic number of 82, ${}^{208}_{82}\text{Pb}$.

3. The balanced nuclear equation is ${}^{212}_{84}\text{Po} \longrightarrow {}^4_2\text{He} + {}^{208}_{82}\text{Pb}$

PRACTICE

Answers in Appendix E

Using 1_0n to represent a neutron and ${}^0_{-1}e$ to represent an electron, complete the following nuclear equations:

- ${}^{253}_{99}\text{Es} + {}^4_2\text{He} \longrightarrow {}^1_0n + \underline{\hspace{1cm}}?$
- ${}^{142}_{61}\text{Pm} + \underline{\hspace{1cm}}? \longrightarrow {}^{142}_{60}\text{Nd}$

extension

Go to go.hrw.com for more practice problems that ask you to complete nuclear equations.



Keyword: HC6NUCX

SECTION REVIEW

- Define mass defect.
- How is nuclear stability related to the neutron-proton ratio?
- Complete and balance the following nuclear equations:
 - ${}^{187}_{75}\text{Re} + \underline{\hspace{1cm}}? \longrightarrow {}^{188}_{75}\text{Re} + {}^1_1\text{H}$

- ${}^9_4\text{Be} + {}^4_2\text{He} \longrightarrow \underline{\hspace{1cm}}? + {}^1_0n$
- ${}^{22}_{11}\text{Na} + \underline{\hspace{1cm}}? \longrightarrow {}^{22}_{10}\text{Ne}$

Critical Thinking

- INTERPRETING GRAPHICS** Examine **Figure 2**, and predict if ${}^9_3\text{Li}$ is a stable isotope of lithium. Explain your answer.