Name Date Block

Most nuclear reactions involve changes in the number of protons and/or neutrons in the nucleus of an atom. These changes are called transmutations because an atom of one element is changed into an atom of a different element. During these changes, nuclear particles may be absorbed and/or emitted along with a release of energy.

There are four types of nuclear reactions:

- natural radioactive decay: transmutations occur by natural radioactivity (the ability of a nucleus to emit a nuclear particle and energy without external stimulation);
- artificial transmutation: transmutations occur by nuclear disintegration caused by external stimulation as a scientist bombards a nucleus with a particle (the addition of another nuclear particle makes the nucleus unstable);
- fission: certain nuclei having a large mass are bombarded with special particles that cause the nuclei to split into two nuclei each having a smaller mass;
- fusion: nuclei of light elements are combined to form heavier nuclei.

Nuclear reactions are written using symbols in the "",X notation. The symbols for the major nuclear particles involved in nuclear reactions are given below.

Alpha particle	⁴ ₂ He (an alpha particle is a helium nucleus)
Proton	11H (the most common hydrogen nucleus is a proton)
Neutron	'on
Electron	°.,e or °.,β (also called a beta particle)
Positron	°ie or °iβ
Gamma ray	°oy

The table below contains information about nuclear reactions involving the emission of radiation.

NUCLEAR CHANGES

Type of Reaction	Radiation (Particle)	Effect on the Atomic Number	Effect on the Atomic Mass
Alpha emission (a)	⁴ ₂ He	decrease by 2	decrease by 4
Beta emission (B)	°.,e or °.,β	increase by I	no change
Positron emission (B*)	°ie or °iβ	decrease by I	no change
Gamma emission	°oY	no change	no change
Electron capture (EC)	°.1e or °.1β	decrease by I	no change

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United States. National Bureau of Standards

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 - The Rise of Digital Reading Nuclear Chemistry Packet Answers
 - Advantages of eBooks Over Traditional Books
- 2. Identifying Nuclear Chemistry Packet Answers
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
- 3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Nuclear Chemistry Packet Answers
 - User-Friendly Interface
- 4. Exploring eBook Recommendations from Nuclear Chemistry Packet Answers
 - Personalized Recommendations
 - Nuclear Chemistry Packet Answers User Reviews and Ratings
 - Nuclear Chemistry Packet Answers and Bestseller Lists
- 5. Accessing Nuclear Chemistry Packet Answers Free and Paid eBooks
 - Nuclear Chemistry Packet Answers Public Domain eBooks
 - Nuclear Chemistry Packet Answers eBook Subscription Services
 - Nuclear Chemistry Packet Answers Budget-Friendly Options
- 6. Navigating Nuclear Chemistry Packet Answers eBook Formats

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- Nuclear Chemistry Packet Answers Enhanced eBook Features
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 - Highlighting and Note-Taking Nuclear Chemistry Packet Answers
 - Interactive Elements Nuclear Chemistry Packet Answers
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 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Nuclear Chemistry Packet Answers
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 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Nuclear Chemistry Packet Answers
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Nuclear Chemistry Packet Answers
 - Setting Reading Goals Nuclear Chemistry Packet Answers
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Nuclear Chemistry Packet Answers
 - Fact-Checking eBook Content of Nuclear Chemistry Packet Answers
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
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