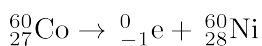


1. Which equation represents a transmutation reaction?

- A)  ${}_{92}^{239}\text{U} \rightarrow {}_{92}^{239}\text{U} + {}_0^0\gamma$   
B)  ${}_{6}^{14}\text{C} \rightarrow {}_{7}^{14}\text{N} + {}_{-1}^0\text{e}$   
C)  $\text{C}_3\text{H}_8 + 5 \text{O}_2 \rightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$   
D)  $n\text{C}_2\text{H}_4 \xrightarrow{\text{catalyst}} (-\text{C}_2\text{H}_4-)_n$

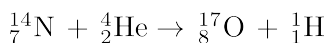
2. Given the nuclear reaction:



This reaction is an example of

- A) fission  
B) fusion  
C) artificial transmutation  
D) natural transmutation
3. Atoms of one element are converted to atoms of another element through
- A) fermentation      B) oxidation  
C) polymerization      D) transmutation

4. The reaction:



Is an example of

- A) a fission reaction  
B) a chain reaction  
C) an artificial transmutation  
D) a natural transmutation
5. Which balanced equation represents natural transmutation?
- A)  ${}_{4}^9\text{Be} + {}_{1}^1\text{H} \rightarrow {}_{3}^6\text{Li} + {}_{2}^4\text{He}$   
B)  ${}_{7}^{14}\text{N} + {}_{2}^4\text{He} \rightarrow {}_{8}^{17}\text{O} + {}_{1}^1\text{H}$   
C)  ${}_{94}^{239}\text{Pu} + {}_{0}^1\text{n} \rightarrow {}_{58}^{144}\text{Ce} + {}_{36}^{94}\text{Kr} + 2{}_{0}^1\text{n}$   
D)  ${}_{92}^{238}\text{U} \rightarrow {}_{90}^{234}\text{Th} + {}_{2}^4\text{He}$

6. Which reaction is an example of natural transmutation?

- A)  ${}_{94}^{239}\text{Pu} \rightarrow {}_{92}^{235}\text{U} + {}_{2}^4\text{He}$   
B)  ${}_{13}^{27}\text{Al} + {}_{2}^4\text{He} \rightarrow {}_{15}^{30}\text{P} + {}_{0}^1\text{n}$   
C)  ${}_{92}^{238}\text{U} + {}_{0}^1\text{n} \rightarrow {}_{94}^{239}\text{Pu} + 2 {}_{-1}^0\text{e}$   
D)  ${}_{94}^{239}\text{Pu} + {}_{0}^1\text{n} \rightarrow {}_{56}^{147}\text{Ba} + {}_{38}^{90}\text{Sr} + 3 {}_{0}^1\text{n}$

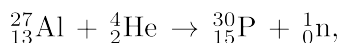
7. Which equation represents artificial transmutation?

- A)  ${}_{92}^{238}\text{U} \rightarrow {}_{90}^{234}\text{Th} + {}_{2}^4\text{He}$   
B)  ${}_{90}^{234}\text{Th} \rightarrow {}_{91}^{234}\text{Pa} + {}_{-1}^0\text{e}$   
C)  ${}_{84}^{218}\text{Po} \rightarrow {}_{82}^{214}\text{Pb} + {}_{2}^4\text{He}$   
D)  ${}_{4}^9\text{Be} + {}_{2}^4\text{He} \rightarrow {}_{6}^{12}\text{C} + {}_{0}^1\text{n}$

8. Which equation represents an artificial transmutation?

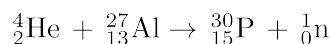
- A)  ${}_{7}^{16}\text{N} \rightarrow {}_{8}^{16}\text{O} + {}_{-1}^0\text{e}$   
B)  ${}_{7}^{14}\text{N} + {}_{2}^4\text{He} \rightarrow {}_{8}^{17}\text{O} + {}_{1}^1\text{H}$   
C)  ${}_{19}^{37}\text{K} \rightarrow {}_{18}^{37}\text{Ar} + {}_{+1}^0\text{e}$   
D)  ${}_{19}^{42}\text{K} \rightarrow {}_{20}^{42}\text{Ca} + {}_{+1}^0\text{e}$

9. The reaction:



Is an example of

- A) single replacement      B) analysis  
C) transmutation      D) synthesis
10. The nuclear reaction:



Is an example of

- A) nuclear fusion  
B) nuclear fission  
C) natural transmutation  
D) artificial transmutation
11. Which equation represents a nuclear reaction that is an example of artificial transmutation?

- A)  ${}_{21}^{43}\text{Sc} \rightarrow {}_{20}^{43}\text{Ca} + {}_{-1}^0\text{e}$   
B)  ${}_{7}^{14}\text{N} + {}_{2}^4\text{He} \rightarrow {}_{8}^{17}\text{O} + {}_{1}^1\text{H}$   
C)  ${}_{4}^{10}\text{Be} \rightarrow {}_{5}^{10}\text{B} + {}_{-1}^0\text{e}$   
D)  ${}_{6}^{14}\text{C} \rightarrow {}_{7}^{14}\text{N} + {}_{-1}^0\text{e}$

12. When  ${}_{88}^{226}\text{Ra}$  undergoes a natural transmutation reaction, it emits

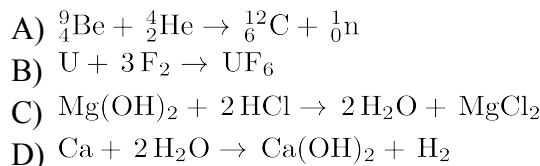
- A) an alpha particle      B) a beta particle  
C) a proton      D) a neutron

13. Which type of reaction converts one element to another element?

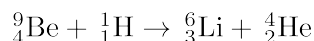
- A) neutralization      B) polymerization  
C) substitution      D) transmutation

14. Artificial transmutation is brought about by using accelerated particles to bombard an atom's
- A) nucleus
  - B) valence shells
  - C) occupied sublevels
  - D) inner principal energy levels
15. The change that is undergone by an atom of an element made radioactive by bombardment with high-energy protons is called
- A) natural transmutation
  - B) artificial transmutation
  - C) natural decay
  - D) radioactive decay
16. Which term represents a type of nuclear reaction?
- A) condensation
  - B) vaporization
  - C) single replacement
  - D) natural transmutation
17. The spontaneous decay of an atom is called
- A) ionization
  - B) crystallization
  - C) combustion
  - D) transmutation
18. Which process converts an atom from one element to another, when the nucleus of an atom is bombarded with high-energy particles?
- A) artificial transmutation
  - B) natural transmutation
  - C) addition polymerization
  - D) condensation polymerization
19. Which equation represents natural transmutation?
- A)  ${}^5_{10}\text{B} + {}^2_4\text{He} \rightarrow {}^7_{13}\text{N} + {}^1_0\text{n}$
  - B)  ${}^6_{14}\text{C} \rightarrow {}^7_{14}\text{N} + {}^0_{-1}\text{e}$
  - C)  $\text{S} + 2\text{e}^- \rightarrow \text{S}^{2-}$
  - D)  $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$
20. Radioactive cobalt-60 is used in radiation therapy treatment. Cobalt-60 undergoes beta decay. This type of nuclear reaction is called
- A) natural transmutation
  - B) artificial transmutation
  - C) nuclear fusion
  - D) nuclear fission

21. Which equation is an example of artificial transmutation?



22. Given the reaction:



Which type of reaction is represented?

- A) natural transmutation
  - B) artificial transmutation
  - C) fission
  - D) fusion
23. Bombarding a nucleus with high-energy particles that change it from one element into another is called
- A) a half-reaction
  - B) a breeder reaction
  - C) natural transmutation
  - D) artificial transmutation
24. Which nuclear equation represents a natural transmutation?
- A)  ${}^4_9\text{Be} + {}^1_1\text{H} \rightarrow {}^3_6\text{Li} + {}^2_4\text{He}$
  - B)  ${}^{27}_{13}\text{Al} + {}^4_2\text{He} \rightarrow {}^{30}_{15}\text{P} + {}^1_0\text{n}$
  - C)  ${}^{14}_7\text{N} + {}^4_2\text{He} \rightarrow {}^{17}_8\text{O} + {}^1_1\text{H}$
  - D)  ${}^{235}_{92}\text{U} \rightarrow {}^{231}_{90}\text{Th} + {}^4_2\text{He}$
25. Which equation represents a spontaneous transmutation?
- A)  $\text{Ca}(\text{s}) + 2\text{H}_2\text{O}(\ell) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{H}_2(\text{g})$
  - B)  $2\text{KClO}_3(\text{s}) \rightarrow 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g})$
  - C)  ${}^{239}_{94}\text{Pu} + 2{}^1_0\text{n} \rightarrow {}^{241}_{95}\text{Am} + {}^0_{-1}\text{e}$
  - D)  ${}^{37}_{20}\text{Ca} \rightarrow {}^{37}_{19}\text{K} + {}^0_{+1}\text{e}$