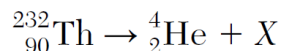


1. Given the equation representing a nuclear reaction in which  $X$  represents a nuclide:



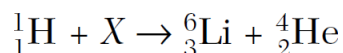
Which nuclide is represented by  $X$ ?

- A)  ${}_{92}^{236}\text{Ra}$       B)  ${}_{88}^{228}\text{Ra}$   
 C)  ${}_{92}^{236}\text{U}$       D)  ${}_{88}^{228}\text{U}$

2. Which nuclear emission has the greatest mass and the *least* penetrating power?

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

3. Given the nuclear equation:



The particle represented by  $X$  is

- A)  ${}_4^9\text{Li}$               B)  ${}_4^9\text{Be}$   
 C)  ${}_5^{10}\text{Be}$             D)  ${}_6^{10}\text{C}$

4. 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)  ${}_{94}^{239}\text{Pu} + {}_0^1\text{n} \rightarrow {}_{56}^{147}\text{Ba} + {}_{38}^{90}\text{Sr} + 3{}_0^1\text{n}$

5. Which of these types of nuclear radiation has the greatest penetrating power?

- A) alpha                  B) beta  
 C) neutron                D) gamma

6. A radioactive isotope has a half-life of 2.5 years. Which fraction of the original mass remains unchanged after 10. years?

- A) 1/2    B) 1/4    C) 1/8    D) 1/16

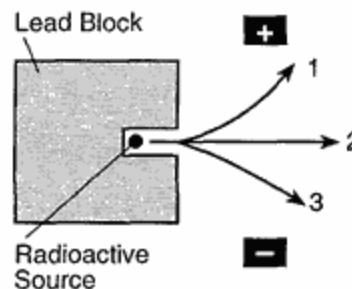
7. Positrons and beta particles have

- A) the same charge and the same mass  
 B) the same charge and different masses  
 C) different charges and the same mass  
 D) different charges and different masses

8. A beta particle may be spontaneously emitted from

- A) a ground-state electron  
 B) a stable nucleus  
 C) an excited electron  
 D) an unstable nucleus

9. The diagram below represents radiation passing through an electric field.



Which type of emanation is represented by the arrow labeled 2?

- A) alpha particle  
 B) beta particle  
 C) positron  
 D) gamma radiation

10. What fraction of a Sr-90 sample remains unchanged after 87.3 years?

- A)  $\frac{1}{2}$   
 B)  $\frac{1}{3}$   
 C)  $\frac{1}{4}$   
 D)  $\frac{1}{8}$

## Regents Chemistry

11. The dating of geological formations is an example of a beneficial use of

- A) isomers
- B) electrolytes
- C) organic compounds
- D) radioactive nuclides

12. Which radioisotopes have the same decay mode and have half-lives greater than 1 hour?

- A) Au-198 and N-16
- B) Ca-37 and Fe-53
- C) I-131 and P-32
- D) Tc-99 and U-233

13. What is the total number of grams of a 32-gram sample of  $^{32}\text{P}$  remaining after 71.5 days of decay?

- A) 1.0 g
- B) 2.0 g
- C) 8.0 g
- D) 4.0 g

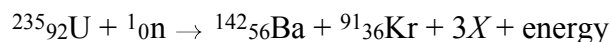
14. Which term represents a type of nuclear reaction?

- A) condensation
- B) vaporization
- C) single replacement
- D) natural transmutation

15. Which equation represents natural transmutation?

- A)  $^{10}_5\text{B} + ^4_2\text{He} \rightarrow ^{13}_7\text{N} + ^1_0\text{n}$
- B)  $^{14}_6\text{C} \rightarrow ^{14}_7\text{N} + ^0_{-1}\text{e}$
- C)  $\text{S} + 2\text{e}^- \rightarrow \text{S}^{2-}$
- D)  $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$

16. Given the balanced equation representing a nuclear reaction:



Which particle is represented by X?

- A)  $^0_{-1}\text{e}$
- B)  $^1_1\text{H}$
- C)  $^4_2\text{H}$
- D)  $^1_0\text{n}$

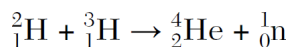
17. What occurs in both fusion and fission reactions?

- A) Small amounts of energy are converted into large amounts of matter.
- B) Small amounts of matter are converted into large amounts of energy.
- C) Heavy nuclei are split into lighter nuclei.
- D) Light nuclei are combined into heavier nuclei.

18. An uncontrolled chain reaction takes place during the

- A) operation of a fission nuclear reactor
- B) explosion of an atomic bomb
- C) production of energy by the Earth's Sun
- D) fusion of light nuclei into heavier nuclei

19. Given the balanced equation representing a nuclear reaction:



Which phrase identifies and describes this reaction?

- A) fission, mass converted to energy
- B) fission, energy converted to mass
- C) fusion, mass converted to energy
- D) fusion, energy converted to mass

20. Which balanced equation represents nuclear fusion?

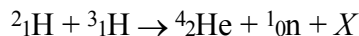
- A)  $^1_0\text{n} + ^{235}_{92}\text{U} \rightarrow ^{142}_{56}\text{Ba} + ^{91}_{36}\text{Kr} + 3^1_0\text{n}$
- B)  $^{226}_{88}\text{Ra} \rightarrow ^{222}_{86}\text{Rn} + ^4_2\text{He}$
- C)  $^6_3\text{Li} + ^1_0\text{n} \rightarrow ^3_1\text{H} + ^4_2\text{He}$
- D)  $^2_1\text{H} + ^3_1\text{H} \rightarrow ^4_2\text{He} + ^1_0\text{n}$

21. Which element is used for dating archaeological discoveries?

- A) carbon-12
- B) carbon-13
- C) carbon-14
- D) carbon-15

## Regents Chemistry

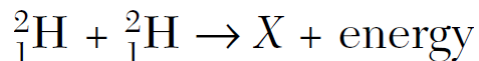
22. In the fusion reaction:



The  $X$  represents

- A) a released electron
- B) another neutron
- C) energy converted from mass
- D) mass converted from energy

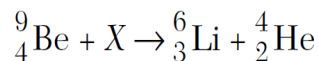
23. Given the fusion reaction:



Which particle is represented by  $X$ ?

- A)  ${}^1_1\text{H}$
- B)  ${}^3_1\text{H}$
- C)  ${}^3_2\text{He}$
- D)  ${}^4_2\text{He}$

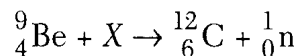
24. In the reaction:



The  $X$  represents

- A)  ${}^0_{+1}\text{e}$
- B)  ${}^1_1\text{H}$
- C)  ${}^0_{-1}\text{e}$
- D)  ${}^1_0\text{n}$

25. Given the nuclear reaction:



What is the identity of particle  $X$ ?

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

26. Which isotope is used to treat cancer?

- A) C-14
- B) U-238
- C) Co-60
- D) Pb-206

27. Which radioisotope is used to treat thyroid disorders?

- A) Co-60
- B) I-131
- C) C-14
- D) U-238

28. A serious risk factor associated with the operation of a nuclear power plant is the production of

- A) acid rain
- B) helium gas
- C) greenhouse gases, such as  $\text{CO}_2$
- D) radioisotopes with long half-lives

29. Which risk is associated with using nuclear fission to produce energy in a power plant?

- A) depletion of hydrocarbons
- B) depletion of atmospheric oxygen
- C) exposure of workers to radiation
- D) exposure of workers to sulfur dioxide

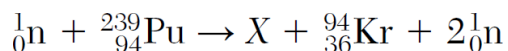
## Regents Chemistry

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- \_\_\_\_\_ 30. Base your answer to the following question on the information below and on your knowledge of chemistry.

A breeder reactor is one type of nuclear reactor. In a breeder reactor, uranium-238 is transformed in a series of nuclear reactions into plutonium-239.

The plutonium-239 can undergo fission as shown in the equation below. The  $X$  represents a missing product in the equation.

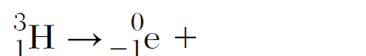


Write a notation for the nuclide represented by missing product  $X$  in this equation.

Base your answers to questions **31** and **32** on the information below and on your knowledge of chemistry.

Illuminated **EXIT** signs are used in public buildings such as schools. If the word **EXIT** is green, the sign may contain the radioisotope tritium, hydrogen-3. The tritium is a gas sealed in glass tubes. The emissions from the decay of the tritium gas cause a coating on the inside of the tubes to glow.

- \_\_\_\_\_ 31. Complete the nuclear equation for the radioactive decay of tritium, by writing a notation for the missing product.



- \_\_\_\_\_ 32. Determine the fraction of an original sample of tritium that remains unchanged after 24.62 years.
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