1. Given the equation representing a nuclear reaction in which \( X \) represents a nuclide:

\[
\frac{232}{90} \text{Th} \rightarrow \frac{4}{2} \text{He} + X
\]

Which nuclide is represented by \( X \)?

1) \( \frac{236}{92} \text{Ra} \)  
2) \( \frac{238}{88} \text{Ra} \)  
3) \( \frac{236}{92} \text{U} \)  
4) \( \frac{228}{88} \text{U} \)

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

1) an alpha particle  
2) a beta particle  
3) a neutron  
4) a positron

3. Which list of nuclear emissions is arranged in order from the least penetrating power to the greatest penetrating power?

1) alpha particle, beta particle, gamma ray  
2) alpha particle, gamma ray, beta particle  
3) gamma ray, beta particle, alpha particle  
4) beta particle, alpha particle, gamma ray

4. What is the mass number of an alpha particle?

1) 1  
2) 2  
3) 0  
4) 4

5. Given the nuclear equation:

\[
\frac{1}{1} \text{H} + X \rightarrow \frac{6}{3} \text{Li} + \frac{4}{2} \text{He}
\]

The particle represented by \( X \) is

1) \( \frac{4}{3} \text{Li} \)  
2) \( \frac{9}{4} \text{Be} \)  
3) \( \frac{10}{5} \text{Be} \)  
4) \( \frac{10}{6} \text{C} \)

6. Which nuclear emission is negatively charged?

1) an alpha particle  
2) a beta particle  
3) a neutron  
4) a positron

7. Positrons and beta particles have

1) the same charge and the same mass  
2) the same charge and different masses  
3) different charges and the same mass  
4) different charges and different masses

8. Which statement describes the relative masses of two different particles?

1) A neutron has less mass than a positron.  
2) A beta particle has less mass than a neutron.  
3) An alpha particle has less mass than a positron.  
4) An alpha particle has less mass than a beta particle.

9. Which particle has the least mass?

1) alpha particle  
2) beta particle  
3) neutron  
4) proton

10. A beta particle may be spontaneously emitted from

1) a ground-state electron  
2) a stable nucleus  
3) an excited electron  
4) an unstable nucleus

11. Given the nuclear equation:

\[
\frac{19}{10} \text{Ne} \rightarrow X + \frac{19}{9} \text{F}
\]

What particle is represented by \( X \)?

1) alpha  
2) beta  
3) neutron  
4) positron

12. Given the nuclear reaction:

\[
\frac{60}{27} \text{Co} \rightarrow 0 \_1 \text{e} + \frac{60}{28} \text{Ni}
\]

This reaction is an example of

1) fission  
2) fusion  
3) artificial transmutation  
4) natural transmutation
13. The diagram below represents radioactive emanations passing through an electric field.

Which type of emanation is represented by the arrow labeled 1?

1) alpha particle  
2) beta particle  
3) positron  
4) gamma ray

14. A carbon-14 atom spontaneously decayed to form a nitrogen-14 atom. This change took place because

1) a transmutation occurred without particle emission  
2) a transmutation occurred with particle emission  
3) nitrogen-14 has an unstable nucleus  
4) carbon-14 has a stable nucleus

15. Which nuclear emission has no charge and no mass?

1) alpha particle  
2) beta particle  
3) gamma ray  
4) positron

16. Which nuclear emission has the greatest penetrating power?

1) proton  
2) beta particle  
3) gamma radiation  
4) positron

17. Which statement best describes gamma radiation?

1) It has a mass of 1 and a charge of 1.  
2) It has a mass of 0 and a charge of –1.  
3) It has a mass of 0 and a charge of 0.  
4) It has a mass of 4 and a charge of +2.

18. What occurs in both fusion and fission reactions?

1) Small amounts of energy are converted into large amounts of matter.  
2) Small amounts of matter are converted into large amounts of energy.  
3) Heavy nuclei are split into lighter nuclei.  
4) Light nuclei are combined into heavier nuclei.

19. Which term identifies a type of nuclear reaction?

1) fermentation  
2) deposition  
3) reduction  
4) fission

20. Given the balanced equation representing a nuclear reaction:

\[ ^{235}_{92}U + ^{1}_0n \rightarrow ^{142}_{56}Ba + ^{91}_{36}Kr + 3X + \text{energy} \]

Which particle is represented by \( X \)?

1) \(^{0}_{-1}e\)  
2) \(^{1}_{1}H\)  
3) \(^{4}_{2}H\)  
4) \(^{1}_{0}n\)

21. Given the diagram representing a reaction:

Which phrase best describes this type of reaction and the overall energy change that occurs?

1) nuclear, and energy is released  
2) nuclear, and energy is absorbed  
3) chemical, and energy is released  
4) chemical, and energy is absorbed
22. Which statement best describes what happens in a fission reaction?

1) **Heavy nuclei split into lighter nuclei.**
2) Light nuclei form into heavier nuclei.
3) Energy is released and less stable elements are formed.
4) Energy is absorbed and more stable elements are formed.

23. The diagram below represents a nuclear reaction in which a neutron bombards a heavy nucleus.

![Diagram of nuclear reaction]

Which type of reaction does the diagram illustrate?

1) **fission**  2) **fusion**  
3) alpha decay  4) beta decay

24. Given the diagram representing a reaction:

![Diagram of nuclear reaction]

Which type of change is represented?

1) **fission**  2) **fusion**  
3) deposition  4) evaporation

25. Which balanced equation represents nuclear fusion?

1) \( \frac{3}{2} \text{H} + \frac{3}{2} \text{H} \rightarrow \frac{3}{2} \text{He} \)
2) \( 2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O} \)
3) \( \frac{6}{3} \text{Li} + \frac{1}{0} \text{n} \rightarrow \frac{3}{2} \text{H} + \frac{3}{2} \text{He} \)
4) \( \text{CaO} + \text{CO}_2 \rightarrow \text{CaCO}_2 \)

26. Given the balanced equation representing a nuclear reaction:

\( ^2\text{H} + ^3\text{H} \rightarrow ^4\text{He} + ^1\text{n} \)

Which phrase identifies and describes this reaction?

1) fission, mass converted to energy
2) fission, energy converted to mass
3) **fusion, mass converted to energy**
4) fusion, energy converted to mass

27. In which type of reaction do two lighter nuclei combine to form one heavier nucleus?

1) combustion  2) reduction  
3) nuclear fission  4) **nuclear fusion**
28. Which equation represents a fusion reaction?

1) \( H_2O(g) \rightarrow H_2O(\ell) \)
2) \( C(s) + O_2(g) \rightarrow CO_2(g) \)
3) \( \frac{2}{1}H + \frac{3}{1}H \rightarrow \frac{4}{2}He + \frac{1}{0}n \)
4) \( \frac{235}{92}U + \frac{1}{0}n \rightarrow \frac{142}{56}Ba + \frac{91}{36}Kr + 3 \frac{1}{0}n \)

29. Which equation represents a fusion reaction?

1) \( \frac{2}{1}H + \frac{3}{1}H \rightarrow \frac{4}{2}He \)
2) \( \frac{14}{6}C \rightarrow \frac{0}{-1}e + \frac{14}{7}N \)
3) \( \frac{238}{92}U + \frac{2}{3}He \rightarrow \frac{241}{94}Pu + \frac{1}{0}n \)
4) \( \frac{1}{0}n + \frac{27}{13}Al \rightarrow \frac{24}{11}Na + \frac{4}{2}He \)

30. Given the balanced equation representing a reaction:

\( \frac{27}{13}Al + \frac{4}{2}He \rightarrow \frac{30}{15}P + \frac{1}{0}n \)

Which type of reaction is represented by this equation?

1) combustion  2) decomposition  3) saponification  4) transmutation
1. 2
2. 1
3. 1
4. 4
5. 2
6. 2
7. 3
8. 2
9. 2
10. 4
11. 4
12. 4
13. 2
14. 2
15. 3
16. 3
17. 3
18. 2
19. 4
20. 4
21. 1
22. 1
23. 1
24. 1
25. 1
26. 3
27. 4
28. 3
29. 1
30. 4