

Nuclear Chemistry Regents Review

- An alpha particle has the same composition as a
 - hydrogen nucleus
 - beryllium nucleus
 - deuterium nucleus
 - helium nucleus
- Which equation represents alpha decay?
 - $^{118}\text{In} \rightarrow ^{118}\text{Sn} + X$
 - $^{234}\text{Th} \rightarrow ^{234}\text{Pa} + X$
 - $^{238}\text{U} \rightarrow ^{234}\text{Th} + X$
 - $^{226}\text{Ra} \rightarrow ^{222}\text{Rn} + X$
- Which of the following particles has the greatest mass?
 - an alpha particle
 - a proton
 - a beta particle
 - an electron
- Which radioactive emanations have a charge of $2+$?
 - alpha particles
 - beta particles
 - gamma rays
 - neutrons
- As an atom of a radioactive isotope emits an alpha particle, the mass number of the atom
 - decreases
 - increases
 - remains the same
 - decreases
- Which particle has a negative charge?
 - lithium ion
 - an aluminum ion
 - an alpha particle
 - a beta particle
- An electron has a charge identical to that of
 - a neutron
 - a proton
 - an alpha particle
 - a beta particle
- Given the reaction:

$$^{238}\text{U} \rightarrow ^{234}\text{Th} + ^4_2\text{He}$$
 This reaction is best described as
 - alpha decay
 - beta decay
 - fission
 - fusion
- As a radioactive element emits gamma radiation only, the atomic number of the element
 - decreases
 - increases
 - remains the same
 - decreases
- A number of emanations from radioactive atoms is passed through electrically charged plates, as shown in the diagram below.

The nuclear emanations 1, 2, and 3 are called, respectively,
 1) alpha, beta, and gamma 3) gamma, alpha, and beta
 2) beta, gamma, and alpha 4) gamma, beta, and alpha

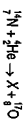
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- The diagram below represents radiation passing through an electric field.
- The diagram below represents radiation passing through an electric field.
- Which type of emanation is represented by the arrow labeled 2?
 - alpha particle
 - beta particle
 - positron
 - gamma radiation
- What is the number of hours required for potassium-42 to undergo 3 half-life periods?
 - 6.2 hours
 - 12.4 hours
 - 24.8 hours
 - 37.2 hours
- An original sample of a radioisotope had a mass of 10 grams. After 2 days, 5 grams of the radioisotope remains unchanged. What is the half-life of this radioisotope?
 - 1 day
 - 2 days
 - 5 days
 - 4 days
- A radioactive element has a half-life of 2 days. Which fraction represents the amount of an original sample of this element remaining after 6 days?
 - $\frac{1}{8}$
 - $\frac{1}{2}$
 - $\frac{1}{3}$
 - $\frac{1}{4}$
- Which of the following radioisotopes has the shortest half-life?
 - ^{14}C
 - ^3H
 - ^{37}K
 - ^{26}P
- In the reaction:

$$X + ^1_1\text{H} \rightarrow ^3_1\text{H} + ^4_2\text{He}$$
 The nucleus represented by X is
 - ^3_1H
 - ^2_1H
 - ^4_2He
 - ^6_3C
- In the reaction:

$$^3_1\text{H} + ^1_0\text{n} \rightarrow ^4_2\text{He} + X$$
 The species represented by X is
 - ^1_1H
 - ^2_1H
 - ^3_1H
 - ^4_2He
- Which equation represents artificial transmutation?
 - $\text{H}_2\text{O} \rightarrow \text{H}^+ + \text{OH}^-$
 - $\text{UF}_6 + 6\text{Na} \rightarrow 6\text{NaF} + \text{U}$
 - $^{235}\text{U} \rightarrow ^{234}\text{Th} + ^4_2\text{He}$
 - $^{24}\text{Al} + ^4_2\text{He} \rightarrow ^{27}\text{P} + ^1_0\text{n}$

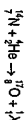
19. Given the equation:



When the equation is correctly balanced, the particle represented by the X will be

- ^0_0e
- ^1_0n
- ^1_1H
- ^2_1H

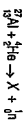
20. In the reaction:



The X represents a

- triton
- deuteron
- proton
- neutron

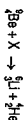
21. Aluminum-27 is bombarded with alpha particles according to the following nuclear equation:



The radioactive element represented by X is an isotope of

- zinc
- phosphorus
- sulfur
- sodium

22. Given the nuclear reaction:



Which particle is represented by X?

- ^1_1H
- ^2_1H
- ^3_1H
- ^4_2He

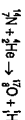
23. In the reaction below



X represents

- an alpha particle
- a beta particle
- a proton
- a triton

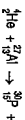
24. The reaction:



is an example of

- a fission reaction
- a chain reaction
- an artificial transmutation
- a natural transmutation

25. The nuclear reaction:



is an example of

- nuclear fusion
- nuclear fission
- natural transmutation
- artificial transmutation

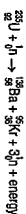
26. Which equation is an example of artificial transmutation?

- $^{235}\text{U} \rightarrow ^{234}\text{Th} + ^4_2\text{He}$
- $^{27}\text{Al} + ^4_2\text{He} \rightarrow ^{28}\text{Si} + ^1_0\text{n}$
- $^{14}\text{C} \rightarrow ^{14}\text{N} + ^0_{-1}\text{e}$
- $^{226}\text{Ra} \rightarrow ^{222}\text{Rn} + ^4_2\text{He}$

27. When a uranium nucleus breaks up into fragments, which type of nuclear reaction occurs?

- fusion
- fission
- replacement
- redox

28. Given the nuclear reaction:



This equation can best be described as

- natural decay
- fission
- fusion
- endothermic

29. When a nucleus with a high mass undergoes fission, the resulting nuclei are more stable than the original nucleus because they have a

- higher binding energy per nucleon
- lower binding energy per nucleon
- higher number of electrons
- lower number of electrons

30. What is the primary result of a fission reaction?

- conversion of mass to energy
- conversion of energy to mass
- binding together of two heavy nuclei
- binding together of two light nuclei

31. Which nuclear equation represents a fusion reaction?

- $^{235}\text{U} + ^1_0\text{n} \rightarrow ^{141}\text{Ba} + ^{92}\text{Kr} + 3^1_0\text{n}$
- $^{235}\text{U} + ^1_0\text{n} \rightarrow ^{141}\text{Ba} + ^{92}\text{Kr} + 3^1_0\text{n}$
- $^1_1\text{H} + ^1_1\text{H} \rightarrow ^2_2\text{He}$
- $^1_1\text{H} + ^1_1\text{H} \rightarrow ^2_2\text{He}$

32. The fusion of hydrogen nuclei with the release of energy can be initiated by a fission reaction because the fission reaction provides a

- high temperature and high pressure
- high temperature and low pressure
- good supply of hydrogen nuclei
- good supply of neutrons

33. Which conditions are required to form ^2_2He during the fusion reaction in the Sun?

- high temperature and low pressure
- high temperature and high pressure
- low temperature and low pressure
- low temperature and high pressure

34. For a given mass of reactants, the energy released is greatest for a reaction involving

- slow oxidation
- rapid oxidation
- fission
- fusion

35. Compared to a nuclear reaction, a chemical reaction differs in that the energy produced by a chemical reaction results primarily from

- a conversion of some of the reactant's mass
- a loss of potential energy by the reactants
- the fusion of two nuclei
- the fission of a nucleus

36. The energy released in a fusion reaction comes from

- a conversion of some of the reactant's mass
- the formation of chemical bonds by the reactants
- the loss of kinetic energy of the reactants
- the splitting of a nucleus

37. According to Table N, which radioactive waste can be stored for decay and then safely released directly into the environment?

- N-16
- Sr-90
- Cs-137
- Pu-239

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38. Which type of reaction produces energy and intensely radioactive waste products?
 1) fusion of lithium and deuterium 3) burning of heating oil
 2) fission of uranium 4) burning of wood
39. Referring to Table N, which substance is a radioactive waste product that is safest to release into the atmosphere after it has decayed to a safe radiation level?
 1) radon-222 3) cesium-137
 2) radium-226 4) cobalt-60
40. A radioactive dating procedure to determine the age of a mineral compares the mineral's remaining amounts of isotope ^{235}U and isotope
 1) ^{232}Th 3) ^{238}U
 2) ^{238}Pu 4) ^{214}Bi
41. Which element is used for dating archaeological discoveries?
 1) carbon-12 3) carbon-14
 2) carbon-13 4) carbon-15
42. Which procedure is based on the half-life of a radioisotope?
 1) accelerating to increase kinetic energy
 2) radiating to kill cancer cells
 3) counting to determine a level of radioactivity
 4) dating to determine age
43. Which radioactive isotope is used in geological dating?
 1) uranium-238 3) cobalt-60
 2) iodine-131 4) technetium-99
44. Which isotopic ratio needs to be determined when the age of ancient wooden objects is investigated?
 1) uranium-235 to uranium-238 3) nitrogen-15 to nitrogen-14
 2) hydrogen-2 to hydrogen-3 4) carbon-14 to carbon-12
45. The radioactive isotope carbon-14 can be used for
 1) determining the age of a sample 3) controlling fission reactions
 2) determining medical disorders 4) controlling speeds of neutrons
46. Which isotope is most commonly used in the radioactive dating of the remains of organic materials?
 1) ^1H 3) ^{32}P
 2) ^{14}N 4) ^{37}K
47. The decay of which radioisotope can be used to estimate the age of the fossilized remains of an insect?
 1) Rn-222 3) C-60
 2) I-131 4) C-14
48. Iodine-131 is used for diagnosing thyroid disorders because it is absorbed by the thyroid gland and
 1) has a very short half-life 3) emits alpha radiation
 2) has a very long half-life 4) emits gamma radiation
49. A radioisotope which is sometimes used by doctors to pinpoint a brain tumor is
 1) carbon-12 3) technetium-99
 2) lead-206 4) uranium-238
50. Radiation used in the processing of food is intended to
 1) increase the rate of nutrient decomposition
 2) kill microorganisms that are found in the food
 3) convert ordinary nutrients to more stable forms
 4) replace chemical energy with nuclear energy

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51. Which radioisotope is used to diagnose thyroid disorders?
 1) lead-206 3) cobalt-60
 2) iodine-131 4) strontium-90
52. A radioisotope is called a tracer when it is used to
 1) kill bacteria in food
 2) kill cancerous tissue
 3) determine the age of animal skeletal remains
 4) determine the way in which a chemical reaction occurs
53. Radioisotopes used for medical diagnosis must have
 1) long half-lives and be quickly eliminated by the body
 2) long half-lives and be slowly eliminated by the body
 3) short half-lives and be quickly eliminated by the body
 4) short half-lives and be slowly eliminated by the body
54. The radioisotope I-131 is used to
 1) control nuclear reactors 3) diagnose thyroid disorders
 2) determine the age of fossils 4) trigger fission reactors
55. The course of a chemical reaction can be traced by using a
 1) polar molecule 3) stable isotope
 2) diatomic molecule 4) radioisotope

56. Base your answers to the following questions on the information below.

Freon was once used as a refrigerant but because it aids in the destruction of ozone (O_3) in our atmosphere it is now being phased out. It was being used as a refrigerant to cool the inside of the refrigerator according to the reverse process shown below.



- a) Which reaction above, the forward or the reverse, would be used to absorb heat and thus cool the food in the refrigerator?
 b) Explain why you chose the forward or reverse reaction above.
 c) Ozone is an allotrope of the element oxygen. What is meant by the term "allotrope"?

57. Base your answers to the following questions on the information below.

The energy released when a radioisotope decays can disrupt a cell's activity and even kill it. That is why the isotope, Co-60, is introduced into humans in the form of radiation treatment and is used to kill cancer cells.

- a) Referring to your Reference Tables, write the nuclear equation for the decay of Co-60.
 b) Base your answers to the following questions on the information below.

Uranium-238, a solid, is a naturally radioactive element found in the earth's crust. As it decays one of the products is radon-222 which is a gas and is very radioactive.

- a) Write the equation for the decay of Rn-222.
 b) The half-life of Radon-222 is 3.82 days. How many grams of a 1.0 gram sample of Rn-222 would remain after 7.64 days?

58. Base your answers to the following questions on the information below.

Nuclear weapons were tested in the atmosphere until a treaty banning this procedure was signed in 1963. The explosion of these fission reaction devices produced radioactive wastes which still contaminate our environment today. One of the radioactive isotopes produced by these explosions was strontium-90, a group 2 element. Strontium-90 can be ingested by humans and absorbed into their skeletal system. Absorbed inside, it can undergo beta decay and produce harmful effects.

- a) Write the nuclear equation for the decay of strontium-90.
 b) Calcium is a major component of bone tissue. Using your knowledge of the relationships of elements within the Periodic Table, explain why radioactive strontium-90 might be found substituting for calcium in bone tissue.
 c) State one possible advantage of using nuclear power instead of burning fossil fuels.
 d) State one possible risk of using nuclear power.
 e) If animals feed on plants that have taken up Sr-90, the Sr-90 can find its way into their bone structure. Explain one danger to the animals.

59. a) $^{90}\text{Sr} \rightarrow ^{90}\text{Zr} + ^0_{-1}\text{e}$
 b) Strontium-90 is in the same family as calcium and therefore reacts as calcium does.
 c) Examples: -less air pollution -low cost -conservation of fossil fuels -more energy produced
 d) Examples: -nuclear meltdown -biological risks (cancer, mutations) -contamination of the environment -radiation exposure -lack of storage facilities for spent fuel rods -radiation emitted
 e) Examples: -Sr-90 is radioactive and might cause tissue damage to the animal. -Sr-90 emits beta particles. -Bones become radioactive.

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

31. 4
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 33. 2
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 38. 2
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 40. 1
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 42. 4
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 44. 4
 45. 1
 46. 1
 47. 4
 48. 1
 49. 3
 50. 2
 51. 2
 52. 4
 53. 3
 54. 3
 55. 4