

Workshuats

Review Quest.

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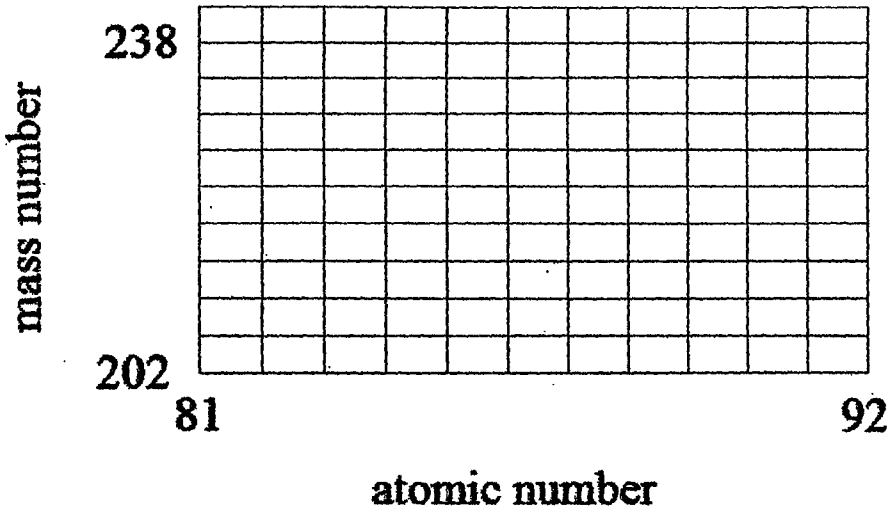
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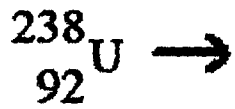
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WS Decay Series of U-238

1. Complete the table using the decay series of U-238



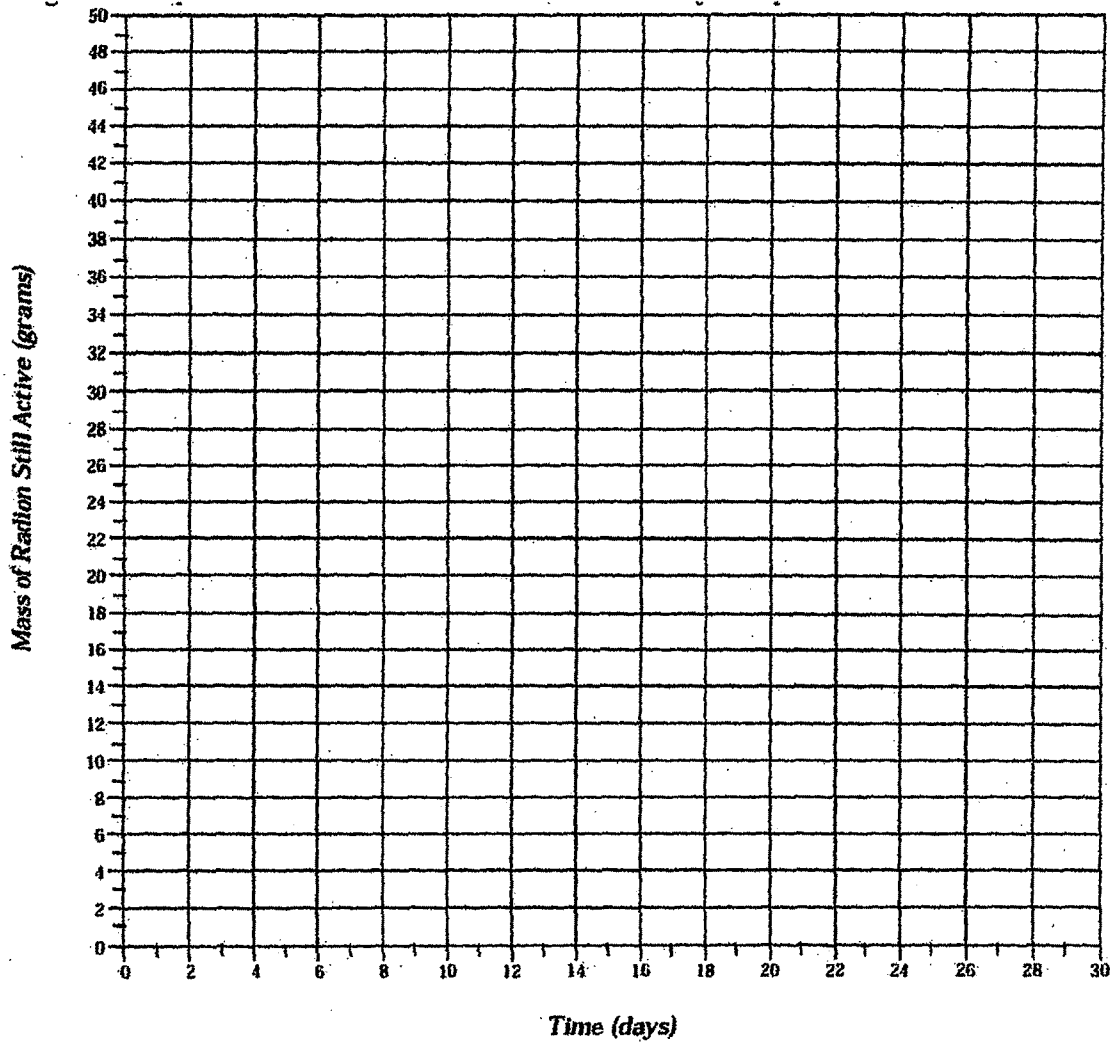
2. Complete the reactions and mark the graph above with the nuclide that is formed.



Name _____

WS Half-life 2

The Half-Life of Radon-226 is approximately 4 days. On the grid below, plot the amount of Radon-226 left after each 4 day time period when you start with a 48g sample of Radon-226



Questions

1. How many grams of radon would be present after 4 days?
2. How many grams of radon would be present after 12 days?
3. How many grams of radon would be present after 24 days?
4. If 8 g of radon are left, what is the time elapsed?
5. How many grams of radon would be present after 6 days?

Name _____

HALF-LIFE WORKSHEET

***Use Reference Table N of the N. Y.S. Chemistry Regents Reference Tables to assist you in answering the following questions.

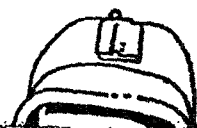
- 1 How long does it take a 100.00g sample of Au-198 to decay to 6.25g?
2. How many half-lives will pass by the time a 60.0g sample of Co-60 decays to 7.5g?
3. How long does it take a 180g sample of Au-198 to decay to 1/8 its original mass?
4. What fraction of a sample of N-16 remains undecayed after 42.78 seconds?
5. What is the half-life of a radioactive isotope if a 500.0g sample decays to 62.5g in 24.3 hours?
6. How old is a bone if it presently contains 0.3125g of C-14, but it was estimated to have originally contained 80.000g of C-14?
7. If you are injected with 1.0000 mg of Tc-99, how long will it take for the sample to decay to 1/64 of its original mass?
8. What is the half-life of a radioactive isotope if it takes 6.2 days for a 72g sample to decay to 18g?
9. Cs-137 is produced as a waste product in nuclear fission reactors. What fraction remains undecayed after 241.60 years?
10. How many half-lives of K-37 will pass after 6.15 seconds?
11. What fraction of Pu-239 (an artificially produced isotope used as a fuel in some nuclear fission reactors) remains undecayed after 219,600 years?
12. If a 700.00g sample of I-131 decays to 43.75g, how much time has passed?
13. How long will it take a 3.5g sample of Fr-220 to decay so that only 1/4 of the original amount of Fr-220 remains?
14. What is the half-life of a radioisotope if 1/16 of it remains undecayed after 26.4 days?
15. H-3 (tritium) is an artificially produce radioisotope used in some nuclear reactions. How much of a 1.000 kg sample remains undecayed after 86.17 years?
16. If a radioactive sample of a pure material decays from 600g to 75g in 42.84 days, what radioisotope could be in the sample?

NUCLEAR DECAY

Name _____

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R

Predict the products of the following nuclear reactions.



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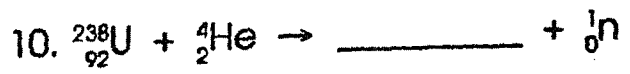
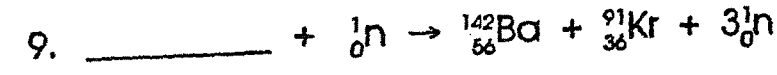
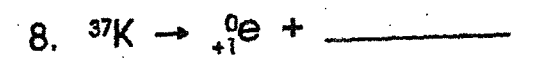
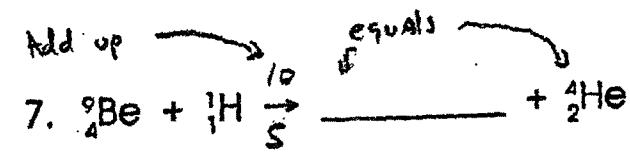
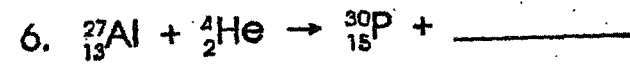
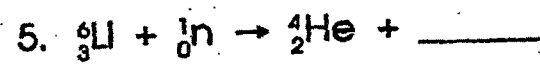
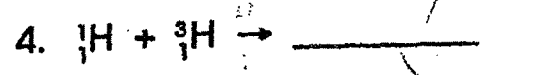
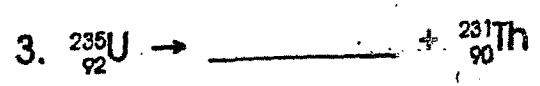
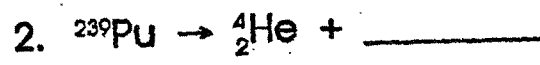
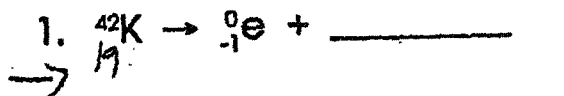
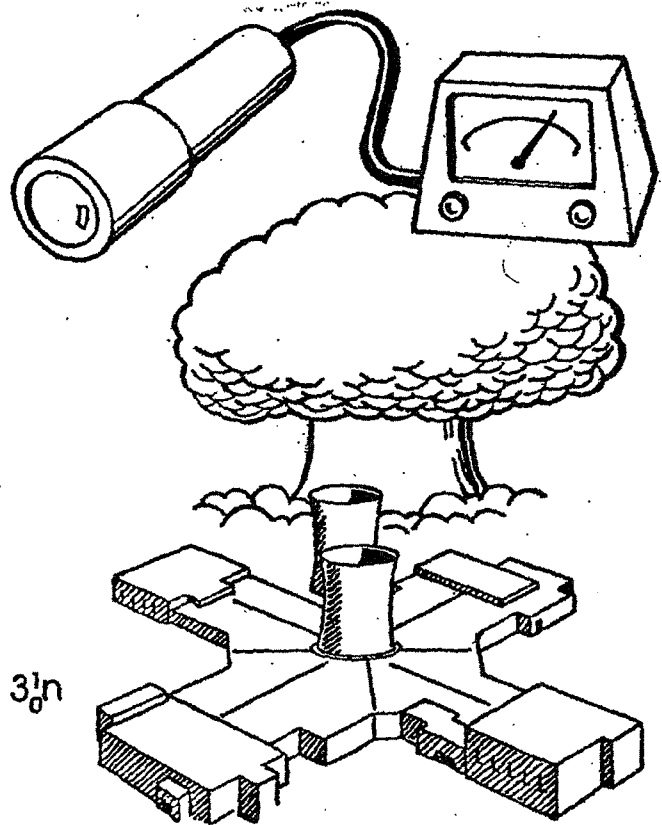


Table O
Symbols Used in Nuclear Chemistry

Name	Notation	Symbol
alpha particle	${}_2^4\text{He}$ or ${}_2^4\alpha$	α
beta particle (electron)	${}_{-1}^0\text{e}$ or ${}_{-1}^0\beta$	β^-
gamma radiation	${}^0_0\gamma$	γ
neutron	${}_0^1\text{n}$	n
proton	${}_1^1\text{H}$ or ${}_1^1\text{p}$	p
positron	${}_{+1}^0\text{e}$ or ${}_{+1}^0\beta$	β^+



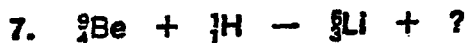
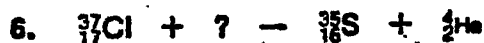
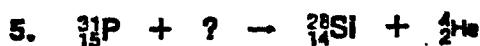
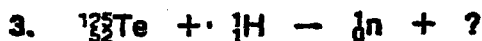
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Nuclear Equations

Practice Problems (Level 1)

Balance each of the nuclear equations shown below by determining the missing particle in each case.



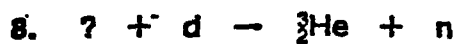
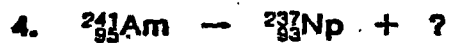
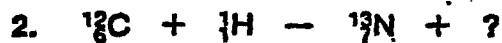
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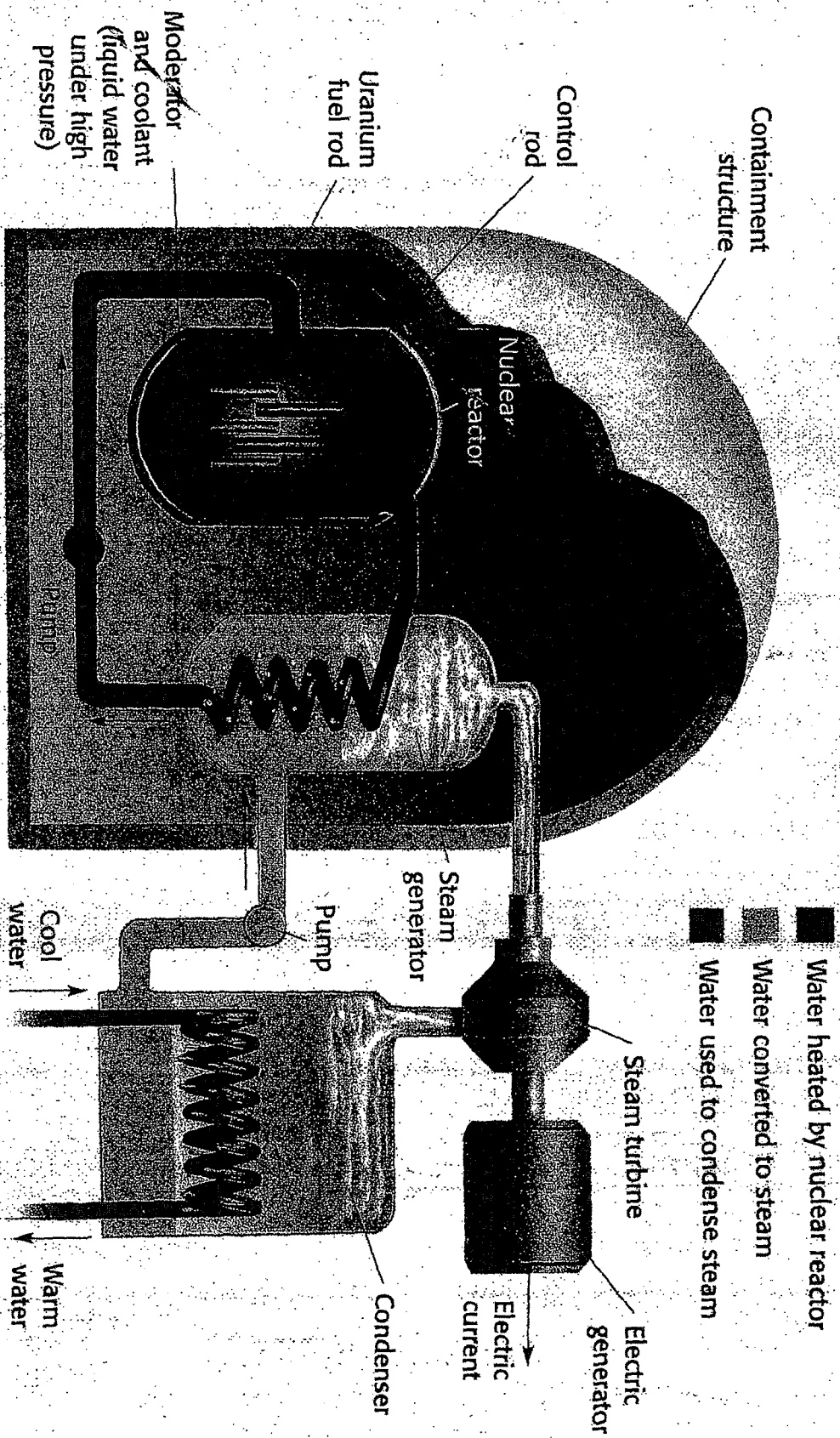
Nuclear Equations

Practice Problems (Level 2)

Balance each of the nuclear equations shown below by determining the missing particle in each case.



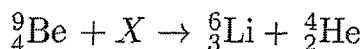
Model of a Pressurized, Light-Water Nuclear Reactor



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. In the reaction:



The X represents

- A) ${}_{+1}^0\text{e}$ B) ${}_{1}^1\text{H}$ C) ${}_{-1}^0\text{e}$ D) ${}_{0}^1\text{n}$
3. Which conditions are required to form ${}_{2}^4\text{He}$ during the fusion reaction in the Sun?
- A) high temperature and low pressure
B) high temperature and high pressure
C) low temperature and low pressure
D) low temperature and high pressure
4. Which nuclide is paired with a specific use of that nuclide?

- A) carbon-14, treatment of cancer
B) cobalt-60, dating of rock formations
C) iodine-131, treatment of thyroid disorders
D) uranium-238, dating of once-living organisms

5. Which equation represents natural transmutation?

- A) ${}_{5}^{10}\text{B} + {}_{2}^4\text{He} \rightarrow {}_{7}^{13}\text{N} + {}_{0}^1\text{n}$
B) ${}_{6}^{14}\text{C} \rightarrow {}_{7}^{14}\text{N} + {}_{-1}^0\text{e}$
C) $\text{S} + 2\text{e}^- \rightarrow \text{S}^{2-}$
D) $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$

6. An original sample of the radioisotope fluorine-21 had a mass of 80.0 milligrams. Only 20.0 milligrams of this original sample remain unchanged after 8.32 seconds. What is the half-life of fluorine-21?

- A) 1.04s B) 2.08s C) 4.16s D) 8.3s

7. A nuclear reaction in which two light nuclei combine to form a more massive nucleus is called

- A) addition B) fission
C) fusion D) substitution

8. 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) ${}_{13}^{27}\text{Al} + {}_{2}^4\text{He} \rightarrow {}_{15}^{30}\text{P} + {}_{0}^1\text{n}$
C) ${}_{7}^{14}\text{N} + {}_{2}^4\text{He} \rightarrow {}_{8}^{17}\text{O} + {}_{1}^1\text{H}$
D) ${}_{92}^{235}\text{U} \rightarrow {}_{90}^{231}\text{Th} + {}_{2}^4\text{He}$

9. The amount of energy released from a fission reaction is much greater than the energy released from a chemical reaction because in a fission reaction

- A) mass is converted into energy
B) energy is converted into mass
C) ionic bonds are broken
D) covalent bonds are broken

10. Which substance can be used as both a coolant and a moderator in a nuclear reactor?

- A) heavy water B) carbon dioxide
C) graphite D) helium

11. Substances used as fuel in nuclear power plants must

- A) have high heats of formation
B) be beta emitters
C) be fissionable
D) be effective moderators

12. Which equation represents a fusion reaction?

- A) $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\ell)$
B) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
C) ${}_{1}^2\text{H} + {}_{1}^3\text{H} \rightarrow {}_{2}^4\text{He} + {}_{0}^1\text{n}$
D) ${}_{92}^{235}\text{U} + {}_{0}^1\text{n} \rightarrow {}_{56}^{142}\text{Ba} + {}_{36}^{91}\text{Kr} + 3{}_{0}^1\text{n}$

13. The temperature levels in a nuclear reactor are maintained primarily by the use of

- A) shielding B) coolants
C) moderators D) control rods

14. If $\frac{1}{8}$ of an original sample of krypton-74 remains unchanged after 34.5 minutes, what is the half-life of krypton-74?

- A) 11.5 min B) 23.0 min
C) 34.5 min D) 46.0 min

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

- A) N-16 B) Sr-90
C) Cs-137 D) Pu-239

16. Which statement best describes gamma radiation?

- A) It has a mass of 1 and a charge of 1.
- B) It has a mass of 0 and a charge of -1.
- C) It has a mass of 0 and a charge of 0.
- D) It has a mass of 4 and a charge of +2.

17. The fission process in a reactor can be regulated by adjusting the number of neutrons available. This is done by the use of

- A) moderators B) control rods
- C) coolants D) shielding

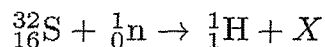
18. During a nuclear reaction, mass is converted into

- A) charge B) energy
- C) isomers D) volume

19. 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

20. Given the nuclear reaction:



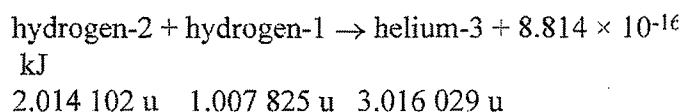
What does X represent in this reaction?

- A) ${}_{15}^{31}\text{P}$ B) ${}_{15}^{32}\text{P}$ C) ${}_{16}^{31}\text{P}$ D) ${}_{16}^{32}\text{P}$

21. Radiation is spontaneously emitted from hydrogen-3 nuclei, but radiation is *not* spontaneously emitted from hydrogen-1 nuclei or hydrogen-2 nuclei. Which hydrogen nuclei are stable?

- A) nuclei of H-1 and H-2, only
- B) nuclei of H-1 and H-3 only
- C) nuclei of H-2 and H-3 only
- D) nuclei from H-1, H-2, and H-3

22. Given the equation representing a reaction where the masses are expressed in atomic mass units:



Which phrase describes this reaction?

- A) a chemical reaction and mass being converted to energy
- B) a chemical reaction and energy being converted to mass
- C) a nuclear reaction and mass being converted to energy
- D) a nuclear reaction and energy being converted to mass

23. Compared to an ordinary chemical reaction, a fission reaction will

- A) release smaller amounts of energy
- B) release larger amounts of energy
- C) absorb smaller amounts of energy
- D) absorb larger amounts of energy

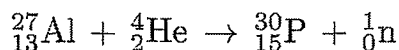
24. Types of nuclear reactions include fission, fusion, and

- A) single replacement B) neutralization
- C) oxidation-reduction D) transmutation

25. Control rods in nuclear reactors are commonly made of boron and cadmium because these two elements have the ability to

- A) absorb neutrons
- B) emit neutrons
- C) decrease the speed of neutrons
- D) increase the speed of neutrons

26. Given the balanced equation representing a reaction:



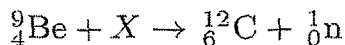
Which type of reaction is represented by this equation

- A) combustion B) decomposition
- C) saponification D) transmutation

27. The energy released in a fusion reaction comes from

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

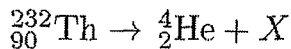
41. Given the nuclear reaction:



What is the identity of particle X ?

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

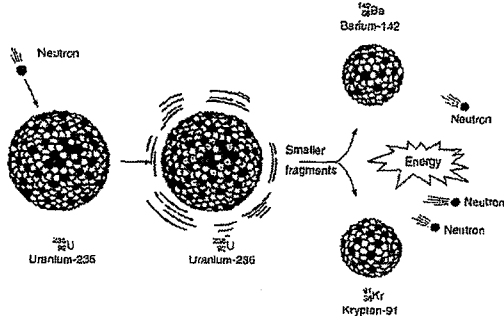
42. Given the equation representing a nuclear reaction in which X represents a nuclide:



Which nuclide is represented by X ?

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

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



Which type of reaction does the diagram illustrate?

- A) fission B) fusion
C) alpha decay D) beta decay

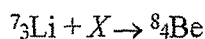
44. A radioisotope which is sometimes used by doctors to pinpoint a brain tumor is

- A) carbon-12 B) lead-206
C) technetium-99 D) uranium-238

45. In which list can all particles be accelerated by an electric field?

- A) alpha particles, beta particles, and neutrons
B) alpha particles, beta particles, and protons
C) alpha particles, protons, and neutrons
D) beta particles, protons, and neutrons

46. Given the reaction:



Which species is represented by X ?

- A) ${}^1_1\text{H}$ B) ${}^2_1\text{H}$ C) ${}^3_2\text{He}$ D) ${}^4_2\text{He}$

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

- A) alpha particle, beta particle, gamma ray
B) alpha particle, gamma ray, beta particle
C) gamma ray, beta particle, alpha particle
D) beta particle, alpha particle, gamma ray

48. A particle accelerator is used to provide charged particles with sufficient

- A) kinetic energy to penetrate a nucleus
B) kinetic energy to penetrate an electron cloud
C) potential energy to penetrate a nucleus
D) potential energy to penetrate an electron cloud

49. Which radioactive isotope is used in geological dating

- A) uranium-238 B) iodine-131
C) cobalt-60 D) technetium-99

50. Which particle has the *least* mass?

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

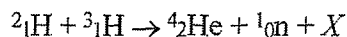
51. Which isotope is used to treat cancer?

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

52. Which nuclides are used to date the remains of a once-living organism?

- A) C-14 and C-12 B) Co-60 and Co-59
C) I-131 and Xe-131 D) U-238 and Pb-206

53. In the fusion reaction:



The X represents

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

54. Which is a gaseous radioactive waste produced during some fission reactions?

- A) nitrogen-16 B) thorium-232
C) uranium-235 D) plutonium-239

55. The operation of a commercial nuclear reactor requires an isotope that will undergo

- A) fission and a controlled chain reaction
- B) fission and an uncontrolled chain reaction
- C) fusion and a controlled chain reaction
- D) fusion and an uncontrolled chain reaction

56. Which element is used for dating archaeological discoveries?

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

57. Which type of radiation has *neither* mass nor charge?

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

58. What is the half-life and decay mode of Rn-222?

- A) 1.91 days and alpha decay
- B) 1.91 days and beta decay
- C) 3.82 days and alpha decay
- D) 3.82 days and beta decay

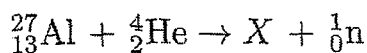
59. A radioisotope is called a tracer when it is used to

- A) kill bacteria in food
- B) kill cancerous tissue
- C) determine the age of animal skeletal remains
- D) determine the way in which a chemical reaction occurs

60. Which isotope will spontaneously decay and emit particles with a charge of +2?

- A) ^{53}Fe B) ^{137}Cs C) ^{198}Au D) ^{220}Fr

61. Given the reaction:



When the equation is correctly balanced, the nucleus represented by *X* is

- A) $^{30}_{13}\text{Al}$ B) $^{30}_{14}\text{Si}$ C) $^{30}_{15}\text{P}$ D) $^{30}_{16}\text{S}$

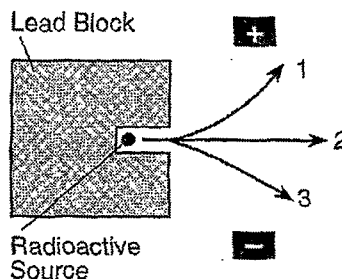
62. A radioactive isotope used in the study of many organic reaction mechanisms is

- A) carbon-12 B) carbon-14
- C) oxygen-16 D) oxygen-18

63. Which term identifies a type of nuclear reaction?

- A) fermentation B) deposition
- C) reduction D) fission

64. 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

65. Which fissionable elements are produced in breeder reactors?

- A) lithium-6 and hydrogen-3
- B) carbon-14 and oxygen-17
- C) uranium-233 and plutonium-239
- D) cesium-137 and radon-222

66. High energy is a requirement for fusion reactions to occur because the nuclei involved

- A) attract each other because they have like charges
- B) attract each other because they have unlike charges
- C) repel each other because they have like charges
- D) repel each other because they have unlike charges

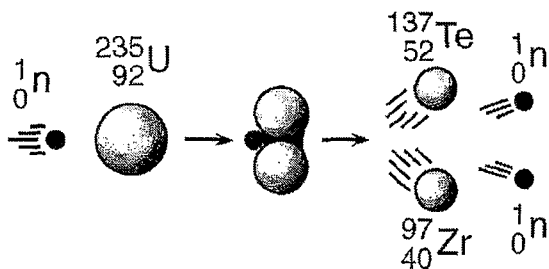
67. In which reaction is mass converted to energy by the process of fission?

- A) $^{14}_7\text{N} + ^1_0\text{n} \rightarrow ^{14}_6\text{C} + ^1_1\text{H}$
- B) $^{235}_{92}\text{U} + ^1_0\text{n} \rightarrow ^{87}_{35}\text{Br} + ^{146}_{57}\text{La} + 3^1_0\text{n}$
- C) $^{226}_{88}\text{Ra} \rightarrow ^{222}_{86}\text{Ra} + ^4_2\text{He}$
- D) $^2_1\text{H} + ^2_1\text{H} \rightarrow ^4_2\text{He}$

68. The waste products from nuclear reactors can be in the form of

- A) solids, only
- B) solids and liquids, only
- C) solids and gases, only
- D) solids, liquids, and gases

69. Given the diagram representing a reaction:



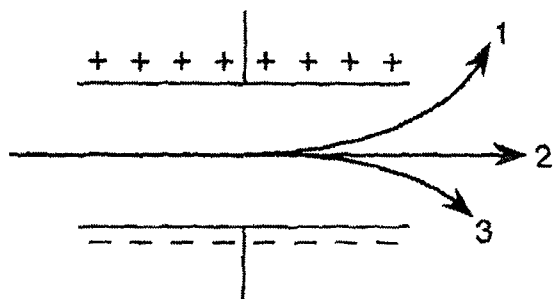
Which phrase best describes this type of reaction and the overall energy change that occurs?

- A) nuclear, and energy is released
 B) nuclear, and energy is absorbed
 C) chemical, and energy is released
 D) chemical, and energy is absorbed
70. What is one benefit associated with a nuclear fission reaction?
- A) The products are not radioactive.
 B) Stable isotopes are used as reactants.
 C) There is no chance of biological exposure.
 D) A large amount of energy is produced.
71. Which radioisotope is used for diagnosing thyroid disorders?
- A) U-238 B) Pb-206
 C) I-131 D) Co-60
72. Which particle can be accelerated by an electric field?
- A) a proton B) a neutron
 C) a helium atom D) a hydrogen atom
73. Which particle can *not* be accelerated by the electric or magnetic fields in a particle accelerator?
- A) neutron B) proton
 C) alpha particle D) beta particle
74. In a fission reactor, the speed of the neutrons may be decreased by
- A) a moderator B) an accelerator
 C) a fuel rod D) shielding
75. An alpha particle has the same composition as a
- A) hydrogen nucleus B) deuterium nucleus
 C) beryllium nucleus D) helium nucleus
76. Which nuclear decay emission consists of energy, only?
- A) alpha particle B) beta particle
 C) gamma radiation D) positron

77. What is the total number of years that must pass before only 25.00 grams of an original 100.0-gram sample of C-14 remains unchanged?

- A) 2865 y B) 5730 y
 C) 11 460 y D) 17 190 y
78. The decay of which radioisotope can be used to estimate the age of the fossilized remains of an insect?
- A) Rn-222 B) I-131
 C) Co-60 D) C-14
79. Which materials are commonly used for shielding in a nuclear fission reactor?
- A) uranium and plutonium
 B) boron and cadmium
 C) steel and concrete
 D) beryllium and heavy water
80. Which statement best describes a primary occurrence in an uncontrolled fission reaction?
- A) Mass is created and energy is released.
 B) Mass is created and energy is stored.
 C) Mass is converted to energy, which is released.
 D) Mass is converted to energy, which is stored.
81. What is the half-life of sodium-25 if 1.00 gram of a 16.00-gram sample of sodium-25 remains unchanged after 237 seconds?
- A) 47.4 s B) 59.3 s C) 79.0 s D) 118 s
82. Which substance has *chemical* properties similar to those of radioactive ^{235}U ?
- A) ^{235}Pa B) ^{233}Pa C) ^{233}U D) ^{206}Pb

83. A mixture of emanations from radioactive atoms is passed through electrically charged plates, as shown in the diagram below.



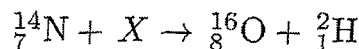
The nuclear emanations 1, 2, and 3 are called, respectively,

- A) alpha, beta, and gamma
 B) beta, gamma, and alpha
 C) gamma, alpha, and beta
 D) gamma, beta, and alpha
84. One benefit of nuclear fission reactions is
- A) nuclear reactor meltdowns
 B) storage of waste materials
 C) biological exposure
 D) production of energy
- 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 CO₂
 D) radioisotopes with long half-lives
86. Which nuclide is listed with its half-life and decay mode?
- A) K-37, 1.24 h, α
 B) N-16, 7.2 s, β^-
 C) Rn-222, 1.6×10^3 y, α
 D) U-235, 7.1×10^8 y, β^-
87. Which type of reaction produces energy and intensely radioactive waste products?
- A) fusion of tritium and deuterium
 B) fission of uranium
 C) burning of heating oil
 D) burning of wood

88. When an atom of the unstable isotope Na-24 decays, it becomes an atom of Mg-24 because the Na-24 atom spontaneously releases

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

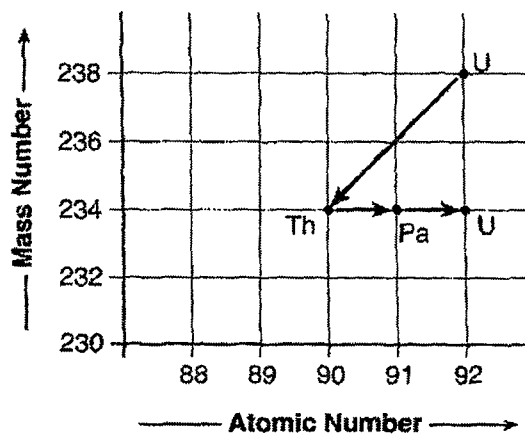
89. Given the nuclear equation:



What is particle X?

- A) an alpha particle B) a beta particle
 C) a deuteron D) a triton

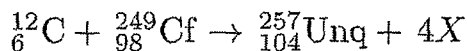
90. The chart below shows the spontaneous nuclear decay of U-238 to Th-234 to Pa-234 to U-234.



What is the correct order of nuclear decay modes for the change from U-238 to U-234?

- A) β^- decay, γ decay, β^- decay
 B) β^- decay, β^- decay, α decay
 C) α decay, α decay, β^- decay
 D) α decay, β^- decay, β^- decay

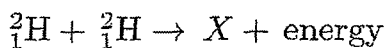
91. Given the correctly balanced nuclear equation:



Which particle is represented by the X?

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

92. Given the fusion reaction:



Which particle is represented by X?

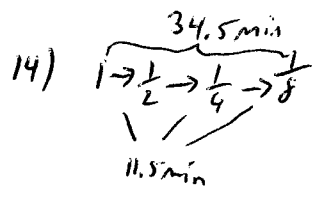
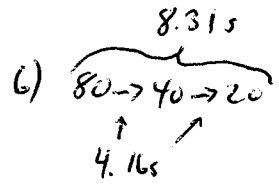
- A) ${}^1_1\text{H}$ B) ${}^3_2\text{He}$ C) ${}^3_1\text{H}$ D) ${}^4_2\text{He}$

93. What is a problem commonly associated with nuclear power facilities?
- A) A small quantity of energy is produced.
 - B) Reaction products contribute to acid rain.
 - C) It is impossible to control nuclear fission.
 - D) It is difficult to dispose of wastes.
94. Energy is released during the fission of Pu-239 atoms as a result of the
- A) formation of covalent bonds
 - B) formation of ionic bonds
 - C) conversion of matter to energy
 - D) conversion of energy to matter
95. Radioisotopes used for medical diagnosis must have
- A) long half-lives and be quickly eliminated by the body
 - B) long half-lives and be slowly eliminated by the body
 - C) short half-lives and be quickly eliminated by the body
 - D) short half-lives and be slowly eliminated by the body
96. Radiation used in the processing of food is intended to
- A) increase the rate of nutrient decomposition
 - B) kill microorganisms that are found in the food
 - C) convert ordinary nutrients to more stable forms
 - D) replace chemical energy with nuclear energy
97. Which radioisotope is used to treat thyroid disorders?
- A) Co-60
 - B) I-131
 - C) C-14
 - D) U-238
98. After decaying for 48 hours, $\frac{1}{16}$ of the original mass of a radioisotope sample remains unchanged. What is the half-life of this radioisotope?
- A) 3.0 h
 - B) 9.6 h
 - C) 12 h
 - D) 24 h

Nuclear Review Key



- P1
- 1 - B
 - 2 - B
 - 3 - B
 - 4 - C
 - 5 - B
 - 6 - C
 - 7 - C
 - 8 - D
 - 9 - A
 - 10 - A
 - 11 - C
 - 12 - C
 - 13 - B
 - 14 - A
 - 15 - A

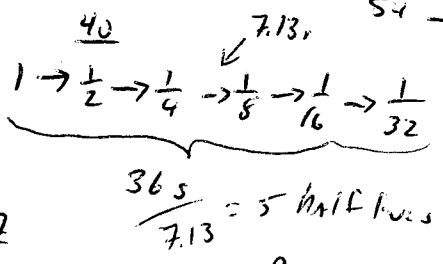


- Short 1/2 life

- P2
- 16 - C
 - 17 - B
 - 18 - B
 - 19 - C
 - 20 - B
 - 21 - A
 - 22 - C
 - 23 - B
 - 24 - D
 - 25 - A
 - 26 - D
 - 27 - A

- P3
- 28 - D
 - 29 - D
 - 30 - B
 - 31 - C
 - 32 - A
 - 33 - B
 - 34 - C
 - 35 - C
 - 36 - A
 - 37 - C
 - 38 - D
 - 39 - B
 - 40 - D

- P4
- 41 - A
 - 42 - B
 - 43 - A
 - 44 - C
 - 45 - B
 - 46 - A
 - 47 - A
 - 48 - A
 - 49 - A
 - 50 - B
 - 51 - C
 - 52 - A
 - 53 - C
 - 54 - A



- P5
- 55 - A
 - 56 - C
 - 57 - A
 - 58 - C
 - 59 - D
 - 60 - D
 - 61 - C
 - 62 - B
 - 63 - D
 - 64 - D
 - 65 - C
 - 66 - C
 - 67 - B
 - 68 - D

- P6
- 69 - A
 - 70 - D
 - 71 - C
 - 72 - A
 - 73 - A
 - 74 - A
 - 75 - D
 - 76 - C
 - 77 - C
 - 78 - D
 - 79 - C
 - 80 - C
 - 81 - B
 - 82 - C

- P7
- 83 - B
 - 84 - D
 - 85 - D
 - 86 - B
 - 87 - B
 - 88 - B
 - 89 - A
 - 90 - D
 - 91 - D
 - 92 - D

- P8
- 93 - D
 - 94 - C
 - 95 - C
 - 96 - B
 - 97 - B
 - 98 - C

