Name: _____ **Class:** _____ **Date:** _____ **ID: A**

Ch.11-Q4W3-Nuclear chemistry Qs. Bank

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Materials that continue to glow in the dark after they have been exposed to light are said to be _____.
a. radioactive
b. unstable
c. phosphorescent
d. incandescent

____ 2. The first person to recognize the existence of radioactivity was _____.
a. Marie Curie
b. Henri Becquerel
c. Albert Einstein
d. Lise Meitner

____ 3. The correct nuclear notation for the isotope oxygen-15 is _____.
a. $^{15}_{8}\mathrm{O}$
b. $^{8}_{15}\mathrm{O}$
c. $^{15}\mathrm{O}_{8}$
d. $_{8}\mathrm{O}^{15}$

____ 4. The ratio of protons to neutrons in stable isotopes of the lighter elements tends to be approximately _____.
a. 1:1
b. 1:2
c. 2:1
d. unpredictable

____ 5. The most difficult radiation to block out is _____.
a. alpha particles
b. beta particles
c. gamma rays
d. visible light rays

____ 6. A particle released during the fission of uranium-235 is a(n) _____.
a. alpha particle
b. beta particle
c. gamma ray
d. neutron

____ 7. If a neutron begins a nuclear chain reaction, then one product of that reaction must be _____.
a. a uranium-235 nucleus
b. a neutron
c. a uranium-238 nucleus
d. a gamma ray

____ 8. In a reactor, nuclear energy is produced in the _____.
a. moderator
b. coolant
c. fuel rods
d. turbine

____ 9. Compared to an electron, a positron has _____.
a. the same mass and charge
b. different mass and charge
c. the same charge, but a different mass
d. the same mass, but a different charge

____ 10. _____ materials absorb light energy, then release it.
a. Nuclear
b. Phosphorescent
c. Radioactive
d. Transuranium

____ 11. Who of the following was not important in the discovery of radiation?
a. Neils Bohr
b. Marie Curie
c. Pierre Curie
d. Henri Becquerel

____ 12. $^{235}_{92}\mathrm{U}$ and $^{238}_{92}\mathrm{U}$ are examples of _____.
a. allotropes
b. isotopes
c. particles of radiation
d. tracers

____ 13. When $^{238}_{92}U$ becomes $^{234}_{90}Th$, what type of decay has taken place?
a. alpha
b. beta
c. gamma
d. positron

____ 14. A(n) _____ is a high energy electron.
a. beta particle
b. helium nucleus
c. alpha particle
d. positron

____ 15. Which type of radiation is most penetrating?
a. alpha
b. beta
c. gamma
d. They are equal.

____ 16. Which is the only type of radiation that might penetrate the walls of a house?
a. alpha
b. beta
c. gamma
d. All will penetrate.

____ 17. What is the source of the electrons produced in beta decay?
a. an outer energy level
b. a valence electron
c. a neutron
d. a proton

____ 18. The radiation detector that uses detection of flashes of light is a _____.
a. bubble chamber
b. film badge
c. Geiger counter
d. scintillation counter

____ 19. How much hydrogen-3 will remain after 60 years if the original sample had a mass of 80.0 g and the half-life of hydrogen-3 is 12 years?
a. 1.25 g
b. 2.50 g
c. 5.00 g
d. 10.0 g

____ 20. Which of the following isotopes is not commonly used for dating objects?
a. carbon-14
b. phosphorus-32
c. potassium-40
d. rubidium-87

____ 21. Which of the following could be dated using carbon-14?
a. ashes from a fire
b. a rock
c. glacial deposits
d. lava fields

____ 22. When one large nucleus is split into two smaller nuclei, the process is nuclear _____.
a. decay
b. fission
c. fusion
d. tracing

____ 23. To control a chain reaction, a moderator, such as _____ is used to slow down neutrons.
a. graphite
b. uranium
c. water
d. the core

____ 24. Two or more nuclei combine to form one larger nucleus in the process of nuclear _____.
a. decay
b. fission
c. fusion
d. tracing

____ 25. Which produces more energy--nuclear fission or nuclear fusion?
a. fission
b. fusion
c. They produce the same amount.
d. It depends on the reaction.

____ 26. The greatest source of radiation most humans are exposed to is _____.
a. cosmic rays
b. medical X rays
c. radon
d. rocks and soil

____ 27. Most radioactive waste is generated in _____.
a. hospitals
b. nuclear reactors
c. tokamaks
d. uranium mines

____ 28. The radioisotope iodine-131 is used to determine the health of the thyroid gland. Iodine-131 is an example of _____.

a. an allotrope
b. a tracer
c. radiation
d. a structure

Matching

Match each item with the correct statement below.

a. alpha particle
b. beta particle
c. deuterium
d. gamma ray
e. gray
f. half-life
g. nuclear fission
h. nuclear fusion
i. nuclear reactor
j. radioactivity
k. sievert
l. tritium

____ 29. The time required for half of a sample of a radioactive substance to undergo nuclear decay is called the _____.
____ 30. A(n) _____ consists of a helium nucleus.
____ 31. The unit of radiation used to measure the amount of radiation received by an organism is called the _____.
____ 32. _____ is the reaction that occurs when two small nuclei join together to form a larger nucleus.
____ 33. The spontaneous emission of radiation by a nucleus is known as _____.
____ 34. The isotope of hydrogen with a mass number of 2 is _____.
____ 35. _____ is the process by which a single large nucleus breaks apart into two smaller nuclei.
____ 36. A(n) _____ is a high-energy form of electromagnetic radiation commonly released during radioactive decay.
____ 37. The _____ is a unit of radiation that measures the amount of radiation absorbed by a tissue.
____ 38. The isotope of hydrogen with a mass number of 3 is _____.
____ 39. A(n) _____ is a device in which a nuclear reaction is used to generate energy.
____ 40. A(n) _____ is a high-energy electron released from a nucleus during radioactive decay.

Short Answer

41. What does the subscript on the nuclear symbol for a beta particle, ${}^{0}_{-1}e$, mean?

42. What does the subscript on the nuclear symbol for the alpha particle, ${}^{4}_{2}\mathrm{He}$, mean?

43. After an isotope decays by the loss of a beta particle, it has one more proton. Where did the extra proton come from?

44. Why would potassium-40 not be a good isotope to date pottery found in Egyptian cities built about 4000 B.C.?

45. Name three different products formed in any nuclear fission reaction.

46. The reactions that typically occur when a neutron strikes a uranium-238 nucleus and a uranium-235 nucleus are different. Explain how.

47. Write a nuclear equation for the fission of plutonium-239.

48. Why is nuclear fusion regarded as a better source of energy for future human needs than is nuclear fission?

49. How does radiation affect the structure of a stable molecule, such as a molecule of water?
50. Write the nuclear symbol for an alpha particle.
51. Write the nuclear symbol for a beta particle.
52. Write the nuclear symbol for an atom of deuterium.
53. Write the nuclear symbol for an atom of tritium.
54. Write the nuclear symbol for an atom of silicon-28.
55. Write the nuclear symbol for an atom of einsteinium-252.
56. Complete the following nuclear equation: ${}^{14}_{6}\mathrm{C} \rightarrow \beta +$
57. Complete the following nuclear equation: ${}^{226}_{88}\mathrm{Ra} \rightarrow \alpha +$
58. Complete the following nuclear equation: ${}^{230}_{90}\mathrm{Th} \rightarrow \text{gamma ray} +$
59. Complete the following nuclear equation: ${}^{11}_{5}\mathrm{B} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{14}_{7}\mathrm{N} +$
60. Complete the following nuclear equation: ${}^{44}_{20}\mathrm{Ca} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{44}_{21}\mathrm{Sc} +$
61. Complete the following nuclear equation: ${}^{9}_{4}\mathrm{Be} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{6}_{3}\mathrm{Li} +$
62. Complete the following nuclear equation: ${}^{235}_{92}\mathrm{U} + {}^{1}_{0}n \rightarrow {}^{95}_{42}\mathrm{Mo} + 2{}^{1}_{0}n +$
63. Complete the following nuclear equation: ${}^{63}_{29}\mathrm{Cu} + {}^{2}_{1}\mathrm{H} \rightarrow 2{}^{1}_{0}n +$
64. Complete the following nuclear equation: ${}^{239}_{94}\mathrm{Pu} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{1}_{0}n +$
65. Explain how nuclear reactions differ from chemical reactions.
66. Complete the following equation: ${}^{210}_{83}\mathrm{Bi} \rightarrow {}^{210}_{84}\mathrm{Po} +$

Problem

Technetium-99m is widely used in diagnosing medical problems. The graph in Figure 21-1 shows the rate at which a 200-gram sample of technetium-99m decays. Answer the following questions using the graph.

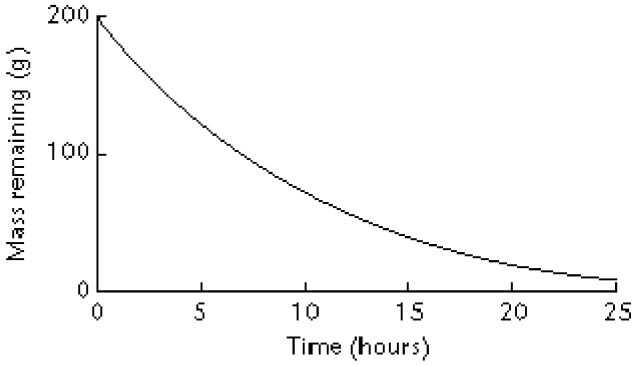

Figure 21-1

67. What is the half-life of technetium-99m?

68. Estimate the amount of the original sample of technetium-99m that would remain after 1 h; after 10 h.

69. Suppose that a doctor needs 25 g of technetium-99m in a medical procedure, and a sample of 100 g is made at 8:00 a.m. What is the latest time at which the procedure can be carried out? Why?

70. The technetium-99m is considered to be no longer useable when less than 6 g remains. At what time would the sample described in the preceding question become unusable?

71. Radioactive isotopes used for medical purposes are usually produced in a nuclear laboratory and shipped to hospitals. What problem can you see in producing and using technetium-99m by this system?

72. Technetium-99m decays in two steps, emitting first a gamma ray, then a beta particle. Write nuclear equations for these two reactions.

Ch.11-Q4W3-Nuclear chemistry Qs. Bank
Answer Section

MULTIPLE CHOICE

1.	ANS: C	PTS: 1	DIF: B	OBJ: 21-1
2.	ANS: B	PTS: 1	DIF: B	OBJ: 21-2
3.	ANS: A	PTS: 1	DIF: B	OBJ: 21-5
4.	ANS: A	PTS: 1	DIF: B	OBJ: 21-2
5.	ANS: C	PTS: 1	DIF: B	OBJ: 21-2
6.	ANS: D	PTS: 1	DIF: B	OBJ: 21-4
7.	ANS: B	PTS: 1	DIF: B	OBJ: 21-4
8.	ANS: C	PTS: 1	DIF: B	OBJ: 21-6
9.	ANS: D	PTS: 1	DIF: B	OBJ: 21-2
10.	ANS: B	PTS: 1	DIF: B	OBJ: 21-1
11.	ANS: A	PTS: 1	DIF: B	OBJ: 21-1
12.	ANS: B	PTS: 1	DIF: B	OBJ: 21-1
13.	ANS: A	PTS: 1	DIF: A	OBJ: 21-2
14.	ANS: A	PTS: 1	DIF: B	OBJ: 21-2
15.	ANS: C	PTS: 1	DIF: B	OBJ: 21-2
16.	ANS: C	PTS: 1	DIF: B	OBJ: 21-2
17.	ANS: C	PTS: 1	DIF: B	OBJ: 21-2
18.	ANS: D	PTS: 1	DIF: B	OBJ: 21-2
19.	ANS: B	PTS: 1	DIF: A	OBJ: 21-3
20.	ANS: B	PTS: 1	DIF: B	OBJ: 21-3
21.	ANS: A	PTS: 1	DIF: B	OBJ: 21-3
22.	ANS: B	PTS: 1	DIF: B	OBJ: 21-4
23.	ANS: C	PTS: 1	DIF: B	OBJ: 21-6
24.	ANS: C	PTS: 1	DIF: B	OBJ: 21-4
25.	ANS: B	PTS: 1	DIF: B	OBJ: 21-4
26.	ANS: C	PTS: 1	DIF: B	OBJ: 21-1
27.	ANS: A	PTS: 1	DIF: B	OBJ: 21-8
28.	ANS: B	PTS: 1	DIF: B	OBJ: 21-8

MATCHING

29.	ANS: F	PTS: 1	DIF: B	OBJ: 21-3
30.	ANS: A	PTS: 1	DIF: B	OBJ: 21-2
31.	ANS: E	PTS: 1	DIF: B	OBJ: 21-7
32.	ANS: H	PTS: 1	DIF: B	OBJ: 21-4
33.	ANS: J	PTS: 1	DIF: B	OBJ: 21-2
34.	ANS: C	PTS: 1	DIF: B	OBJ: 21-4
35.	ANS: G	PTS: 1	DIF: B	OBJ: 21-4
36.	ANS: D	PTS: 1	DIF: B	OBJ: 21-2

37. ANS: K PTS: 1 DIF: B OBJ: 21-7
38. ANS: L PTS: 1 DIF: B OBJ: 21-2
39. ANS: I PTS: 1 DIF: B OBJ: 21-6
40. ANS: B PTS: 1 DIF: B OBJ: 21-2

SHORT ANSWER

41. ANS:
The -1 represents the charge on the electron.

PTS: 1 DIF: B OBJ: 21-2

42. ANS:
The 2 represents the number of protons present in the particle (2).

PTS: 1 DIF: B OBJ: 21-2

43. ANS:
The proton is produced when a neutron decays to produce an electron (the beta particle) and a proton.

PTS: 1 DIF: B OBJ: 21-2

44. ANS:
The half-life of potassium-40 is so great that changes over a period of a few thousand years would be difficult to detect.

PTS: 1 DIF: B OBJ: 21-3

45. ANS:
The products of any nuclear fission reaction include energy, smaller atomic nuclei, and neutrons.

PTS: 1 DIF: B OBJ: 21-4

46. ANS:
The uranium-238 nucleus absorbs the neutron and is converted to plutonium-239, whereas uranium-235 undergoes nuclear fission.

PTS: 1 DIF: A OBJ: 21-4

47. ANS:
Any equation is acceptable provided that it balances and that both neutrons and smaller atomic nuclei are shown. An example would be:
$^{239}_{94}\text{Pu} + {}^{1}_{0}n \rightarrow {}^{120}_{48}\text{Cd} + {}^{117}_{46}\text{Pd} + {}^{1}_{30}n$

PTS: 1 DIF: B OBJ: 21-5

48. ANS:
Fusion produces more energy per gram than does fission, uses fuels that are abundant, and produces fewer dangerous waste products.

PTS: 1 DIF: B OBJ: 21-4

49. ANS:
The radiation energizes electrons in the molecule and can cause chemical bonds to break, changing the molecule.

PTS: 1 DIF: B OBJ: 21-1

50. ANS:
$^{4}_{2}\mathrm{He}$

PTS: 1 DIF: B OBJ: 21-2

51. ANS:
$^{0}_{-1}e$

PTS: 1 DIF: B OBJ: 21-2

52. ANS:
$^{2}_{1}\mathrm{H}$

PTS: 1 DIF: B OBJ: 21-5

53. ANS:
$^{3}_{1}\mathrm{H}$

PTS: 1 DIF: B OBJ: 21-5

54. ANS:
$^{28}_{14}\mathrm{Si}$

PTS: 1 DIF: B OBJ: 21-5

55. ANS:
$^{252}_{99}\mathrm{Es}$

PTS: 1 DIF: B OBJ: 21-5

56. ANS:
$^{14}_{7}\mathrm{N}$

PTS: 1 DIF: B OBJ: 21-5

57. ANS:
$^{222}_{86}\mathrm{Rn}$

PTS: 1 DIF: B OBJ: 21-5

58. ANS:
$^{230}_{90}\mathrm{Th}$

PTS: 1 DIF: B OBJ: 21-5

59. ANS:
$^{1}_{0}n$

PTS: 1 DIF: B OBJ: 21-5

60. ANS:
$^{1}_{0}n$

PTS: 1 DIF: B OBJ: 21-5

61. ANS:
$^{4}_{2}\text{He}$

PTS: 1 DIF: B OBJ: 21-5

62. ANS:
$^{139}_{50}\text{Sn}$

PTS: 1 DIF: B OBJ: 21-5

63. ANS:
$^{63}_{30}\text{Zn}$

PTS: 1 DIF: B OBJ: 21-5

64. ANS:
$^{242}_{96}\text{Cm}$

PTS: 1 DIF: B OBJ: 21-5

65. ANS:
Chemical reactions involve changes in the number or configuration of electrons, and nuclear reactions involve the protons and neutrons found in the nucleus.

PTS: 1 DIF: B OBJ: 21-1

66. ANS:
$^{0}_{-1}e$

PTS: 1 DIF: B OBJ: 21-5

PROBLEM

67. ANS:
The half-life is approximately 6 h.

PTS: 1 DIF: B OBJ: 21-3

68. ANS:
180 g; 70 g

PTS: 1 DIF: A OBJ: 21-3

69. ANS:
The latest time would be at roughly 8 p.m. the same day. Two half-lives, 6 h. each, would have elapsed.

PTS: 1 DIF: A OBJ: 21-8

70. ANS:
The sample would become unusable at roughly 8 a.m. the next day.

PTS: 1 DIF: B OBJ: 21-3

71. ANS:
The isotope may have decayed during shipping.

PTS: 1 DIF: B OBJ: 21-8

72. ANS:
$^{99}_{43}\text{Tc} \rightarrow {}^{99}_{43}\text{Tc} + \text{gamma ray}; {}^{99}_{43}\text{Tc} \rightarrow {}^{0}_{-1}e + {}^{99}_{44}\text{Ru}$

PTS: 1 DIF: A OBJ: 21-5