

Table N Selected Radioisotopes

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| <p>1 Nuclei of U-238 atoms are</p> <p>(1) stable and spontaneously absorb alpha particles</p> <p>(2) stable and spontaneously emit alpha particles</p> <p>(3) unstable and spontaneously absorb alpha particles</p> <p>(4) unstable and spontaneously emit alpha particles</p> <p>2 When an atom of the unstable isotope Na-24 decays, it becomes an atom of Mg-24 because the Na-24 atom spontaneously releases</p> <p>(1) an alpha particle (3) a neutron</p> <p>(2) a beta particle (4) a positron</p> <p>3 Which statement describes the stability of the nuclei of potassium atoms?</p> <p>(1) All potassium atoms have stable nuclei that spontaneously decay.</p> <p>(2) All potassium atoms have unstable nuclei that do not spontaneously decay.</p> <p>(3) Some potassium atoms have unstable nuclei that spontaneously decay.</p> <p>(4) Some potassium atoms have unstable nuclei that do not spontaneously decay.</p> | <p>4 What evidence indicates that the nuclei of strontium-90 atoms are unstable?</p> <p>(1) Strontium-90 electrons are in the excited state.</p> <p>(2) Strontium-90 electrons are in the ground state.</p> <p>(3) Strontium-90 atoms spontaneously absorb beta particles.</p> <p>(4) Strontium-90 atoms spontaneously emit beta particles.</p> <p>5 Which nuclear emission is listed with its notation?</p> <p>(1) gamma radiation, ${}^0_0\gamma$ (3) neutron, ${}_0^1\beta$</p> <p>(2) proton, ${}^4_2\text{He}$ (4) alpha particle, ${}^1_1\text{H}$</p> <p>6 Which radioisotope is used in dating geological formations?</p> <p>(1) I-131 (3) Ca-37</p> <p>(2) U-238 (4) Fr-220</p> <p>7 What is the mass of an original 5.60-gram sample of iron-53 that remains unchanged after 25.53 minutes?</p> <p>(1) 0.35 g (3) 1.40 g</p> <p>(2) 0.70 g (4) 2.80 g</p> <p>8 Which radioisotope has the fastest rate of decay?</p> <p>(1) ${}^{14}\text{C}$ (3) ${}^{53}\text{Fe}$</p> <p>(2) ${}^{37}\text{Ca}$ (4) ${}^{42}\text{K}$</p> |
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Base your answers to questions 9 on the information below and on your knowledge of chemistry.

Iodine has many isotopes, but only iodine-127 is stable and is found in nature. One radioactive iodine isotope, I-108, decays by alpha particle emission. Iodine-131 is also radioactive and has many important medical uses.

- 9 Complete the equation below for the nuclear decay of I-108.



Base your answers to questions 10 on the information below and on your knowledge of chemistry.

Some isotopes of neon are Ne-19, Ne-20, Ne-21, Ne-22, and Ne-24. The neon-24 decays by beta emission. The atomic mass and natural abundance for the naturally occurring isotopes of neon are shown in the table below.

Naturally Occurring Isotopes of Neon

Isotope Notation	Atomic Mass (u)	Natural Abundance (%)
Ne-20	19.99	90.48
Ne-21	20.99	0.27
Ne-22	21.99	9.25

10 Identify the decay mode of Ne-19.

Base your answers to questions 11 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.

11 Determine the fraction of an original sample of tritium that remains unchanged after 24.62 years.

Base your answers to questions 12 on the information below and on your knowledge of chemistry.

Some isotopes of potassium are K-37, K-39, K-40, K-41, and K-42. The natural abundance and the atomic mass for the naturally occurring isotopes of potassium are shown in the table below.

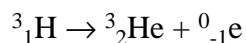
Naturally Occurring Isotopes of Potassium

Isotope Notation	Natural Abundance (%)	Atomic Mass (u)
K-39	93.26	38.96
K-40	0.01	39.96
K-41	6.73	40.96

12 Identify the decay mode of K-37.

Base your answers to questions 13 on the information below and on your knowledge of chemistry.

A nuclear reaction is represented by the equation below.



13 Identify the decay mode of hydrogen-3.

Base your answers to questions 14 on the information below and on your knowledge of chemistry.

When a cobalt-59 atom is bombarded by a subatomic particle, a radioactive cobalt-60 atom is produced. After 21.084 years, 1.20 grams of an original sample of cobalt-60 produced remains unchanged.

14 Based on Table N, identify the decay mode of cobalt-60.

Base your answers to questions 15 on the information below and on your knowledge of chemistry.

When uranium-235 nuclei are bombarded with neutrons, many different combinations of smaller nuclei can be produced. The production of neodymium-150 and germanium-81 in one of these reactions is represented by the equation below.



Germanium-81 and uranium-235 have different decay modes. Ge-81 emits beta particles and has a half-life of 7.6 seconds.

15 Complete the equation below for the decay of Ge-81 by writing a notation for the missing nuclide.



Answer Keys

1 4

2 2

3 3

4 4

5 1

6 2

7 2

8 2

9 Allow 1 credit. Acceptable responses include, but are not limited to:

- ^{104}Sb
- ^{104}Sb
- Sb-104
- antimony-104

10 Allow 1 credit. Acceptable responses include, but are not limited to:

- positron decay
- β^+
- $\boxed{}e$
- $\boxed{}\beta$

11 Allow 1 credit. Acceptable responses include, but are not limited to:

- 1 —4 0.25
- 25%

12 Allow 1 credit. Acceptable responses include, but are not limited to:

- positron decay
- β^+
- ${}^0_{+1}e$

13 Allow 1 credit. Acceptable responses include, but are not limited to:

- β^-
- beta decay
- ${}^0_{-1}e$
- ${}^0_{-1}\beta$

14 Allow 1 credit. Acceptable responses include, but are not limited to:

- β^-
- e_{-01}
- beta
- beta decay
- beta particle
- $\boxed{{}^0}_{-1}\beta$

15 Allow 1 credit. Acceptable responses include, but are not limited to:

- $^{81}_{33}\text{As}$
- As-81
- arsenic-81
- 81As