1. Which of the following correctly compares gamma rays to microwaves?

a. Gamma rays have a shorter wavelength, a higher frequency, and carry less energy than microwaves.

b. Gamma rays have a shorter wavelength, a higher frequency, and carry more energy than microwaves.

c. Gamma rays have a longer wavelength, a lower frequency, and carry less energy than microwaves.

d. Gamma rays have a shorter wavelength, a lower frequency, and carry more energy than microwaves.

B

2. Which of the following is true concerning the isotopes potassium-41 and potassium-39?

a. Potassium-41 has two more protons than potassium-39.

b. Potassium-41 has one more proton and one more electron than potassium-39.

c. Potassium-41 has one more proton and one more neutron than potassium-39.

d. Potassium-41 has two more neutrons than potassium-39.

D

3. Consider the following two isotopes of uranium:

U and U

Which of the following is true?

a. One of the isotopes has 235 neutrons, and the other has 238 neutrons.

b. One of the isotopes has 143 protons, and the other has 146 protons.

c. One of the isotopes has 143 neutrons, and the other has 146 neutrons.

d. One of the isotopes has a mass of 327, and the other has a mass of 330.

C

4. Which of the following applies to isotopes of an element?

|  |  |
| --- | --- |
| I. | They have the same number of protons. |
| II. | They have the same number of neutrons. |
| III. | They have the same number of electrons. |
| IV. | They have the same atomic number. |
| V. | They have the same mass number. |

a. I., II., and III. only c. II., III., and IV. only

b. I., III., and IV. only d. III., IV., and V. only

B

5. Which of the following is correct concerning atomic number, mass number, and neutron number for any nucleus?

|  |  |
| --- | --- |
| I. | atomic number = mass number - neutron number |
| II. | mass number = atomic number - neutron number |
| III. | neutron number = mass number + atomic number |
| IV. | atomic number = mass number + neutron number |
| V. | mass number = atomic number + neutron number |
| VI. | neutron number = mass number - atomic number |

a. II., IV., and VI. only c. I., V., and VI. only

b. II., III., and IV. only d. III., IV., and V. only

C

6. Using the below symbols, which of the following represents an alpha particle?



a. symbol A c. symbol C

b. symbol B d. symbol D

D

7. After a radioactive nucleus has decayed via alpha emission, the daughter nucleus has:

a. an atomic number decreased by four, and a mass number decreased by two

b. both a mass number and an atomic number decreased by two

c. a mass number that is unchanged, and an atomic number increased by one

d. a mass number decreased by four, and an atomic number decreased by two

D

8. After a radioactive nucleus has decayed via beta emission, the daughter nucleus has:

a. an atomic number decreased by four, and a mass number decreased by two

b. both a mass number and an atomic number decreased by two

c. a mass number that is unchanged, and an atomic number increased by one

d. a mass number decreased by four, and an atomic number decreased by two

C

9. Which of the following nuclear decay processes would form a daughter nucleus with an atomic number larger than the parent nucleus?

a. -decay c. -decay

b. -decay d. -decay

B

10. The alpha decay of radon-222 will yield which of the following?

a. polonium-218 c. astatine-222

b. francium-222 d. bismuth-220

A

11. What nucleus will be formed when Po first undergoes alpha decay and then the daughter nucleus formed from that decay undergoes beta decay?

a. Tl c. Pb

b. Bi d. At

B

12. If the daughter nucleus formed as a result of alpha decay is Ir then the parent nucleus was an isotope of which element?

a. thallium c. gold

b. mercury d. lead

C

Consider the below illustration representing a nuclear decay event:



13. Which two of the following statements about the nature of the daughter nucleus are true?

|  |  |
| --- | --- |
| I. | The mass is the same as the parent nucleus’s mass. |
| II. | The mass is less than the parent nucleus’s mass. |
| III. | The atomic number is lower than the parent nucleus’s atomic number. |
| IV. | The atomic number is higher than the parent nucleus’s atomic number. |

a. I. and III. c. II. and III.

b. I. and IV. d. II. and IV.

B

14. How would you describe the penetrating power of a beta particle?

a. more penetrating than both alpha and gamma radiation

b. less penetrating than both alpha and beta radiation

c. more penetrating than gamma, but less penetrating than alpha radiation

d. less penetrating than gamma, but more penetrating than alpha radiation

D

15. The half-life of plutonium-242 is about 400 000 years. How long would it take for a 10.0 g sample of this radioisotope to decay to 1.25 g?

a. 800 000 years c. 1 600 000 years

b. 1 200 000 years d. 2 000 000 years

B

16. Which of the following isotope pairs is likely to have a daughter-to-parent ratio of 3 to 1 after approximately 1.5 billion years?

|  |  |  |
| --- | --- | --- |
|  | Parent | Daughter |
| a. | thorium-235 | lead-206 |
| b. | rubidium-87 | strontium-87 |
| c. | potassium-40 | argon-40 |
| d. | uranium-235 | lead-207 |

a. a b. b c. c d. d

D

Use the following information to answer the next three questions.

17. On April 26, 1986, an explosion at the nuclear power plant at Chernobyl in Ukraine released the greatest quantity of radioactive material ever associated with an industrial accident. One of the principal radioisotopes released was iodine-131, which has a half-life of 8 days. Iodine-131 decays via beta emission.

The daughter nucleus resulting from the decay of iodine-131 is:

a. antimony-127 c. tellurium-129

b. indium-128 d. xenon-131

D

18. What would the daughter-to-parent ratio be for this isotope pair 32 days after the iodine-131 was released into the environment?

a. 3 to 1 c. 15 to 1

b. 7 to 1 d. 31 to 1

B

19. The official account of the Chernobyl accident estimates the total amount of iodine-131 released to be between 80 and 400 g. If measurements taken 40 days after the accident indicated that a total of 10 g of iodine-131 remained, what mass of this radioisotope was originally released?

a. 80 g c. 160 g

b. 120 g d. 320 g

D

Use the following decay curve for strontium-90 to answer the next two questions.



20. The half-life of strontium-90 is approximately:

a. 15 years c. 50 years

b. 30 years d. 60 years

B

21. What mass of strontium-90 will exist in 150 years if you began with 100.0 g today?

a. 25.0 g c. 6.25 g

b. 12.5 g d. 3.12 g

D

22. Which of the following are correct statements about nuclear fission?

|  |  |
| --- | --- |
| I. | Two small nuclei fuse to form a single larger nucleus. |
| II. | Mass is converted into energy. |
| III. | Nuclear power plants employ the process to generate energy. |
| IV. | The process occurs in the Sun and in hydrogen bombs. |

a. I., II., and III. only c. II. and III. only

b. I. and IV. only d. I., II., III., and IV.

C

23. Which of the following represent the energy transformations occurring in a typical nuclear reactor?

a. electrical  mechanical  thermal  nuclear

b. nuclear  thermal  mechanical  electrical

c. nuclear  mechanical  thermal  electrical

d. mechanical  thermal  electrical  nuclear

B

Consider the following nuclear equation:

He + ?  He + 2 H

24. Which of the following represents the missing particle?

a. H c. H

b. He d. He

D

25. The majority of the energy released from a hydrogen bomb results from:

a. a controlled fission chain reaction c. a controlled fusion chain reaction

b. an uncontrolled fission chain reaction d. an uncontrolled fusion chain reaction

D

26. A major obstacle associated with the development of fusion reactors for commercial energy production is:

a. the worldwide shortage of available hydrogen for fuel

b. the fact that the energy available from fusion reactors is much less than that from fission reactors

c. the huge temperatures required to initiate and maintain nuclear fusion

d. that fusion reactors will generate much more radioactive waste than fission reactors generate

C

27. The bombs dropped on Hiroshima and Nagasaki in early August 1945 were examples of:

a. controlled fission chain reactions c. controlled fusion chain reactions

b. uncontrolled fission chain reactions d. uncontrolled fusion chain reactions

B