This chapter has 53 questions.
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1. The three types of nuclear radiation are
   - ○ protons, electrons, neutrons.
   - ○ electrical, strong nuclear, weak nuclear.
   - ○ radiation, convection, conduction.
   - → ○ gamma, beta, alpha.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual
Type: Definition

Multiple Choice Question
MC The three types of nuclear radiation are

2. The word "radioactive" means
   - ○ an atomic nucleus absorbs neutrons.
   - ○ there is significant interference between atomic radiation and radio reception.
   - → ○ there are nuclei present which will spontaneously emit nuclear radiation.
   - ○ an atom spontaneously captures an electron from a neighboring atom.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual

Multiple Choice Question
MC The word radioactive means

3. The discovery of the neutron helped people understand
   - → ○ how two atoms of the same element can have different atomic masses.
   - ○ why the nucleus has a positive charge.
   - ○ how electrons are attracted to the nucleus.
   - ○ why the nucleus is much more massive than the electrons in an atom.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: The structure of the nucleus
Type: Conceptual

Multiple Choice Question
MC The discovery of the neutron helped people u...

4. The number of protons in the nucleus of an atom determines
   - ○ the half-life of the nucleus.
   - → ○ the density of the nucleus.
   - ○ the atomic mass.
   - ○ the number of neutrons in the nucleus.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: The structure of the nucleus
Type: Conceptual

Multiple Choice Question
MC The number of protons in the nucleus of an a...

5. The "alpha" particle is
   - ○ two electrons bound to two protons.
   - → ○ two protons bound to two neutrons.
   - ○ an electron.
   - ○ two electrons bound to two neutrons.
   - ○ a photon.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual
Type: Definition

Multiple Choice Question
MC The alpha particle is

6. The "beta" particle is
   - → ○ an electron.
   - ○ electromagnetic radiation.
   - ○ two electrons bound to two neutrons.
   - ○ a helium nucleus.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy

Multiple Choice Question
MC The beta particle is

Topic: Radioactive decay
Type: Conceptual
Type: Definition

7. A "gamma" ray is
   - ○ an electron.
   - → ○ electromagnetic radiation.
   - ○ two electrons bound to two neutrons.
   - ○ a helium nucleus.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual
Type: Definition

Multiple Choice Question
MC A gamma ray is

8. During radioactive decay, the daughter element is always
   - ○ more massive than the parent.
   - ○ the same mass as the parent.
   - → ○ less massive than the parent.
   - ○ None of these.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual

Multiple Choice Question
MC During radioactive decay, the daughter eleme...

9. When a nucleus undergoes alpha decay, the daughter element always has
   - → ○ less charge than the parent.
   - ○ the same atomic number as the parent.
   - ○ more neutrons than the parent.
   - ○ more electrons than the parent.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual

Multiple Choice Question
MC When a nucleus undergoes alpha decay, the da...

10. A nucleus undergoes beta decay. Which of the following statements is true?
    - → ○ The daughter element has more protons than the parent.
    - ○ The daughter element has fewer protons than the parent.
    - ○ Both daughter and parent elements have the same atomic number.
    - ○ The daughter element has the same number of protons as the parent.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual

Multiple Choice Question
MC A nucleus undergoes beta decay. Which of the...

11. The "half-life" of a large collection of radioactive nuclei is
    - ○ the number of nuclei that decay in 1 second.
    - ○ the number of nuclei that remain after 1 second.
    - ○ larger for heavy nuclei than for lighter nuclei.
    - → ○ the time for half of the collection to decay.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual

Multiple Choice Question
MC The half-life of a large collection of rad...

12. Which of the following mechanisms can change the half-life of radioactive nuclei?
    - ○ Increasing the number of nuclei in the sample
    - ○ Extreme high pressure
    - ○ Extreme high temperature
    - → ○ None of these

Select

Accessibility: Keyboard Navigation
Difficulty: Medium
Topic: Radioactive decay
Type: Conceptual

Multiple Choice Question
MC Which of the following mechanisms can change...

13. A nucleus undergoes radioactive decay, emitting a gamma ray. Which of the following statements is true?
    - ○ The daughter nucleus has more neutrons than the parent.
    - ○ A nuclear proton changes into an electron-positron pair.
    - → ○ Both daughter and parent nuclei have the same atomic number.
    - ○ The daughter nucleus is more massive than the parent.

Select

Multiple Choice Question
MC A nucleus undergoes radioactive decay, emitt...

Accessibility: Keyboard Navigation
Difficulty: Medium
Topic: Radioactive decay
Type: Conceptual

14. What is the source of the energy released in nuclear reactions?

- ○ The binding of orbital electrons to the nuclear protons.
- → ○ The conversion of mass to energy.
- ○ The conversion of nuclear kinetic energy to particle potential energy.
- ○ Heat released during the radioactive decay process.

Select

Multiple Choice Question
MC What is the source of the energy released in...

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear reactors
Type: Conceptual

15. In nuclear fission,

- → ○ a nucleus is split into two less massive nuclei.
- ○ two heavy nuclei are induced to decay simultaneously.
- ○ high-energy particles are released from a nucleus that is at rest.
- ○ a nucleus is bombarded with another nucleus in order to induce an alpha decay.

Select

Multiple Choice Question
MC In nuclear fission,

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear reactions and nuclear fission
Type: Conceptual

16. The separation of different isotopes of a particular element can be difficult because

- ○ all isotopes are dangerous because of their radioactivity.
- ○ neutrons are so small.
- → ○ chemical reactions happen the same way for the isotopes.
- ○ the masses of the isotopes are the same.

Select

Multiple Choice Question
MC The separation of different isotopes of a pa...

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: The structure of the nucleus
Type: Conceptual

17. In a nuclear reactor, "chain reaction" refers primarily to

- ○ an out-of-control explosion.
- ○ the process of heating water to create steam to generate electric power.
- ○ the enrichment of uranium to make fuel for the reactor.
- → ○ the process by which the fission of one nucleus causes other nuclei to undergo fission.

Select

Multiple Choice Question
MC In a nuclear reactor, chain reaction refer...

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear reactors
Type: Conceptual

18. The substance that comes from a nuclear reactor which is used to generate power is

- ○ enriched uranium.
- → ○ high-pressure steam.
- ○ radioactive materials.
- ○ graphite.

Select

Multiple Choice Question
MC The substance that comes from a nuclear reac...

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear reactors
Type: Conceptual

19. A primary waste product of nuclear reactors that are designed for only power generation is

- ○ enriched uranium.
- ○ graphite.
- → ○ radioactive materials.
- ○ high-pressure steam.

Select

Multiple Choice Question
MC A primary waste product of nuclear reactors ...

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear reactors
Type: Conceptual

Select

20. In nuclear fusion,

- → ○ two smaller nuclei combine to form a larger nucleus.
- ○ many radioactive nuclei decay at once.
- ○ a large nucleus splits into smaller fragments.
- ○ the temperatures required are so high that it has never been accomplished on Earth.

Multiple Choice Question
MC In nuclear fusion,

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear weapons and nuclear fusion
Type: Conceptual

21. The N^{14} nucleus consists of
- ○ 14 neutrons.
- ○ 14 protons.
- ○ 21 protons and 7 electrons.
- → ○ 7 protons and 7 neutrons.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Radioactive decay
Type: Conceptual

Multiple Choice Question
MC The N14 nucleus consists of

22. Two nuclei have the same number of protons but different numbers of neutrons. We call these two nuclei
- → ○ isotopes.
- ○ isobars.
- ○ atomic mass units.
- ○ ions.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: The structure of the nucleus
Type: Conceptual

Multiple Choice Question
MC Two nuclei have the same number of protons b...

Type: Definition

23. Energy released in a nuclear fission process is produced by
- ○ electrons moving from a higher energy orbit to a lower energy orbit.
- ○ the conversion of some charge to energy.
- ○ the conversion of gravitational potential energy into kinetic energy.
- → ○ conversion of some mass to energy.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear reactions and nuclear fission
Type: Conceptual

Multiple Choice Question
MC Energy released in a nuclear fission process...

24. In a decay of $_{90}Th^{232}$ by emission of an alpha particle, the daughter nucleus will be
- ○ $_{92}U^{232}$.
- ○ $_{90}Th^{228}$.
- ○ $_{87}Ac^{232}$.
- ○ $_{88}Ra^{230}$.
- → ○ $_{88}Ra^{228}$.

Select

Accessibility: Keyboard Navigation
Difficulty: Medium
Topic: Radioactive decay
Type: Numerical

Multiple Choice Question
MC In a decay of 90Th232 by emission of an alph...

25. Generally, the number of neutrons present in nuclei that are fission fragments is _____ the number of neutrons of corresponding nuclei of stable isotopes.
- ○ less than
- ○ equal to
- → ○ greater than

Select

Accessibility: Keyboard Navigation
Difficulty: Medium
Topic: Nuclear reactions and nuclear fission
Type: Conceptual

Multiple Choice Question
MC Generally, the number of neutrons present in...

26. A deuterium nucleus and a tritium nucleus react to yield one alpha particle, a neutron, and energy. This is an example of a
- ○ chemical reaction.
- ○ fission reaction.
- → ○ fusion reaction.
- ○ chain reaction.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear weapons and nuclear fusion
Type: Conceptual

Multiple Choice Question
MC A deuterium nucleus and a tritium nucleus re...

Select

27. A deuterium nucleus and a tritium nucleus react to yield one alpha particle, a neutron, and energy. For this reaction, the sum of the masses of reaction products after the reaction is _____ the sum of the masses of particles before the reaction.
- → ○ less than
- ○ equal to

○ greater than

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question — Topic: Nuclear weapons and nuclear fusion
MC A deuterium nucleus and a tritium nucleus re... — Type: Conceptual

28. In a modern light water reactor, the ratio of U^{235} to U^{238} in the nuclear fuel is typically in the approximate ratio of
○ 0.7%.
○ 100%.
○ 11%.
→ ○ 3%.
Select ○ 67%.

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear reactors
Multiple Choice Question — Type: Conceptual
MC In a modern light water reactor, the ratio o... — Type: Definition

29. The purpose of the moderator in a reactor is to
→ ○ slow neutrons down so that they will be more likely to initiate fission reactions.
○ provide cooling for the control rods.
○ reduce the number of neutrons available for the chain reaction.
Select ○ separate the nuclear fuel from the spent products of fission.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question — Topic: Nuclear reactors
MC The purpose of the moderator in a reactor is... — Type: Conceptual

30. Both conventional fossil fuel and nuclear power plants
→ ○ produce waste heat that can affect the weather or upset the ecology of rivers or lakes.
○ produce carbon dioxide, which may increase global warming.
○ contribute to the problem of acid rain.
Select ○ produce hazardous waste products that must be stored in isolation for thousands of years.

Accessibility: Keyboard Navigation
Difficulty: Medium
Multiple Choice Question — Topic: Nuclear reactors
MC Both conventional fossil fuel and nuclear po... — Type: Conceptual

31. The primary reason that nuclear fusion has proven difficult to adapt for commercial power generation is that
○ the fuel is difficult to purify.
○ the possible fuel is scarce.
○ the temperatures involved are too low for efficient production.
Select → ○ nuclei repel each other due to their positive charges.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question — Topic: Nuclear weapons and nuclear fusion
MC The primary reason that nuclear fusion has p... — Type: Conceptual

32. A sample of U^{235} that is below the critical mass will not sustain a chain reaction because
→ ○ too many neutrons escape through the surface of the sample without initiating fission.
○ the inertia of the sample is too low for efficient fission.
○ nuclei repel each other due to their positive charges.
Select ○ the heat produced by the spontaneous fission of some nuclei is insufficient.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question — Topic: Nuclear reactors
MC A sample of U235 that is below the critical ... — Type: Conceptual

33. The average U.S. citizen receives measurable radiation from man-made sources such as power plants, medical and dental X-rays, and consumer products. The radiation received from natural sources is
○ about the same as that received from artificial sources.
○ almost immeasurable.
→ ○ more than that received from artificial sources.
Select ○ measurable but less than that received from artificial sources.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question — Topic: Radioactive decay
MC The average U.S. citizen receives measurable... — Type: Conceptual

Select 34. Walther Bothe and Wilhelm Becker discovered a new kind of particle radiation in 1930. The particle was later determined to be a neutron. Bothe and Becker generated neutron radiation by
○ heating nuclei to extremely high temperatures to boil the neutrons off.

○ using an isotope that decays by emitting neutrons.
○ using electrons to attract protons away from the nucleus.
→ ○ firing a beam of alpha particles at a beryllium target.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question
Topic: Radioactive decay
MC Walther Bothe and Wilhelm Becker discovered ...
Type: Conceptual

35. The Tokamak is a type of

○ moderator used in pressurized heavy water reactors.
→ ○ experimental fusion reactor.
○ nuclear reactor using graphite as a moderator, such as the reactor at Chernobyl.
○ particle accelerator.

Select

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: Nuclear weapons and nuclear fusion
Multiple Choice Question
Type: Conceptual
MC The Tokamak is a type of
Type: Definition

36. The number of neutrons in a stable isotope must

○ equal the number of protons plus electrons.
○ equal the number of electrons.
○ equal the number of protons.
Select → ○ None of the choices is correct.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question
Topic: The structure of the nucleus
MC The number of neutrons in a stable isotope m...
Type: Conceptual

37. Two atoms have the same number of neutrons but different numbers of protons. These two atoms

→ ○ will exhibit different chemical properties.
○ are isotopes of each other.
○ have the same number of electrons.
Select ○ have the same atomic mass.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question
Topic: The structure of the nucleus
MC Two atoms have the same number of neutrons b...
Type: Conceptual

38. In a nuclear fission reaction,

○ one nucleus splits into two equal halves.
→ ○ one nucleus splits into two parts, neither daughter having a mass close to the parent.
○ one nucleus splits into two parts, one very small and one almost the same mass as the parent.
Select ○ two nuclei combine to form a single, more massive nucleus.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question
Topic: Nuclear reactions and nuclear fission
MC In a nuclear fission reaction,
Type: Conceptual

39. A feature of the nuclear reactor at Chernobyl that contributed to the magnitude of the accident there was that

→ ○ water was used only as a coolant, not a moderator.
○ plutonium could build up quickly in the reactor.
○ the uranium fuel was more highly enriched.
Select ○ the reactor did not have control rods.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question
Topic: Nuclear reactors
MC A feature of the nuclear reactor at Chernoby...
Type: Conceptual

40. In all nuclear reactions,

○ energy must be conserved.
○ the total number of protons plus neutrons must be conserved.
○ charge is not created or lost.
Select → ○ all of these.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question
Topic: The structure of the nucleus
MC In all nuclear reactions,
Type: Conceptual

Select 41. A piece of uranium can be made into nuclear explosive only after it is purified into uranium-235, because

○ it has to be soldered with lead for safety.

→ ○ the other naturally occurring isotopes of uranium interfere with efficient chain reactions.
○ uranium-235 is the heaviest isotope known to mankind.
○ before purification, the uranium-235 nucleus will not split apart.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question — Topic: Nuclear weapons and nuclear fusion
MC A piece of uranium can be made into nuclear ... — Type: Conceptual

42. The atomic mass system is based upon
○ the mass of uranium-238, since it is the heaviest element occurring in nature.
○ the mass of the neutron.
○ the mass of liquid water.
Select → ○ the mass of carbon-12, a very common isotope of carbon.

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: The structure of the nucleus
Multiple Choice Question — Type: Conceptual
MC The atomic mass system is based upon — Type: Definition

43. The instability of uranium-235 compared to uranium-238, along with the relative stability of hydrogen compared to tritium, shows that the stability of a given nucleus depends upon
○ the speed of electrons orbiting the nucleus: more mass means more gravitational pull.
→ ○ adding or subtracting neutrons, which can change a stable isotope into an unstable isotope.
Select ○ the mass: heavier nuclei are always less stable.
○ the number of electrons in the nucleus.

Accessibility: Keyboard Navigation
Difficulty: Easy
Multiple Choice Question — Topic: Radioactive decay
MC The instability of uranium-235 compared to u... — Type: Conceptual

44. Momentum and energy from focused laser beams can be used in nuclear fusion. This is because
→ ○ light cannot be melted, so its pressure can confine the reaction.
○ light is not magnetic.
○ light can also function as a moderator, like graphite or water in a uranium reactor.
Select ○ the wavelength of light is small enough to penetrate each proton.

Accessibility: Keyboard Navigation
Difficulty: Hard
Multiple Choice Question — Topic: Nuclear weapons and nuclear fusion
MC Momentum and energy from focused laser beams... — Type: Conceptual

45. Neutrons were discovered by James Chadwick by observing the behavior of
○ gold atoms in a thin foil.
○ copper conducting electricity in the absence of a magnetic field.
○ carbon dioxide molecules under high pressure.
Select → ○ the collision after-effects of protons emerging from paraffin.

Accessibility: Keyboard Navigation
Difficulty: Easy
Topic: The structure of the nucleus
Multiple Choice Question — Type: Conceptual
MC Neutrons were discovered by James Chadwick b... — Type: Definition

46. Suppose a radioactive isotope has a half-life of 2.0 hours. For an initial sample of 6400 nuclei, the number remaining after 6.0 hours is about _____.
800
Select

Difficulty: Easy
Fill-in-the-Blank Question — Topic: Radioactive decay
FB Suppose a radioactive isotope has a half-lif... — Type: Numerical

47. To make a bomb based on the fission reaction work, one must at the time of detonation bring together an amount of fissionable material equal to or larger than the _____ mass.
critical
Select

Difficulty: Easy
Fill-in-the-Blank Question — Topic: Nuclear weapons and nuclear fusion
FB To make a bomb based on the fission reaction... — Type: Conceptual

48. The energy radiated by the sun has as its primary origin energy produced by _____ reactions.
fusion
Select

Difficulty: Easy
Fill-in-the-Blank Question — Topic: Nuclear weapons and nuclear fusion
FB The energy radiated by the sun has as its pr... — Type: Conceptual

Select 49. Control rods are inserted into a nuclear reactor when you want the nuclear reaction rate to _____ (two words).

slow down

Difficulty: Easy
Fill-in-the-Blank Question — Topic: Nuclear reactors
FB Control rods are inserted into a nuclear rea... — Type: Conceptual

50. The _____ was a particle predicted to exist long before it was observed because energy is not conserved in beta decays without it.

antineutrino

Select

Difficulty: Easy
Fill-in-the-Blank Question — Topic: Radioactive decay
FB The _____ was a particle predicted to e... — Type: Conceptual

51. The nuclide $_{93}Np^{239}$ decays by emission of a negative electron. The daughter nucleus will have an atomic number _____ and a mass number _____.

94, 239

Select

Difficulty: Medium
Fill-in-the-Blank Question — Topic: Radioactive decay
FB The nuclide 93Np239 decays by emission of a ... — Type: Numerical

52. Materials that are used as moderators in nuclear power reactors are carbon (graphite) and _____.

water

Select

Difficulty: Easy
Fill-in-the-Blank Question — Topic: Nuclear reactors
FB Materials that are used as moderators in nuc... — Type: Conceptual

53. The atomic mass unit is based on the mass of the _____ atom.

carbon-12

Select

Difficulty: Easy
Topic: The structure of the nucleus
Fill-in-the-Blank Question — Type: Conceptual
FB The atomic mass unit is based on the mass of... — Type: Definition