

**Phys.G12-subatomic physics-H.W****Multiple Choice**

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

- \_\_\_\_\_ 1. Radium-226 decays to radon-222 by emitting  
a. beta particles. c. gamma particles.  
b. alpha particles. d. positrons.
- \_\_\_\_\_ 2. In fission reactions, how must the binding energy per nucleon vary?  
a. The binding energy per nucleon increases as atomic number increases.  
b. The binding energy per nucleon decreases as atomic number increases.  
c. The binding energy per nucleon remains constant as atomic number increases.  
d. none of the above
- \_\_\_\_\_ 3. As the number of protons in the nucleus increases, the repulsive force  
a. remains unchanged. c. becomes weaker.  
b. drops to zero. d. becomes stronger.
- \_\_\_\_\_ 4. Which interaction of nature depends on the distance through which it acts and is involved in beta decay?  
a. strong c. gravitational  
b. weak d. electromagnetic
- \_\_\_\_\_ 5. If the stable nuclei are plotted with neutron number versus proton number, the curve formed by the stable nuclei does not follow the line  $N = Z$ . Which of the following influences the binding energy so that this "valley of stability" forms?  
a. the size of the nuclear surface c. the volume of the nucleus  
b. the Coulomb repulsive force d. the proton-neutron mass difference
- \_\_\_\_\_ 6. In fusion reactions, how does the binding energy per nucleon vary?  
a. The binding energy per nucleon increases as atomic number increases.  
b. The binding energy per nucleon remains constant as atomic number increases.  
c. The binding energy per nucleon remains constant as atomic number decreases.  
d. The binding energy per nucleon decreases as atomic number increases.
- \_\_\_\_\_ 7. Rutherford's experiments involving the use of alpha particle beams directed onto thin metal foils demonstrated the existence of which of the following?  
a. neutron c. proton  
b. positron d. nucleus
- \_\_\_\_\_ 8. In the radioactive formula,  ${}_{86}^{220}\text{Rn} \rightarrow {}_{84}^{216}\text{Po} + \text{X}$ , what does X represent?  
a.  ${}_{-1}^0e$  c.  ${}_{2}^4\text{He}$   
b.  ${}_{1}^0e$  d.  $\lambda$
- \_\_\_\_\_ 9. How many half-lives does it take for a radioactive substance to decay to 12.5 percent of its original amount?  
a. 3 c. 1  
b. 2 d. 4
- \_\_\_\_\_ 10. If there are 128 neutrons in Pb-210, how many neutrons are found in the nucleus of Pb-206?  
a. 130 c. 124  
b. 122 d. 126

- \_\_\_\_\_ 11. What does the mass number of a nucleus indicate?
- the number of neutrons and protons present
  - the number of protons present
  - the average atomic mass of the element
  - the number of neutrons present
- \_\_\_\_\_ 12. To which of the following is the atomic number of a given element equivalent?
- the sum of the protons and neutrons in the nucleus
  - the number of electrons in the outer shells
  - the number of protons in the nucleus
  - the number of neutrons in the nucleus
- \_\_\_\_\_ 13. The natural logarithm of 2 (0.693) divided by the half-life of a radioactive substance is equal to the
- activity.
  - decay rate.
  - decay lifetime.
  - decay constant.
- \_\_\_\_\_ 14. Which interaction of nature holds the planets, stars, and galaxies together, even though its effect on elementary particles is negligible?
- strong
  - gravitational
  - electromagnetic
  - weak
- \_\_\_\_\_ 15. Which statement about quarks is *not* correct?
- There are six quarks that fit together in pairs.
  - Only two quarks are needed to construct a hadron.
  - Every quark has an antiquark of opposite charge.
  - An isolated quark has been observed by physicists.
- \_\_\_\_\_ 16. When bismuth-214 emits a beta particle, the remaining daughter nucleus is
- actinium-215.
  - lead-213.
  - polonium-214.
  - bismuth-215.
- \_\_\_\_\_ 17. Which of these particles are classified as hadrons?
- neutrinos
  - leptons
  - electrons
  - mesons
- \_\_\_\_\_ 18. Which interaction of nature binds neutrons and protons into nuclei?
- strong
  - electromagnetic
  - weak
  - gravitational
- \_\_\_\_\_ 19. As the early universe cooled and expanded, which interaction separated first from the four unified interactions?
- the strong interaction
  - the electromagnetic interaction
  - the gravitational interaction
  - the weak interaction
- \_\_\_\_\_ 20. At this time, all nuclear reactors operate through
- neither fission nor fusion.
  - fusion only.
  - fission only.
  - both fission and fusion.
- \_\_\_\_\_ 21. Which of the following do physicists believe are fundamental particles?
- three quarks and six leptons
  - six quarks and three leptons
  - three quarks and three leptons
  - six quarks and six leptons
- \_\_\_\_\_ 22. Which interaction of nature binds atoms and molecules by attracting unlike charges and repulsing like charges?
- electromagnetic
  - weak
  - gravitational
  - strong

- \_\_\_\_\_ 23. Which of the following is *not* one of the current questions regarding the standard model?
- How many quarks make up a proton?
  - What determines particle mass?
  - Can quarks exist in isolation?
  - Why do quarks carry fractional charge and electrons carry whole charge?
- \_\_\_\_\_ 24. The alpha emission process results in the daughter nucleus differing in what manner from the parent?
- Atomic mass increases by one.
  - Atomic number increases by one.
  - Atomic mass decreases by two.
  - Atomic number decreases by two.
- \_\_\_\_\_ 25. What daughter isotopes are produced when a neutron combines with a nucleus of  ${}_{92}^{235}\text{U}$ ? Assume that three neutrons are also produced in the reaction.
- ${}_{56}^{141}\text{Ba}$ ,  ${}_{36}^{94}\text{Kr}$
  - ${}_{56}^{142}\text{Ba}$ ,  ${}_{36}^{93}\text{Kr}$
  - ${}_{56}^{140}\text{Ba}$ ,  ${}_{36}^{95}\text{Kr}$
  - ${}_{56}^{140}\text{Ba}$ ,  ${}_{36}^{93}\text{Kr}$
- \_\_\_\_\_ 26. When are heavy nuclei most stable?
- when they contain more neutrons than protons
  - when they contain more protons than neutrons
  - when the Coulomb force is stronger than the nuclear force
  - when they contain equal numbers of protons and neutrons
- \_\_\_\_\_ 27. In order to adequately control a chain reaction, it is necessary to have within the fissionable material a nonfissionable material. How does this material interact with neutrons?
- The material scatters neutrons.
  - The material converts neutrons.
  - The material absorbs neutrons.
  - The material emits neutrons.
- \_\_\_\_\_ 28. What are the components of natural radiation, in order from least to most penetrating?
- alpha, beta, and gamma
  - gamma, beta, and alpha
  - beta, gamma, and alpha
  - alpha, gamma, and beta
- \_\_\_\_\_ 29. Samples of two different isotopes, X and Y, both contain the same number of radioactive atoms. The half-life of Sample X is twice that of Sample Y. How do their rates of radiation compare?
- Sample X has a greater rate than Sample Y.
  - The rates of Sample X and Sample Y are equal.
  - Sample X has a smaller rate than Sample Y.
  - This cannot be determined from the information given.
- \_\_\_\_\_ 30. What particle is emitted when Pu-240 decays to U-236?
- alpha
  - beta
  - positron
  - gamma
- \_\_\_\_\_ 31. Light nuclei are stable when the ratio of protons to neutrons is
- greater than 1.
  - equal to 1.
  - less than 1.
  - equal to 2.
- \_\_\_\_\_ 32. During the expansion of the early universe, which two interactions were the last to separate?
- the strong and weak interactions
  - the electromagnetic and gravitational interactions
  - the electromagnetic and weak interactions
  - the gravitational and strong interactions
- \_\_\_\_\_ 33. What particle is emitted when P-32 decays to S-32?
- positron
  - beta
  - gamma
  - alpha

- \_\_\_\_\_ 34. What is the binding energy of a nucleus?
- the energy released when nucleons bind together to form a stable nucleus
  - the average energy with which any nucleon is bound in the nucleus
  - the energy needed to remove one of the nucleons
  - the mass of the nucleus times  $c^2$
- \_\_\_\_\_ 35. How does a radioactive isotope that emits an alpha particle change?
- Mass number decreases by one.
  - Atomic number decreases by one.
  - Atomic number decreases by four.
  - Mass number decreases by four.
- \_\_\_\_\_ 36. Why is it *not* possible for a thermonuclear fusion reaction to be maintained in the ocean?
- The deuterium in the ocean is not radioactive.
  - There is insufficient deuterium in the ocean.
  - The density is not high enough.
  - The temperature is not high enough.
- \_\_\_\_\_ 37. Which of the following is an example of a baryon?
- electron
  - lepton
  - proton
  - meson
- \_\_\_\_\_ 38. The nucleus of an atom is made up of which of the following combinations of particles?
- protons, electrons, and neutrons
  - electrons and neutrons
  - electrons and protons
  - protons and neutrons
- \_\_\_\_\_ 39. At around what mass number is the binding energy per nucleon greatest?
- 26
  - 235
  - 58
  - 111
- \_\_\_\_\_ 40. How is a fission reactor different from a fusion reactor?
- The transportation of fuel is safer.
  - There is less radioactive waste.
  - The fuel must be processed.
  - The fuel is cheaper.

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