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

Honors Chemistry Ch 5 PRACTICE TEST

Matching

Match each item with the correct statement below.

a. atomic orbital
b. aufbau principle
c. electron configuration
d. ground state
e. Pauli exclusion principle
f. Heisenberg uncertainty principle

____ 1. region of high probability of finding an electron

____ 2. states the impossibility of knowing both velocity and position of a moving particle at the same time

____ 3. lowest energy level

____ 4. tendency of electrons to enter orbitals of lowest energy first

____ 5. arrangement of electrons around atomic nucleus

____ 6. each orbital has at most two electrons

Match each item with the correct statement below.

a. atomic emission spectrum
b. frequency
c. wavelength
d. photon
e. quantum
f. spectrum

____ 7. discrete bundle of electromagnetic energy

____ 8. energy needed to move an electron from one energy level to another

____ 9. number of wave cycles passing a point per unit of time

____ 10. distance between wave crests

____ 11. separation of light into different wavelengths

____ 12. frequencies of light emitted by an element

Multiple Choice

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

____ 13. In Bohr's model of the atom, where are the electrons and protons located?
a. The electrons move around the protons, which are at the center of the atom.
b. The electrons and protons move throughout the atom.
c. The electrons occupy fixed positions around the protons, which are at the center of the atom.
d. The electrons and protons are located throughout the atom, but they are not free to move.

____ 14. In the Bohr model of the atom, an electron in an orbit has a fixed ____.
a. position
b. color
c. energy
d. size

____ 15. How does the energy of an electron change when the electron moves closer to the nucleus?
a. It decreases.
b. It increases.
c. It stays the same.
d. It doubles.

____ 16. The principal quantum number indicates what property of an electron?
a. position
b. speed
c. energy level
d. electron cloud shape

____ 17. What is the shape of the $3p$ atomic orbital?
a. sphere
b. dumbbell
c. bar
d. two perpendicular dumbbells

____ 18. How many energy sublevels are in the second principal energy level?
a. 1
b. 2
c. 3
d. 4

____ 19. What is the maximum number of *f* orbitals in any single energy level in an atom?
a. 1
b. 3
c. 5
d. 7

____ 20. What is the maximum number of *d* orbitals in a principal energy level?
a. 1
b. 2
c. 3
d. 5

____ 21. What is the maximum number of orbitals in the *p* sublevel?
a. 2
b. 3
c. 4
d. 5

____ 22. What is the maximum number of electrons in the second principal energy level?
a. 2
b. 8
c. 18
d. 32

____ 23. When an electron moves from a lower to a higher energy level, the electron ____.
a. always doubles its energy
b. absorbs a continuously variable amount of energy
c. absorbs a quantum of energy
d. moves closer to the nucleus

____ 24. The shape (not the size) of an electron cloud is determined by the electron's ____.
a. energy sublevel
b. position
c. speed
d. principal quantum number

____ 25. The letter "*p*" in the symbol $4p^3$ indicates the ____.
a. spin of an electron
b. orbital shape
c. principle energy level
d. speed of an electron

____ 26. If the spin of one electron in an orbital is clockwise, what is the spin of the other electron in that orbital?
a. zero
b. clockwise
c. counterclockwise
d. both clockwise and counterclockwise

____ 27. What types of atomic orbitals are in the third principal energy level?
a. *s* and *p* only
b. *p* and *d* only
c. *s, p,* and *d* only
d. *s, p, d,* and *f*

____ 28. What is the next atomic orbital in the series 1*s*, 2*s*, 2*p*, 3*s*, 3*p*?
a. 2*d*
b. 3*d*
c. 3*f*
d. 4*s*

____ 29. According to the aufbau principle, ____.
a. an orbital may be occupied by only two electrons
b. electrons in the same orbital must have opposite spins
c. electrons enter orbitals of highest energy first
d. electrons enter orbitals of lowest energy first

____ 30. What is the number of electrons in the outermost energy level of an oxygen atom?
a. 2
b. 4
c. 6
d. 8

____ 31. What is the electron configuration of potassium?
a. $1s^2 2s^2 2p^2 3s^2 3p^2 4s^1$
b. $1s^2 2s^2 2p^{10} 3s^2 3p^3$
c. $1s^2 2s^2 3s^2 3p^6 3d^1$
d. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

____ 32. If three electrons are available to fill three empty 2*p* atomic orbitals, how will the electrons be distributed in the three orbitals?
a. one electron in each orbital
b. two electrons in one orbital, one in another, none in the third
c. three in one orbital, none in the other two
d. Three electrons cannot fill three empty 2*p* atomic orbitals.

____ 33. How many unpaired electrons are in a sulfur atom (atomic number 16)?
a. 0
b. 1
c. 2
d. 3

____ 34. How many half-filled orbitals are in a bromine atom?
a. 1
b. 2
c. 3
d. 4

____ 35. Stable electron configurations are likely to contain ____.
a. filled energy sublevels
b. fewer electrons than unstable configurations
c. unfilled *s* orbitals
d. electrons with a clockwise spin

____ 36. What is the basis for exceptions to the aufbau diagram?
a. Filled and half-filled energy sublevels are more stable than partially-filled energy sublevels.
b. Electron configurations are only probable.
c. Electron spins are more important than energy levels in determining electron configuration.
d. Some elements have unusual atomic orbitals.

____ 37. Which electron configuration of the $4f$ energy sublevel is the most stable?
a. $4f^7$
b. $4f$
c. $4f^{13}$
d. $4f^{14}$

____ 38. Which of the following electron configurations of outer sublevels is the most stable?
a. $4d^5 5s^1$
b. $4d^4 5s^2$
c. $4d^3 5s^3$
d. $4d^2 5s^4$

____ 39. How does the speed of visible light compare with the speed of gamma rays, when both speeds are measured in a vacuum?
a. The speed of visible light is greater.
b. The speed of gamma rays is greater.
c. The speeds are the same.
d. No answer can be determined from the information given.

____ 40. Which color of visible light has the shortest wavelength?
a. yellow
b. green
c. blue
d. violet

____ 41. Which of the following electromagnetic waves have the highest frequencies?
a. ultraviolet light waves
b. X-rays
c. microwaves
d. gamma rays

____ 42. Which type of electromagnetic radiation includes the wavelength 10^{-7} m?
a. gamma ray
b. microwave
c. radio wave
d. visible light

____ 43. How are the frequency and wavelength of light related?
a. They are inversely proportional to each other.
b. Frequency equals wavelength divided by the speed of light.
c. Wavelength is determined by dividing frequency by the speed of light.
d. They are directly proportional to each other.

____ 44. What is the wavelength of an electromagnetic wave that travels at 3×10^8 m/s and has a frequency of 60 MHz? (1 MHz = 1,000,000 Hz)
a. $\frac{60{,}000{,}000 \text{ Hz}}{300{,}000{,}000 \text{ m/s}}$
b. 60 MHz × 300,000,000 m/s
c. $\frac{300{,}000{,}000 \text{ m/s}}{60{,}000{,}000 \text{ Hz}}$
d. No answer can be determined from the information given.

____ 45. The light given off by an electric discharge through sodium vapor is ____.
a. a continuous spectrum
b. an emission spectrum
c. of a single wavelength
d. white light

____ 46. Emission of light from an atom occurs when an electron ____.
a. drops from a higher to a lower energy level
b. jumps from a lower to a higher energy level
c. moves within its atomic orbital
d. falls into the nucleus

____ 47. As changes in energy levels of electrons increase, the frequencies of atomic line spectra they emit ____.
a. increase
b. decrease
c. remain the same
d. cannot be determined

____ 48. The atomic emission spectra of a sodium atom on Earth and of a sodium atom in the sun would be ____.
a. the same
b. different from each other
c. the same as those of several other elements
d. the same as each other only in the ultraviolet range

____ 49. What is the approximate energy of a photon having a frequency of 4×10^{7} Hz? ($h = 6.6 \times 10^{-34}$ J·s)
a. 3×10^{-26} J
b. 3×10^{-27} J
c. 2×10^{-41} J
d. 3×10^{42} J

____ 50. What is the approximate frequency of a photon having an energy 5×10^{-24} J? ($h = 6.6 \times 10^{-34}$ J·s)
a. 8×10^{9} Hz
b. 3×10^{-57} Hz
c. 3×10^{-58} Hz
d. 1×10^{-10} Hz

____ 51. Which of the following quantum leaps would be associated with the greatest energy of emitted light?
a. n = 5 to n = 1
b. n = 4 to n = 5
c. n = 2 to n = 5
d. n = 5 to n = 4

____ 52. Which variable is directly proportional to frequency?
a. wavelength
b. velocity
c. position
d. energy

____ 53. How do the energy differences between the higher energy levels of an atom compare with the energy differences between the lower energy levels of the atom?
a. They are greater in magnitude than those between lower energy levels.
b. They are smaller in magnitude than those between lower energy levels.
c. There is no significant difference in the magnitudes of these differences.
d. No answer can be determined from the information given.

____ 54. What are quanta of light called?
a. charms
b. excitons
c. muons
d. photons

____ 55. Which scientist developed the quantum mechanical model of the atom?
a. Albert Einstein
b. Erwin Schrodinger
c. Niels Bohr
d. Ernest Rutherford

____ 56. Bohr's model could only explain the spectra of which type of atoms?
a. single atoms with one electron
b. bonded atoms with one electron
c. single atoms with more than one electron
d. bonded atoms with more than one electron

____ 57. The quantum mechanical model of the atom ____.
a. defines the exact path of an electron around the nucleus
b. was proposed by Niels Bohr
c. involves the probability of finding an electron in a certain position
d. has many analogies in the visible world

____ 58. Who predicted that all matter can behave as waves as well as particles?
a. Albert Einstein
b. Erwin Schrodinger
c. Max Planck
d. Louis de Broglie

____ 59. According to the Heisenberg uncertainty principle, if the position of a moving particle is known, what other quantity CANNOT be known?
a. mass
b. charge
c. spin
d. velocity

____ 60. How can the position of a particle be determined?
a. by analyzing its interactions with another particle
b. by measuring its velocity
c. by measuring its mass
d. by determining its charge

____ 61. The wavelike properties of electrons are useful in ____.
a. defining photons
b. writing electron configurations
c. magnifying objects
d. determining the velocity and position of a particle

____ 62. In an *s* orbital, the probability of finding an electron a particular distance from the nucleus does NOT depend on ____.
a. a quantum mechanical model
b. direction with respect to the nucleus
c. the Schrodinger equation
d. the electron energy sublevel

Short Answer

63. Give the electron configuration for a neutral atom of beryllium.

64. Give the electron configuration for a neutral atom of chlorine.

65. Give the electron configuration for a neutral atom of selenium.

66. Write the electron configuration for chromium.

67. What is the frequency of ultraviolet light with wavelength 2.94×10^{-8} m? ($c = 3.00 \times 10^{8}$ m/s)

68. What is the wavelength of gamma ray electromagnetic radiation with a frequency of 2.73×10^{20} Hz? ($c = 3.00 \times 10^{8}$ m/s)

69. What is the frequency of a radar photon with energy 6.80×10^{-25} J? ($h = 6.63 \times 10^{-34}$ J·s)

70. What is the energy of a microwave photon that has a frequency of 1.12×10^{12} Hz? ($h = 6.63 \times 10^{-34}$ J·s)

Numeric Response

71. How many electrons are in the highest occupied energy level of a neutral chlorine atom?

72. How many electrons are in the highest occupied energy level of a neutral strontium atom?

73. How many electrons are in the highest occupied energy level of copper?

Essay

74. Describe the shapes and relative energies of the *s, p, d,* and *f* atomic orbitals.

75. Explain why the 4*s* sublevel fills before the 3*d* sublevel begins to fill as electrons are added.

76. Describe the different principles that govern the building of an electron configuration.

77. What is the explanation for the discrete lines in atomic emission spectra?

78. Why are you unable to observe the wavelike motion of a soccer ball as it is kicked toward a goal?

79. What is the quantum mechanical model?

80. Explain what is meant by the Heisenberg uncertainty principle.