

## Unit 3, Part II Review 2017

### 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

- A** 1. region of high probability of finding an electron  
**E** 2. states the impossibility of knowing both velocity and position of a moving particle at the same time  
**D** 3. lowest energy level  
**B** 4. tendency of electrons to enter orbitals of lowest energy first  
**C** 5. arrangement of electrons around atomic nucleus  
**E** 6. each orbital has at most two electrons

Match each item with the correct statement below.

- a. wavelength  
b. frequency  
c. photon  
d. quantum

- C** 7. discrete bundle of electromagnetic energy  
**D** 8. energy needed to move an electron from one energy level to another  
**B** 9. number of wave cycles passing a point per unit of time (Think about my steps demonstration)  
**A** 10. distance between wave crests (Think about my steps demonstration)

### Multiple Choice

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

- A** 11. 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.
- C** 12. In the Bohr model of the atom, an electron in an orbit has a fixed \_\_\_\_\_.  
a. position  
b. color  
c. energy  
d. size
- A** 13. 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.

- B** 14. What is the shape of the  $3p$  atomic orbital?  
a. sphere  
b. dumbbell  
c. bar  
d. two perpendicular dumbbells

- B** 15. How many energy sublevels are in the second principal energy level?  
a. 1  
b. 2  
c. 3  
d. 4

- D** 16. What is the maximum number of  $f$  orbitals in any single energy level in an atom?  
a. 1  
b. 3  
c. 5  
d. 7

- D** 17. What is the maximum number of  $d$  orbitals in a principal energy level?  
a. 1  
b. 2  
c. 3  
d. 5

- B** 18. What is the maximum number of orbitals in the  $p$  sublevel?  
a. 2  
b. 3  
c. 4  
d. 5

- B** 19. What is the maximum number of electrons in the second principal energy level?  
a. 2  
b. 8  
c. 18  
d. 32

- C** 20. 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

- B** 21. 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

- C** 22. 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

- C** 23. 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  $f$

- D** 24. 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

- C** 25. What is the number of electrons in the outermost energy level of an oxygen atom?  
a. 2  
b. 4  
c. 6  
d. 8

25 2 2 4

26. What is the electron configuration of potassium?
- $1s^2 2s^2 2p^6 3s^2 3p^2 4s^1$
  - $1s^2 2s^2 2p^6 3s^2 3p^3$
  - $1s^2 2s^2 3s^2 3p^6 3d^1$
  - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

27. If three electrons are available to fill three empty  $2p$  atomic orbitals, how will the electrons be distributed in the three orbitals?
- one electron in each orbital
  - two electrons in one orbital, one in another, none in the third
  - three in one orbital, none in the other two
  - Three electrons cannot fill three empty  $2p$  atomic orbitals.

28. How many unpaired electrons are in a sulfur atom (atomic number 16)?
- 0
  - 1
  - 2
  - 3
- C 2 11 1 1  
3p

29. Stable electron configurations are likely to contain \_\_\_\_.
- filled energy sublevels
  - fewer electrons than unstable configurations
  - unfilled  $s$  orbitals
  - electrons with a clockwise spin

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

31. Which color of visible light has the shortest wavelength?
- yellow
  - blue
  - green
  - violet

32. Which of the following electromagnetic waves have the highest frequencies?
- ultraviolet light waves
  - X-rays
  - microwaves
  - gamma rays

33. How are the frequency and wavelength of light related?
- They are inversely proportional to each other.
  - Frequency equals wavelength divided by the speed of light.
  - Wavelength is determined by dividing frequency by the speed of light.
  - They are directly proportional to each other.

34. Emission of light from an atom occurs when an electron \_\_\_\_.
- drops from a higher to a lower energy level
  - jumps from a higher to a higher energy level
  - moves within its atomic orbital
  - falls into the nucleus

35. As changes in energy levels of electrons increase, the frequencies of atomic line spectra they emit \_\_\_\_.
- increase
  - decrease
  - remain the same
  - cannot be determined
- E ↑ f ↑ wavelength ↓

36. The atomic emission spectra of a sodium atom on Earth and of a sodium atom in the sun would be \_\_\_\_.
- the same
  - different from each other
  - the same as those of several other elements
  - the same as each other only in the ultraviolet range

37. Which of the following quantum leaps would be associated with the greatest energy of emitted light?
- $n = 5$  to  $n = 1$
  - $n = 4$  to  $n = 5$
  - $n = 7$  to  $n = 5$
  - $n = 5$  to  $n = 4$

38. Which variable is directly proportional to frequency?
- wavelength
  - velocity
  - position
  - energy

39. Which scientist developed the quantum mechanical model of the atom?
- Albert Einstein
  - Erwin Schrodinger
  - Niels Bohr
  - Ernest Rutherford

40. Bohr's model could only explain the spectra of which type of atoms?
- single atoms with one electron
  - bonded atoms with one electron
  - single atoms with more than one electron
  - bonded atoms with more than one electron

41. The quantum mechanical model of the atom \_\_\_\_.
- defines the exact path of an electron around the nucleus
  - was proposed by Niels Bohr
  - involves the probability of finding an electron in a certain position
  - has many analogies in the visible world

42. Who predicted that all matter can behave as waves as well as particles?
- Albert Einstein
  - Max Planck
  - Erwin Schrodinger
  - Louis de Broglie
- (Not on test)

43. According to the Heisenberg uncertainty principle, if the position of a moving particle is known, what other quantity CANNOT be known?
- mass
  - spin
  - charge
  - velocity

44. What element has the electron configuration  $1s^2 2s^2 2p^6 3s^2 3p^2$ ?
- nitrogen
  - selenium
  - silicon
  - silver

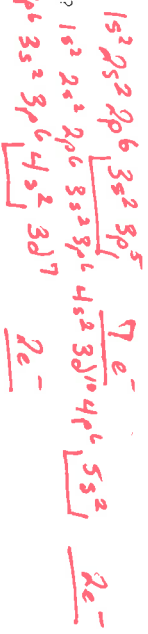
45. Which of the following is true about the electron configurations of the noble gases?
- The highest occupied  $s$  and  $p$  sublevels are completely filled.
  - The highest occupied  $s$  and  $p$  sublevels are partially filled.
  - The electrons with the highest energy are in a  $d$  sublevel.
  - The electrons with the highest energy are in an  $f$  sublevel.

Numeric Response

- 46. How many electrons are in the highest occupied energy level of a neutral chlorine atom?
- 47. How many electrons are in the highest occupied energy level of a neutral strontium atom?
- 48. How many electrons are in the highest occupied energy level of copper?
- 49. How many electrons are there in the highest occupied energy level of atoms in Group 5A (Nitrogen family) elements?
- 50. How many electrons are present in the d sublevel of a neutral atom of nickel?
- 51. Give the electron configuration for a neutral atom of beryllium.
- 52. Give the electron configuration for a neutral atom of chlorine.
- 53. Give the electron configuration for a neutral atom of selenium.
- 54. Write the electron configuration for chromium.
- 55. Describe the shapes and relative energies of the s, p, d, and f atomic orbitals.
- 56. Explain why the 4s sublevel fills before the 3d sublevel begins to fill as electrons are added.
- 57. Describe the different principles (rules) that govern the building of an electron configuration.
- 58. What is the explanation for the discrete lines in atomic emission spectra?
- 59. What is the quantum mechanical model?
- 60. Explain what is meant by the Heisenberg uncertainty principle.

Essay

- 51.  $1s^2 2s^2 2p^6 3s^2 3p^4$  or  $[Ar] 3s^2 3p^4$
- 52.  $1s^2 2s^2 2p^6 3s^2 3p^5$  or  $[Ne] 3s^2 3p^5$
- 53.  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4 4p^4$  or  $[Ar] 4s^2 3d^4 4p^4$
- 54.  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$  or  $[Ar] 4s^2 3d^4$



X = "Row #" (principle number)

57. (cont.) Pauli Exclusion - "Unique Snowflake" - All electrons must have a unique designation

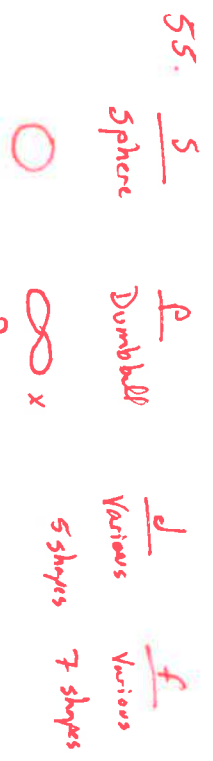


58. Lines are result of different size drops in Energy.



59. A probability model showing an "Electron Cloud" as an area with 90% probability of where an electron might be located.

60. The location and the velocity of an electron cannot both be known at the same time. One or the other can be known, but not both. The act of measuring changes / affects location and/or velocity.



56. It takes less Energy to start level 4s than to fill 3d due to electron repulsion of d orbitals between existing p orbitals.

57. Aufbau - "Glasses of wine" - fill from lowest orbital first.

Hund's Rule - "Seeds on a bus" - "Singles before Doubles" - Electrons will fill orbitals individually before pairing up due to e<sup>-</sup> repulsion.