

QUANTUM NUMBERS WORKSHEET Name _____

1. State the four quantum numbers and the possible values they may have.
2. Name the orbitals described by the following quantum numbers
 - a. $n = 3, L = 0$
 - b. $n = 3, L = 1$
 - c. $n = 3, L = 2$
 - d. $n = 5, L = 0$
3. Give the n and L values for the following orbitals
 - a. $1s$
 - b. $3s$
 - c. $2p$
 - d. $4d$
 - e. $5f$
4. Circle all of the following orbital destinations that are theoretically possible.
 - a. $7s$
 - b. $1p$
 - c. $5d$
 - d. $2d$
 - e. $4f$
 - f. $5g$
 - g. $6i$
5. Without referring to a text, periodic table or handout, deduce the maximum number of electrons that can occupy an:
 - a. s orbital _____
 - b. the subshell of p orbitals _____
 - c. the subshell of d orbitals _____
 - d. the subshell of f orbitals _____
 - e. the subshell of g orbitals _____
6. Circle all of the following electron configurations that are ruled out by the Pauli exclusion principle.
 - a. $1s^2 2s^2 2p^7$
 - b. $1s^2 2s^2 2p^6 3s^3$
 - c. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{12}$
 - d. $1s^2 2s^2 2p^6 3s^2 3p^6$
7. Explain why the following ground-state electron configurations are not possible:
 - a. $1s^2 2s^3 2p^3$
 - b. $1s^2 2s^2 2p^3 3s^6$
 - c. $1s^2 2s^2 2p^7 3s^2 3p^8$
 - d. $1s^2 2s^2 2p^6 3s^2 3p^1 4s^2 3d^{14}$
8. Give two examples (i.e. list 2 elements that are examples) of:
 - a. an atom with a half-filled subshell
 - b. an atom with a completely filled outer shell
 - c. an atom with its outer electrons occupying a half-filled subshell and a filled subshell.
9. Place the following orbitals in order of increasing energy:

 $1s, 3s, 4s, 6s, 3d, 4f, 3p, 7s, 5d, 5p$

10. What are the possible m_l values for the each of the following types of orbitals?

- a. s
- b. p
- c. d
- d. f

11. How many possible orbitals are there for $n =$

- a. 4
- b. 10

12. How many electrons can inhabit all of the $n=4$ orbitals?

13. Fill in the blanks with the correct response:

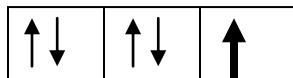
- a. The number of orbitals with the quantum numbers $n=3$, $l=2$ and $m_l = 0$ is _____.
- b. The subshell with the quantum numbers $n=4$, $l=2$ is _____.
- c. The m_l values for a d orbital are _____.
- d. The allowed values of l for the shell with $n=2$ are _____.
- e. The allowed values of l for the shell with $n=4$ are _____.
- f. The number of orbitals in a shell with $n=3$ is _____.
- g. The number of orbitals with $n=3$ and $l=1$ is _____.
- h. The maximum number of electrons with quantum numbers with $n=3$ and $l=2$ is _____.
- i. When $n=2$, l can be _____.
- j. When $n=2$, the possible values for m_l are _____.
- k. The number of electrons with $n=4$, $l=1$ is _____.
- l. The subshell with $n=3$ and $l=1$ is designated as the _____ subshell.
- m. The lowest value of n for which a d subshell can occur is $n=$ _____.

14. Which sets of quantum numbers are unacceptable? (Select a, b, c, or any combination)

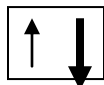
- a. $n=3$, $l= -2$, $m_l= 0$, $m_s= +\frac{1}{2}$
- b. $n=2$, $l= 2$, $m_l= -1$, $m_s= -\frac{1}{2}$
- c. $n=6$, $l= 2$, $m_l= -2$, $m_s= +\frac{1}{2}$

15. Write the values for the quantum numbers for the **bold** electron in the following diagrams:

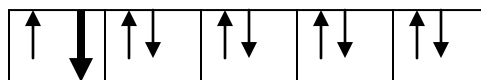
a. 3p orbitals



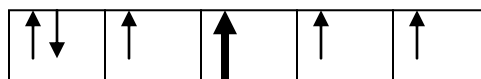
b. 5s



c. 4d orbitals



d. 3d orbitals



16. Which is the first element that can have an electron with the following set of quantum numbers:

- a. (3, 2, 1, 1/2)
- b. (2, 1, -1, -1/2)
- c. (3, 0, 0, -1/2)
- d. (2, 1, -1, 1/2)

17. The following deals with the element mercury:

- a. Write out the noble gas (shorthand) electron configuration of mercury.
- b. Draw the orbital diagram (arrows) of mercury.
- c. What is the quantum numbers of the last electron placed?

18. The following deals with the element sulfur:

- a. Write out the noble gas (shorthand) electron configuration of sulfur.
- b. Draw the orbital diagram (arrows) of sulfur.
- c. What is the quantum numbers of the last electron placed?

19. Which of the following sets of quantum numbers represent valid sets? EXPLAIN what is wrong with the ones that are not valid.

- a. (3, 3, 0, -1/2)
- b. (2, 1, 0, 1/2)
- c. (6, 5, -1, 1/2)
- d. (6, 4, 2, 1)
- e. (4, 3, 4, -1/2)
- f. (3, 2, 1, 1/2)

20. What is the maximum number of electrons that can be identified by each of the following sets of quantum numbers (none is a possible answer).

a. (2, 1, 0,)

b. (6, 5, -1,)

c. (3, 2, 1, 1/2)

d. (2, 2, 1, -1/2)

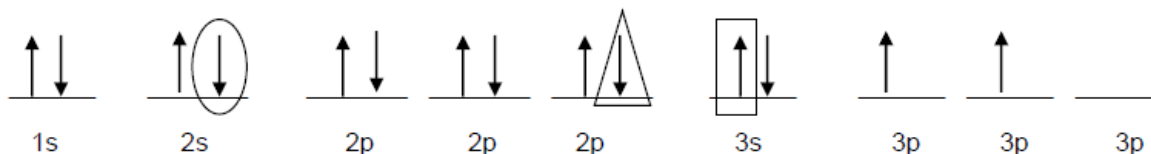
e. (3, 0, 1,)

f. (5, 1, ,)

g. (3, , ,)

h. (2, 1, 0,)

21. Given the following electron box diagram, write the set of quantum numbers for each electron that is marked.



Circled = _____ Boxed : _____

Triangle = _____ Last one placed: _____

22. List all possible sets of quantum numbers for $n = 3$

23. List all possible atomic orbitals with $n = 4$

24. What are the possible values of (l) if:

a.) $n=2$

b.) $n=4$

25. What letters correspond with the values of (l) in #3?

26. How do you designate the orbitals when:
a.) $n=2, l=0$ b.) $n=3, l=2$ c.) $n=3, l=1$
27. How many orbitals are there if:
a.) $l=2$ b.) $l=3$
28. What is the maximum number of electrons found in the:
a.) 1st principal energy level b.) 2nd principal energy level
c.) 3rd principal energy level d.) 4th principal energy level
29. How many electrons are there in:
a.) a (s) subshell b.) a (p) subshell c.) a (d) subshell d.) a (f) subshell
30. How many electrons are there in:
a.) a (p) orbital b.) a (f) orbital
31. How many orbitals are there in:
a.) a (s) subshell b.) a (p) subshell c.) a (d) subshell d.) a (f) subshell
32. For the following pairs of orbitals, indicate which is higher in energy:
a.) 3p or 4p b.) 4s or 4d c.) 2s or 3d d.) 5s or 4f
33. What type of orbital (s, p, d, or f) is designated by:
a.) $n=4, l=1, m_l=0$ b.) $n=3, l=2, m_l=0$ c.) $n=2, l=0, m_l=0$
34. Indicate which of the following sets of quantum numbers could NOT occur **and explain why**:
a.) 1,1,0,+1/2 b.) 2,1,0,+1/2 c.) 2,0,1,-1/2 d.) 2,1,0,0 e.) 3,2,0,-1/2
35. Arrange the following sets of quantum numbers in order of increasing energy. If they have the same energy, place them together.
a.) 4,2,-1,+1/2 b.) 1,0,0,-1/2 c.) 3,1,1,-1/2 d.) 2,0,0,+1/2 e.) 2,1,0,+1/2 f.) 3,1,1,+1/2