**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. $n = 3, \ell = 0$ 3s
b. $n = 3, \ell = 1$ 3p
c. $n = 3, \ell = 2$ 3d
d. $n = 5, \ell = 0$ 5s

3. Give the n and $\ell$ values for the following orbitals

a. 1s $n = 1$ $\ell = 0$
b. 3s $n = 3$ $\ell = 0$
c. 2p $n = 2$ $\ell = 1$
d. 4d $n = 4$ $\ell = 2$
e. 5f $n = 5$ $\ell = 3$

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:
a. s orbital 2 b. the subshell of p orbitals 6 c. the subshell of d orbitals 10
d. the subshell of f orbitals 14 e. the subshell of g orbitals 18

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. $1s^2 2s^2 2p^6 3s^2 3p^6$

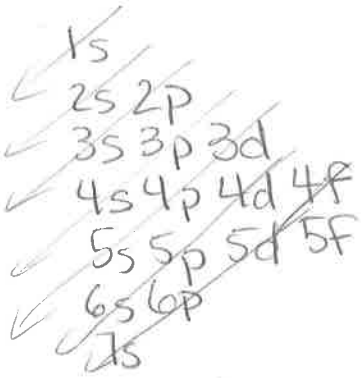
7. Explain why the following ground-state electron configurations are not possible:
a. $1s^2 2s^3 2p^3$ b. $1s^2 2s^2 2p^7 3s^6$ c. $1s^2 2s^2 2p^7 3s^2 3p^8$ d. $1s^2 2s^2 2p^6 3s^2 3p^1 4s^2 3d^{14}$

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

1s 2s 2p 3s 3p 4s 3d
4p 5s 4d 5p 6s 4f
5d 6p 7s



10. What are the possible $m_\ell$ values for the each of the following types of orbitals?

a. s $\ell=0$ $m_\ell = 0$
b. p $\ell = 1$ $m_\ell = -1, 0, 1$
c. d $\ell = 2$ $m_\ell = -2, -1, 0, 1, 2$
d. f $\ell = 3$ $m_\ell = -3, -2, -1, 0, 1, 2, 3$

11. How many possible orbitals are there for n = $(n^2)$

a. 4 16
b. 10 100

12. How many electrons can inhabit all of the n=4 orbitals? 32

13. Fill in the blanks with the correct response:

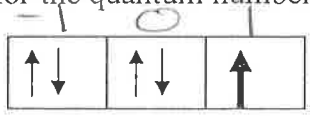
a. The number of orbitals with the quantum numbers $n$=3, $l$=2 and $m_l$ = 0 is 1.
b. The subshell with the quantum numbers $n$=4, $l$=2 is 4d.
c. The $m_l$ values for a d orbital are $m_\ell = -2, -1, 0, 1, 2$
d. The allowed values of $l$ for the shell with $n$=2 are 0, 1.
e. The allowed values of $l$ for the shell with $n$=4 are 0, 1, 2, 3
f. The number of orbitals in a shell with $n$=3 is 9.
g. The number of orbitals with $n$=3 and $l$=1 is 3.
h. The maximum number of electrons with quantum numbers with $n$=3 and $l$=2 is 10. 3d
i. When $n$=2, $l$ can be 0, 1.
j. When $n$=2, the possible values for $m_l$ are -1, 0, 1.
k. The number of electrons with $n$=4, $l$=1 is 6.
l. The subshell with $n$=3 and $l$=1 is designated as the 3p subshell.
m. The lowest value of n for which a d subshell can occur is n= 3.

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

a. $n$=3, $l$= -2, $m_l$= 0, $m_s$= +½ $\ell \neq$ negative
b. $n$=2, $l$= 2, $m_l$= -1, $m_s$= -½ $\ell < n$
c. $n$=6, $l$= 2, $m_l$= -2, $m_s$= +½ ✓

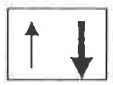
15. Write the values for the quantum numbers for the **bold** electron in the following diagrams:

a. 3p orbitals



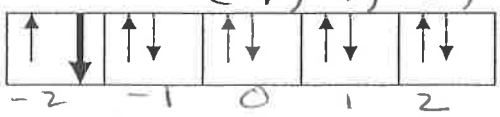

$(3, 1, 1, +\frac{1}{2})$

b. 5s

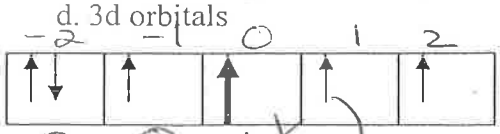


$(5, 0, 0, -\frac{1}{2})$

c. 4d orbitals $(4, 2, -2, -\frac{1}{2})$




d. 3d orbitals




$(3, 2, 0, +\frac{1}{2})$

16. Tabulate all of the possible orbitals (by name, i.e. 4s) for n=4 and give the three quantum numbers which define each orbital.

4s $(4, 0, 0)$ 4p $(4, 1, -1 \to +1)$ 4d $(4, 2, -2 \to +2)$ 4f $(4, 3, -3 \to +3)$

17. Write electron configurations for the following atoms:

a. N (7e) $1s^2 2s^2 2p^3$
b. Ni (28) [Ar] $4s^2 3d^8$
c. Zr (40) [Kr] $5s^2 4d^2$
d. Sn (50) [Kr] $5s^2 4d^{10} 5p^2$
e. Br (35) [Ar] $4s^2 3d^{10} 4p^5$