

QUANTUM NUMBERS WORKSHEET

1. State the four quantum numbers, then explain the possible values they may have and what they actually represent.

n – Principal Quantum Number: represents the energy level the electron is in, linked to the periods of the periodic. Can be 1 to 7

l – Secondary Quantum Number/Orbital Shape Quantum number: represents the shape of the orbital- s, p, f, d. l is a range of n-1.

m_l – Magnetic quantum number: represents the number of orbits possible. M_l is a range of l.

m_s – Spin Quantum number: represents the electron and its spin. Two possibilities $+1/2$, $-1/2$

2. State the number of possible electrons described by the following quantum numbers

- a. $n = 3, l = 0$ **2**
- b. $n = 3, l = 1$ **6**
- c. $n = 3, l = 2, m_l = -1$ **2**
- d. $n = 5, l = 0, m_l = -2, m_s = -1/2$ **Not possible**

3. Give the n and l values for the following orbitals

- a. 1s **$n=1, l=0$**
- b. 3s **$n=3, l=0$**
- c. 2p **$n=2, l=1$**
- d. 4d **$n=4, l=2$**
- e. 5f **$n=5, l=3$**

4. What are the m_l values for the following types of orbitals?

- a. s **$m_l = 0$**
- b. p **$m_l = -1, 0, 1$**
- c. d **$m_l = -2, -1, 0, 1, 2$**
- d. f **$m_l = -3, -2, -1, 0, 1, 2, 3$**

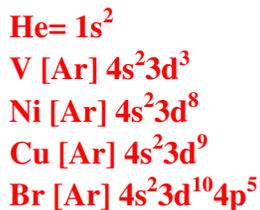
6. How many possible orbitals are there for n =

- a. 4 **s-1, p-3, d-5, f-7 = 16 orbitals**
- b. 6 **9 orbitals**

7. Write the complete set of quantum numbers that represent the **valence electrons** for the following elements:

- a. He $n=1, l=0, ml=0, ms=+1/2$
 $n=1, l=0, ml=0, ms=-1/2$
- b. V $n=4, l=0, ml=0, ms=+1/2$
 $n=4, l=0, ml=0, ms=-1/2$
- c. Ni $n=4, l=0, ml=0, ms=+1/2$
 $n=4, l=0, ml=0, ms=-1/2$
- d. Cu $n=4, l=0, ml=0, ms=+1/2$
 $n=4, l=0, ml=0, ms=-1/2$
- e. Br $n=4, l=0, ml=0, ms=+1/2$
 $n=4, l=0, ml=0, ms=-1/2$
 $n=4, l=1, ml=-1, ms=+1/2$
 $n=4, l=1, ml=0, ms=+1/2$
 $n=4, l=1, ml=1, ms=+1/2$
 $n=4, l=1, ml=-1, ms=-1/2$
 $n=4, l=1, ml=0, ms=-1/2$

8. Write the electron configurations for the elements above.



9. Without referring to a text, periodic table or handout, deduce the maximum number of electrons that can occupy an:

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

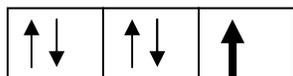
10. How many electrons can inhabit all of the $n=4$ orbitals?

$$\begin{array}{r} 4s = 2 \\ 4p = 6 \\ 4d = 10 \\ 4f = 14 \\ \hline 32 \text{ Total Electrons} \end{array}$$

11. Fill in the blanks with the correct response:
- The number of orbitals with the quantum numbers $n=3$, $l=2$ and $m_l = 0$ is 1.
 - The subshell with the quantum numbers $n=4$, $l=2$ is d.
 - The m_l values for a d orbital are -2, -1, 0, 1, 2.
 - The allowed values of l for the shell with $n=2$ are 0, 1.
 - The allowed values of l for the shell with $n=4$ are 0, 1, 2, 3.
 - The number of orbitals in a shell with $n=3$ is $1+3+5=9$ (s, p, d).
 - The number of orbitals with $n=3$ and $l=1$ is 3.
 - The maximum number of electrons with quantum numbers with $n=3$ and $l=2$ is 10.
 - When $n=2$, l can be 0, 1.
 - When $n=2$, the possible values for m_l are -1, 0, 1.
 - The number of electrons with $n=4$, $l=1$ is 6.
 - The subshell with $n=3$ and $l=1$ is designated as the p or -1, 0, 1 subshell.
 - The lowest value of n for which a d subshell can occur is $n=$ 3.

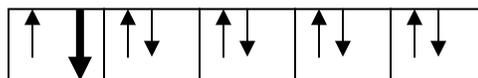
12. Write the values for the quantum numbers for the **bold** electron in the following diagrams:

a. 3p orbitals



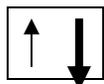
a. $n=3, l=1, m_l=1, m_s=+1/2$

c. 4d orbitals



c. $n=4, l=2, m_l=-2, m_s=-1/2$

b. 5s



b. $n=5, l=0, m_l=0, m_s=-1/2$

d. 3d orbitals



d. $n=3, l=2, m_l=0, m_s=+1/2$

13. How many electrons can occupy any single subshell orbital? 2

- 14.
- What is the value of l for a 4 f electron? **3**
 - What is the orbital designation for an electron in the 3rd shell and p sublevel? **3p**
 - What are the possible values of m_l for a 5d electron? **2, 1, 0, -1, -2**
 - What is the maximum number of electrons in the 3rd energy level? **18**
 - How many orbitals have the following quantum numbers: $n=4, l=2, m_l=-2$? **1**
 - How many electrons have the following quantum numbers: $n=4, l=2, m_l=-2$? **2**