**Quantum Numbers Handout**

**Shells and Orbitals**

Bohr theorized that electrons orbit around the nucleus in defined energy levels called shells, which are indicated by the letter \_\_\_\_\_\_. Scientists later discovered this model to be incomplete; while these shells do exist they can be subdivided into subshells.

Electrons in an atom can be found moving in defined 3-D areas called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Shells with higher n-values have (more/less) orbitals within them.

The mathematical relationship between n-values and orbitals is every shell can have \_\_\_\_\_\_\_ orbitals.

* The n = 1 shell has \_\_\_\_ orbitals
* The n = 2 shell has \_\_\_\_ orbitals
* The n = 3 shell has \_\_\_\_ orbitals
* The n = 4 shell has \_\_\_\_ orbitals

Each orbital can have a maximum of \_\_\_\_\_\_\_ electrons in it.

Each energy level can have a maxiumum of \_\_\_\_\_\_\_\_\_\_ in it.

**Quantum Numbers**

Quantum numbers are a system of numbers used to describe the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an electron within an atom .

There are \_\_\_\_\_\_ different quantum numbers that can be used to describe the position of an electron in an atom.

**Principal Quantum Number ( )**

The principal quantum number describes the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that an electron can occupy in a given atom.

The principal quantum number for an atomic orbital has \_\_\_\_\_\_\_\_ number values (1, 2, 3, etc.).

For example, if an electron is describe with the principal quantum number of n = 3, this means that the electron is located in the \_\_\_\_\_\_\_\_\_\_\_\_\_ energy level.

**Secondary Quantum Number ( )**

The secondary quantum number represents the type of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ that an electron is in. It describes the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an orbital that an electron is found in.

It has whole number values that range from \_\_\_\_\_ to \_\_\_\_\_ for each value of (n) .

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Value of (l)** | **0** | **1** | **2** | **3** |
| **Orbital Type** |  |  |  |  |

A 3f orbital would be described by what quantum numbers?

n =\_\_\_\_\_\_\_\_\_\_

l = \_\_\_\_\_\_\_\_\_\_

What is the range of l values for orbitals in the 3rd energy level?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

How many types of orbitals are found in the 4th energy level?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Magnetic Quantum Number ( )**

The magnetic quantum number describes the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an orbital in space.

The values of ml range from \_\_\_\_\_ to \_\_\_\_\_\_, including \_\_\_\_\_\_\_\_\_.

When (l) = 2 there are \_\_\_\_\_\_\_ possible orbitals with the following ml values:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Spin Quantum Number ( )**

The spin quantum number describes the \_\_\_\_\_\_\_\_\_\_\_ that an electron is \_\_\_\_\_\_\_\_\_\_\_\_\_.

ms values can only have \_\_\_\_\_ possible values \_\_\_\_\_\_ and \_\_\_\_\_\_\_\_.

When 2 electrons are in the same orbital they must have \_\_\_\_\_\_\_\_\_\_\_\_\_ spin values.

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ principle states that no 2 electrons in the same atom can have the same:

**Complete the Following Table:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **n** | **(l)** | **orbital type** | **subshell name** | **ml range** | **Total # of orbital types** | **Total orbitals in that energy level** |
| **1** |  |  |  |  |  |  |
| **2** | **0** | **s** | **1s** | **0** | **1** | **4** |
| **1** | **p** | **2p** | **-1, 0, +1** | **3** |
| **3** |  |  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **4** |  |  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |