

# Overview of Quantum Numbers

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## General Chemistry I

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1. **Principal Quantum Number: n**

The shell number is the same as the value of **n**. All orbitals with the same value of **n** are in the same shell. As **n** increases, not only does the size of the shell increase (the average distance from the nucleus increases) but the energy of the shell also increases. These are integer values.

2. **Secondary Quantum Number: l**

This is also known as the angular quantum number and groups the orbitals into subshells. The maximum value of **l** is known as  $l_{\max}$ .

$$l_{\max} = n - 1$$

The possible integer values of **l** range from 0 to  $l_{\max}$ .

$$0, 1, 2, 3, \dots, l_{\max}$$

3. **Magnetic Quantum Number:  $m_l$**

A given value of **l** has a specific number of  $m_l$  values. Each value of  $m_l$  corresponds to an orbital. The integer values of  $m_l$  range from  $-l$  to  $l$ .

$$-l, -l + 1, -l + 2, \dots, 0, \dots, l - 2, l - 1, l$$

The total number of  $m_l$  values equals the number of orbitals available for a specific value of **l**.

4. **Spin Quantum Number:  $m_s$**

This indicates the assigned spin for an electron. The possible values are non-integer and are commonly referred to as “spin up” and “spin down”.

$$+\frac{1}{2} \text{ or spin up} \qquad -\frac{1}{2} \text{ or spin down}$$

Two electrons in a single orbital must be spin-paired which is a result of the Pauli exclusion principle.