The Spin Quantum Number \( (m_s) \) describes the angular momentum of an electron. An electron spins around an axis and has both angular momentum and orbital angular momentum. Because angular momentum is a vector, the Spin Quantum Number \( (s) \) has both a magnitude \( (1/2) \) and direction (+ or -).

Each orbital can only hold two electrons. One electron will have a +1/2 spin and the other will have a -1/2 spin. Electrons like to fill orbitals before they start to pair up. Therefore the first electron in an orbital will have a spin of +1/2. After all the orbitals are half filled, the electrons start to pair up. This second electron in the orbital will have a spin of -1/2. If there are two electrons in the same orbital, it will spin in opposite directions.

**Combinations of Quantum Numbers**

- The three quantum numbers \( (n, l, \text{ and } m) \) that describe an orbital are integers: 0, 1, 2, 3.
- The principal quantum number \( (n) \) cannot be zero. The allowed values of \( n \) are therefore 1, 2, 3, 4...
- The angular quantum number \( (l) \) can be any integer between 0 and \( n - 1 \).
  - If \( n = 3 \), \( l \) can be either 0, 1, or 2.
- The magnetic quantum number \( (m) \) can be any integer between \(-l\) and \(+l\).
  - If \( l = 2 \), \( m \) can be -2, -1, 0, +1, or +2.
- Orbitals that have same value of principal quantum number form a Shell\((n)\).
- Orbitals within the shells are divided into subshell \((l)\)
  - \( s: l = 0 \) \( p: l = 1 \) \( d: l = 2 \) \( f: l = 3 \)

**Exercise \( \PageIndex{1} \): Tungsten**

What is the spin quantum number for Tungsten (symbol W)?

**Answer**

Tungsten has 4 electrons in the 5d orbital. Therefore 1 electron will go into each orbital (no pairing). The 4th electron will have a +1/2 spin.

**Exercise \( \PageIndex{2} \): Gold**

What is the spin quantum number for Gold (symbol Au)?

**Answer**

Gold has 9 electrons in the 5d orbital. Therefore the electrons will start to pair up, which means the 9th electron will pair up, giving it a -1/2 spin.

**Exercise \( \PageIndex{3} \): Sulfur**

What is the spin quantum number for Sulfur (symbol S)?

**Answer**

Sulfur has 4 electrons in the 3p orbitals. The 4th electron in this orbital will be the first one to pair up with another electron, therefore giving it a -1/2 spin.
References
