

# What are Quantum Numbers and Electron Orbitals?

## Worksheet

Quantum numbers ( $n$ ,  $l$ ,  $m_l$ ,  $m_s$ ) define the energy level, shape, orientation, and spin of electron orbitals. An orbital is a region of space where an electron has a high probability of being found.

## Questions

- The principal quantum number  $n$  determines
  - Energy level and distance from nucleus
  - Orbital shape
  - Orbital orientation
  - Electron spin
- How many p-orbitals are in a p subshell?
  - 1
  - 2
  - 3
  - 5
- What does the spin quantum number  $m_s$  tell us?
  - Orbital shape
  - Electron's rotation: up or down
  - Orbital energy
  - Number of electrons
- An orbital can hold a maximum of
  - 1 electron
  - 2 electrons
  - 6 electrons
  - 10 electrons
- Describe the quantum numbers for an electron in a 2p orbital.
- How many electrons can a 3d subshell hold?
- What is the difference between an orbital and a Bohr orbit?
- Define: What are quantum numbers?
- Define: What does the principal quantum number  $n$  represent?
- Define: What is an orbital?

## Answer Key

1. A) Energy level and distance from nucleus -  $n = 1, 2, 3$  defines which shell and its energy;  $l$  defines shape.
2. C)  $3 - l = 1$  for p;  $m_l = 1, 0, +1$  3 p-orbitals, holding up to 6 electrons.
3. B) Electron's rotation: up or down -  $m_s = +$  or represents the two possible spin states in an orbital.
4. B) 2 electrons - Each orbital holds 2 electrons with opposite spins (Pauli exclusion principle).
5.  $n = 2$  (second energy level)  $l = 1$  (p subshell)  $m_l = 1, 0, \text{ or } +1$  (three p-orbitals)  $m_s = +$  or (electron spin)
6.  $n = 3, l = 2$  (d subshell)  $m_l$  ranges from  $-2$  to  $+2$  5 d-orbitals Each orbital holds 2 electrons (up and down spin)  
Total:  $5 \times 2 = 10$  electrons
7. Bohr orbit: fixed, circular path at defined distance Quantum orbital: probabilistic region where electron is likely found Orbitals come from solving Schrodinger equation, not fixed paths
8. Four numbers ( $n, l, m_l, m_s$ ) that uniquely describe the energy, shape, orientation, and spin of an electron in an atom.
9. The energy level or shell;  $n = 1, 2, 3$  Higher  $n =$  farther from nucleus = higher energy.
10. A region of space where an electron has a high probability ( $>90\%$ ) of being found, not a fixed path.

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