

# What is Atomic Orbital Theory?

## Worksheet

An orbital is a region of space where an electron has a 90% probability of being found. Orbitals have shapes (spherical s, dumbbell-shaped p, cloverleaf d) and come in subshells (s, p, d, f).

## Questions

1. The shape of an s orbital is
  - A) dumbbell
  - B) cloverleaf
  - C) spherical
  - D) toroidal
2. How many d orbitals are in a d subshell?
  - A) 1
  - B) 3
  - C) 5
  - D) 7
3. Which orbital is larger: 1s or 3s?
  - A) 1s
  - B) 3s
  - C) same size
  - D) depends on atom
4. The Pauli exclusion principle states that
  - A) all electrons have the same spin
  - B) no two electrons can have identical quantum numbers
  - C) electrons cannot occupy p orbitals
  - D) orbitals must be spherical
5. How many electrons can fill the 2p subshell?
6. Write the quantum numbers for one electron in a 3d orbital.
7. Compare the size of 1s and 2s orbitals.
8. Define: What is an orbital?
9. Define: What are the four types of subshells?
10. Define: How many electrons fit in p orbitals?

## Answer Key

1. C) spherical - s orbitals ( $l=0$ ) are spherically symmetric.
2. C) 5 - d subshell has  $l=2$ ,  $m_l = 2, 1, 0, +1, +2$  5 orbitals.
3. B) 3s - As  $n$  increases, the orbital is farther from the nucleus and larger in size.
4. B) no two electrons can have identical quantum numbers - Each electron has a unique set of quantum numbers ( $n, l, m_l, m_s$ ), so max 2 electrons per orbital.
5. 2p means  $n=2, l=1$  (p orbital). There are 3 p orbitals ( $m_l = 1, 0, +1$ ). Each orbital holds max 2 electrons. Total:  $3 \times 2 = 6$  electrons in 2p.
6. 3d means  $n=3, l=2$  (d orbital). There are 5 d orbitals ( $m_l = 2, 1, 0, +1, +2$ ). One possible set: ( $n=3, l=2, m_l=+1, m_s=+1/2$ ) for an electron in one 3d orbital.
7.  $n=1$ : 1s orbital is closest to nucleus (smallest).  $n=2$ : 2s orbital is farther away (larger). Orbitals expand as  $n$  increases; higher energy.
8. A region of space where there is a ~90% probability of finding an electron. It has a characteristic shape and energy.
9. s ( $l=0$ ), p ( $l=1$ ), d ( $l=2$ ), f ( $l=3$ ). They differ in shape and electron capacity.
10. 6 electrons maximum (3 p orbitals, 2 electrons each).

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