

Quantum Numbers for Nitrogen Electrons

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Response: To determine the correct set of quantum numbers for two of the outermost p electrons in a ground-state nitrogen atom:

1. **Ground-State Electron Configuration:** Nitrogen ($Z = 7$) has the ground-state configuration $1s^2 2s^2 2p^3$.

2. **Hund's Rule Application:**

- For the three $2p$ electrons ($l = 1$), each electron must occupy a distinct orbital (m_l values must be unique: $+1, 0, -1$).
- All three unpaired electrons in degenerate orbitals must have parallel spins (the same spin quantum number, m_s , either all $+\frac{1}{2}$ or all $-\frac{1}{2}$).

3. **Requirements for any pair of these three electrons:**

- m_l **values:** Must be different from each other (e.g., 0 and $+1$, $+1$ and -1 , or 0 and -1).
- m_s **values:** Must be identical to each other (either both $+\frac{1}{2}$ or both $-\frac{1}{2}$).

4. **Evaluating the Given Options:**

- (1) $m_l = +1, m_l = +1$: Incorrect (both electrons are in the same orbital, violating Pauli exclusion / Hund's rule for ground state).
- (2) $m_s = +\frac{1}{2}, m_s = -\frac{1}{2}$: Incorrect (spins are paired/opposite instead of parallel).
- (3) $m_l = 0$ and $m_l = +1$ (different orbitals), and $m_s = +\frac{1}{2}$ for both (parallel spins).
This satisfies Hund's rule.
- (4) $m_s = +\frac{1}{2}, m_s = -\frac{1}{2}$: Incorrect (spins are not parallel).
- (5) $m_s = -\frac{1}{2}, m_s = +\frac{1}{2}$: Incorrect (spins are not parallel).

Correct Answer: (3)
