

Understanding Quantum Numbers Analysis

<https://gemini.google.com/app/bb9896287adc4f10>

Response: Statements **(c)** and **(d)** are true.

- **Analysis of Quantum Numbers:**

- $n = 3$ represents the **third main energy level** (principal quantum level).
- For $n = 3$, the allowed values for the azimuthal quantum number l are 0, 1, 2, which correspond to s , p , and d subshells respectively.
- For a given l , the magnetic quantum number m_l can take values from $-l$ to $+l$:
 - For an s orbital ($l = 0$): $m_l = 0$
 - For a p orbital ($l = 1$): $m_l = -1, 0, +1$
 - For a d orbital ($l = 2$): $m_l = -2, -1, 0, +1, +2$
- The spin quantum number m_s can be either $+\frac{1}{2}$ or $-\frac{1}{2}$ for any allowed state.

- **Evaluation of Statements:**

- **(a) False:** The principal quantum number $n = 3$ corresponds to the third main energy level, not the first.
 - **(b) False:** The electron *can* be in a d orbital ($l = 2$), but it is not *required* to be, because a p orbital ($l = 1$) also has $m_l = -1$.
 - **(c) True:** Since $l = 1$ (p orbital) allows $m_l = -1$, the electron can be in a $3p$ orbital.
 - **(d) True:** Any electron can have a spin quantum number of $m_s = -\frac{1}{2}$.
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