

Quantum Numbers and Atomic Orbitals

- (a) What is a quantum number? What is an atomic orbital? (b) How many quantum numbers are required to specify a single atomic orbital? What are they?
- Without giving the ranges of possible values of the four quantum numbers, n , l , m_l , and m_s , describe briefly what information each one gives.
- An electron is in one of the $3p$ orbitals. What are the possible values of the quantum numbers n , l , m_l , and m_s for the electron?
- What is the maximum number of electrons in an atom that can have the following quantum numbers?

(a) $n = 3$;	(e) $n = 3$ and $l = 2$;
(b) $n = 3$ and $l = 1$;	(f) $n = 3$, $l = 2$ and $m_l = 1$;
(c) $n = 3$, $l = 1$, and $m_l = 1$;	(g) $n = 3$, $l = 1$, and $m_l = 1$;
(d) $n = 3$, $l = 1$, $m_l = 1$, and $m_s = +\frac{1}{2}$;	(h) $n = 3$, $l = 2$, $m_l = 0$, and $m_s = -\frac{1}{2}$.
- What are the values of n and l for the following subshells?

(a) $1s$;	(d) $3d$;
(b) $4s$;	(e) $4f$
(c) $3p$;	
- What values can m_l take for:

(a) a $3d$ orbital,	(c) a $3p$ orbital?
(b) a $1s$ orbital, and	
- How many orbitals in any atom can have the given quantum number or designation?

(a) $4p$;	(e) $6d$;
(b) $3p$;	(f) $5d$;
(c) $3px$;	(g) $5f$;
(d) $n = 5$;	(h) $7s$.
- The following incorrect sets of quantum numbers in the order n , l , m_l , m_s are written for paired electrons or for one electron in an orbital. Correct them, assuming n values are correct.

(a) $1, 0, 0, +\frac{1}{2}, +\frac{1}{2}$;	(d) $3, 1, 2, +\frac{1}{2}$;
(b) $2, 2, 1, \pm\frac{1}{2}$;	(e) $2, 1, -1, 0$;
(c) $3, 2, 3, \pm\frac{1}{2}$;	(f) $3, 0, -1, -\frac{1}{2}$.
- (a) How are a $1s$ orbital and a $2s$ orbital in an atom similar? How do they differ? (b) How are a $2px$ orbital and a $2py$ orbital in an atom similar? How do they differ?