QUANTUM NUMBERS

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Quantum numbers can be used to describe the location of any one electron within an atom.

Four components:

1. Principal quantum number (n)
2. Azimuthal quantum number (l)
3. Magnetic quantum number (m_l)
4. Spin quantum number (m_s or s)

QUANTUM NUMBERS

1. Principal Quantum Number

Represented as “n”.

n indicates the energy level.

n has a whole number value ≥ 1.

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2. Azimuthal Quantum Number

Represented as "l ".

l indicates the orbital type.

l has a whole number value ≥ 0.

l = 0 represents the s-orbital

l = 1 represents the p-orbitals

etc.

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3. Magnetic Quantum Number

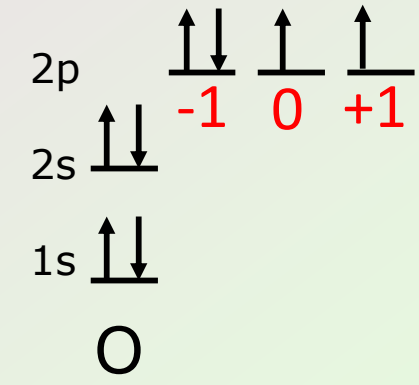
Represented as "m_l".

m_l is determined by the l value:

$$-l \leq m_l \leq +l, \text{ where } m_l \text{ are integers}$$

Each m_l value represents a specific orbital.

Ex:



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Example #3

List all quantum numbers for all orbitals containing electrons for the first four energy levels.

n Principal Quantum Number Symbol = n Values = 1, 2, 3, . . . n = number of subshells	ℓ Angular Momentum Quantum Number Symbol = ℓ Values = 0 . . . $n - 1$	m_ℓ Magnetic Quantum Number Symbol = m_ℓ Values = $-\ell$ . . . 0 . . . $+\ell$
1	0 s	0
2	0 s 1 p	0 +1, 0, −1
3	0 s 1 p 2 d	0 +1, 0, −1 +2, +1, 0, −1, −2
4	0 s 1 p 2 d 3 f	0 +1, 0, −1 +2, +1, 0, −1, −2 +3, +2, +1, 0, −1, −2, −3

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4. Spin Quantum Number

Represented as "s" or "m_s".

Electrons spin in one of two directions.

s = +½ (up-spin) or s = -½ (down-spin)

Convention suggest up-spin electrons are placed in orbitals first.

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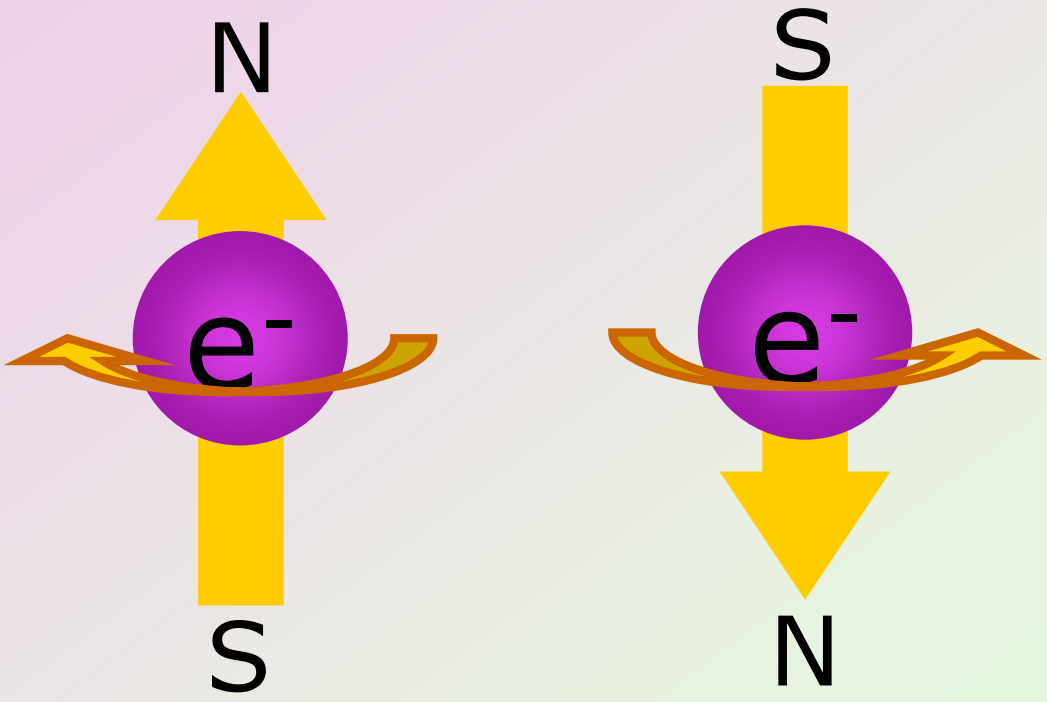
4. Spin Quantum Number

Spin numbers and magnetism:



By spinning in one direction, the electron produces the magnetic field oriented to the north. Spinning in the other direction produces a magnetic field in the opposite direction.

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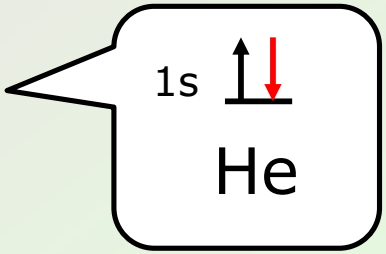
Example #4

What is the set of quantum numbers that represents the final electrons added to the following atoms:

a)He $n = 1; l = 0; m_l = 0; s = -½$



b)O $n = 2; l = 1; m_l = -1; s = -½$

c)Al $n = 3; l = 1; m_l = -1; s = +½$

d)Fe $n = 3; l = 2; m_l = -2; s = -½$

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Example #5

Identify the atom represented by the following electron address. This would be the last electron added to the atom.

a) $n = 1;\ l = 0;\ m_l = 0;\ s = +1/2$ H

b) $n = 3;\ l = 2;\ m_l = +1;\ s = -1/2$ Cu

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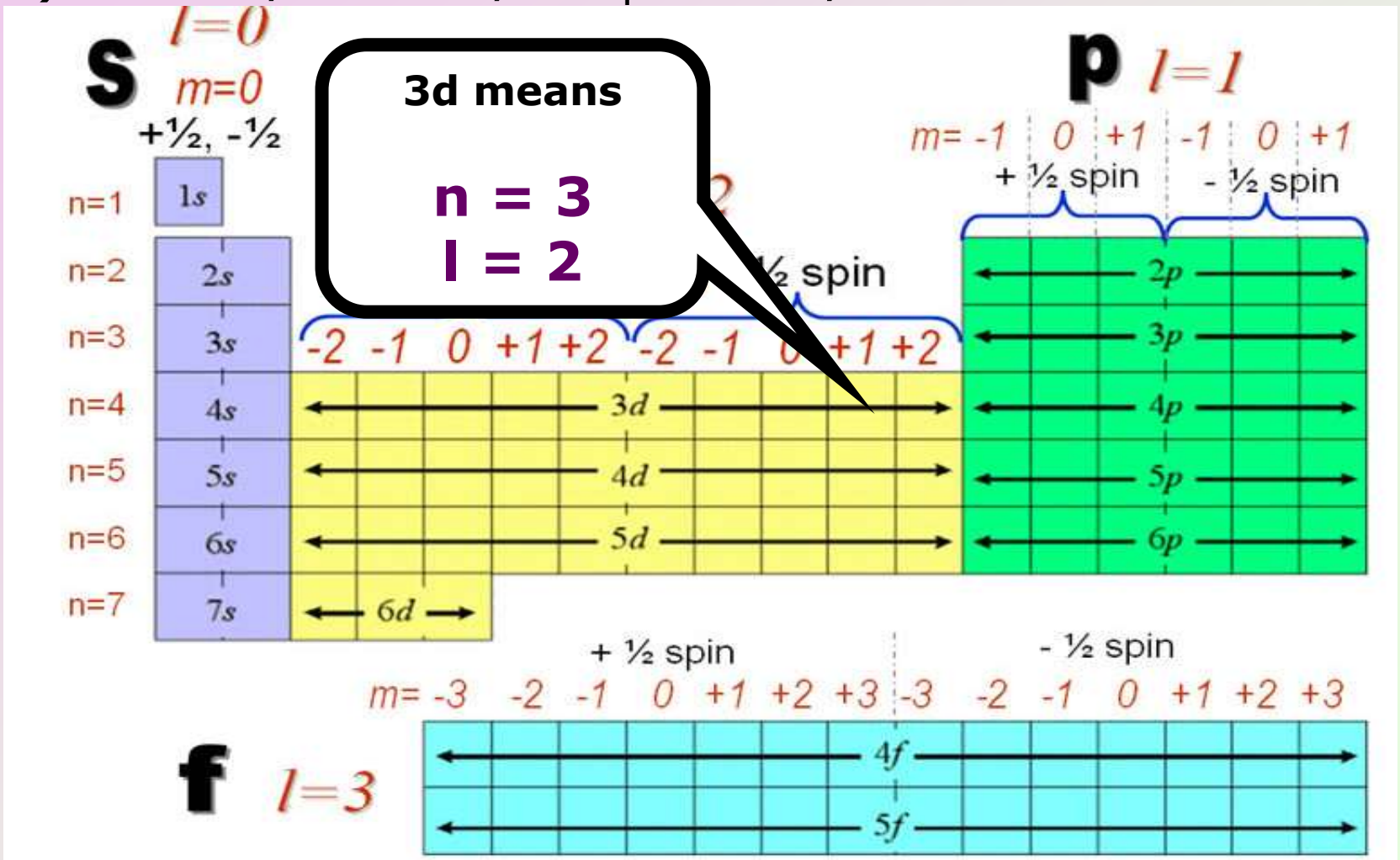
Example #5

b) n = 3; l = 2; m_l = +1; s = -1/2 Cu



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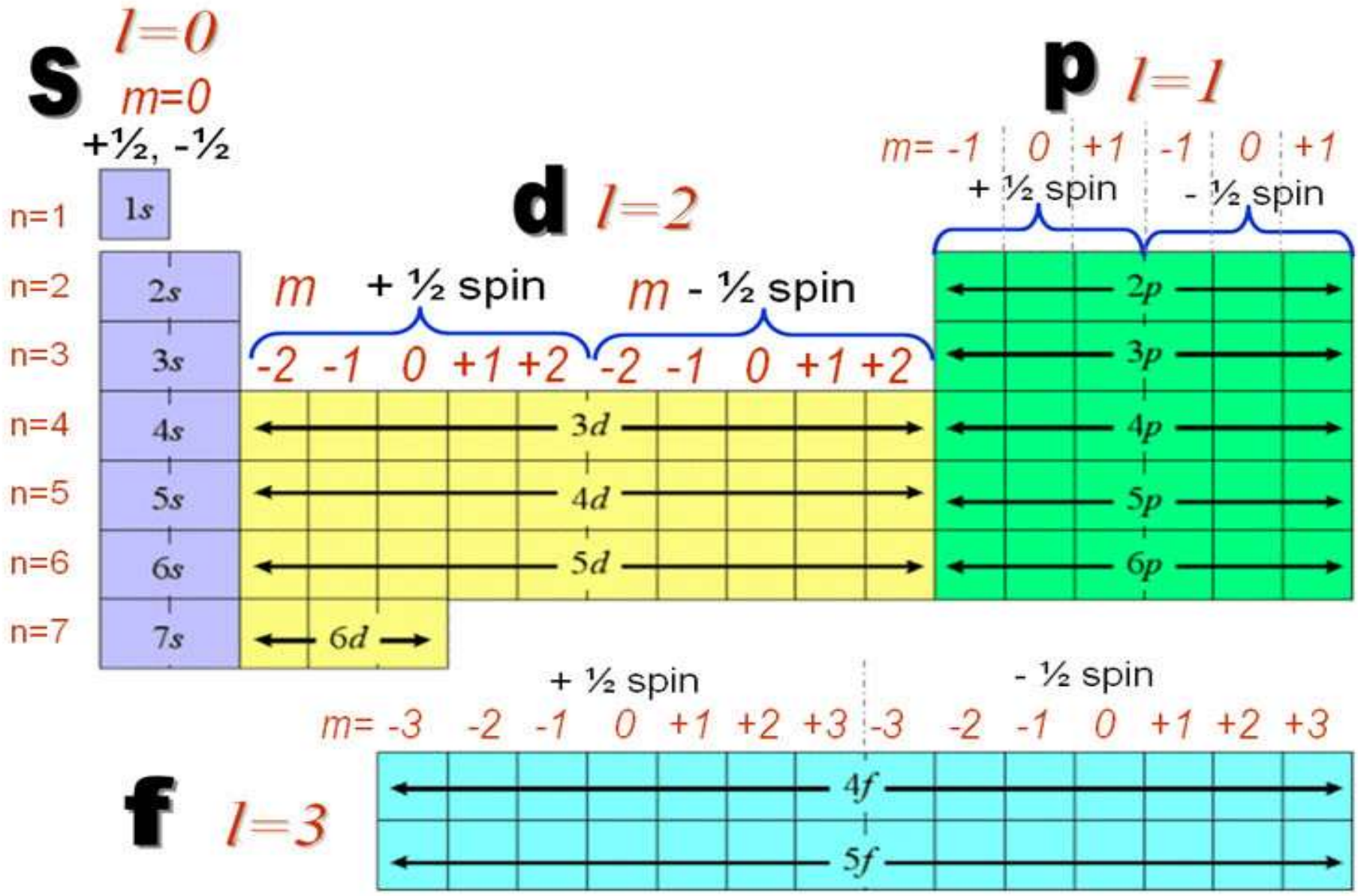

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