

If spin multiplicity $(2s+1)$ is shown with spectroscopic symbol 'L', then term is obtained

$$\text{New Term} = {}^{2s+1}L = {}^{s+1}L$$

Total orbital angular momentum 'L' and Total spin angular momentum 'S' these L and S interact to give the resultant angular momentum

This resultant angular momentum is denoted by symbol 'J'.

And such interaction ^{of} orbital angular momentum with total spin angular momentum is known as (L-S) coupling

or (R-S) coupling.

The 'J' can have all values

from $(L-S)$ to $(L+S)$

i.e: $J = (L-S) \text{ to } (L+S)$

For more than half filled orbital,

'J' can have $[L+S]$ values

and for less than half filled orbitals,

'J' can have $[L-S]$ values in ground state.

Since 'J' is the total angular momentum (i.e. resultant of angular momentums, L & S)

The value of 'J' can have only positive value.

or we can say the value of J is always positive but never negative.

If 'J' value is shown 'term', it is called spectroscopic energy state or simply state.

Energy state or state = ${}^{2s+1}L_J$

Find All the possible states for a system in p^2 and d^2 systems.

A system can have many sets of quantum numbers or Russel-Saunders's states.

Out of which, some are singlets and rest are triplets.

In a singlet state, spins are paired. It means the magnetic quantum numbers are the same for two electrons. It is given below.

$$\text{For an orbital } \boxed{\uparrow\downarrow}, \quad S = \overset{\text{Total spin of orbital}}{\frac{1}{2}} - \frac{1}{2} = 0$$

Hence Spin multiplicity $(2S+1)$.

$$= 2 \times 0 + 1$$

$$= 0 + 1$$

$$= 1 \text{ (Singlet)}$$

But, in a triplet state, spins are parallel

i.e. magnetic quantum numbers are different for two electrons
e.g.

For $\boxed{\uparrow}$ and $\boxed{\uparrow}$ orbitals

$$S = \frac{1}{2} + \frac{1}{2} = 1$$

$$\therefore 2S+1 = 2 \times 1 + 1 = 3 \text{ (Triplet)}$$

To calculate all possible states of a system, then first such set the arrangement of electrons in orbitals is selected for which the L value is the maximum.

It is then followed in decreasing order of L values are corresponding spin multiplets are calculated.

In order to calculate all possible states of a system,

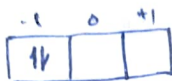
firstly one such set, i.e. the arrangement of electrons in orbitals is selected for which the L value is the maximum.

It is then followed in decreasing order of L values and corresponding spin multiplets are calculated.

Examples:- The p^2 system has 15 states:-

$$\text{Now } \frac{L_6}{L_2 L_6 - 2} = \frac{L_6}{L_2 L_4} = \frac{2 \cdot 5 \cdot L_4}{2 \cdot 1 \cdot L_4} = 15 \text{ states}$$

The set with the highest L value is given as:-



$$\therefore L = 2 (D),$$

$$S = 0$$

$$\therefore 2S + 1 = 2 \times 0 + 1 = 0 + 1 = 1 \text{ (Singlet)}$$

$$\therefore \text{Term} = {}^1D$$

Similarly, 3P & 1S are other terms for the p^2 system:-

Term ↓	Set	L ↓	S ↓	$2S+1$ ↓	Term ↓	No. of states ↓						
1D	<table border="1" style="margin: 0 auto;"> <tr> <td style="text-align: center;">-1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">+1</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table>	-1	0	+1	1	0	0	2	0	1	1D	$1 \times 5 = 5$
-1	0	+1										
1	0	0										
3P	<table border="1" style="margin: 0 auto;"> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> </table>	1	1	0	1	1	3	3P =	$3 \times 3 = 9$			
1	1	0										
1S	<table border="1" style="margin: 0 auto;"> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> </table>	0	1	0	0	0	1	1S =	$1 \times 1 = 1$			
0	1	0										