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TOPIC - Aufbau principle,  
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Aufbau is a German word which means "to build up" Elements are built up by gradual addition of electrons in orbitals. In the ground state of an atom, the electron tends to occupy the available orbitals in the increasing order of energy. Lower energy orbitals are better seats for electrons and better seats are occupied first. This principle was enunciated by Pauli. The lower energy orbital has lower  $n+l$  value, where  $n$  = principal quantum number and  $l$  = azimuthal quantum number e.g.

Orbital	$n+l$ value
1s	$1+0 = 1$
2s	$2+0 = 2$
2p	$2+1 = 3$
3s	$3+0 = 3$
3p	$3+1 = 4$
3d	$3+2 = 5$
4s	$4+0 = 4$
4p	$4+1 = 5$
4d	$4+2 = 6$
4f	$4+3 = 7$
5s	$5+0 = 5$
5p	$5+1 = 6$
5d	$5+2 = 7$
5f	$5+3 = 8$
6s	$6+0 = 6$
6p	$6+1 = 7$
6d	$6+2 = 8$
7s	$7+0 = 7$

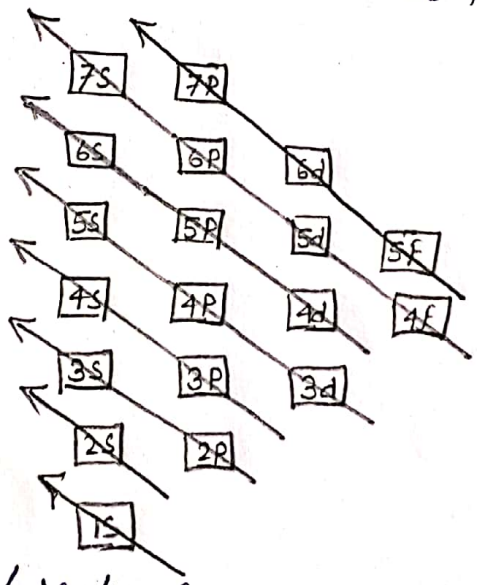
When orbitals have same  $n+l$  value, then lower the  $n$  value, the lower is its energy e.g

orbitals	$n+l$ value	Energy order
2p, 3s	3	2p < 3s
3p, 4s	4	3p < 4s
3d, 4p, 4s	5	3d < 4p < 4s
4d, 5d, 6p, 7s	7	4f < 5d < 6p < 7s
5f, 6d	8	5f < 6d

Hence the energy order of atomic orbitals can be shown as—

$$1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s < 5f < 6d$$

Therefore Aufbau order provides us the energy order of atomic orbitals.



Since the  $n+l$  value for  $(3+2=5)$  is greater than that of  $4s$ -orbitals  $(4+0=4)$ , therefore  $4s$  is filled before  $3d$ , i.e. the energy of the  $4s$ -orbital is lower than that of  $3d$  orbital. The  $4f$  and  $7s$ -orbitals have identical  $n+l$  values i.e. 7. Naturally  $4f$  is filled before  $7s$ . The order of the energy of the different orbitals can be remembered with the help of the diagram as given above.

This principle is of immense importance in writing the electronic configurations.