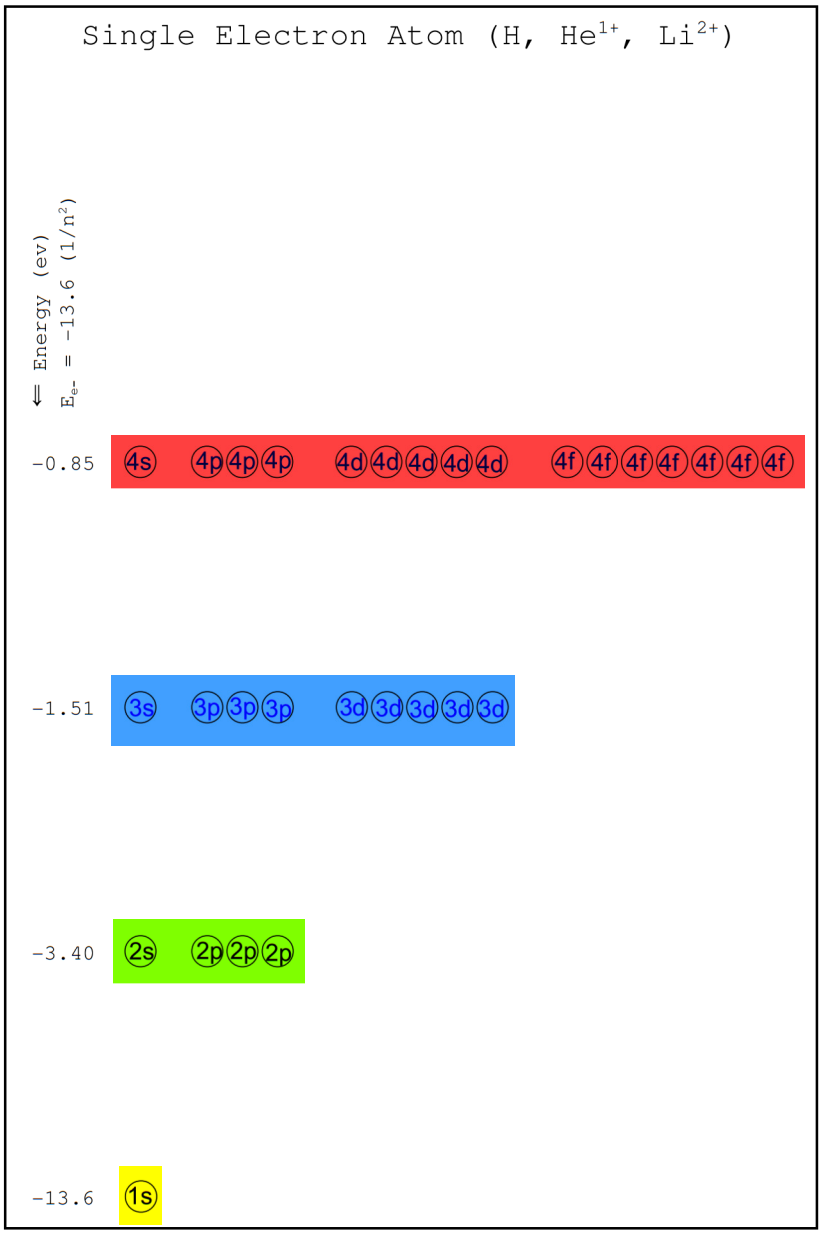
Quantum Number Organizer

n principle quantum number	energy level	**l** angular momentum quantum number	orbital type	m_l magnetic quantum number	m_s spin quantum number	number of electrons	
						per orbital	per energy level
1	**1st**	0	**s**	0	−1/2	**2**	**2**
1		0		0	+1/2		
2	**2nd**	0	**s**	0	−1/2	**2**	**8**
2		0		0	+1/2		
2		1	**p**	−1	−1/2	**6**	
2		1		−1	+1/2		
2		1		0	−1/2		
2		1		0	+1/2		
2		1		+1	−1/2		
2		1		+1	+1/2		
3	**3rd**	0	**s**	0	−1/2	**2**	**18**
3		0		0	+1/2		
3		1	**p**	−1	−1/2	**6**	
3		1		−1	+1/2		
3		1		0	−1/2		
3		1		0	+1/2		
3		1		+1	−1/2		
3		1		+1	+1/2		
3		2	**d**	−2	−1/2	**10**	
3		2		−2	+1/2		
3		2		−1	−1/2		
3		2		−1	+1/2		
3		2		0	−1/2		
3		2		0	+1/2		
3		2		+1	−1/2		
3		2		+1	+1/2		
3		2		+2	−1/2		
3		2		+2	+1/2		

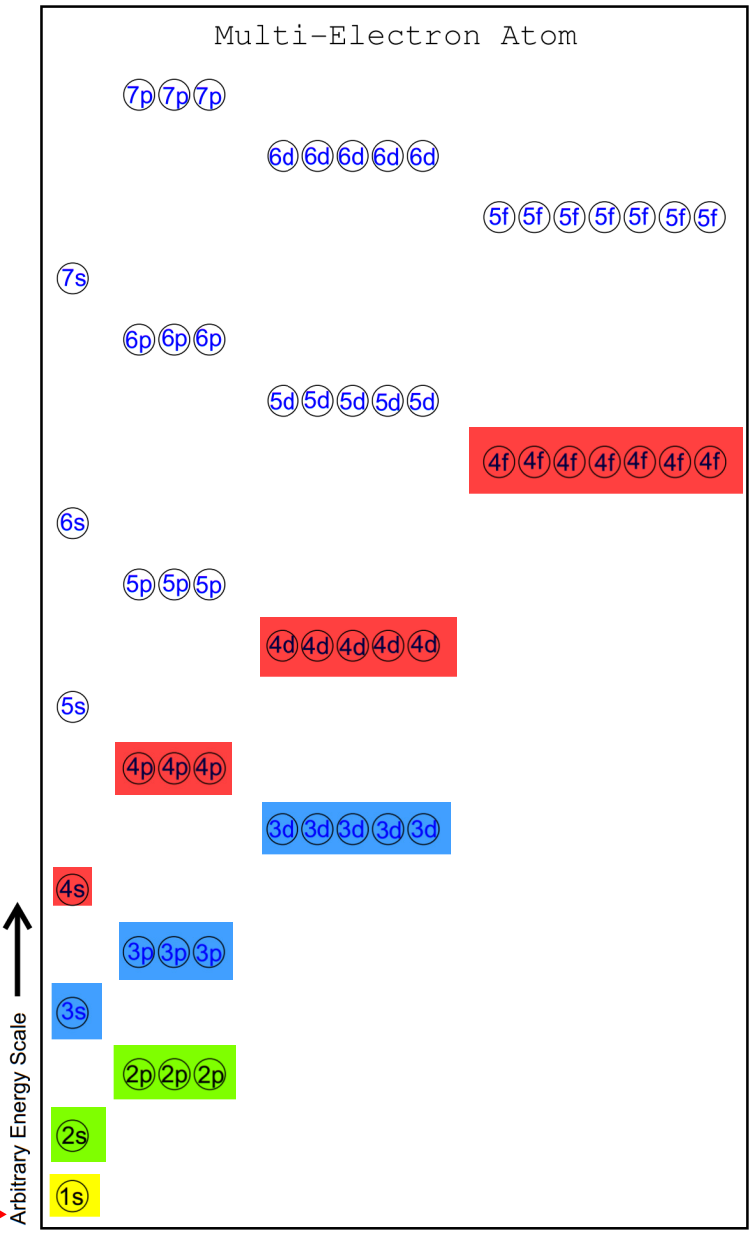
allowed values, Pauli exclusion principle and the Aufbau principle will generate an organized arrangement of possible quantum number combinations

Energy Level Diagrams Showing Energy Shift From Single to Multi-Electron Atom

This diagram is generated from the "quantum number organizer" plus $E_{e^-} = -13.6eV(1/n^2)$



e-/e- repulsion complicate the energy, energy increases such that this effect is magnified as you go from s to p to d to f



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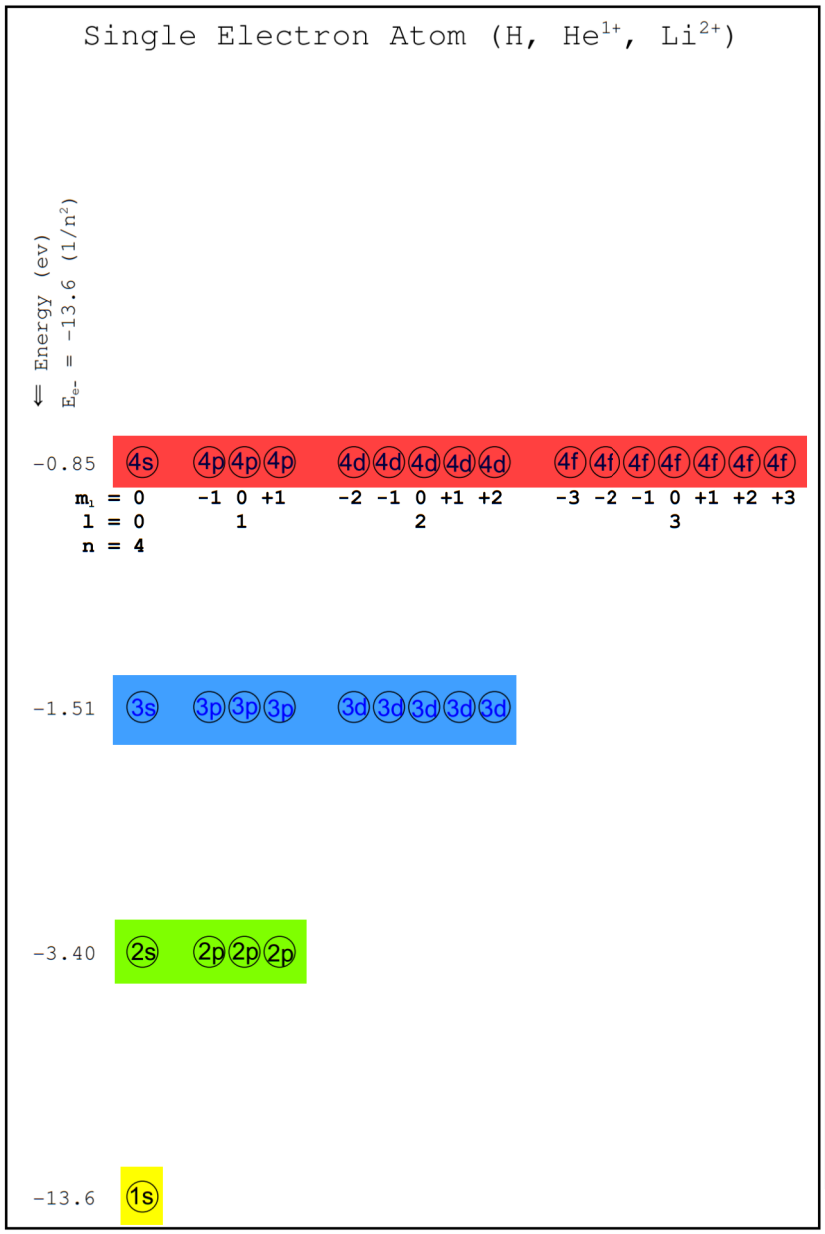

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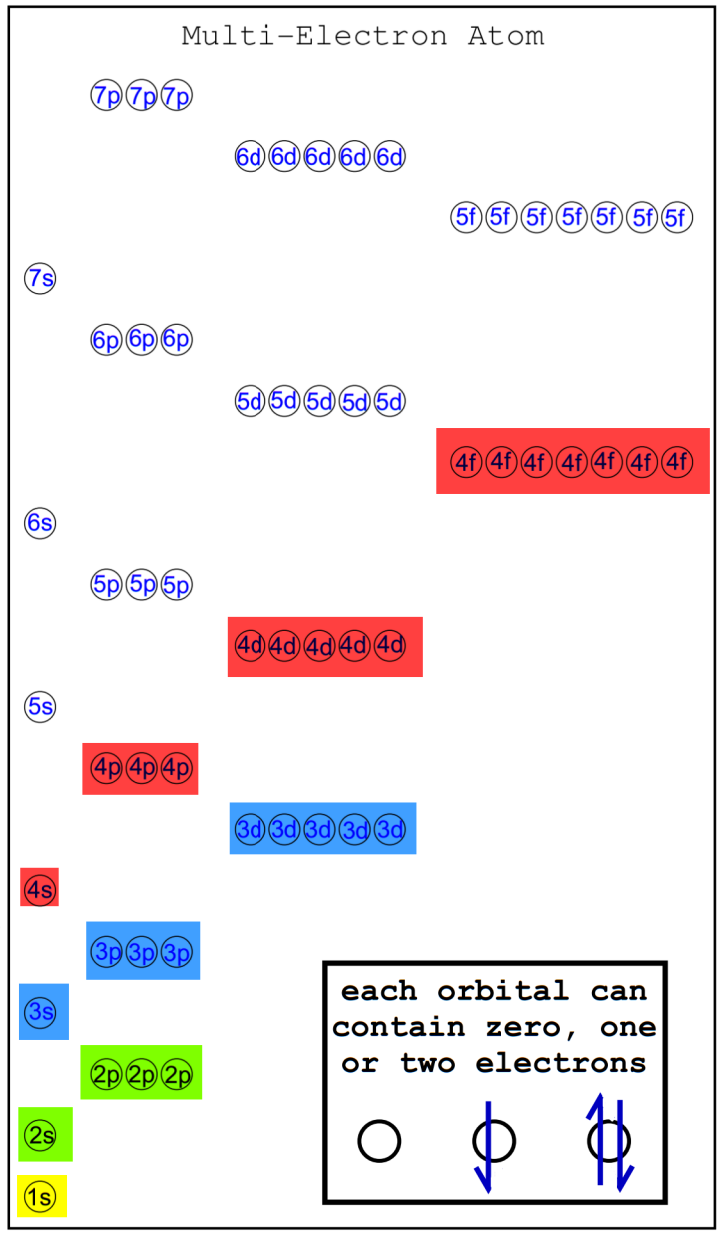
Arbitrary Energy Scale



This has been filled out using the sequence of energy (lowest to highest) from the previous page. Each orbital is capable of holding two electrons each, therefore the widths of each block is as follows: s = 2, p = 6, d = 10, f = 14

$1s^1$																	$1s^2$
$2s^1$	$2s^2$											$2p^1$	$2p^2$	$2p^3$	$2p^4$	$2p^5$	$2p^6$
$3s^1$	$3s^2$											$3p^1$	→	→	→	→	$3p^6$
$4s^1$	$4s^2$	$3d^1$	$3d^2$	$3d^3$	$3d^4$	$3d^5$	$3d^6$	$3d^7$	$3d^8$	$3d^9$	$3d^{10}$	$4p^1$	→	→	→	→	$4p^6$
$5s^1$	$5s^2$	$4d^1$	→	→	→	→	→	→	→	→	$4d^{10}$	$5p^1$	→	→	→	→	$5p^6$
$6s^1$	$6s^2$	$5d^1$	→	→	→	→	→	→	→	→	$5d^{10}$	$6p^1$	→	→	→	→	$6p^6$
$7s^1$	$7s^2$	$6d^1$	→	→	→	→	→	→	→	→	$6d^{10}$						

$4f^1$	→	→	→	→	→	→	→	→	→	→	→	→	$4f^{14}$
$5f^1$	→	→	→	→	→	→	→	→	→	→	→	→	$5f^{14}$

m_s = -1/2 or +1/2

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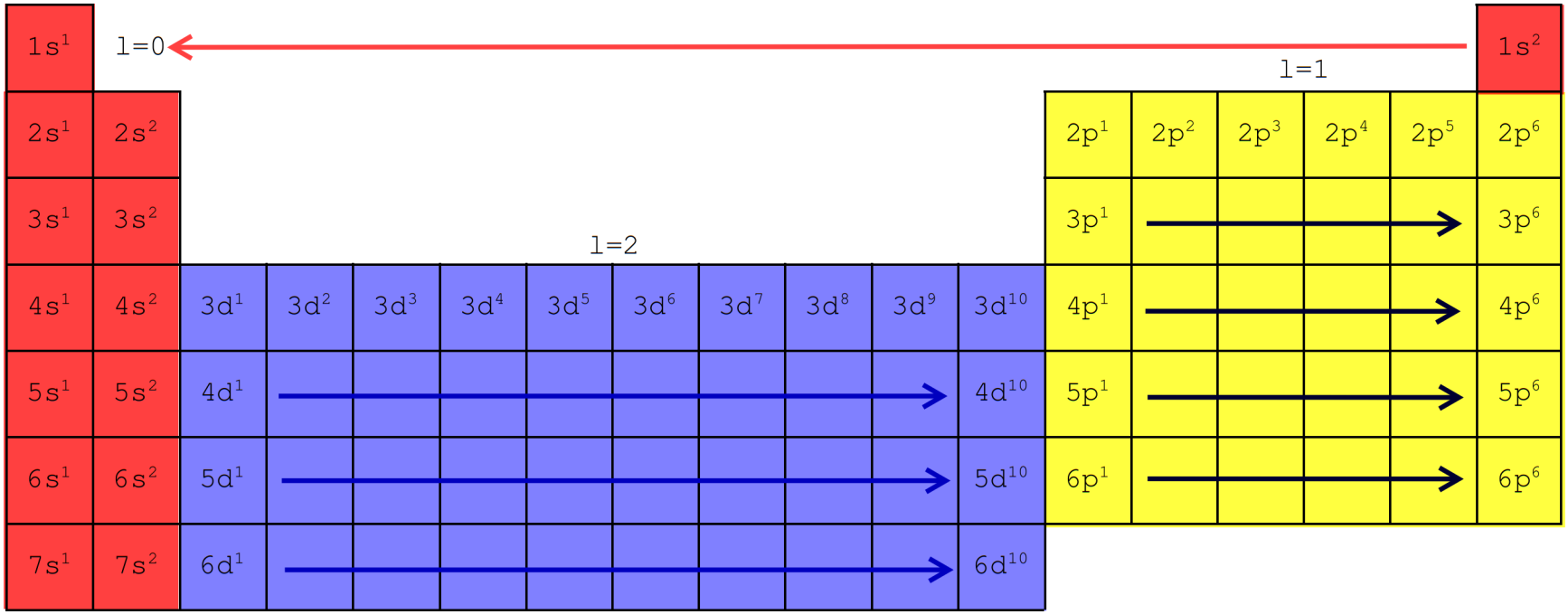
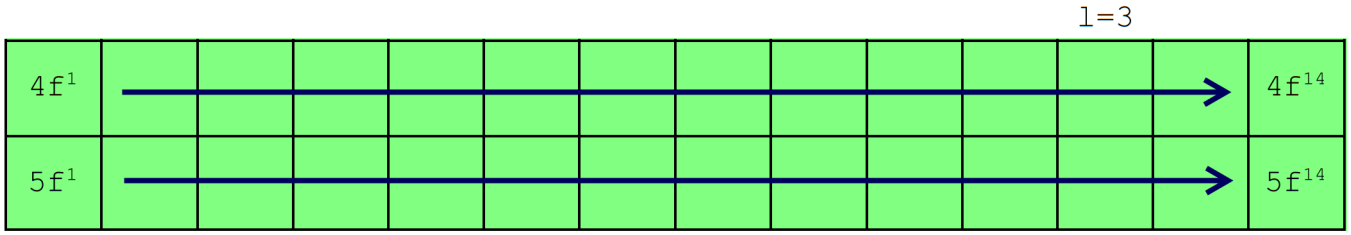
l = 0, l = 1, l = 2, l = 3





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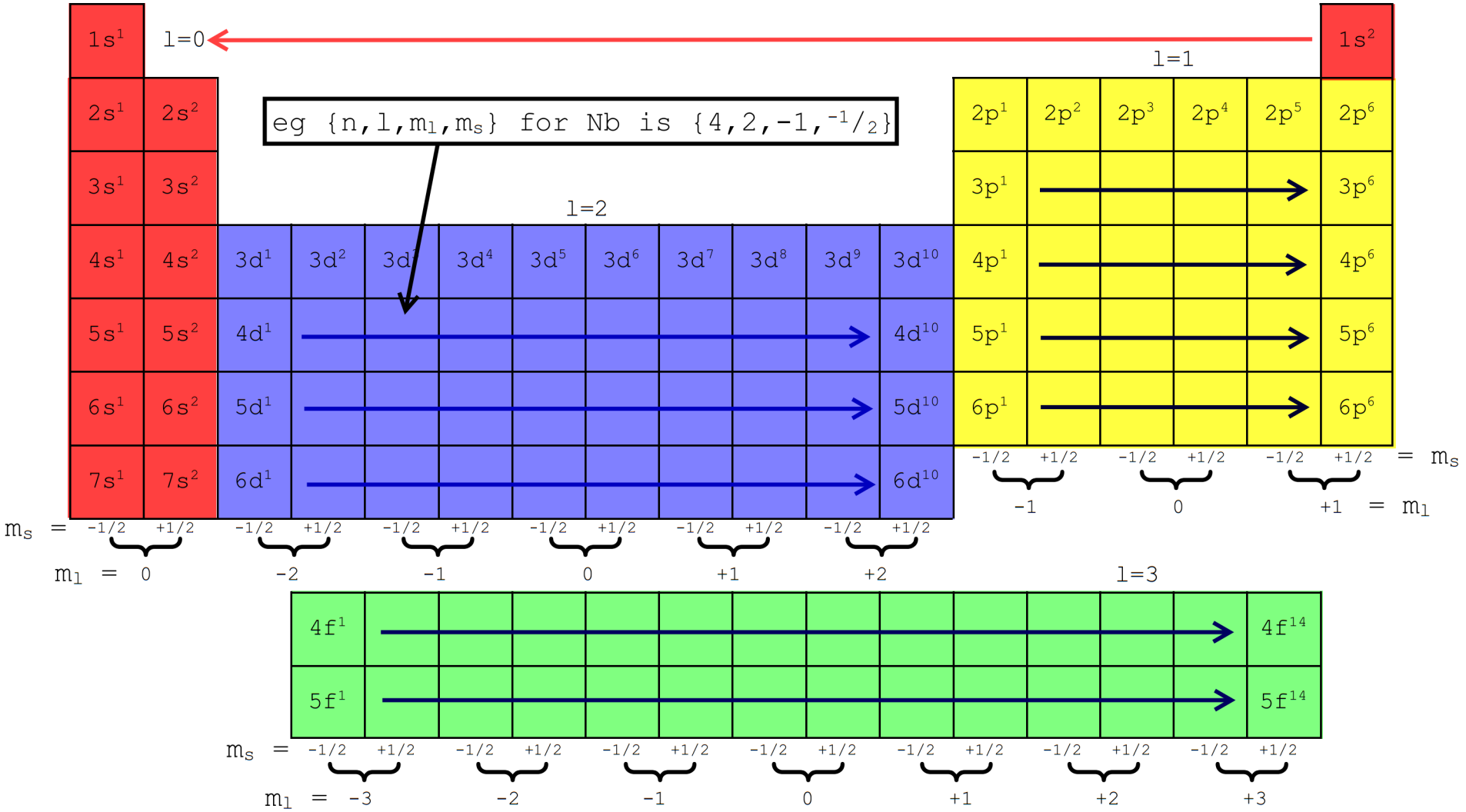

Two Types of Quantum Questions:

- electron configuration question
- list the quantum number question

Electron configuration means make reference to all electrons in an atom

eg $_{22}Ti$ $1s^2$
$2s^2\ 2p^6$
$3s^2\ 3p^6$
$4s^2\ 3d^2$

$_{98}Cf^{3+}$ $1s^2$
$2s^2\ 2p^6$
$3s^2\ 3p^6$
$4s^2\ 3d^{10}\ 4p^6$
$5s^2\ 4d^{10}\ 5p^6$
$6s^2\ 4f^{14}\ 5d^{10}\ 6p^6$
$7s^2\ 5f^7$

element	n	l	m_l	m_s	end of config.
S	3	1	0	+½	$3p^4$
Ta	5	2	−1	−½	$5d^3$
Pr or Pa	4 or 5	3	−2	−½	$4f^3$
Ge	4	1	−1	+½	$4p^2$
He	1	0	0	+½	$1s^2$
Md	5	3	3	−½	$5f^{13}$
Ca	4	0	0	+½	$4s^2$
Mo	4	2	−1	+½	$4d^4$
$_{103}Lr$	6	2	−2	−½	$6d^1$
Yb	4	3	3	+½	$4f^{14}$