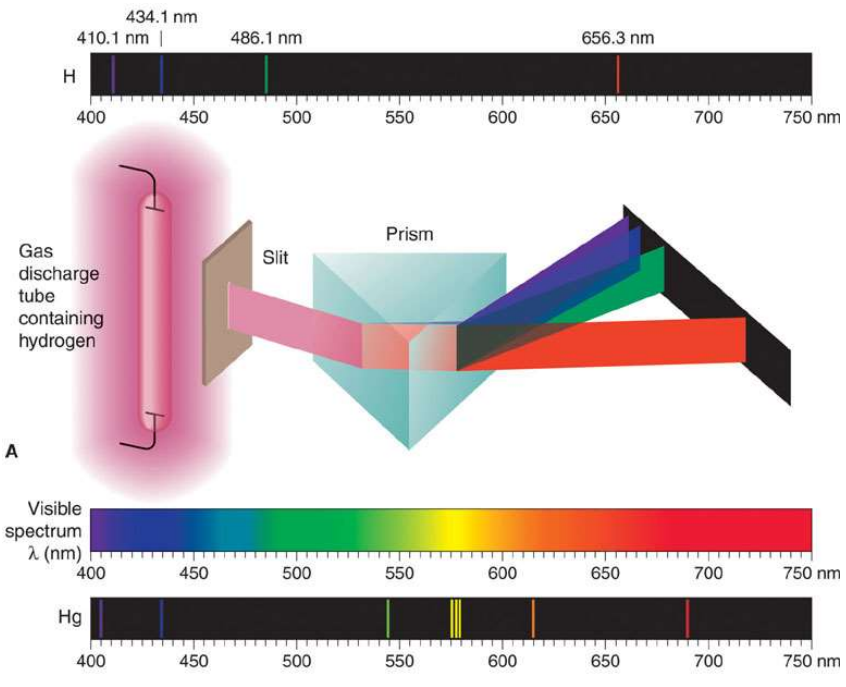
3. ELECTRON CONFIGURATIONS

UNIT 5 – QUANTUM MODEL OF THE ATOM

CH40S MR. WIEBE

1

REVIEW



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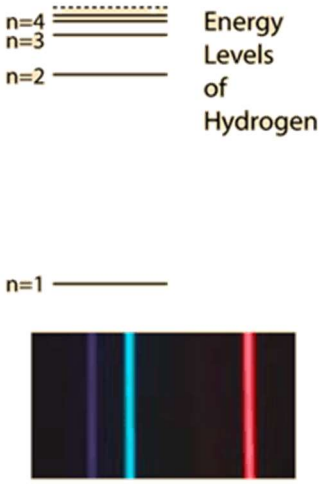
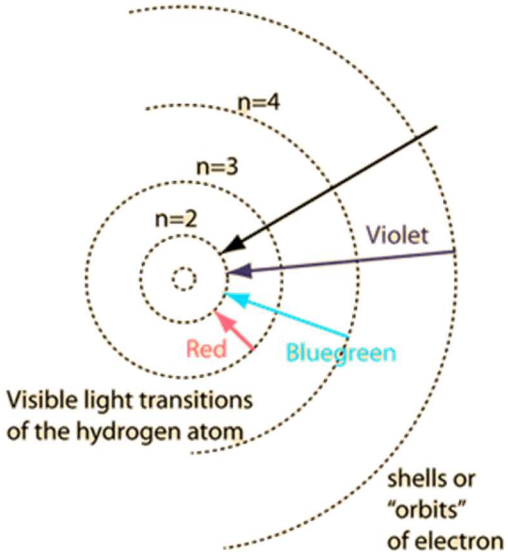
REVIEW





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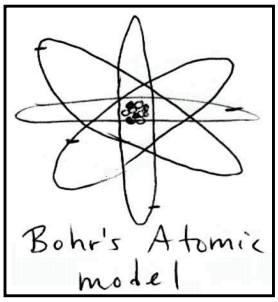
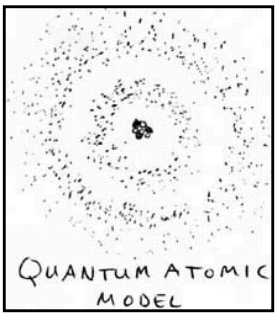
IS IT REALLY THAT SIMPLE?

- Although it works great for single-electron atoms, Bohr's model fails for atoms with 2 or more electrons!
- Ultimately, the failures of Bohr's model lay in the fact that he treated the electron as a particle rather than a wave!





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MODIFYING THE BOHR MODEL

- Louis de Broglie made the leap that if light can behave as "wave-particles" or photons, then so can matter!
- He showed that the wavelength of a baseball is negligible (as expected), but that the wavelength of an electron was on the order of magnitude equal to that of electromagnetic radiation!
- This is what Bohr had missed – an atomic model must make use of the wave-nature of electrons to be complete!

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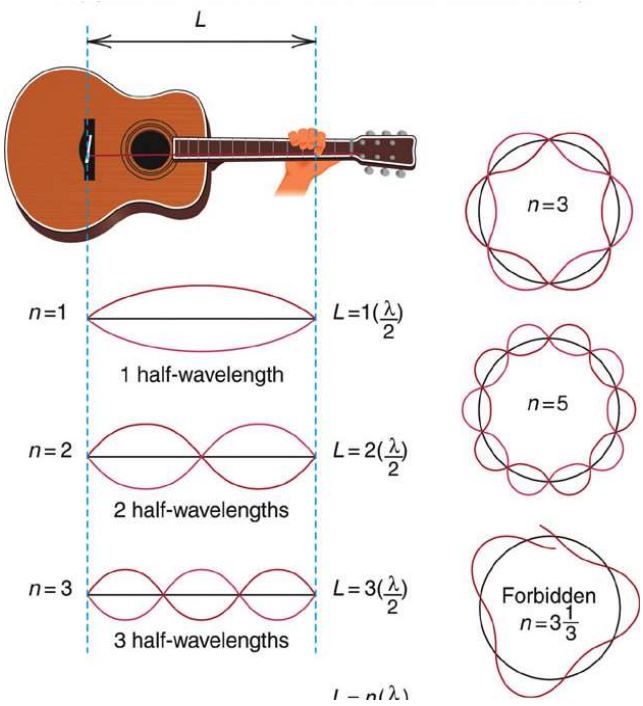
Electrons Must Act Like Standing Waves



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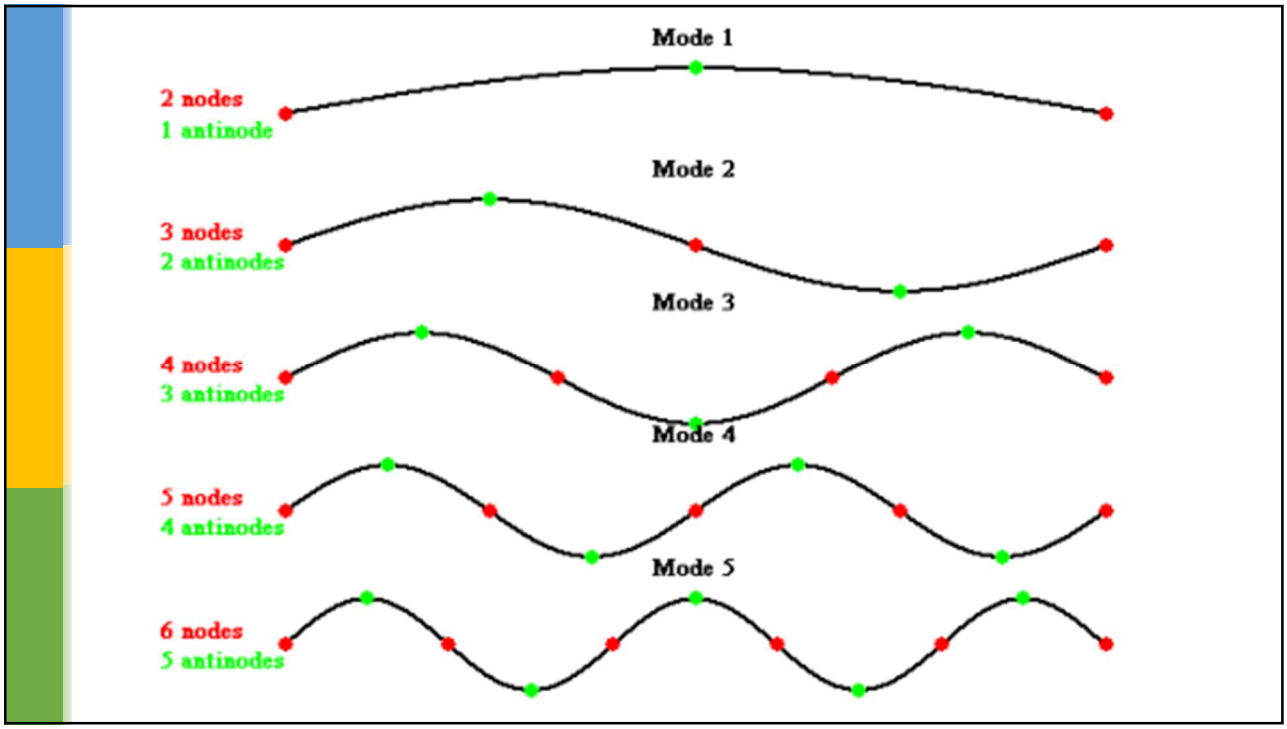

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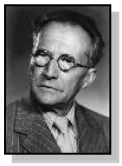
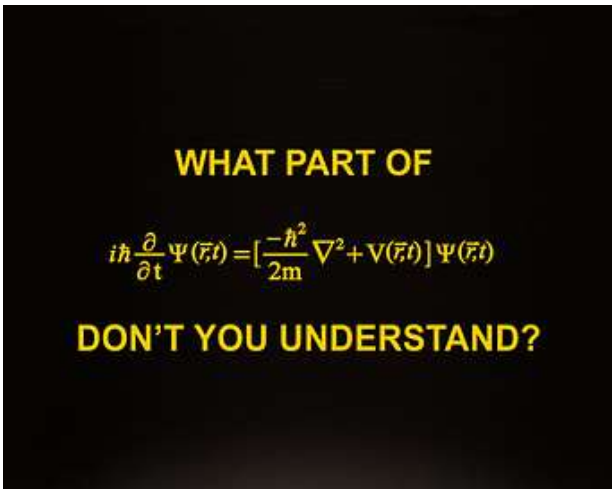
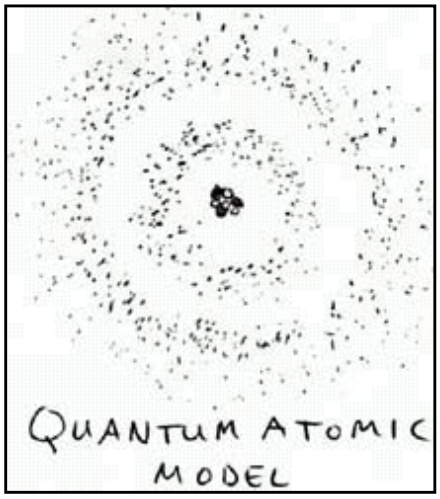
The Schrödinger Wave Equation







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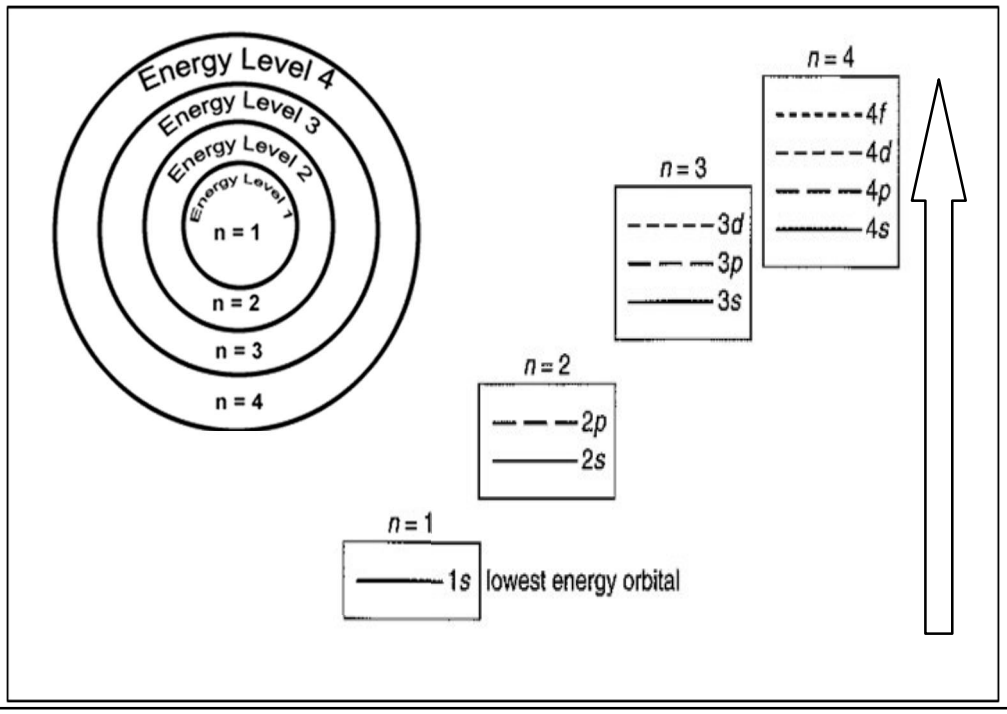
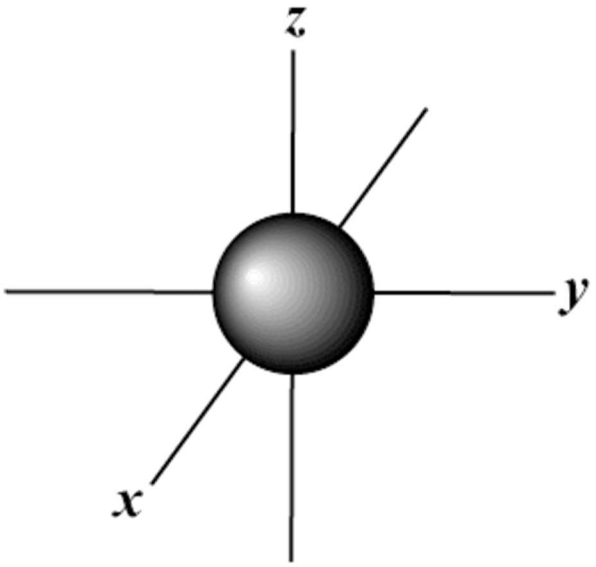


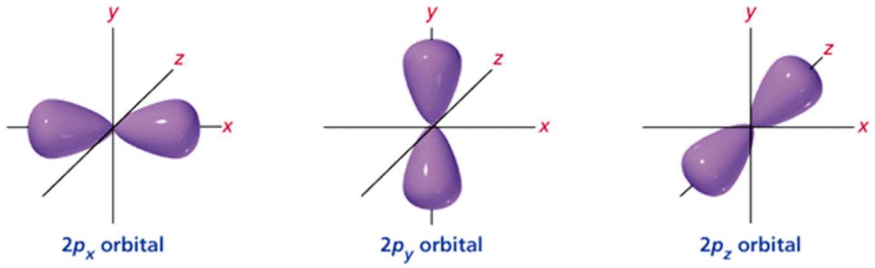
s orbitals

There is only 1 arrangement of an s orbital.

One s orbital is found in **every** energy level.



p orbitals



There are **<u>3 arrangements</u>** of p orbitals.

Three p orbitals are found in energy levels **<u>after and including n=2</u>**.

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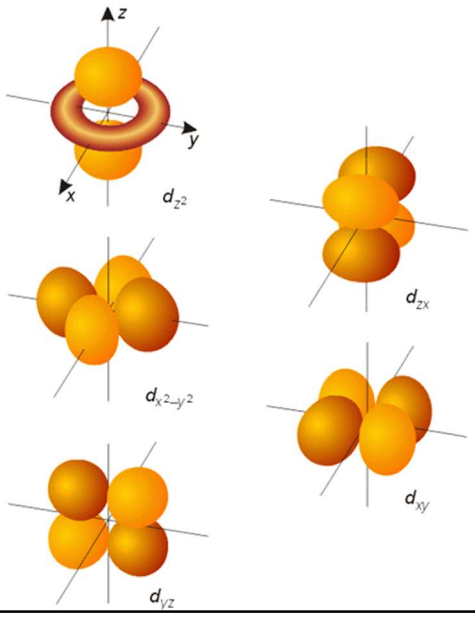
d orbitals



There are **<u>5 arrangements</u>** of d orbitals

Five d orbitals are found in energy levels **<u>after and including n=3</u>**.

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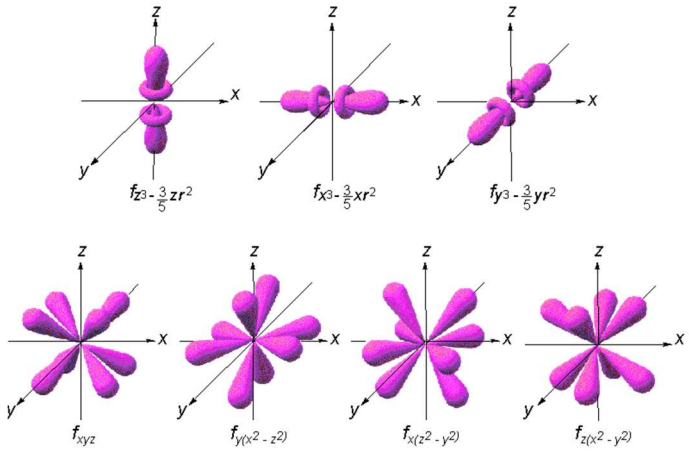
f orbitals



There are **7 arrangements** of f orbitals

Seven f orbitals are found in energy levels **after and including n=4**.

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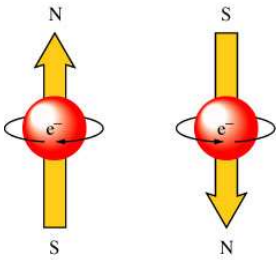
THE PAULI EXCLUSION PRINCIPLE

WOLFGANG PAULI

Electrons occupying the same orbital must have opposite spins. As such, the maximum number of electrons allowed in any orbital is 2!



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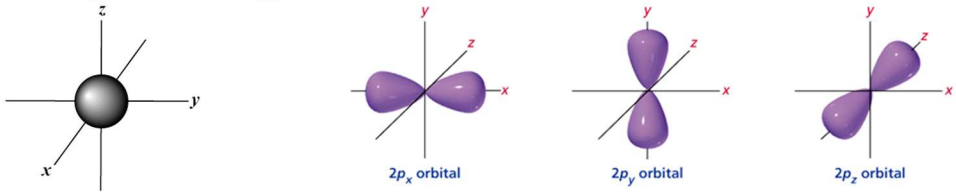
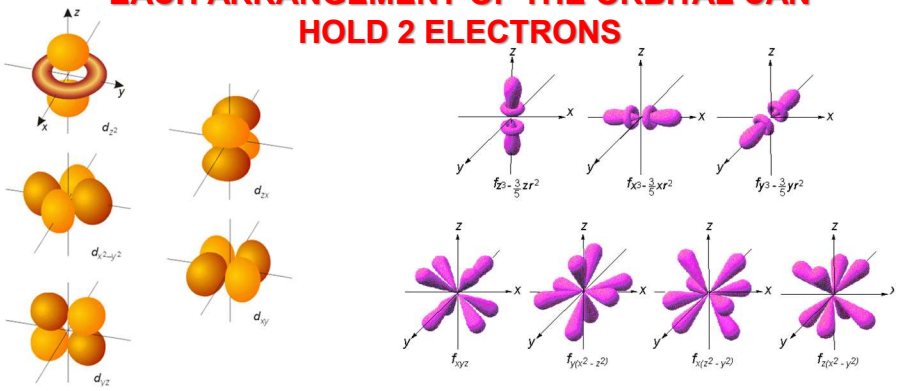
Putting it Together



EACH ARRANGEMENT OF THE ORBITAL CAN HOLD 2 ELECTRONS



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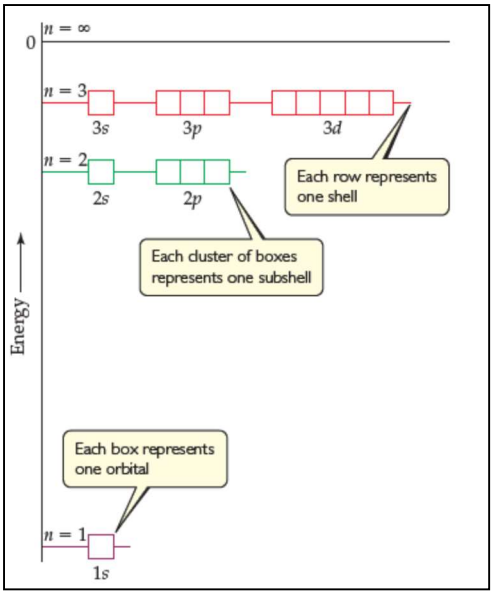

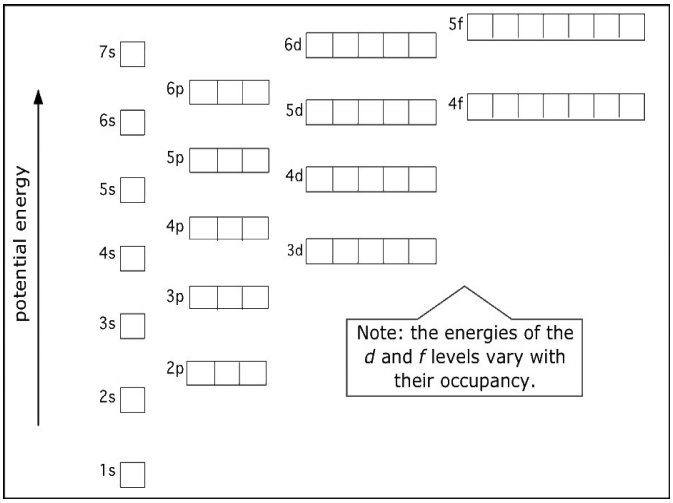

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OTHER CONSIDERATIONS

2. Aufbau Principle

WOLFGANG PAULI

Electrons always fill the lowest energy orbitals first.

OTHER CONSIDERATIONS

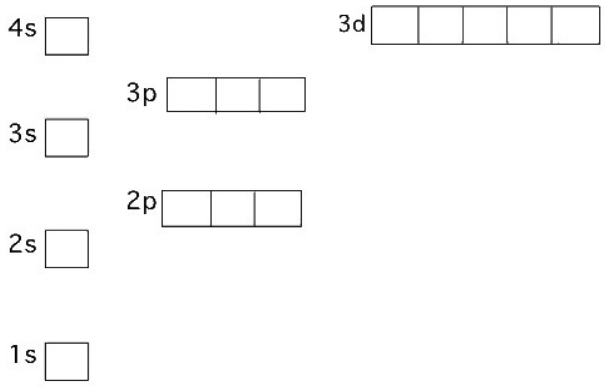
3. Hund's Rule

FRIEDRICH HUND

Electrons only pair up in orbitals after every orbital contains single electrons.

VERTICAL ORBITAL DIAGRAMS

Determine the electron configuration for carbon.



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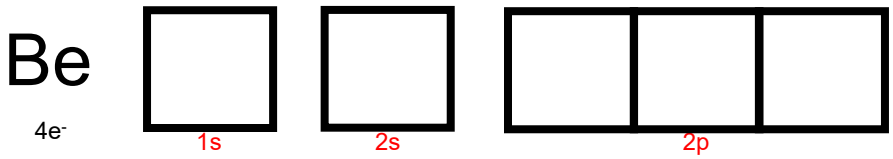
HORIZONTAL ORBITAL DIAGRAMS

Write carbon's electron configuration in a horizontal diagram.



An atom will either gain electrons to fill half-filled orbitals in an energy level or lose electrons to empty an energy level.

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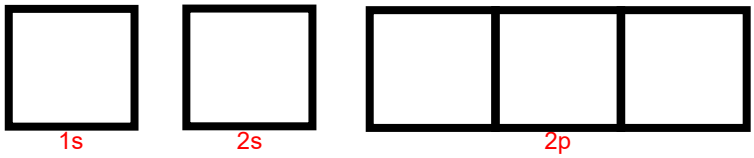
SUBLEVEL NOTATION

Write the electron configuration for oxygen in sublevel notation.

Horizontal Notation:

O

$8e^-$



Sublevel Notation:

How many electrons does an oxygen atom need to gain or lose to achieve a stable electron configuration?

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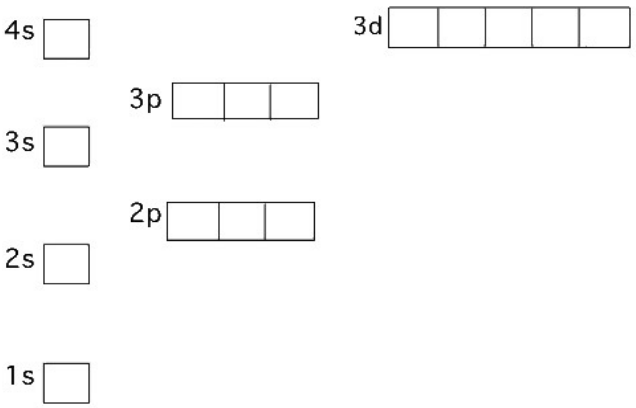
VALENCE ELECTRONS

Complete the orbital energy diagram below for iron and then write its electron configuration in sublevel notation. How many valence electrons does iron possess? How many unpaired electrons does it possess?



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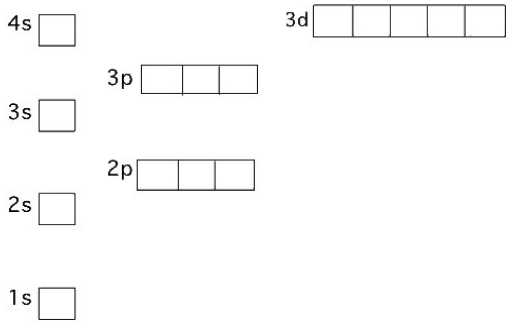
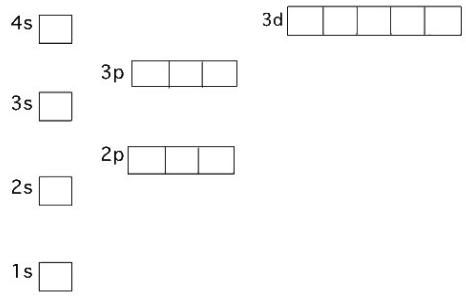
ION SUBLEVEL NOTATION

Write the electron configuration for a chloride **ion** in sublevel notation.



ION SUBLEVEL NOTATION

Write the electron configuration for a manganese **ion** in sublevel notation.



SUMMARY

Energy Level	Sub-Energy Levels	Orbitals	Electrons in Each Orbital	Number of Electrons in Each Sub-Energy Level	Total Electrons in Energy Level
1	1s	1 s,	2	2	2
2	2s, 2p	1 s, 3 p's	2	2, 6	8
3	3s, 3p, 3d	1 s, 3 p's, 5 d's	2	2, 6, 10	18
4	4s, 4p, 4d, 4f	1 s, 3 p's, 5 d's, 7 f's	2	2, 6, 10, 14	32