

# BOND THEORIES

## Valance Bond theory

Schweitzer

“Science is the process of creating models with predictive power”

# Why do some chemicals react differently than others!!

- Diamond vs. Graphite
- Both are made out of pure carbon yet diamonds are the hardest known substance and graphite is used as a lubricant.



- How do scientists develop a bonding model?
  - Look at things that are happening in everyday life. Then try to explain.
  - We are working backwards.

# Why do some chemicals react differently than others!!

- Water
  - 2 Hydrogen atoms
  - 1 Oxygen
- Carbon Dioxide
  - 1 Carbon
  - 2 Oxygens
- Ammonia
  - 1 Nitrogen
  - 3 Hydrogens
- Ammonium
  - 1 Nitrogen
  - 4 Hydrogens
- We know the composition of many compounds & ratios (Dalton)
- HOW AND WHY DO THEY FIT TOGETHER?
- GOOD QUESTION.
  - If we knew we could build molecules to server our purposes.

# What is actually doing the bonding?

- Valence electrons: The outer electrons determine an atom's bonding patterns.
  - Example: Alkali metals all have 1 valence electron and they all react violently with water.

# Why do atoms bond?

- Atoms bond to attain a lower more stable energy state.
- This usually means filling outer energy levels.
- Atoms can transfer (ionic) or share (covalent) electrons to fill outer energy levels

# How does water bond?

Lets look at the electron configurations

What can this tell us?

## ■ oxygen

- $1s^2 2s^2 2p_x 2p_y 2p_z$



## ■ Hydrogen

- $1s^1$



## ■ Hydrogen

- $1s^1$



Notice

Oxygen has two un-bonded electrons

And it bonded twice.

Hydrogen has 1 un-bonded electron and

only bonds once.



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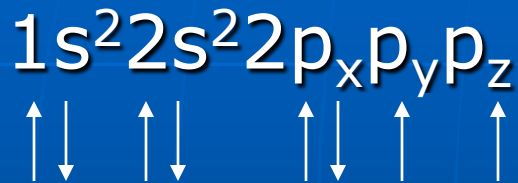
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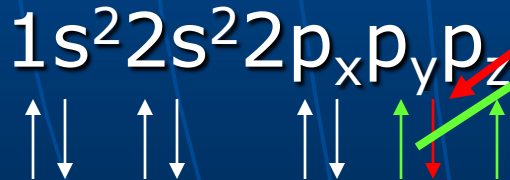
Oxygen



Hydrogen



Oxygen

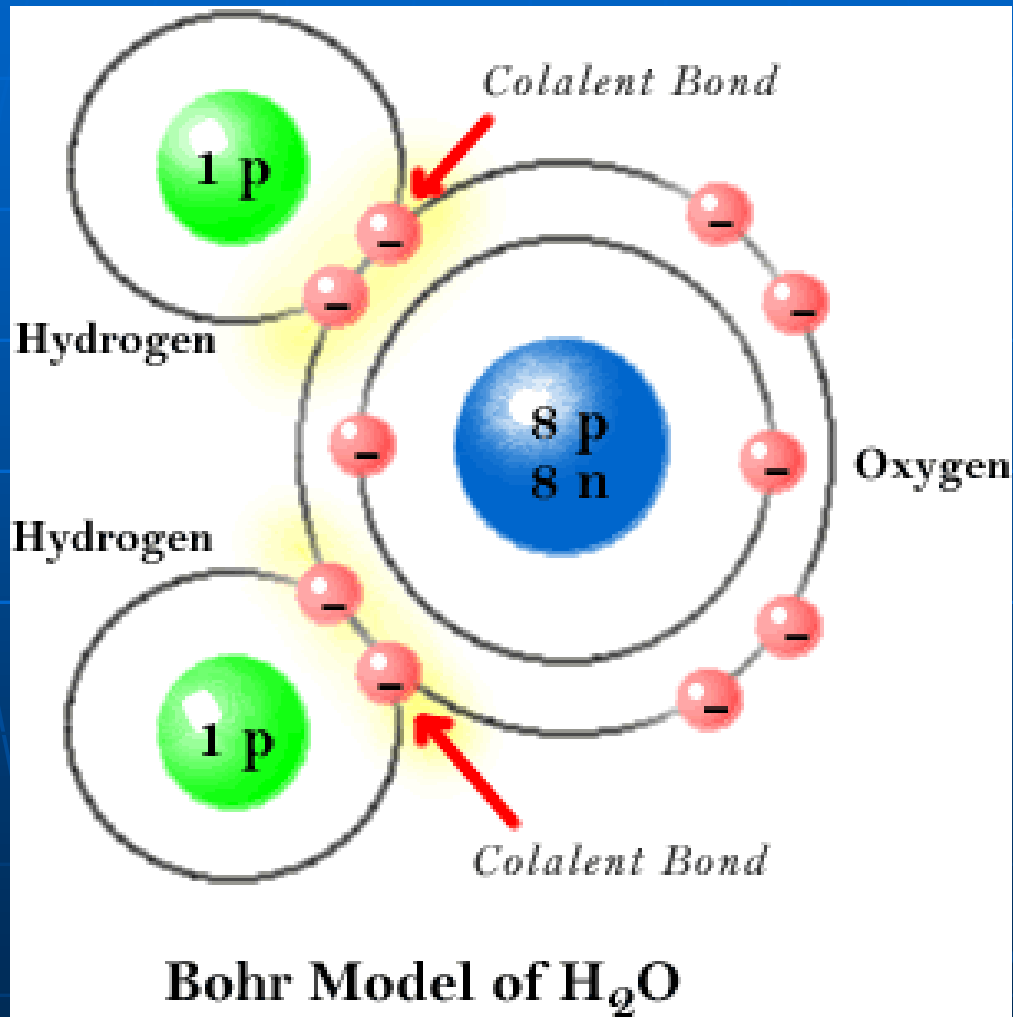


Hydrogen



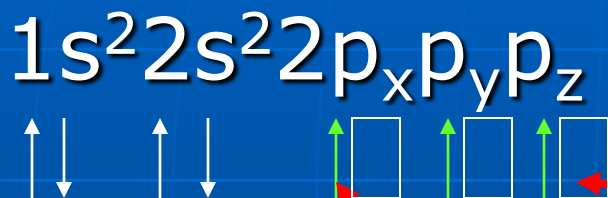
Suborbitals overlap sharing electrons filling each atoms outer Electron orbital.

# Sharing e-



# How does ammonia bond

- $\text{NH}_3$



Hydrogen



Hydrogen



Hydrogen



Nitrogen has three empty electrons shells, therefore we might assume it will bond 3 times.

What would you expect to be the formula between Hydrogen and Fluorine?

Science is the process of making models with predictive power!!

# Did you say HF?

- Hydrogen

$1s^1$



- Fluorine

$1s^2 2s^2 2p_x p_y p_z$

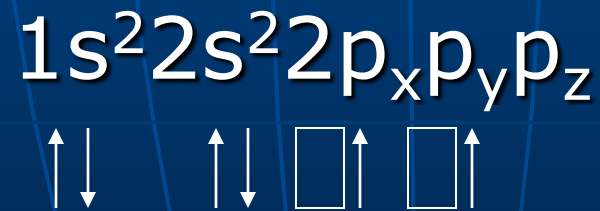


How many times does Carbon  
bond?

Draw out an orbital diagram to confirm.

# How many times does Carbon bond?

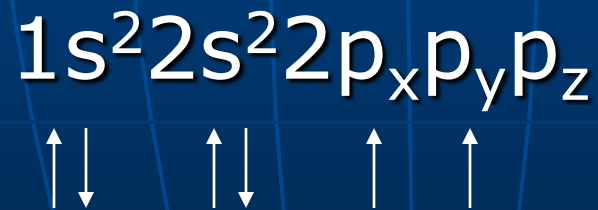
4 Bonds ???





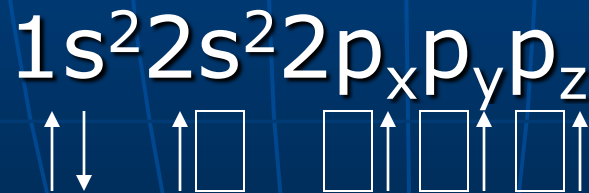
# How many times does Carbon bond?

How is it that carbon can bond 4 times, yet only have two open spots.... Time for a new theory!!!



# How many times does Carbon bond?

**Promotion:** Very often an atom can promote up an electron from a lower electron level. Now it has 4 open spots.



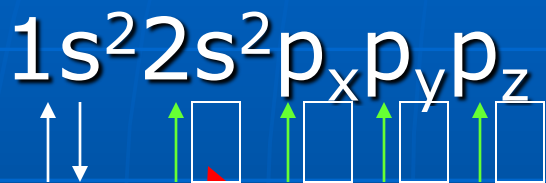
# What bonding pattern would you expect form Carbon and Chlorine?

Draw out the orbital diagrams for each of the Substances and determine the bonding pattern.

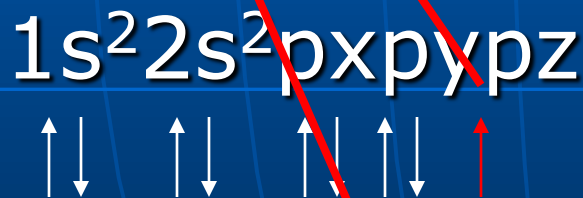
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Carbon

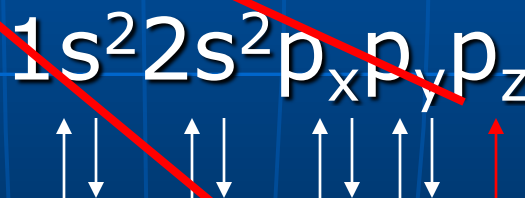
**CCl<sub>4</sub>**



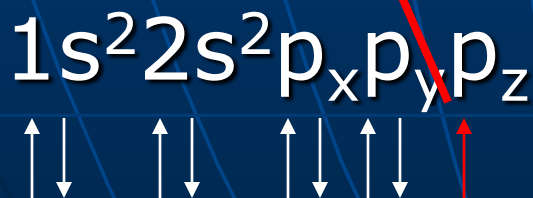
Chlorine



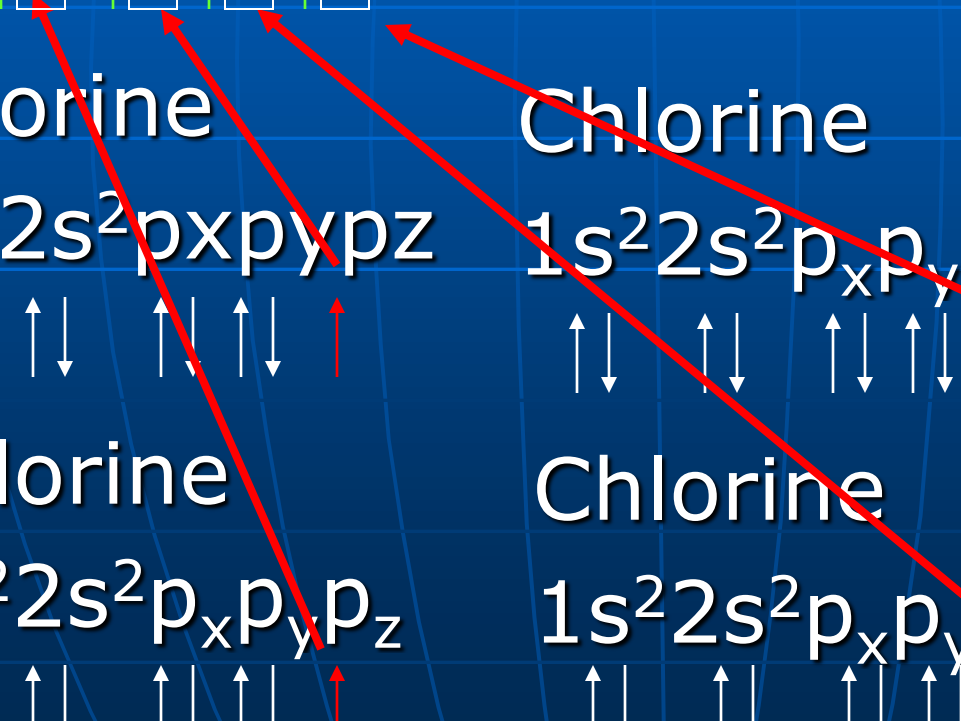
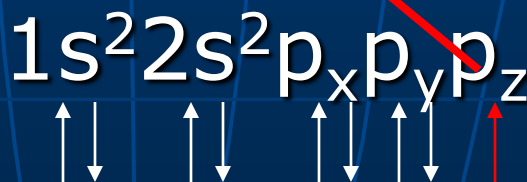
Chlorine



Chlorine



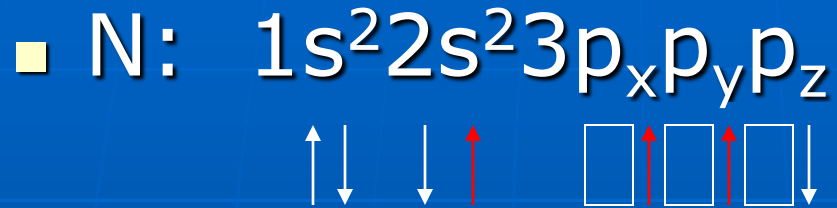
Chlorine



# Ammonium $\text{NH}_4^+$

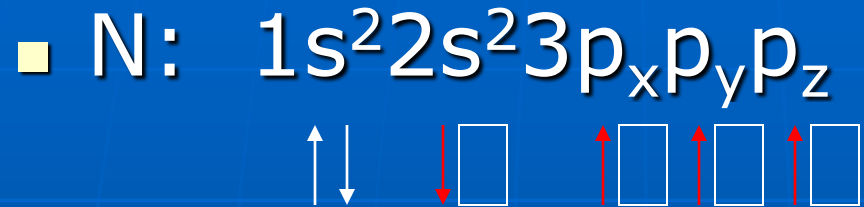
- Does promotion occur in this chemical?
- Draw out an orbital diagram.

# Ammonium $\text{NH}_4^+$



Notice: We lost an electron!!

# Ammonium $\text{NH}_4^+$



Yes, promotion is occurring!

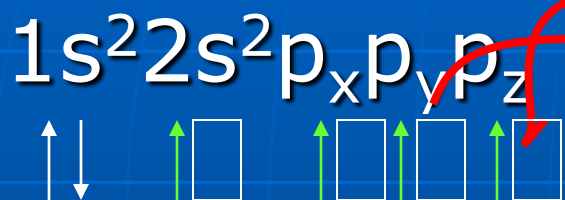
# Try Carbon and oxygen

- Draw the orbital diagrams for Carbon and oxygen. Try to determine the bonding ratio.

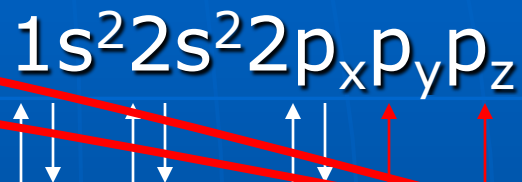


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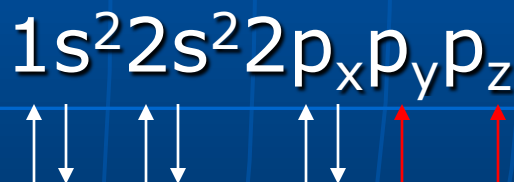
carbon



Oxygen



Oxygen



This particular molecule shares two electrons each  
General Chemistry END HERE!!!

# Paramagnetic vs. Diamagnetic

- Paramagnetic: substance exhibits a small magnetism.
- Diamagnetism: Substance does not exhibit any magnetism.

# Ferromagnetism

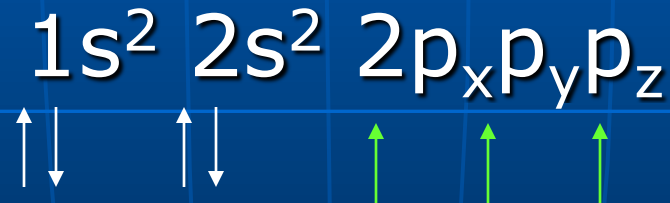
Substances that are strongly magnetic, usually containing Iron.

Atoms align up in crystals where the magnetic fields of the individual atoms line up magnifying this into a strong magnet.

Interestingly if you melt a magnet it loses its magnetic properties.

# How is magnetism produced?

- Currently it is theorized that lone pair electrons cause an atom to be paramagnetic or slightly magnetic.
- Example: Nitrogen.



# This worked great explaining, Except ☹️

- Oxygen



Oxygen is not paramagnetic. Dam it.

Now we need a new theory.

Hence: Molecular Orbital theory is Born.

Honors Chemistry Stop here!!!