

Chapter 14: Lect 2 Chemical Bonding

Ionic Bonds
Covalent Bonds
Metallic Bonds

Review from Friday: Ionic Bonding

Na

Cl

You Try It! Go back to Fri notes

- > See if you can write the chemical formula for each of the two ions.
- > Remember, positive ions can only bond with negative ions, and vice versa and the numbers must be balanced.

Cation (+)	Anion (-)	Compound
Li ¹⁺	S ²⁻	
Mg ²⁺	Cl ¹⁻	
Al ³⁺	(PO ₄) ³⁻	

You Try It!

Cation (+)	Anion (-)	Compound
Li ¹⁺	S ²⁻	Li ₂ S
Mg ²⁺	Cl ¹⁻	
Al ³⁺	(PO ₄) ³⁻	

You Try It!

Cation (+)	Anion (-)	Compound
Li ¹⁺	S ²⁻	Li ₂ S
Mg ²⁺	Cl ¹⁻	MgCl ₂
Al ³⁺	(PO ₄) ³⁻	

You Try It!

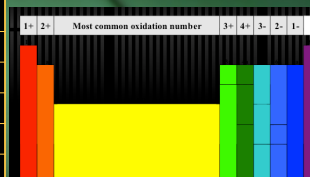
Cation (+)	Anion (-)	Compound
Li ¹⁺	S ²⁻	Li ₂ S
Mg ²⁺	Cl ¹⁻	MgCl ₂
Al ³⁺	(PO ₄) ³⁻	Al(PO ₄)

Review from Friday

- Oxidation Numbers and the cover of your little book

Giving vs. Getting: Oxidation Numbers for your LB

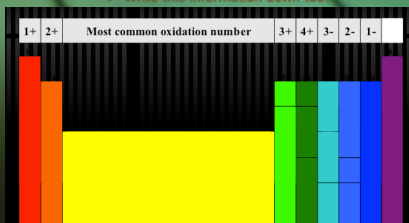
Atom	Electrons gained or lost	Oxidation #
K	Loses 1	1+
Mg	Loses 2	2+
Al	Loses 3	3+
P	Gains 3	3-
Se	Gains 2	2-
Br	Gains 1	1-
Ar	Loses 0	0



Now you try it! Giving vs. Getting For your Little Book Cover

- Use this table to help and remember...
 - **Positive** Oxidation Number = **losing** electrons
 - **Negative** Oxidation Number = **gaining** electrons

➤ Write this information down too!



Let's review Bonding??

- Let's see what Tim & Mobey have to say about Chemical Bonding;
- [Click here](#)

BrainPop: Chemical Bonds

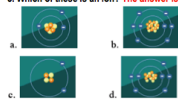
1. If an atom has no charge, which of the following must be true?

- It has more neutrons than protons or electrons
- There are only neutrons inside the atom
- Its number of protons is equal to its number of electrons

2. Based on what you know about atomic structure, what can you infer about the word "nuclear"?

- It relates to protons and neutrons
- It relates to electrons
- It relates to neutrons only
- It relates to ions only

3. Which of these is an ion? **The answer is D**



4. Atom X has 10 electrons. Atom Y has eight electrons. Which of them is more likely to bond with another atom?

- Atom X
- Atom Y
- Neither of them is likely to bond
- They are equally likely to bond

5. Which of these atoms is most likely to bond with another atom? **The answer is A**



6. An atom has 15 total electrons. How many electrons does it have in its outer shell?

- Three
- Four
- Five
- Six

7. The relationship between the number of electrons in an atom's outer shell and the atom's tendency to bond is called the octet rule. What can you infer about the meaning of "octet"?

- It refers to negative charges
- It refers to sets of eight
- It refers to different states of matter

8. Atom A has 7 electrons in its outer shell. Atom B has 1 electron in its outer shell. They react and bond. Now both atoms have eight electrons in their outer shells. What kind of bond has formed?

- Covalent
- Ionic
- Metallic
- Electron

9. Cations have positive charges. Anions have negative charges. What force draws the two together?

- Magnetic attraction
- Ionic attraction
- Electromagnetic attraction
- Electrostatic attraction

10. Substance M is a blue, brittle solid. Substance N is a colorless, flammable gas. What can we predict about the compound created when M and N form a covalent bond?

- It will be a liquid, since M is a solid and N is a gas
- It will be blue, since M is blue and N is colorless
- It will probably be flammable, since N is flammable
- There's no way to tell based on the information given

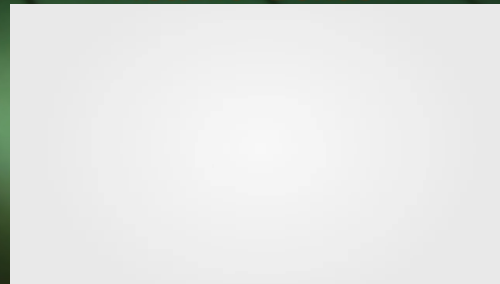
Quick Reminder Information

- More details to come...
- 3 types of bonds:
 1. Ionic: taking/giving of electrons (we discussed this on Friday)
 2. Covalent: went to Kindergarten and learned to share!! (Sharing of electrons- more info on this next time)
 3. Metallic Bonds

Metallic bond

- Quickly... a metallic bond is the force of attraction between a positively charged **metal ion** and the **electrons** in a metal.
- Metals atoms are so tightly packed, their electron shells overlap.
- This lets electrons move freely from one atom to another.
- THIS lets metal conduct electricity & change shape easily (ductility, malleability).
- Cool animation: [click here](#)

Metallic Bonds



Comparing Bonds

- It is really important that you understand the difference between covalent bonds.

Covalent	Ionic
Share Electrons	Transfer/give-take Electrons
Creates molecules	Creates ions
Bond consists of 2 electrons	Bonds form with all oppositely charged neighbors
Nonmetal - Nonmetal	Metal - Nonmetal

Ionic & Covalent Bonding



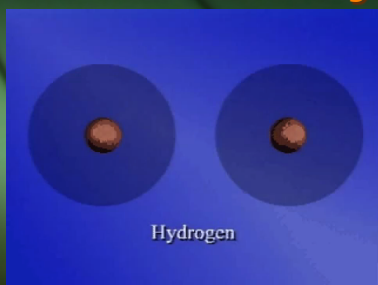
Chemical Bonding

Part 2:
Covalent Bonds,
Chemical Formulas, Structural Diagrams

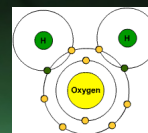
Types of bonds

- There are a couple different types of bonds.
 1. **Ionic** Bond
 2. **Covalent** Bond
 3. **Metallic** Bond
- Now, we are going to talk about covalent bonds.

6. Covalent Bonding



Bond with me



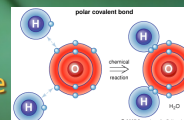
- A chemical bond forms when atoms **transfer** or **share electrons**.
- For example, in a water molecule, each hydrogen atom shares its single electron with the oxygen at the center.
- This way, all of the atoms are happy with full shells.
- Almost all elements form chemical bonds easily - which is why most matter is found in compounds.

Covalent Bonding

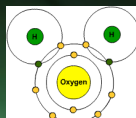
Single Covalent Bonding

Cooperating Covalents

- What is a covalent bond?
- A bond formed by **shared electrons**.
- Also, **molecules** are groups of atoms that are held together by covalent bonds in a specific ratio & shape.

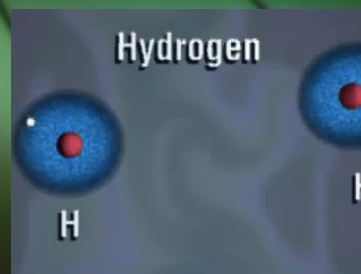


Covalent Bonds



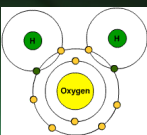
- A **covalent bond** is formed when atoms **share** electrons.
- The bonds between oxygen and hydrogen in a water molecule are covalent bonds.
- There are two covalent bonds in a water molecule, between the oxygen and each of the hydrogen atoms.
- Each bond represents one electron.
- In a covalent bond, electrons are **shared** between atoms, not transferred.

Special information about Hydrogen bonding

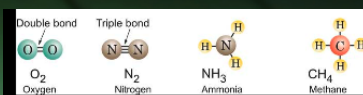


"M" is for Molecule

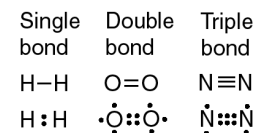
- A group of atoms held together by covalent bonds is called a **molecule**.
- Water is a molecule, and so is sugar.
- Other examples of molecules are
 - methane (CH₄)
 - ammonia (NH₃)
 - oxygen (O₂)
 - nitrogen (N₂).



Fancy Bonding

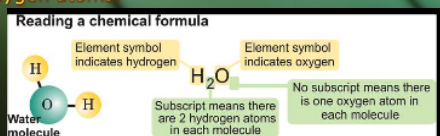


- Sometimes, atoms share more than one electron.
- Occasionally, they can share 2 or even 3 electrons.
- These are called **double** and **triple** bonds.



Chemical Formulas

- Molecules are represented by a **chemical formula**.
- The chemical formula tells you the **exact number** of each kind of atom in the molecule.
- For example, the chemical formula for water is H₂O.
- The **subscript** 2 indicates there are two hydrogen atoms in the molecule.
- The chemical formula also tells you that water always contains twice as many hydrogen atoms as oxygen atoms.



Chemical Formula Take 2

- Water is a simple molecule, so the formula is pretty easy.
- Let's look at a more complex molecule.
- Baking soda, or sodium bicarbonate, is NaHCO₃.
- That means it has:
 - 1 Sodium (Na)
 - 1 Hydrogen (H)
 - 1 Carbon (C)
 - 3 Oxygen (O)

You Try it!

- Let's see how you do it. Next to each formula, write the name and number of each element.

Chemical Formula	Elements - #
C ₆ H ₆	
NH ₃	
Al(OH) ₃	
CO(NH ₂) ₂	

You Try it!

Chemical Formula	Elements - #
C ₆ H ₆	Carbon - 6 Hydrogen - 6
NH ₃	
Al(OH) ₃	
CO(NH ₂) ₂	

You Try it!

Chemical Formula	Elements - #
C_6H_6	Carbon - 6 Hydrogen - 6
NH_3	Nitrogen - 1 Hydrogen - 3
$Al(OH)_3$	
$CO(NH_2)_2$	

You Try it!

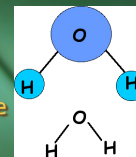
Chemical Formula	Elements - #
C_6H_6	Carbon - 6 Hydrogen - 6
NH_3	Nitrogen - 1 Hydrogen - 3
$Al(OH)_3$	Aluminum - 1 Oxygen - 3 Hydrogen - 3
$CO(NH_2)_2$	

You Try it!

Chemical Formula	Elements - #
C_6H_6	Carbon - 6 Hydrogen - 6
NH_3	Nitrogen - 1 Hydrogen - 3
$Al(OH)_3$	Aluminum - 1 Oxygen - 3 Hydrogen - 3
$CO(NH_2)_2$	Carbon - 1 Oxygen - 1 Nitrogen - 2 Hydrogen - 4

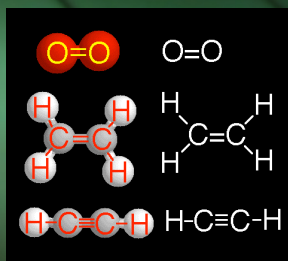
Structural Diagram

- The shape of a molecule is also important to its function and properties.
- For this reason, molecules are represented by **structural diagrams** which show the shape and arrangement of atoms.
- A single bond is represented by a bold short line.
- For example, water would look like this:



Structural Diagram - take 2

- Double and triple bonds are indicated by **double** and **triple** lines.
- Here are some examples:



Structural Diagram - take 3

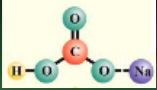
- Of course, real molecules are **3-dimensional**, not flat as shown in a structural diagram.
- For example, methane - CH_4 - has the shape of a 4-sided pyramid called a tetrahedron.

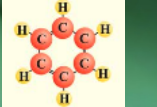
Chemical Formula	Diagram with Electrons	Flat Structural Diagram	3D Structural Diagram
CH_4			

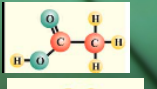
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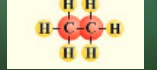
Match the structural diagram with its chemical formula.

- C_2H_6
- $NaHCO_3$
- $HC_2H_3O_2$
- C_6H_6

A 

B 

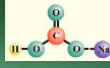
C 

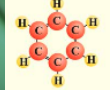
D 

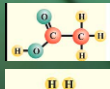
You Try it!

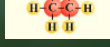
Match the structural diagram with its chemical formula.

- C_2H_6 - D
- $NaHCO_3$ - A
- $HC_2H_3O_2$ - C
- C_6H_6 - B

A 


B 

C 

D 

Lewis Dot Molecules

- > We've already seen how you draw a Lewis dot structure.
- > The dots represent the valence electrons of an atom.
- > We can draw Lewis dot structures for molecules too.
- > Each element forms bonds to reach one of the magic numbers of valence electrons: **2** or **8**.
- > In dot diagrams of a happy molecule, each element symbol has either 2 or 8 dots around it.



Lewis Dot Molecule - Example

- > Draw the dot diagram for carbon tetrachloride, CCl_4 .

- List the elements in the molecule
 - > Carbon
 - > Chlorine

Lewis Dot Molecule - Example

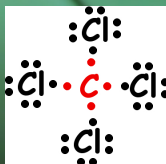
- > Draw the dot diagram for carbon tetrachloride, CCl_4 .

- List the elements in the molecule
 - > Carbon - 4
- Determine how many valence electrons each element has.
 - > Chlorine - 7

Lewis Dot Molecule - Example

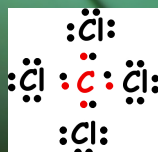
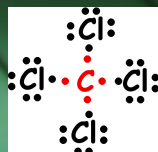
- > Draw the dot diagram for carbon tetrachloride, CCl_4 .

- List the elements in the molecule
 - > Carbon - 4
 - > Chlorine - 7
- Determine how many valence electrons each element has.
- Match the elements so that each atom has 8 (or 2 for H & He) electrons.



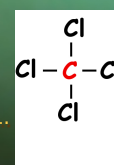
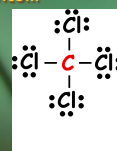
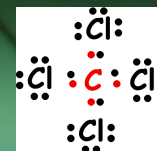
Lewis Dot Molecule - Example

- Notice that with this molecule, each atom has 8 electrons.
- The shells are all full!!!!
- Each chlorine atom shares an electron with carbon.
- In return, carbon shares its electrons with chlorine.
- We can change the drawing to look like this...



Lewis Dot Molecule - Example

- Eventually, this drawing changes into...
- This one...
- And finally, into this one....



9. Time for a little music!

What Kinds Of Bonds Are These?

Lyrics & Music © 2005, Mark Rosengarten

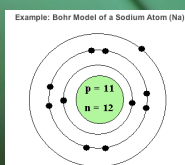
You Try it!

- Now, time for you to draw Lewis dot diagrams of molecules!!
- And count some atoms!

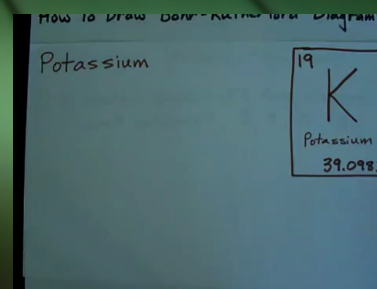
LB: Bohr Models

- Bohr Models show ALL the electrons, protons and neutrons in an atom.
- Start by completing the info on the side.
- Complete the info in the nucleus
- Finish by drawing ALL the electrons around the nucleus.

- Symbol: Na
- Atomic Number: 11
- # of Electron: 11
- # of protons: 11
- Atomic Mass: 23
- # of Neutrons: 12
- Oxidation Number: 1+



Video: How to draw a Bohr diagram



LB: Lewis Dot Structures:

- Information needed:
- Example: Aluminum
Atomic # 13:
- Symbol: Al
- Valence electrons: 3
- You simply put the valence electrons around the element symbol



Video: How to draw a Lewis Dot Diagram

Lewis Dot Structure for Aluminum



And finally, Counting Atoms: (found at the bottom of the lecture)

- | | |
|---|--|
| ➤ Name: Calcium Carbonate: | ➤ The Formula is : CaCO_3 |
| ➤ Also known as: Limestone | ➤ How many atoms do we have:
Ca: 1 C: 1 O: 3 total: 5 atoms |
| ➤ Formula: CaCO_3 | ➤ What is their atomic number: |
| ➤ We have to account for each and every atom: | Ca: 20 C: 6 O: 8 |
| ➤ Ca: Calcium | ➤ Ca: Alkaline Earth Metal: metal |
| ➤ C: Carbon | ➤ C: Carbon Family: nonmetal |
| ➤ O: Oxygen | ➤ O: Oxygen Family: nonmetal |