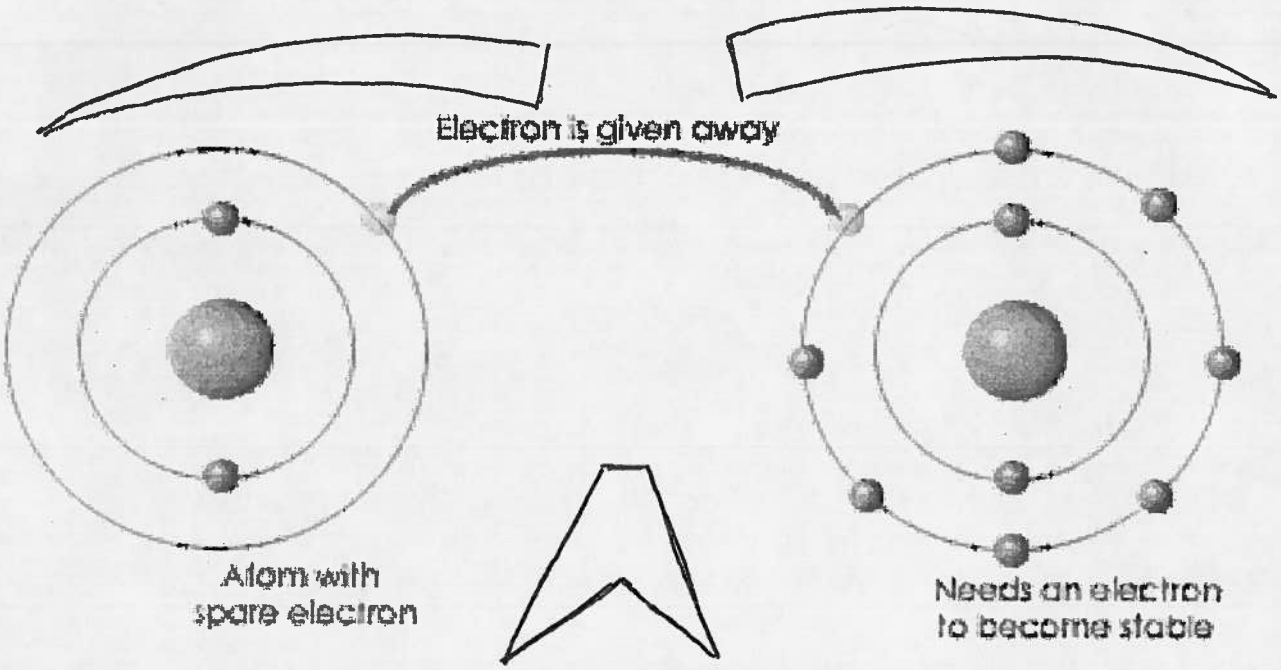
STUDENT *STUDENT*

Regents Chemistry

PRACTICE PACKET

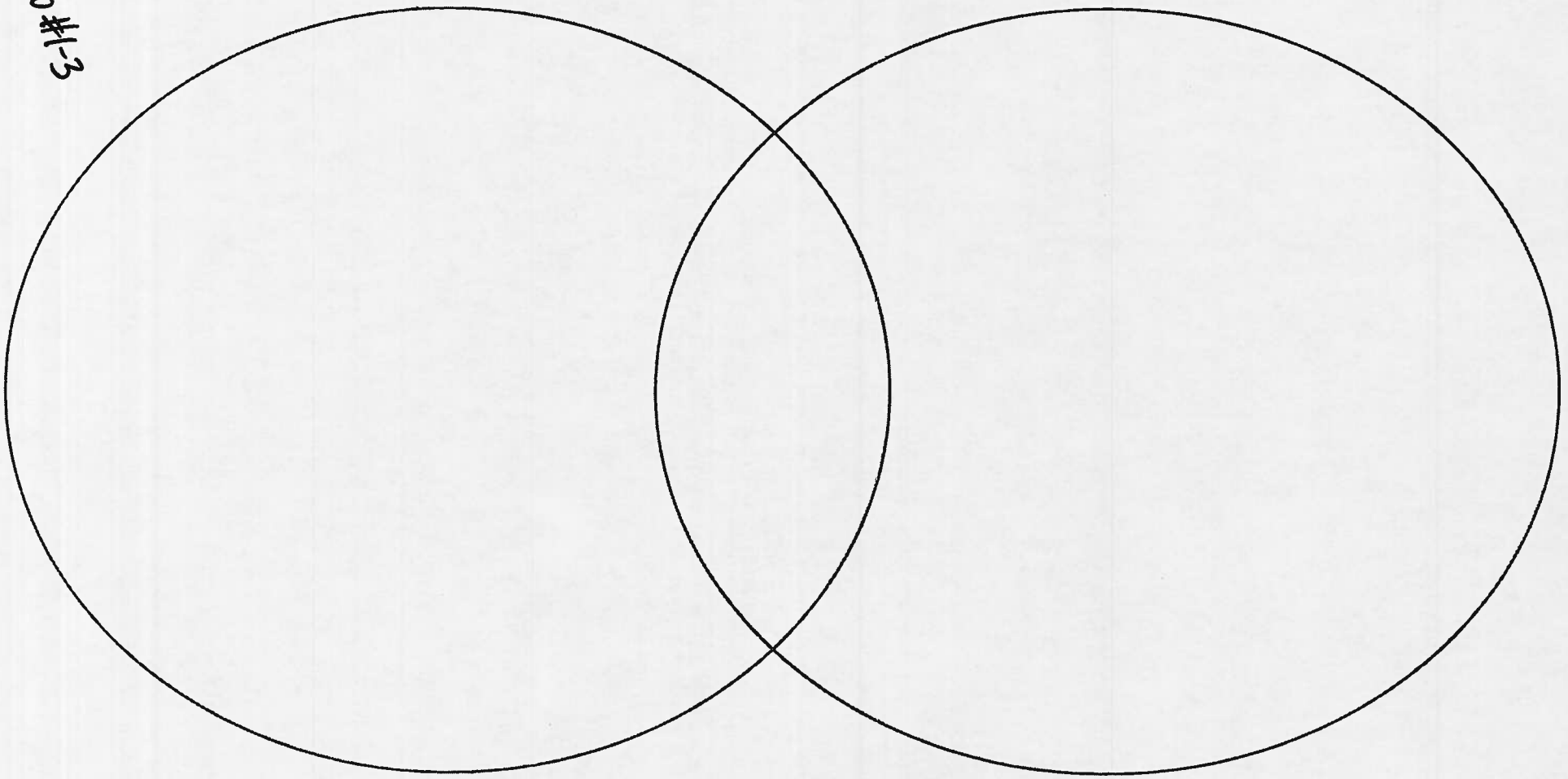
Unit 4: Bonding & Naming



Apply HW #1-3

Comparing & Contrasting Types of Chemical Bonds

Use your Homework Videos #1, 2 & 3 to complete the Diagram below



Summarize: How will you tell between an Ionic Compound or a Covalent one if you had samples in front of you?

Practice: Determine the oxidation number of each element and polyatomic ion within the compounds below. That includes elements within polyatomic ions.

Compound	Oxidation Numbers
1. NH_4Cl	NH_4 = N = H = Cl =
2. H_2O	H = O =
3. $(NH_4)_3PO_4$	NH_4 = N = H = PO_4 =
4. $H_2S_2O_7$	
5. Ba_3P_2	
6. H_2O_2	
7. CO_2	
8. NaOH	
9. Al_2O_3	
10. NO_2	
11. $AlPO_4$	
12. P_2O_5	
13. Na_2O_2	
14. FeO	
15. Fe_2O_3	

Best after H.W #4

Practice: Determine the oxidation number of each element and polyatomic ion within the compounds below. That includes elements within polyatomic ions.

1. $MgSO_4$ _____

2. $CrPO_4$ _____

3. $Ba(OH)_2$ _____

4. PbS _____

5. Na_2CO_3 _____

6. BaF_2 _____

7. $Cu(NO_3)_2$ _____

8. AgI _____

9. $NiSO_4$ _____

10. $Zn_3(PO_4)_2$ _____

11. Na_3N _____

12. Cu_2CO_3 _____

13. $(NH_4)_2SO_4$ _____

14. $CaCO_3$ _____

15. KCl _____

16. $FeSO_4$ _____

17. $LiBr$ _____

Based on H.W #4

18. $MgCl_2$ _____

19. $FeCl_3$ _____

20. NH_4NO_3 _____

21. $Al(OH)_3$ _____

22. $PbSO_3$ _____

23. $NaClO_2$ _____

24. $CaCrO_4$ _____

25. $NiBr_3$ _____

26. $(NH_4)_3PO_4$ _____

27. $NaHSO_4$ _____

28. Hg_2Cl_2 _____

29. $Mg(NO_2)_2$ _____

30. $CuSO_4$ _____

31. $NaHCO_3$ _____

32. FeO _____

33. Fe_2O_3 _____

34. MgF_2 _____

Based on H.W #4

Naming Ionic Compounds

Write the names for each of the following IONIC compounds. Don't forget Roman Numerals when dealing with a transition metal.

1. $MgSO_4$ _____
2. NH_4Cl _____
3. $CrPO_4$ _____
4. $Ba(OH)_2$ _____
5. PbS _____
6. Na_2CO_3 _____
7. BaF_2 _____
8. $Cu(NO_3)_2$ _____
9. AgI _____
10. $NiSO_4$ _____
11. $Zn_3(PO_4)_2$ _____
12. Na_3N _____
13. Cu_2CO_3 _____
14. $(NH_4)_2SO_4$ _____
15. $CaCO_3$ _____
16. KCl _____
17. $FeSO_4$ _____
18. $LiBr$ _____
19. $MgCl_2$ _____
20. $FeCl_3$ _____
21. NH_4NO_3 _____
22. $Al(OH)_3$ _____
23. $CuC_2H_3O_2$ _____
24. $PbSO_3$ _____
25. $NaClO_2$ _____
26. $CaCrO_4$ _____
27. $NiBr_3$ _____
28. $(NH_4)_3PO_4$ _____
29. $NaHSO_4$ _____
30. Hg_2Cl_2 _____
31. $Mg(NO_2)_2$ _____
32. $CuSO_4$ _____
33. $NaHCO_3$ _____
34. FeO _____
35. Fe_2O_3 _____
36. MgF_2 _____

Based on H.W #5

Now, write the correct formula for each of the compounds listed below

1. potassium iodide _____
2. barium chloride _____
3. lithium bromide _____
4. sodium hypochlorite _____
5. iron (III) sulfite _____
6. chromium (III) sulfide _____
7. calcium carbonate _____
8. sodium acetate _____
9. cobalt (II) fluoride _____
10. sodium phosphide _____
11. tin (IV) oxide _____
12. gold (III) bromide _____
13. copper (II) iodide _____
14. strontium chloride _____
15. lithium acetate _____
16. magnesium hydroxide _____
17. nickel (II) nitrate _____
18. silver oxide _____
19. zinc chloride _____
20. magnesium phosphate _____
21. chromium (III) sulfite _____
22. copper (II) sulfide _____
23. iron (III) bromide _____
24. aluminum nitride _____
25. calcium sulfate _____
26. sodium phosphate _____
27. iron (III) nitrate _____
28. ammonium carbonate _____
29. aluminum phosphate _____
30. sodium nitrate _____
31. potassium nitrate _____
32. calcium carbonate _____
33. ammonium acetate _____
34. aluminum hydroxide _____
35. magnesium sulfide _____
36. sodium chloride _____
37. barium nitrate _____
38. sodium hydroxide _____

Based on H.W #5

Write the chemical formulas that correspond to the chemical names below.

1. magnesium sulfate _____
2. strontium iodide _____
3. potassium perchlorate _____
4. sodium sulfide _____
5. iron (III) chloride _____
6. lithium oxide _____
7. silver sulfite _____
8. sodium phosphate _____
9. ammonium hydroxide _____
10. tin (IV) carbonate _____
11. barium hypochlorite _____
12. nickel (II) fluoride _____
13. strontium nitrate _____
14. magnesium hypochlorite _____
15. calcium carbonate _____

Based on H.W #5

Name of Compound	Positive Ion	Negative Ion	Formula
Cesium bromide	Cs^{+1}	Br^{-1}	CsBr
Calcium iodide			
Aluminum chloride			
Strontium oxide			
Radium chloride			
Aluminum phosphide			
Tin (II) sulfide			
Tin (IV) sulfide			
Barium Chloride			
Magnesium sulfide			
Beryllium nitride			
Lead (IV) fluoride			
Sodium oxide			
Magnesium arsenide			

Based on H.W #5

Naming Covalent (Molecular) Compounds

# of atoms	1	2	3	4	5	6	7	8
Prefix								

1. CO_2 _____
2. CO _____
3. SO_2 _____
4. BF_3 _____
5. N_2O _____
6. NO _____
7. N_2O_3 _____
8. H_2S _____
9. N_2O_4 _____
10. N_2O_5 _____
11. PCl_3 _____
12. PCl_5 _____
13. NH_3 _____
14. SCl_6 _____

Based on H.W #6

15. P_2O_5 _____

16. CCl_4 _____

17. SiO_2 _____

18. CS_2 _____

19. OF_2 _____

20. PBr_3 _____

21. SiF_4 _____

22. IF_5 _____

23. SF_6 _____

24. $SiCl_3$ _____

25. P_4S_3 _____

26. H_2O _____

27. SF_4 _____

28. XeF_4 _____

29. SbF_5 _____

30. CI_4 _____

31. BCl_3 _____

32. CCl_4 _____

Based on H.W #6

Writing Covalent Compound Formulas

1. silicon tetrafluoride _____
2. iodine pentafluoride _____
3. sulfur hexafluoride _____
4. chlorine dioxide _____
5. tetraphosphorous trisulfide _____
6. sulfur tetrafluoride _____
7. xenon tetrafluoride _____
8. dihydrogen monoxide _____
9. carbon disulfide _____
10. sulfur dioxide _____
11. boron trichloride _____
12. carbon difluoride _____
13. boron trifluoride _____
14. diarsenic pentoxide _____
15. phosphorus trichloride _____
16. dinitrogen pentoxide _____
17. nitrogen trihydride _____
18. carbon monoxide _____
19. silicon dioxide _____
20. bromine pentachloride _____
21. sulfur tetrabromide _____

Based on H.W #6

Names and Formulas of Compounds

Write either the traditional or Stock system name for each of the following compounds.

1. Na_2S _____
2. NH_4Cl _____
3. CuF _____
4. CuF_2 _____
5. $PbSO_4$ _____
6. $Hg(NO_3)_2$ _____
7. Al_2O_3 _____
8. N_2O_4 _____

Write the formula for each of the following compounds.

9. nickel (II) chloride _____
*10. cuprous nitrate _____
11. ammonium sulfate _____
12. magnesium nitride _____
13. mercury (I) sulfide _____
14. carbon monoxide _____
*15. nitrogen (III) oxide _____
16. diphosphorus pentoxide _____

Best after HW #5 & 6

Write the formulas for the following combinations:

1. sodium and chlorine _____
2. beryllium and sulfur _____
3. cesium and iodine _____
4. lithium and oxygen _____
5. aluminum and fluorine _____
6. zinc and phosphorus _____

Write the names for the following ionic compounds:

1. $BaCl_2$ _____
2. SrS _____
3. MgI_2 _____
4. ZnO _____
5. $AlCl_3$ _____
6. $CaCl_2$ _____

Write the correct formulas for the following compounds:

1. lithium fluoride _____
2. magnesium iodide _____
3. potassium oxide _____
4. silver sulfide _____

The following compounds have cations that have more than one oxidation state. Write the names for the following compounds using a Roman numeral appropriately.

Ex: CuCl copper (I) chloride

1. $FeBr_3$ _____
2. CrF_2 _____
3. Au_2O_3 _____
4. MnO _____
5. Ni_2S_3 _____
6. PbO_2 _____

Write chemical formulas for the following compounds.

1. manganese (II) oxide
2. lead (II) chloride
3. gold (III) oxide
4. mercury (II) sulfide
5. copper (I) iodide
6. palladium (IV) bromide

After H.W #5&6

Naming & Writing Chemical Compounds

Compound	Ionic or covalent	Name of Compound
CO_2		
$NiBr_3$		
Hg_2Cl_2		
CS_2		
SCl_6		
BaF_2		
CCl_4		
P_2O_5		
LiI		
PbS		
FeO		

Best after #5&6

Writing Chemical Formulas

Name of Compound	Ionic or covalent	Formula
Carbon disulfide		
Sulfur dioxide		
Sodium phosphide		
Silver oxide		
Tin (IV) oxide		
Boron trichloride		
Carbon difluoride		
Gold (III) bromide		
Strontium chloride		
Copper (II) iodide		
Boron trifluoride		
Diarsenic pentoxide		
Lithium acetate		

Best after #5 & 6

Naming & Writing Chemical Compounds

Formula	Ionic or Covalent	Name
		copper (II) iodide
CCl_4		
		lithium acetate
BaF_2		
SiO_2		
		Magnesium hydroxide
		Diphosphorus pentoxide
		Silver oxide
SCl_6		
		Sodium phosphide

Best after #5 & 6

Naming Chemical Compounds

Name the following chemical compounds:

1. $NaBr$ _____
2. $Ca(C_2H_3O_2)_2$ _____
3. P_2O_5 _____
4. $Ti(SO_4)_2$ _____
5. $FePO_4$ _____
6. K_3N _____
7. SO_2 _____
8. $CuOH$ _____
9. $Zn(NO_2)_2$ _____
10. V_2S_3 _____

Write the formulas for the following chemical compounds:

1. silicon dioxide _____
2. nickel (III) sulfide _____
3. manganese (II) phosphate _____
4. silver acetate _____
5. diboron tetrabromide _____
6. magnesium sulfate heptahydrate _____
7. potassium carbonate _____
8. ammonium oxide _____
9. tin (IV) selenide _____
10. carbon tetrachloride _____

Best after #5 & 6

Name _____

Ionic Lewis Dot Structures

Directions: In a previous lab, you placed magnesium into the Bunsen burner flame and observed a reaction with oxygen. In this activity you will utilize your knowledge of bonding and the atom to figure out what occurred (how electrons were transferred) during this reaction. You are to work with a partner to complete the following questions.

1. Write the Bohr electron configuration (use your periodic table) for calcium: _____
2. How many valence electrons does an atom of calcium have? _____
3. Write the Bohr electron configuration for oxygen: _____
4. How many valence electrons does an atom of oxygen have? _____
5. Draw the Lewis dot structure for the neutral atoms in the boxes below:

Ca	O

6. Recall that in an ionic bond (as in CaO) the metal gives away electrons, while the nonmetal gains electrons. The oxidation numbers of each element will tell you have many electrons are being gained or lost.
7. Ca has an oxidation number of +2, so how many electrons will it lose? _____
8. has an oxidation number of -2, so how many electrons will it gain?_____
9. Using arrows, show the transfer of electrons from calcium to oxygen in the Lewis dot diagrams you drew in question 5.
10. Show the Lewis dot structure that results from the transfer of electrons below. Be sure to show any charges on the atoms that have lost or gained electrons.

After H.W #7

11. Have all of the atoms in CaO fulfilled the octet rule? _____
12. **Practice:** Draw Lewis dot diagrams for the following ionic compounds. Make sure that the compounds fulfill the octet rule after bonding.

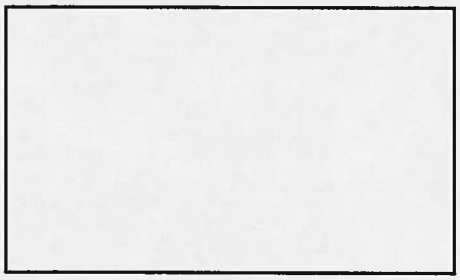
1st Element	2nd Element	Formula	Lewis Dot
Ba	I		
K	F		
Ca	O		
Cs	O		
Na	S		
Ca	Br		
K	Br		

After H.W #7

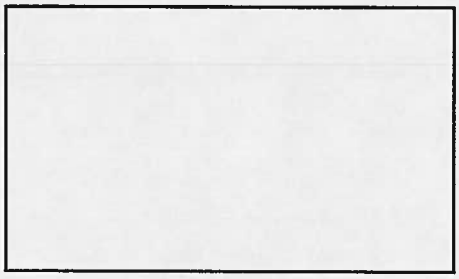
IONIC Lewis Dot Bonding

Draw Lewis dot bonding diagrams for the IONIC compounds below.

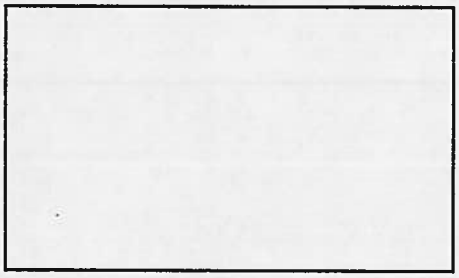
1. Mg + Cl



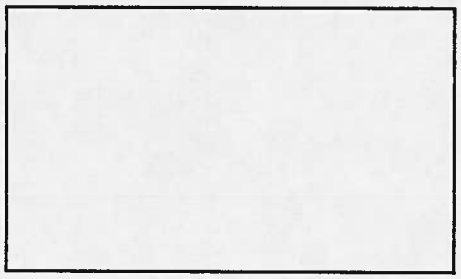
2. Ca + O



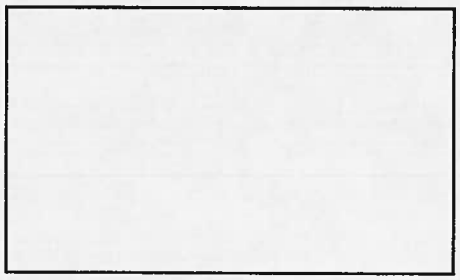
3. Na + P



4. Ag + O



5. Be + S

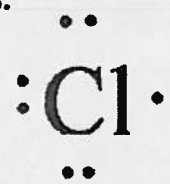


After H.W #7

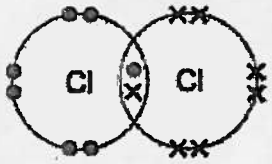
Tutorial for Drawing Lewis Dot Diagrams for Compounds

From class we have learned that the outermost electrons (valence electrons) of an atom are responsible for bonding. In 1920, a man named G.N. Lewis developed a system to represent bonding in compounds. This system used electron-dot diagrams in which dots represent valence electrons. Today we are going to learn how to represent a compound with these Lewis electron-dot diagrams.

You will recall from our past units that a Lewis dot symbol consists of the element symbol surrounded by dots to represent the number of valence electrons. For example, the Lewis dot diagram for Chlorine is:

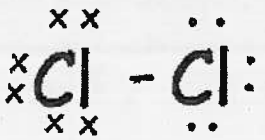


The method for drawing Lewis diagrams for compounds is similar to drawing Lewis dot diagrams for a single atom. Each atom in a compound is represented by their symbol, and valence electrons are represented by lines for electron pair bonds and dots for unbound electrons. For example, if we look back at the Chlorine atom. We know that a chlorine atom needs one additional electron to fulfill its octet (8 is great!). Therefore, two chlorine atoms might bond together to form a nonpolar covalent compound. When the two chlorine atoms combine they will each share one electron, giving both chlorine atoms a stable octet and forming a covalent bond.



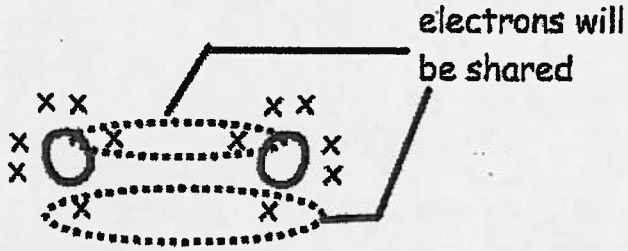
Above you can see that each chorine atom has three pairs of electrons that are not involved in bonding. These are called unbounded electron pairs, or lone pairs. It is important to note however that each chlorine atom is surrounded by eight electrons, showing each atom has a stable octet of electrons.

One thing that is different when drawing Lewis Dot diagrams for compounds is that pairs of electrons that are shared between atoms are represented by a dash (we call this a bond). Note that each dash represents two electrons. So, we can re-write the compound Cl_2 as follows:

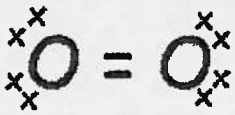


After H.W #8

Sometimes it is necessary to represent a compound with more than one bond. For example, oxygen has 6 valence electrons, with two atoms combining to form O_2. In this case the two oxygen atoms share two pairs of electrons (forming a double bond).



Recall from the last page, that a dash represents **ONE PAIR** of electrons being shared in a bond. So, if there are **TWO PAIRS** of electrons being shared, we will have two dashes to represent a double bond. The "extra" pairs of electrons will position themselves as far away from each other and the bonded pairs as possible as seen below:



The following procedure is a method that can be used to derive the Lewis dot diagrams for most compounds.

1. Find how many valence electrons (N) are in the molecule that needs to be shown on the Lewis
   Structure by using the periodic table. Find the charge, add an electron for every negative charge and remove an electron for every positive charge.

2. Draw out the single bonds and initial framework, called the skeleton, of the molecule.

3. Complete the octets around the non-central atoms i.e. the terminal atoms by using the lone-
   pairs of electrons.

4. Compare the number of electrons currently depicted to the number needed (N) in the central
   atom and add electrons to it if less the number is less than N.

5. If there are extra lone-pair electrons and the octet rule is not filled for the central atom, use the
   extra electrons to form double or triple bonds around the central atom.

6. Check the formal charge of each atom (Formal Charge explained below).

After H.W #8

When constructing the structures keep in mind the following:

- The dots surrounding the chemical symbol are the valence electrons, and each dash represents one covalent bond (consisting of two valence electrons)
- Hydrogen is always terminal in the structure
- The atom with the lowest ionization energy is typically the central atom in the structure
- The octet rule means there are 8 valence electrons around the atoms, but for hydrogen the maximum is 2 electrons
- Lewis structures are different for covalent and ionic bonds

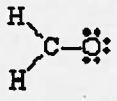
Example: Constructing the Lewis Structure of the formaldehyde (H_2CO) molecule.

1. First find the valence electrons:

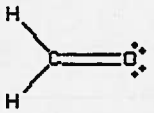
H_2CO: 2(1) e^- (from the H atoms) + 4 e^- (from the C atom) + 6 e^- (from the O atom)

There are 12 valence electrons.

2. Next draw out the framework of the molecule and place pairs of electrons around the terminal atom(s), (in this case, there is only one terminal atom because the hydrogen atoms have already reached their max of $2e^-$):



3. To satisfy the octet of Carbon, one of the pairs of electrons on Oxygen must be moved to create a double bond with Carbon. Therefore our Lewis Structure would look as it does below:



4. The Hydrogen atoms are each filled up with their two electrons and both the Carbon and the Oxygen atoms' octets are filled. CHECK!

After H.W. #8

COVALENT Lewis Dot Bonding

Draw Lewis dot bonding diagrams for the COVALENT compounds below.

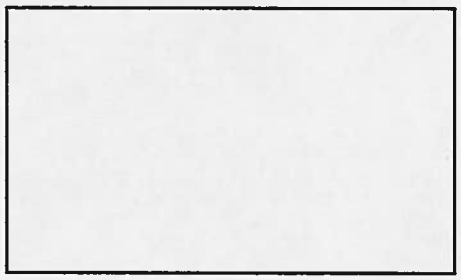
Cl_2	CCl_4
O_2	CH_4
C_2H_4	PF_3
NH_3	HF

Best after H.W #8

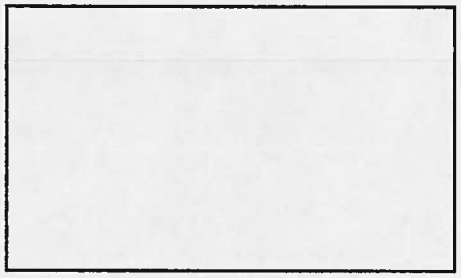
IONIC Lewis Dot Bonding

Draw Lewis dot bonding diagrams for the IONIC compounds below.

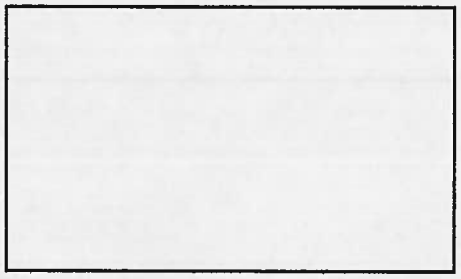
1. Ba + S



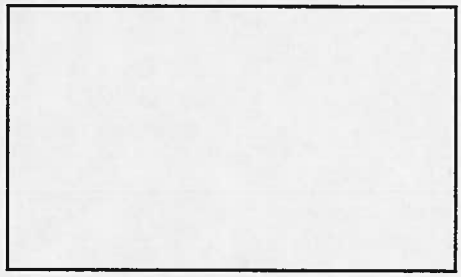
2. Na + O



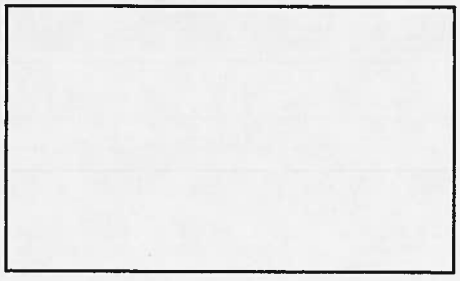
3. Li + O



4. Na + C



5. Al + Cl



After H.W #7&8

Covalent Lewis Dot Bonding

Draw Lewis dot bonding diagrams for the COVALENT compounds below.

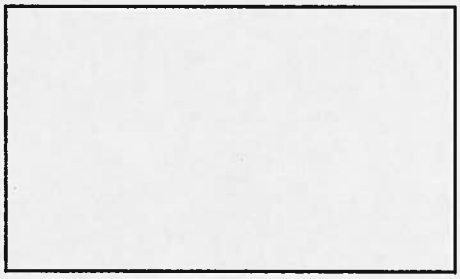
H_2	H_2O
CH_3I	CH_2O
F_2	CO_2
N_2	HCN *(Bonus)*

After H.W #7 & 8

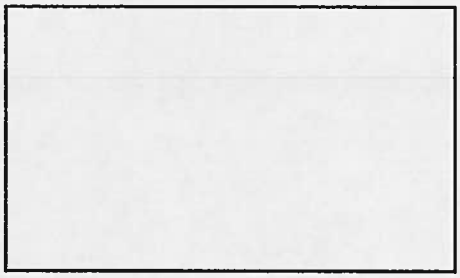
IONIC Lewis Dot Bonding

Draw Lewis dot bonding diagrams for the IONIC compounds below.

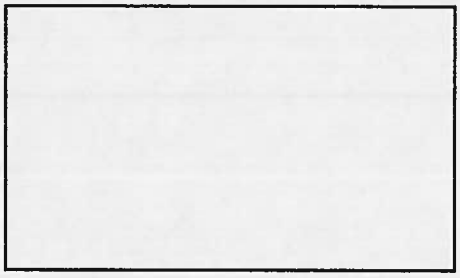
1. KCl



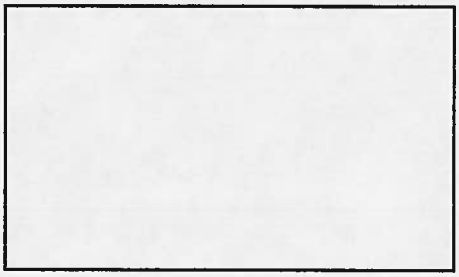
2. $BeBr_2$



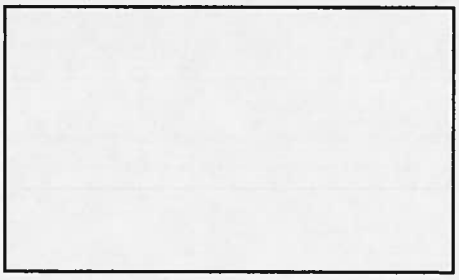
3. MgO



4. Na_3N



5. Ag_2S



After H.W #8/7

BOND POLARITY

1. What is electronegativity?

2. What factor causes some combinations or atoms to form ions, and other combinations of atoms to form covalent bonds. Explain in detail.

3. What is a nonpolar covalent bond? Explain the electronegativity differences attributed to this type of bond.

4. What is a polar bond? Explain the electronegativity differences attributed to this type of bond.

5. Explain the relationship between electronegativity difference and polarity.

6. What is a dipole?

7. What symbol indicates a partial charge? _____

Best after H.W #9/10

8. How do you determine which atom gets the partial negative charge?

_____

_____

9. Given the following indicate which atom will receive the partial negative charge and which atom will receive the partial positive charge. Place the partial charges in the upper right hand corner of the atom symbol:

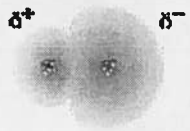
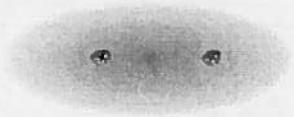
   a. H - Cl
   b. H - F
   c. S -F
   d. N - O

10. Compare the degree (which compound is most polar, which is least polar) of polarity in HF, HBr, HCl, and HI.

_____

_____

11. Classify the type of molecule the diagrams below represent (Ionic, Polar Covalent, or Nonpolar Covalent), and explain your reasoning.

Electron Distribution Diagram	Type of Compound	Reason for Classification of Compound
		
		
		

After HW #9 & 10

12. Write Lewis structures for each of the following molecules. Indicate any partial charges that may exist for polar bonds with δ^+ or δ^-

(a) PCl_3	(b) CBr_4
(c) CS_2	(d) H_2O
(e) CH_4	(f) NH_3

Best after H.W # 9 & 10

Intermolecular Forces

1) Which of the following will have the higher boiling point? Explain your answer using intermolecular forces.

NH_3 or N_2

2) Why does dry ice (solid CO_2) evaporate before sodium chloride?

3) Why does gasoline (C_8H_{18}) exist in the liquid form while methane (CH_4), the gas we use to power out bunsen burners, exists in the gas form even though both compounds are nonpolar?

4) Identify the intermolecular forces that exist in the following molecules.

Compound	Type of IMF
H_2O	
N_2	
HCl	
LiCl	

5) Of the compounds in question 4, which has the strongest surface tension?

After HW #10

Intermolecular Forces

1. In terms of the forces of attraction holding them together, explain why a NaCl crystal has a melting point of 800°C while an ice cube of pure water has a melting point of 0°C.

2. Predict the relative melting points of CO_2 and SiO_2 bases on their attractive forces and the information given in question one. Explain your reasoning. (Hint: SiO_2 is a covalent ***network***)

3. List the noble gases from highest to lowest boiling point. Explain your answer based on intermolecular forces of attraction.

4. Explain why I_2 is a solid, Br_2 is a liquid but $Cl_2$and F_2 are gases even though they are all Halogens.

5. List the following substances from highest to lowest melting point; use attractive force to justify your answers.

   KCl, Cl_2, CH_4, H_2S, SiO_2 and H_2O

After All H.W done

Relative Melting Point (m.p.)/Boiling Point (b.p.)

NaCl	H_2Se	O_2	H_2O
$C_{(diamond)}$	H_2S	CO_2	MgO

1. Group the compounds above according to the type of bonding present.

Covalent network	Ionic	Polar covalent/IMF's	Nonpolar covalent/IMF's

2. Which of the compounds would you expect to have the highest melting point?

_____

3. Which of the compounds would you expect to have the lowest melting point?

_____

HBr	$MgCl_2$	NH_3	HCl
CCl_4	$SiO_{2(network)}$	N_2	LiBr

4. Group the compounds above according to the type of bonding present.

Covalent network	Ionic	Polar covalent/IMF's	Nonpolar covalent/IMF's

5. Which of the compounds would you expect to have the highest melting point?

_____

6. Which of the compounds would you expect to have the lowest melting point?

_____

After all H.W done

If the statement is true, write T on the line. If it is false, change the underlined word or words to make it true. Write your answer on the line provided.

_____ 1. A group of atoms united by <u>ionic</u> bonds is called a molecule.

_____ 2. A covalent bond is formed by a <u>shared</u> pair of electrons.

_____ 3. A double covalent bond consists of <u>two</u> shared electrons.

_____ 4. Dipole-dipole interactions are the only IMF's that exist in nonpolar molecules.

_____ 5. Polar molecules always have a higher M.P./B.P. nonpolar molecules.

_____ 6. In nonpolar covalent bonds, the electrons are shared <u>unequally</u> between two atoms.

_____ 7. Hydrogen bonds are basically a specific, very strong version of dipole-dipole interactions.

Challenge Question: Carbon tetrachloride has polar bonds between the atoms but the overall molecule is nonpolar. Explain why the bonds are polar and why the molecules are nonpolar.

_____

_____

_____

After all HW done

For each of the bonds below, determine the electronegativity difference (SHOW ALL WORK) and the type of bond that results (ionic, polar covalent, or nonpolar covalent).

Bond	Electronegativity Difference	Bond Type
H---O		
C---C		
K---F		
N---H		
Na---F		
H---H		

Draw Lewis Dot Structures for the following compounds. Indicate the type of bond by using either brackets and charges (ionic) or dashes (covalent).

1. NH_3	2. PCl_3
3. H_2	4. CCl_4
5. $MgCl_2$	6. KBr

After all H.W Done