

Bonding Lab

name: _____ 80/1200

We will use ball and peg models to visualize various compounds and how they form in relation to their valence electrons. We'll examine the shapes these compounds make, how they translate into Lewis Dot Diagrams, practice drawing structural models, and finally, to evaluate if the various individual bonds are polar or non-polar, as well as to determine if the molecules themselves are polar or non-polar.

Background: Ionic bonds form between metal cations and non-metal anions. The valence electrons of the cations are "transferred" to the anions and not shared by the ions. When two non-metals bond (like hydrogen chloride) ionic bonds DO NOT FORM. Instead, the bonds are called covalent bonds. Covalent bonds are between 2 non-metals that are bonded together. The electrons are "shared" between the atoms in the compound. This sharing is to varying degrees - depending upon the difference in Electronegativity values (Table S).

We use the electro-negativity differences to determine if the atoms are sharing the electrons equally in their bond (NON-POLAR BONDS), or if they are shared unevenly (POLAR BONDS). To determine how much the electrons are shared we measure the difference in the electro-negativity values from Table S. Fill in this chart .

example compounds	Write the electro-negativity values for each atom	EN difference	Full name of the bond in compound
NaCl			
HF			
HCl			
N ₂			

1. Ionic bonds will form between metals and non-metals.
2. Covalent Bonds, between two non-metals and they can be polar or non-polar.
3. Let's examine the water molecule. The EN difference between the H and the O is _____. This makes the bonds between H and O _____.

Dipole arrows are used in Lewis Dot Diagrams to show where the electron was (+ now) and where it went (- charge now, has the arrow head).






Lewis Dot diagram for water	structural diagram for water	structural with dipole arrows

Symmetry in Molecules

[radial symmetry means molecule is NON polar]

Define RADIAL SYMMETRY:

Draw a circle, an heart, and an irregular but smooth closed curved figure in the three boxes. Determine if they exhibit radial symmetry or not.

circle	heart	irregular closed curved figure
		
Radial Symmetry or NOT	Radial Symmetry or NOT	Radial Symmetry or NOT

Molecules with radial symmetry are NON-POLAR molecules,
Molecules without radial symmetry are POLAR MOLECULES.

The only symmetry that "counts" in chemistry is RADIAL SYMMETRY.

Ionic bonds are polar (cation/anion), some covalent bonds are polar (difference in electronegativity values), or nonpolar covalent (no difference in electronegativity).

Bonds can be POLAR (ionic or polar covalent) or NON-POLAR.

Using the model kits, create these 16 compounds (you can do them in any order).

Compounds to make: ammonia, water, chloroform (CHCl_3), nitrogen gas, nitrogen tri-bromide, chlorine fluoride, hydrogen gas, carbon tetrachloride, carbon disulfide, sulfur dichloride, ethane, carbon dioxide, methane, diatomic oxygen, phosphorous trichloride, and carbon monoxide.

As you make the molecular models, use them to help you fill in the next three pages of charts.

Table 1 compound name	formula	DRAW the LEWIS dot diagram	DRAW the Structural diagram	Does this compound exhibit RADIAL SYMMETRY?	Is this molecule polar or non-polar?
	NH ₃				
	H ₂ O				
chloroform	CHCl ₃				
	N ₂				
	NBr ₃				
	ClF				
ethane	C ₂ H ₆				
	CO				

Table 2 compound name	formula	DRAW THE LEWIS dot diagram	DRAW the structural diagram	Does this compound exhibit RADIAL SYMMETRY?	Is This molecule polar or non-polar?
	CCl ₄				
	SCl ₂				
	CO ₂				
	CH ₄				
	O ₂				
	PCl ₃				
	H ₂				
	CS ₂				

Table 3: Show what you know, for each of the compounds below put the letter of the bond (or bonds) present in the compound.

- | | |
|--------------------------------------|------------------------------------|
| A. single non polar covalent | B. double non polar covalent |
| C. triple non polar covalent | D. single polar covalent |
| E. double polar covalent | F. triple polar covalent |
| G. resonating covalent | H. hydrogen bond |
| I. Ionic bond | J. breaks the octet rule (too big) |
| K. breaks the octet rule (too small) | L. coordinate covalent bond |
| M. electron dispersion attraction | N. dipole attraction |

formula	Proper name	Which bonds are present (use letters)			
NH ₃					
MgO					
Al ₂ O ₃					
C ₂ H ₆					
C ₂ H ₄					
O ₃					
CCl ₄					
HF					
I ₂					
CO					
O ₂					
CuSO ₄ ·5H ₂ O					
PCl ₅					
Li ₂ O					
CS ₂					
MgSO ₄ ·7H ₂ O					
N ₂					
CO ₂					

This Lab Report Requires:

Cover page with Introduction (1 + 1 = 2)

Three pages of tables, fill in all the blanks (6 points per page = 18)

An Extended Conclusion, topics below (5)

25 points total, due on: _____ .

Your illustrated and very wordy conclusion shall detail the following:

1. What substances forms ionic bonds and what forms covalent bonds?
Give 2 examples of each.
2. How is electro-negativity difference used to determine bond polarity?
Who won the Nobel Prize for this work in chemistry?
3. Why do all of the HONClBrIF twins exhibit non-polar bonds?
4. Describe all the bonds between each pair of HONClBrIF's, H-H, etc.
5. Describe the coordinate covalent bond in carbon monoxide. Describe the resonance bonding found in ozone. What is the "octet rule" and why is it more of a rule of thumb and not the law? What compound breaks the octet rule?
6. Explain how to determine if molecules are polar or non polar.
Give 2 examples for polar, and for non polar.
7. Explain why some molecules have polar bonds but are themselves non-polar molecules (such as CH_4). Name two other non polar molecules with polar bonds.
8. Give some details of the three kinds of intermolecular bonding: the electron dispersion attractions that every atom and every compound has, dipole attraction, and also hydrogen bonding.
Which two of these three attractions make up "van der Waal's forces"?
9. Describe metallic bonds and give examples of 2 metals that exhibit these, and describe how the theory of these kinds of bonds provide metals with the ability to be malleable, ductile, and to conduct electricity.