Bonding Lab

name: _____

80/1200

We will use ball and peg models to help us see the shapes of molecules, and relate that to their valence electrons. You must make the ball and peg models FIRST, before you draw anything. If you draw any diagrams incorrectly (bent when they are straight or straight when they are bent, your teacher will know, and you will lowe points instantly. There are no shortcuts. We are MAKING MODELS OF MOLECULES, then we will draw what we see. Initial this here. _____

One you draw the Lewis Dot Diagrams, and structural diagrams you will determine both BOND POLARITY and MOLECULAR POLARITY of each.

Background:
Ionic bonds form between metal cations and non-metal anions. By definition these are "polar" since they have a positive (cation) and a negative (anion) side. In ionic bonds the valence electrons of the cations are <u>transferred</u> to the anions, they are not shared by ions.

Two or more non-metals bond (like HBr, or H_2O) form bonds called covalent bonds. In covalent bonds the non-metals atoms the valence electrons are <u>shared</u>. The electrons can be shared evenly (forming a nonpolar bond) or unevenly (making a polar bond) This is measured by the difference in the atom's electronegativity values from Table S.
The greater their electro-negativity differences, the greater the polarity of the bond.

Covalent bonds can share one pair of electrons (single bond), two pairs of electrons (double bond), or even three pairs of electrons (triple bond). Each of these can be polar or nonpolar.

Molecular Polarity is different; it's based upon shape of the molecule. If the molecular shape is nonpolar (or balanced) if it has radial symmetry (like a pizza).

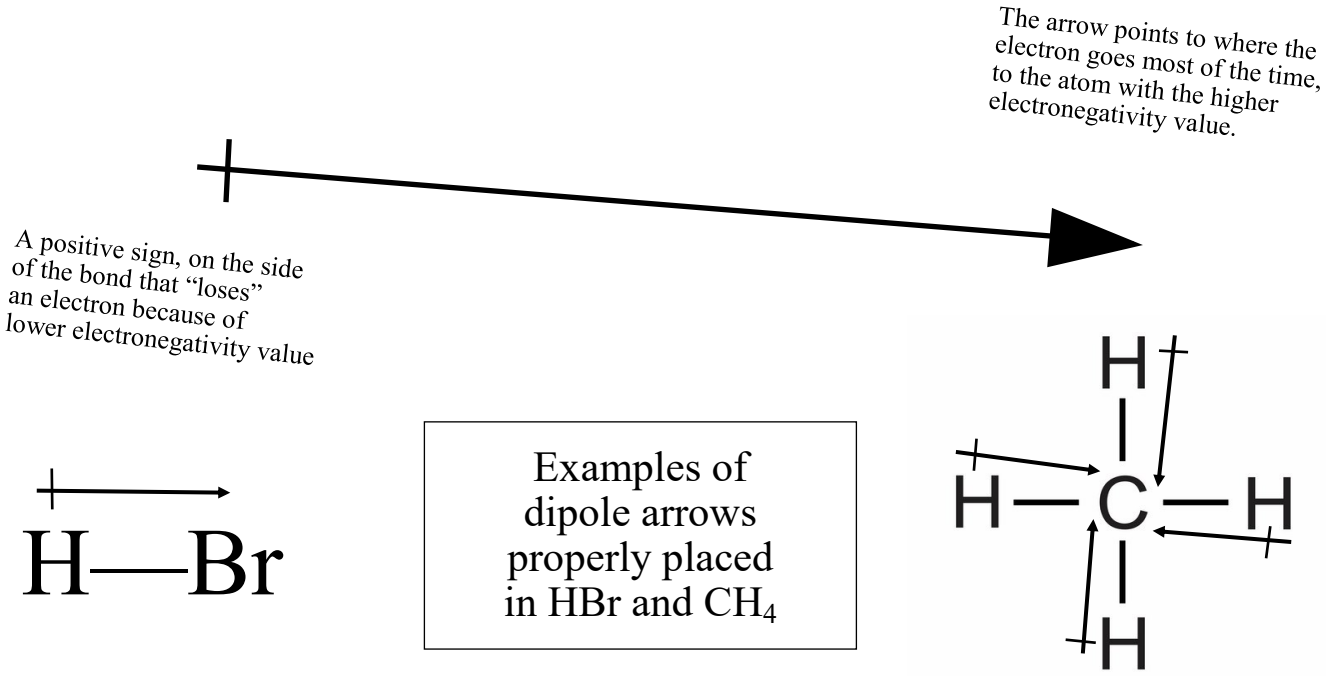
If the molecule DOES NOT have radial symmetry, the molecule is polar.

<u>Radical symmetry</u> is incorrect. Radicals are those are people that want to change the world.

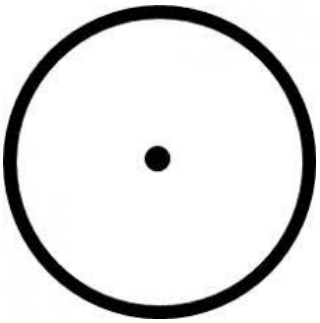
You can show bond polarity in structural diagrams by using a “dipole arrow”.

The dipole arrow does not replace the bond dash.
One end of the arrow is a positive sign (the side of the bond with a lower Electronegativity)

The other side of the arrow is the arrowhead, which points to the atom that has the higher electronegativity value, the side of the bond that pulls the electrons more, which makes that side of the bond “more negative” most of the time.



Draw 4 molecules with dipole arrows going in the right direction.	
1. CH_4	2. CO_2
3. OF_2	4. $AsBr_3$ (think hard)

5. Define RADIAL SYMMETRY: Cut the "pizza" to show you understand. 	
6 Draw structural diagrams of H_2O Based upon shape H_2O is a polar molecule with polar bonds.	7 Draw structural diagrams of CH_4 Based upon shape CH_4 is a nonpolar molecule with polar bonds.

<u>Memorize this</u> (to be the best you of all time)

Molecules with radial symmetry are NON-POLAR molecules,
Molecules without radial symmetry POLAR molecules (they have no balance).

Ionic bonds are technically always polar (cation/anion).

Some covalent bonds are polar, they have a difference in electronegativity values.

Some covalent bonds are nonpolar, they have no difference in electronegativity values.

Covalent bonds can be single, double or triple, because they SHARE
a single pair, or a double pair, or a triple pair of electrons.

Ionic bonds are "just" ionic - never single double or triple. They do not share pairs of electrons. Ionic bonds are always polar, but we don't need to say that; A positive cation on one side and a negative anion on the other is obviously polar.

You must make a model of each compound BEFORE you draw it.
I can tell if you're faking it as the diagrams will be OBVIOUSLY WRONG to me.
There are no shortcuts, just do the chem.

compound name	formula	DRAW a LEWIS dot diagram	DRAW the structural diagram	Does molecule have RADIAL SYMMETRY?	Polar or Nonpolar Molecule?
	NH_3				
	H_2O				
	HCl				
	NBr_3				
ethane	C_2H_6				

compound name	formula	DRAW a LEWIS dot diagram	DRAW the structural diagram	Does molecule have RADIAL SYMMETRY?	Polar or Nonpolar Molecule?
ethene	C_2H_4				
ethyne	C_2H_2				
	CCl_4				
	CH_4				
Trichloro-methane (chloroform)	$CHCl_3$				
Tribromo-methane	$CHBr_3$				

compound name	formula	DRAW a LEWIS dot diagram	DRAW the structural diagram	Does molecule have RADIAL SYMMETRY?	Polar or Nonpolar Molecule?
Difluoro methane	CH_2F_2				
	SCl_2				
Chlorine mono-fluoride	ClF				
	PCl_3				
	F_2				
	O_2				
	N_2				
Hydrogen cyanide	HCN				

compound name	formula	DRAW a LEWIS dot diagram	DRAW the structural diagram	Does molecule have RADIAL SYMMETRY?	Polar or Nonpolar Molecule?
	$AsCl_3$				
	AsF_3				
	CS_2				
	CO_2				
One really hard one… Acetic Acid $HC_2H_3O_2$ You need 4 yellow, 2 black, 2 red, 6 pegs and 2 springs. Fill all holes, no pegs or springs unbonded.					

Part C. Recognize the bonding… Using the LETTERS, decide which bonds are present in each compound. Some substances have more than one bond.

A. Single Polar Covalent
B. Double Polar Covalent
C. Coordinate Covalent
D. Single Nonpolar Covalent
E. Double Nonpolar Covalent
F. Triple Polar Covalent
G. Triple Nonpolar Covalent
H. Resonating
I. Ionic

Number of Bonds Present	Types of bonds (use letters)	Chemical Formula	Proper Chemical Name
2	A A	H_2O	Dihydrogen monoxide
4		CH_4	
		F_2	Fluorine (or diatomic fluorine)
		PCl_3	
Does Not Apply		KCl	
Does Not Apply		Fe_2O_3	
Does Not Apply		$TiCl_4$	
		C_2H_2	From the lab
		C_2H_4	From the lab
		H_2S	
		AsF_3	
		CO	
		CO_2	
		HCN	
Does Not Apply		Rb_2S	
		SiO_2	

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I. Ionic

Number of Bonds Present	Types of bonds (use letters)	Chemical Formula	Proper Chemical Name
3	A A A	NH_3	Dihydrogen monoxide
Does Not Apply	I	MgO	
		SF_2	
Does not apply		O_3	
		CCl_4	
		I_2	
		HF	
		BF_3	
		O_2	
Does Not Apply		Li_2O	
		CS_2	
		N_2	
Does Not Apply		$AuCl_3$	
		H_2	
		NBr_3	
		CH_2F_2	From the lab

Bonding Lab Rubric	Do this...	Points
Cover page	Include one sentence explaining why we did this lab.	2
Lab part A	Lab Handout Questions 1– 7	7
23 molecules (boxes)	Dots, structural, radial symmetry, and molecular polarity	25
Part C	Naming compounds, determining bond types	12
Conclusion	See below (one point each) A list conclusion is fine.	24
Due on:	total	70

Your long, illustrated, and very wordy conclusion, worth 24 points includes…

1. What elements forms ionic bonds? Which form covalent bonds? Give 2 examples of each.
2. How is electro-negativity difference used to determine bond polarity? Give examples of 3 polar covalent bonds that are very polar, less polar and non-polar. Show the electronegativity math that makes you know how to rank the polarity of these bonds.

3. Why do all of the HONClBrIF twins exhibit only non-polar bonds?
4. Draw small structural diagrams for all 7 of the HONClBrIF twins. H_2, O_2, etc.

5. Describe the coordinate covalent bond in carbon monoxide. Draw it too using two different colors for carbon and for oxygen.
6. Describe the resonating bond found in ozone. Draw it two ways: once showing "resonating from one structure to another" and again properly showing both sides of the molecule with "1½" bond diagrams.

7. What is the "octet rule"? What species adhere to it (mostly)
8. Explain how to determine if molecules are polar or non polar. Draw 2 examples for polar molecules with radial symmetry lines that they do not follow, and two examples of nonpolar molecules with radial symmetry lines that they follow.

9. Explain why ionic bonds are not classified as single, double or triple. (think of NaCl, MgO, and AlP)

10. Name the 3 kinds of intermolecular bonding. Explain how the halogens, OF_2 or NH_3 exhibit them.
11. How do scientists describe metallic bonds (poetically) Name 2 metals that exhibit these metallic bonds.

12 A, B, C, and D: Draw a Lewis Dot Diagram for NBr_3,CF_4, SCl_2, and CS_2
State the molecular polarity and the bond polarity for each.

12 E Draw the Lewis Dot Diagram for NaCl, and MgF_2