

Name: _____ Period: _____ Date: _____

BONDING NOTES HONORS CHEMISTRY

Directions: This packet will serve as your notes for this chapter. Follow along with the PowerPoint presentation and fill in the missing information. Important terms / ideas are in all capitals and bolded!

- **CHEMICAL BOND:**

-Types include _____, _____, or _____

-Differences in _____ determine the bond type

- **IONIC BOND:**

-Each atom achieves a _____ configuration (_____ valence shell)

-Usually between a _____ and a _____

-**Formula Unit:** _____ whole-number ratio of ions in an ionic compound (ex: NaCl or MgCl₂)

- Ionic Bonding

How to Show Using Electron Dot Structures:	<ol style="list-style-type: none">1) Draw the _____ for each element in the ionic compound2) Determine which element will _____ and which will _____ and how many3) Use _____ to show the e- being _____ to an empty space on the anion's dot structure4) Continue until each element has a _____... add more of each element as needed
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-Example: Show the electron dot structures for _____ and _____ using arrows to indicate the transfer of e-.

*To write the _____ for the compound: write the element symbol for the cation followed by the anion symbol... to indicate the _____ of each use _____ (none needed if just one)!!

-Example: Show the electron dot structures for _____ and _____ using arrows to indicate the transfer of e-.

-More Examples: Show the electron dot structures for each pair and show the transfer of electrons using arrows. Be sure to include the charge on each ion after the transfer and write the formula unit.

_____ and _____ _____ and _____

_____ and _____ _____ and _____

- Ionic Compounds

-Formed from _____ and _____ ions bonded together

-Known as " _____ "

-Formed from regular _____ arrangement of formula units

- Properties of Ionic Compounds

Ionic Compound Characteristics	<ol style="list-style-type: none"> 1) _____ bonded: strong attraction between the ions 2) Solid _____ lattice structure 3) _____ melting point and boiling point... due to the strong _____ between ions and the _____ structure 4) _____ in water / DISSOCIATE (break apart into _____) 5) Conduct _____ when melted or dissolved in water (because they form _____)... too orderly when _____ 6) Extremely _____... if you hit them hard enough they will _____ because they don't want to bend and there will be a strong _____ force
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- **METALLIC BONDS:**

-Forces of attraction hold _____ together

-Not _____

-Have _____ properties to ionic compounds

-Metals _____ hold on to their valence e-

-Positive ions (cations) are _____ in a " _____ "

***ELECTRONS ARE _____ TO _____ !!**

- Properties of Metals

1) _____

2) _____

3) _____

-All due to the fact that their _____ are _____!

-Electrons allow the atoms of metals to _____ like _____!

- **ALLOYS:**

-Formed by _____ a mix of ingredients and then _____

-Examples: _____ (Cu and Zn), _____ (Cu and Sn), and _____ (Fe, C, etc.)

- Why Make Alloys?

-Properties are _____ to individual elements

-Sterling Silver (92.5% Ag, 7.5% Cu): _____, more _____ than pure Ag / _____ enough to work

-Steels: _____ resistant, ductile, hard, tough, and _____

- **COVALENT BOND:**

-Involves two _____

-Known as covalent or _____ compounds

-**MOLECULE:** _____ of atoms joined by a _____ bond

-**DIATOMIC MOLECULES:** elements that _____ exist as _____ atoms

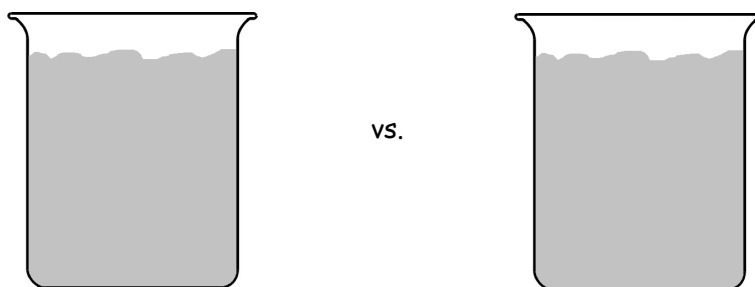
Ex: H₂, N₂, O₂, F₂, Cl₂, Br₂, and I₂

***Way to Remember... HONCIBrIF**

- Properties of Covalent Compounds

Covalent Compound Characteristics	1) Low _____ and _____ points 2) Don't usually _____ electricity 3) Not usually soluble in _____ (some dissolve but don't dissociate... _____!) 4) Don't form crystals (most _____ or _____ at room temperature)
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- DISSOCIATION vs. DISSOLVING



- Types of Covalent Bonding

-There are _____ types of covalent bonds:

Type	Definition / Number of e-
1) SINGLE:	
2) DOUBLE:	
3) TRIPLE:	

*Remember the octet rule... _____ electrons are needed!!

- Bond Length

-As the number of bonds between two atoms _____, the bond length _____...
the bonds become _____ and _____!!

- Molecular Dot Structures

-Visual representation of how the _____ are _____ together in a molecule

-Shows valence e- as _____... can see _____ of covalent bond as well (sharing of _____ dots = a _____ bond)

***HOW TO DRAW A MOLECULAR DOT STRUCTURE:**

- 1) Determine the _____ number of _____ available for the entire molecule from the amount each element has... This is the # of e- that **MUST** be in the final structure
- 2) Position any C or N atoms in the center... With atoms other than C or N, put the _____ electronegative atom in the center (usually the atom that there is _____ of in the formula)... H never in center unless it's the only element
- 3) Whatever atoms are remaining in the formula go _____ the "center" (evenly distributed when possible)
- 4) Any atoms next to the center need to _____ at least a pair of electrons between the atoms (covalent bonding)... Insert pairs of e- between bonded atoms
- 5) Give each atom a complete octet by adding _____ (lone) pairs until each atom is "happy" with its number
- 6) Total the e- in the molecule and see if total from _____ is reached... If so, then done
- 7) If _____ the #, add double or triple bonds and remove pairs... If _____ the #, add lone pairs (extra) to the center atom

*DO NOT _____ an atom's valence shell... Ex: H only wants _____ electrons!!

- **HONC 1234**

-Certain elements **USUALLY** have a specific number of _____ (shared pairs) in a molecule!!!

_____ - _____ **bond**
_____ - _____ **bonds**
_____ - _____ **bonds**
_____ - _____ **bonds**

*Sometimes this rule can be **VERY** helpful in figuring out a dot structure, while other times it might just confirm or not help

-Atoms still need a _____!!

**** _____ IF YOU LOVE _____!!**

- **Molecular Dot Structures**

-Example: Write the dot structure for: _____.

-More Examples:

Write the dot structure for: _____.

Write the dot structure for: _____.

Write the dot structure for: _____.

Write the dot structure for: _____.

- Exceptions to the Octet Rule

-If the number of electrons doesn't work out...

1) **H** - full valence shell is _____ e-

2) **B** - generally satisfied with _____ valence e-

3) **Be** - generally satisfied with _____ valence e-

4) **N** - can be satisfied with _____ valence e-

5) **As, S, I, Se, and P**, etc. can expand their octet to have _____, _____, or _____ valence e-

*Don't need to memorize the elements in this rule... if you follow your steps, it becomes easy to see that an element **MUST** be able to expand!

- Structural Formulas

-Uses a _____ to represent a covalent bond

-Unshared pairs still shown as _____

-Examples:

- **RESONANCE STRUCTURES:**

-Found in many _____ bonded molecules


-Ex: _____ or _____

-Draw both:

- **VSEPR Theory:** Valence electron pairs attempt to get as FAR APART as possible, thus changing the 3D shape of the molecule!!!!

Types of Electron Pairs	
Bonding Pairs	Lone Pairs
Why are some shapes 3D instead of 2D?	

- **Common Molecular Shapes** (*Do NOT memorize Bond Angle!)

Shape Name	Details
LINEAR	Bond Angle(s): 180° Number of <i>attached</i> atoms on the <u>central</u> atom: 2 Number of <i>lone</i> pairs on the <u>central</u> atom: 0 Sketch: 
BENT	Bond Angle(s): Number of <i>attached</i> atoms on the <u>central</u> atom: Number of <i>lone</i> pairs on the <u>central</u> atom: Sketch:
TRIGONAL PLANAR	Bond Angle(s): Number of <i>attached</i> atoms on the <u>central</u> atom: Number of <i>lone</i> pairs on the <u>central</u> atom: Sketch:

Shape Name	Details
TRIGONAL PYRAMIDAL	Bond Angle(s): Number of <i>attached</i> atoms on the <u>central</u> atom: Number of <i>lone</i> pairs on the <u>central</u> atom: Sketch:
TETRAHEDRAL	Bond Angle(s): Number of <i>attached</i> atoms on the <u>central</u> atom: Number of <i>lone</i> pairs on the <u>central</u> atom: Sketch:
SQUARE PLANAR	Bond Angle(s): Number of <i>attached</i> atoms on the <u>central</u> atom: Number of <i>lone</i> pairs on the <u>central</u> atom: Sketch:
TRIGONAL BIPYRAMIDAL	Bond Angle(s): Number of <i>attached</i> atoms on the <u>central</u> atom: Number of <i>lone</i> pairs on the <u>central</u> atom: Sketch:
SQUARE PYRAMIDAL	Bond Angle(s): Number of <i>attached</i> atoms on the <u>central</u> atom: Number of <i>lone</i> pairs on the <u>central</u> atom: Sketch:

Shape Name	Details
OCTAHEDRAL	Bond Angle(s): Number of <i>attached</i> atoms on the <u>central</u> atom: Number of <i>lone</i> pairs on the <u>central</u> atom: Sketch:

****TO DETERMINE ANY MOLECULAR SHAPE NAME, YOU MUST DRAW A DOT STRUCTURE FOR THE MOLECULE FIRST, THEN COUNT ATTACHED AND LONE ON THE CENTER ATOM!****

Practice:

- SHAPE HYBRIDIZATIONS

Hybridization	Details
sp	
sp^2	
sp^3	
sp^3d	
sp^3d^2	

****MAGIC TRICK: TO DETERMINE THE HYBRIDIZATION, YOU MUST DRAW A DOT STRUCTURE FOR THE MOLECULE FIRST, THEN COUNT ATOMS ATTACHED... THE SUPERSCRIPTS IN THE CORRECT HYBRIDIZATION SCHEME ADD UP TO THE NUMBER ATTACHED**

****DOUBLE BONDS... ALWAYS =**

****TRIPLE BONDS... ALWAYS =**

Practice:

- **Sigma vs. Pi Bonds**

SIGMA (σ)	PI (π)

Practice:

- **BOND ENTHALPY:**

-Bonds BREAKING = _____

-Bonds FORMING = _____

-Change in enthalpy (_____) for a reaction can be found using the bond energies:

$$\Delta H_{\text{rxn}} = \Sigma(\text{energies of bonds } \underline{\hspace{2cm}}) - \Sigma(\text{energies of bonds } \underline{\hspace{2cm}})$$

How to Calculate for a Reaction:	1) Draw the _____ for all the substances in order to see which bonds will break and form 2) Sum the _____ of ALL of the bonds that are broken and _____ the sum of the energies of ALL of the bonds that are formed 3) Amounts of each _____ (from the reaction _____) need to be considered when calculating
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-Average Bond Energies (kJ/mol):

H-H	432	N-N	160	Br-Br	193	C=C	614
H-F	565	N-F	272	I-I	149	C≡C	839
H-Cl	427	N-Cl	200	I-Cl	208	O=O	495
H-Br	363	N-Br	243	I-Br	175	C=O	799
H-I	295	N-O	201	S-H	347	C≡O	1074
C-H	413	O-H	467	S-F	327	N=O	607
C-C	347	O-O	146	S-Cl	253	N=N	418
C-N	305	O-F	190	S-Br	218	N≡N	941
C-O	358	O-Cl	203	S-S	266	C=N	615
C-F	485	O-I	234	Si-Si	340	C≡N	891
C-Cl	339	F-F	154	Si-H	393		
C-Br	276	F-Cl	253	Si-C	360		
C-I	240	F-Br	237	Si-O	452		
C-S	259	Cl-Cl	239				
N-H	391	Cl-Br	218				

Higher energy = _____ bond!

-Example: Calculate the change in enthalpy for the reaction using bond energies.

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-Example: The formation of ethyl butanoate, one of the compounds that give pineapple its flavor, is produced according to the reaction below. Calculate the change in enthalpy for the reaction using bond energies.

- Bond Polarity

-Covalent bonds involve the _____ of electrons but not all atoms share _____!

-Electrons are in a " _____ " between atoms

	Definition	Properties	Examples
NONPOLAR COVALENT BONDS		-Compounds _____ in water ("like dissolves like") -LOWER _____ and _____ than polar compounds	
POLAR COVALENT BONDS		-Compounds are _____ in water ("like dissolves like") - _____ boiling and melting point than nonpolar compounds (but still _____)	

- Polarity

-Difference in _____ (ability of an atom to pull e- towards itself) between the atoms determines what type of bond forms...

Electronegativity Difference	Type of Bond	Example
0.0 - 0.4 (SMALL)		S-Se 2.5 - 2.4 = 0.1
0.5 - 2.0 (MID)		Cl-P 3.5 - 2.1 = 1.4
> 2.0 (HIGH)		Na-F 4.0 - 0.9 = 3.1

-Example: _____

____ = electronegativity of 2.1

____ = electronegativity of 3.0

_____ → difference is 0.9

Cl " _____ " shared e- giving it a slight _____ charge

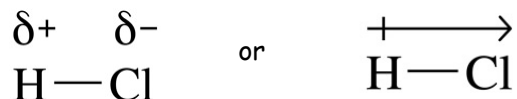
H has shared e- _____ time giving it a slight _____ charge

• **PARTIAL CHARGES:**

-Much less than a ____ or ____ in _____ bonding

-DELTA denotes partial charges (δ^+ , δ^-)

-Written as:



*Having a _____ and the right _____ make HCl a _____ and it is a **DIPOLE** (_____)!!

• **Polar Molecules**

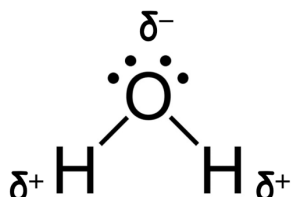
-For a molecule to be considered POLAR it must have:

- At least _____ polar bond
- _____ shape (many times, _____ pairs on the center)

*For our purposes, this will always be true unless it is IONIC or DIATOMIC!

****Just having _____ does _____ make a molecule polar!!**

-Example: H₂O



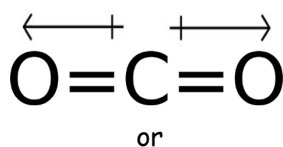
2 Polar Bonds (_____)

Highly electronegative _____ pulls the e- away from the _____

_____ shape

_____ molecule

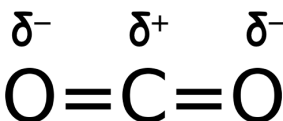
- Example: CO₂



2 Polar Bonds (_____)

Highly electronegative _____ pulls the e- away from the _____

_____ shape / _____ dipole



_____ molecule

***TO DETERMINE POLAR OR NONPOLAR: YOU MUST DRAW A DOT STRUCTURE... LOOK FOR LONE PAIRS ON THE CENTER (FOR US, THAT MEANS POLAR!)**

-More Examples:

- **INTERMOLECULAR ATTRACTIONS (IMFs):**

- _____ than ionic or covalent bonds (show as a _____ instead of a solid line)

-Make _____ and _____ compounds possible

-Contribute to the properties of the substance

*NOT _____!!

- Types of IMFs

IMF Type	Characteristics / Examples
LONDON DISPERSION FORCES (LDFs):	Due to the random movement of _____ in _____ molecules... when _____ are more abundant on one side of a molecule, there is a weak force of _____ to another molecule (_____) <ul style="list-style-type: none"> ○ Example:
DIPOLE-DIPOLE INTERACTIONS:	Happen when _____ molecules are attracted to each other... attraction between the _____ charges (_____) <ul style="list-style-type: none"> ○ Example:
HYDROGEN BONDING:	Special type of dipole-dipole attraction... can ONLY occur when _____ is bonded to _____, _____, or _____ (_____ because of the bigger electronegativity difference between the two atoms) <ul style="list-style-type: none"> ○ Responsible for determining properties of _____ ○ Example:

-Examples:

***TO DETERMINE THE IMF TYPE FOR A MOLECULE: YOU MUST DRAW THE DOT STRUCTURE AND DETERMINE IF IT IS POLAR / NONPOLAR AND ALSO LOOK FOR H BONDED TO CERTAIN ELEMENTS IF IT IS POLAR!!**

- Attractions and Properties

-Wide range of _____ properties among covalent compounds due to varying _____

-NETWORK SOLIDS:

-_____ melting points (_____ or higher)

-To melt, _____ the covalent bonds need to be _____ (Example: _____)