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 $MgCl_2$)

- Ionic Bonding

  -How to show using Electron Dot Structures:

  1) Draw the _____ for each element in the ionic compound

  2) Determine which element will _____ and which will _____ and how many

  3) Use _____ to show the e- being _____to an empty space on the anion's dot structure

  4) Continue until each element has a _____… add more of each element as needed

  -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

  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

- **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 _____!

  -Crystalline Structure

  - Metal atoms are very _____ and orderly like a _____

- **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: H_2, N_2, O_2, F_2, Cl_2, Br_2, and I_2

- Properties of Covalent Compounds

  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)

- Types of Covalent Bonding

  -There are _____ types of covalent bonds:

  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 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

-Atoms still need a _____!!

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

- Molecular Dot Structures

-Example: Write the dot structure for: _____.

-Example: Write the dot structure for: _____.

-Example: Write the dot structure for: _____.

-Example: Write the dot structure for: _____.

-Example: 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-

- 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**:

  -Molecules are really _____, not _____

  -Unshared pairs are held _____ to the atom and they _____ the bonding pairs which pushes them _____ together

  -Types of e- pairs:

  - **BONDING PAIRS ➔**
  - **LONE PAIRS ➔**

    *LONE PAIRS REPEL _____ THAN BONDING PAIRS!!!

- Common Molecular Shapes (Give an example, draw models, and indicate bond angle for each)

  -**LINEAR**:

  -**TRIGONAL PLANAR**:

  -**TETRAHEDRAL**:

  -**TRIGONAL PYRAMIDAL**:

  -**BENT**:

-**TRIGONAL BIPYRAMIDAL**:

-**OCTAHEDRAL**:

-**SQUARE PYRAMIDAL**:

-**SQUARE PLANAR**:

- **ORBITAL HYBRIDIZATION THEORY**:

  -Covalent bonds form when atomic orbitals _____

  -Mixing of s, p, and sometimes d orbitals that allows bonds to form… _____

  -Ex: _____ / ____ hybridization

- Shape Hybridizations

  -LINEAR (2 attached):

  -**TRIGONAL PLANAR** (3 attached):

  -**TETRAHEDRAL** (4 attached):

  -**TRIGONAL BIPYRIMIDAL** (5 attached):

  -**OCTAHEDRAL** (6 attached):

Depends on which _____ of orbitals are being _____!

- Multiple Bond Hybridizations

  -Single Bonds: _____ Double Bonds: _____ Triple Bonds: _____

- **SIGMA (σ) BONDS**:

  -_____ bonds

  -Ex: _____

- **PI (π) BONDS**:

  -_____ than sigma bonds

  -**Double bonds** = ___ sigma / ___ pi

  -**Triple bonds** = ___ sigma / ___ pi

  -Ex: _____ / _____

- **BOND ENTHALPY**:

  -Bonds BREAKING = _____

  -Bonds FORMING = _____

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

  ΔH_{rxn} = **Σ(energies of bonds _____) – Σ(energies of bonds _____)**

  -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

-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

- **NONPOLAR COVALENT BONDS**:

  -Compounds _____ in water ("like dissolves like")

  -LOWER _____ and _____ than polar compounds

  -Ex:

- **POLAR COVALENT BONDS**:

  -Compounds are _____ in water ("like dissolves like")

  -_____ boiling and melting point than nonpolar compounds (but still _____)

  -Ex:

- 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		S-Se 2.5 - 2.4 = 0.1
0.5 - 2.0		Cl-P 3.5 - 2.1 = 1.4
> 2.0		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 (_____, _____)

  -Written as:

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

- Polar Molecules

  -For a molecule to be POLAR it must have:

  - At least _____ polar bond
  - _____ shape (_____) or asymmetrical atoms

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

  -Example: _____

  2 Polar Bonds (_____)

  Highly electronegative ____ pulls the e- away from the ____

  _____ shape

  _____ molecule

  *DRAW:

- Example: _____

2 Polar Bonds (_____)

Highly electronegative ____ pulls the e- away from the ____

_____ shape / _____ dipole

_____ molecule

*DRAW:

- **INTERMOLECULAR ATTRACTIONS**:

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

-Make _____ and _____ compounds possible

-Contribute to the _____ of the substance

*NOT _____!!

-VAN DER WAALS FORCES:

1) **LONDON DISPERSION FORCES**: 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 (_____)
   - Example:

2) **DIPOLE-DIPOLE INTERACTIONS**: happen when _____ molecules are attracted to each other… attraction between the _____ charges (_____)
   - Example:

-NON VAN DER WAALS FORCE

3) **HYDROGEN BONDING**: strong attractions between the ____ end of one dipole and the ____, ____, or ____ atom of another dipole (_____)
   - Like a _____ interaction, only _____ because of _____ electronegativity difference between the two atoms
   - Responsible for determining _____ of _____
   - Example:

- Attractions and Properties

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

  -**NETWORK SOLIDS**:

  -_____ melting points (_____ or higher)

  -To melt, _____ the covalent bonds need to be _____

  -Example: _____