

HONORS CHEMISTRY: REVIEWING IONIC BONDS

Learning Activities: SWBAT...

...review/extend ionic bond knowledge base.



DATE: _____

SODIUM <3 CHLORINE

IN MOST STABLE COMPOUNDS, ALL ATOMS INVOLVED HAVE GAINED NOBLE GAS ELECTRON CONFIGURATIONS.

- It is extremely important and useful to start viewing chemical bonding in this fashion.
- In ionic compounds, atoms will gain or lose electrons to become _____ with the closest noble gas.

ex) Na =

Cl =

If sodium loses one electron it becomes **isoelectric** with neon:

If chlorine gains one electron it becomes **isoelectric** with argon:

**Remember: all chemical compounds have to be...
These ions form a 1:1 ratio, NaCl.**

Try this...

ex) Al =

O =

If aluminum loses three electrons it becomes **isoelectric** with neon:

If oxygen gains two electrons it becomes **isoelectric** with neon:

So it would take 2 aluminum ions (+3 charge) to balance out 3 oxygen ions (-2 charge) =

- Ionic compounds are composed of _____ combining together into large, stable _____.
- Cations will always be _____ than their parent atom, anions will always be _____.
- Many transition metals are capable of multiple charges, for reasons beyond the scope of this class.
- Polyatomic ions are...

Predict the most likely charge of the following ions. What noble gas do they become isoelectric with?

Rb =

Se =

Mg =

Ga =

Br =

Determine the formula for the following ionic compounds:

beryllium bromide

ferric hydroxide

ammonium bicarbonate

Determine the name of the following ionic compounds:

CoBr₃

NaClO

LiC₂H₃O₂

*"Look not mournfully into the past. It comes not back again. Wisely improve the present. It is thine.
Go forth to meet the shadowy future, without fear." ~ Henry Wadsworth Longfellow*

HONORS CHEMISTRY

IONIC REVIEW

NAME _____

Find the orbital diagram, electron configuration and noble gas abbreviation of Cesium.

How many valence electrons does it have? What is its most likely charge?

Name an element that cesium would form a 1:1 ratio with:

Name an element that cesium would form a 2:1 ratio with:

Name an element that calcium would form a 1:1 ratio with:

Determine the formulas of the following ionic compounds:

Cuprous hypophosphite

Tin (II) Bicarbonate

Potassium peroxide

Determine the name of the following ionic compounds:

TIN

$\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2$

$\text{Sn}(\text{SCN})_4$

*"It is a mistake to think you can solve any major problems just with potatoes."
- Douglas Adams*

HONORS CHEMISTRY: ELECTRONEGATIVITY AND YOU

DATE: _____

LEARNING ACTIVITIES: SWBAT...

- ...explain the relationship between bond length and bond energy.
- ...use electronegativity values to determine the nature of a chemical bond.

Remember that **bond energy** (KJ/mol)...

... is the energy required to...

... also equals...

... and bond length are...

- As bond length decreases...

ex) H - H length = 75 pm Bond energy = 436 KJ/mol

I - I length = 266 pm, Bond energy = 151 KJ/mol

Remember: ionic bonds are _____. Covalent bonds are _____.

WHAT CAUSES CERTAIN COMPOUNDS TO HAVE IONIC BONDS AND OTHERS TO HAVE COVALENT BONDS?

ELECTRONEGATIVITY:

- Values range from _____ to _____.
- The higher the value...
- This is similar to electron affinity and follows the same periodic trends.
- Note: As with electron affinity, we'll ignore the noble gases since...

VERTICAL TREND:

Why? As previously stated, radius and shielding effects both _____ down a family
∴ the nucleus has...

HORIZONTAL TREND:


Why? As previously stated, the number of protons _____
, while the shielding effect remains _____
∴ the nuclear pull on the electrons in a bond _____.

ALL ELECTRONS ARE NOT EQUALLY SHARED! THIS DECIDES WHAT TYPE OF CHEMICAL BOND EXISTS!

To determine what kind of chemical bond is present, one must compare the electronegativities of the two atoms. **Determine the absolute difference between the two atoms:**



TYLER DEWITT TALKS ABOUT
ELECTRONEGATIVITY

H 2.1	<div></div> <div>TYLER DEWITT TALKS ABOUT ELECTRONEGATIVITY</div>																He x
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0	Ne x
Na 0.9	Mg 1.2											Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0	Ar x
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.9	Ni 1.9	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	Kr x
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	Xe x
Cs 0.7	Ba 0.9	La-Lu 1.0-1.2	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.9	Bi 1.9	Po 2.0	At 2.2	Rn x
Fr 0.7	Ra 0.9	Ac 1.1	Th 1.3	Pa 1.4	U 1.4	Np- No 1.4-1.3											

WHAT IS THE ELECTRONEGATIVITY DIFFERENCE?

< 0.3 ex)

0.3 - 1.7 ex)

> 1.7 ex)

WHAT TYPE OF BOND IS IT?

= equal sharing of e⁻

= uneven sharing of e⁻

= complete transfer of e⁻

Note 1: If the difference is right on the split between two choices (0.3 or 1.7), then you'll have to use experience to determine which bond type is present.

Note 2: Not everyone agrees on the cut-off points between the different bond types.

Find electronegativity difference of each of the following types of bonds & determine bond type.

H-H

Na-Cl

Ca-S

H-O

Rb-Br

F-Cl

Ca-O

C-H

REVIEW & REFLECTION

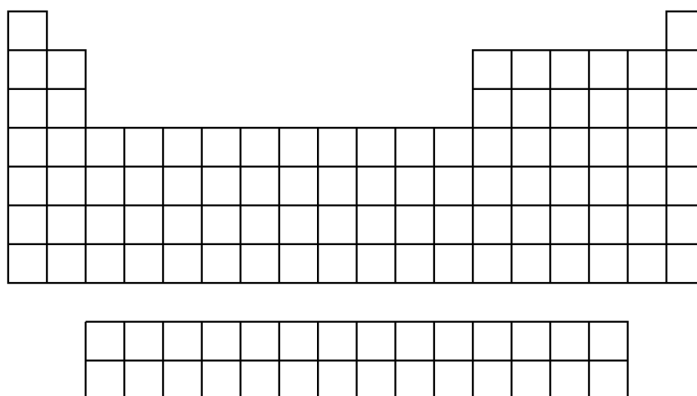
"He who has a why to live can bear almost any how." ~ Friedrich Nietzsche

HONORS CHEMISTRY

ELECTRONEGATIVITY

NAME _____

Show the vertical and horizontal trends for electronegativity (and explain why).



Compare and contrast electronegativity with electron affinity.

Compare and contrast electronegativity breakpoints from the video with the one's in Tro. What does this tell you about established electronegativity breakpoints?

Find the electronegativity difference for each of the following & determine the bond type.

N - O

F - F

F - O

Na - H

W - Cl

Se - Br

"I was brought up to believe that the only thing worth doing was to add to the sum of accurate information in the world." - Margaret Mead

HONORS CHEMISTRY: LEWIS DOT STRUCTURES

DATE: _____

Learning Activities: **SWBAT** . . .

...draw Lewis structures for covalent compounds.

LEWIS STRUCTURES [A.K.A. LEWIS DOT STRUCTURES]:

- Each atom usually wants _____ electrons, either through _____ or _____.
- **Unshared pair:**

SYMBOLS USED IN LEWIS DOT STRUCTURES:

Unshared pair:

Single bond: (Represents the sharing of one pair of electrons between two atoms.)

Double bond: (Represents the sharing of two pairs of electrons between two atoms.)

Triple bond: (Represents the sharing of three pairs of electrons between two atoms.)

THOUGH NOT USUALLY DONE, HOW WOULD YOU DRAW LEWIS STRUCTURE FOR SINGLE ATOMS?

- Look at the periodic table to determine the number of valence electrons that atom has.
- Can put up to two dots (representing two electrons) on each of symbol's four sides.
- Electrons will take side to themselves before they pair up.
- All sides are equivalent, so it doesn't matter which side you put unshared pairs (or bonds) on.

H

Cl

O

C

MORE IMPORTANTLY, HOW DO YOU DRAW LEWIS STRUCTURES FOR ENTIRE MOLECULES?

1. Count up total number of valence electrons.

-

2. Draw chemical symbols in rough representation of structure of molecule.

-

- General guideline:

- General guideline:

3. Start by connecting the atoms to each other with single bonds.

- Though there are exceptions, most atoms will not...



BOZEMAN SCIENCE
TALKS LEWIS DOT

4. Then distribute unshared pairs to the atoms so as to complete as many octets as possible.

- Remember:

- If there aren't enough electrons to give every atom a full octet then (and only then)...

...

- Usually there aren't leftover electrons, but if there are... *t*

5. CHECK YOUR WORK. Make sure that you used the correct number of electrons!

Try drawing the Lewis Structure for HCl...

Try drawing the Lewis Structure for CH₂O...



CRASH COURSE
ON LEWIS DOT

Try these for practice: ICl, HBr, CH₂Cl₂, CH₃OH, CO, N₂, HCN, C₂H₂, C₂Cl₄

*"To find contentment, enjoy your life without comparing it with that of another."
~ Condorcet*

HONORS CHEMISTRY

BASIC LEWIS DOT

NAME _____

Draw the Lewis dot structures for each of the following. Don't forget to show the electron bookkeeping!



"Always do right. This will gratify some people and astonish the rest." - Mark Twain

HONORS CHEMISTRY: ADVANCED LEWIS DOT STRUCTURE RULES

DATE: _____

Learning Activities: SWBAT...

- ...explain and draw resonance structures.
- ...draw Lewis Dot Structures for polyatomic ions.

SITUATION #1: ODD NUMBER OF VALENCE ELECTRONS

Try to draw the Lewis Structure for NO_2 .



OZONE HOLE



- Due to the odd number of electrons...
- In cases like this:
- This is allowed if octet formation is impossible.
- Rather unstable structures, but they can exist.

SITUATION #2: MORE THAN ONE POSSIBLE STRUCTURE

Try to draw the Lewis Structure for ozone, O_3 .

- Sometimes two drawings are equally possible.
- Which one exists?
- Actual bond is...
(Bond length measurements match expected results.)
- **Resonance structures:**
- Draw all possible structures and use a double ended arrow to point between each.

SITUATION #3: POLYATOMICS

Try to draw the Lewis Structure for the ammonium polyatomic, NH_4^+ .

Remember,

The only difference is that...

- Add or subtract electrons as defined by charge
- Complete the Lewis Structure as normal, accounting for electron charges.
- Put entire structure in brackets and indicate charge.



RESONANCE STRUCTURES

*"If we are ever in doubt to what to do,
it is a good rule to ask ourselves what we shall wish tomorrow
that we had done today." ~ Avelbury*



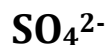
POLYATOMIC LEWIS STRUCTURES

HONORS CHEMISTRY

ADVANCED LEWIS DOT

NAME _____

Draw the Lewis dot structures for each of the following. Don't forget to show the electron bookkeeping!



VSEPR PRACTICE: Find the 3D structure of all molecules on both sides of this paper.

*"You can't do anything about the length of your life,
but you can do something about its width and depth." - Evan Esar*

Learning Activities: ... predict the shape of a molecule from its Lewis structure using VSEPR theory.

LEWIS STRUCTURES ARE A 2-D REPRESENTATION OF A MOLECULE.

WE CAN ALSO USE LEWIS STRUCTURES TO PREDICT THE 3-D SHAPE OF MOLECULES.

- The shape of a molecule is extremely important information. For example...

VSEPR THEORY:

THE RULES

1. Draw Lewis structure for the molecule.

2. Count up the number of electron clouds on a single atom.

What counts as an electron cloud?

-
-

3. Determine the basic geometry.

Two electron clouds =

Three electron clouds =

Four electron clouds =

4. Determine the actual geometry by looking at the number of bonding/nonbonding electron pairs.

-

5. Adjust bond angles due to unshared pairs.

-

# of electron clouds	Geometry category	Bonding pairs	Unshared pairs	Actual molecular geometry	Example
2	Linear	2	0	Linear	CO_2 $\text{O}=\text{C}=\text{O}$
3	Trigonal planar FLAT LIKE A FRISBEE SIDE VIEW TOP VIEW	3	0	Trigonal planar	CH_2O
		2	1	Bent	O_3
4	Tetrahedral LOOKS LIKE A JACK REPRESENTS GOING BACK INTO PAGE REPRESENTS COMING OUT OF PAGE	4	0	Tetrahedral	CH_4
		3	1	Trigonal pyramidal	NH_3
		2	2	Bent	H_2S

Determine the geometry and draw the structural formulas for the following molecules:

BF_3 , CHCl_3 , Br_2 , AlCl_3 , HCl , PH_3 , NO_2 , H_2O , H_3O^+ , GaI_3 , CF_3Cl , CO

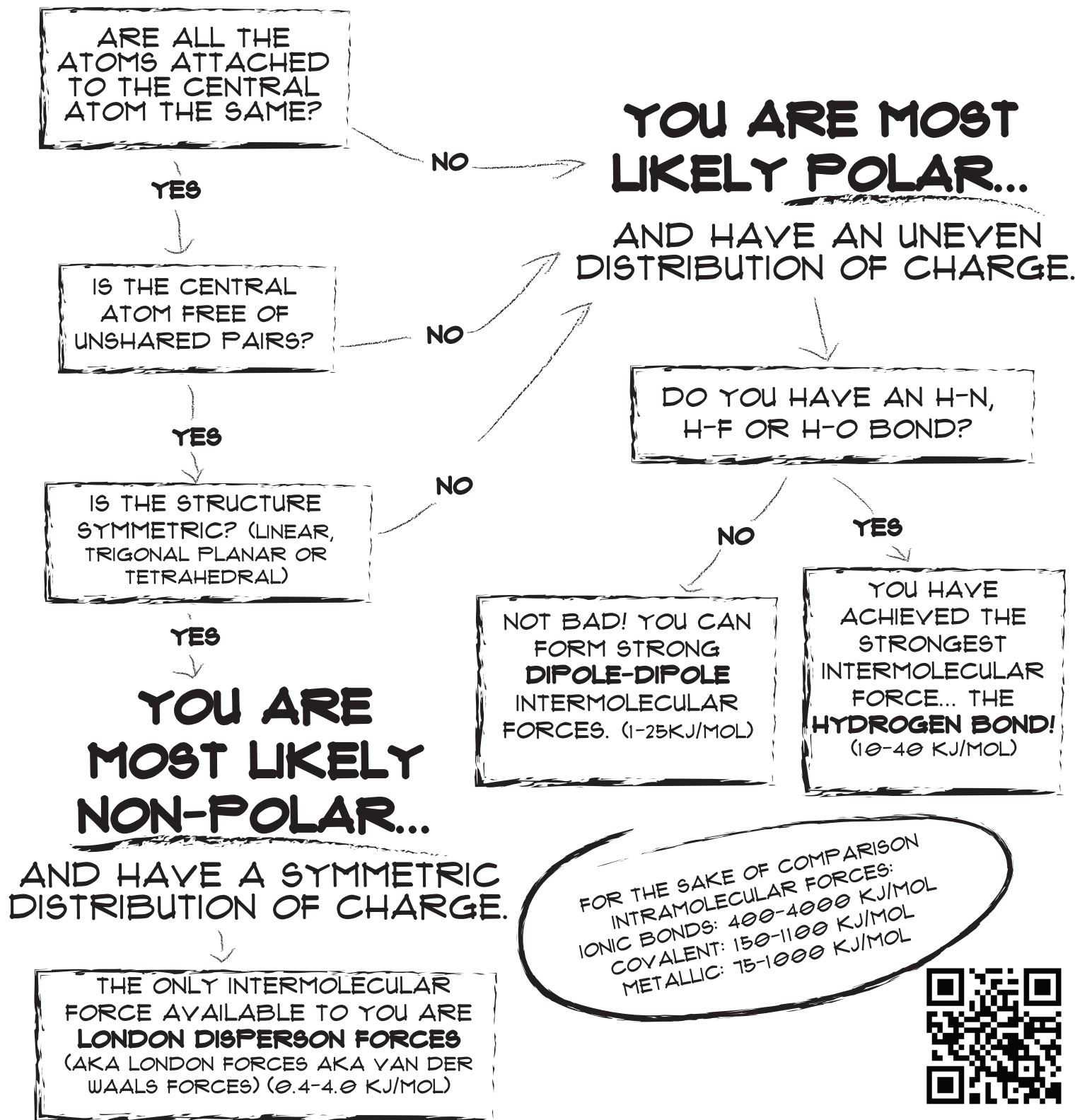


TYLER DEWITT ON VSEPR



*"Seize from every moment its unique novelty,
and do not prepare your joys." ~ Andre Gide*

TO DETERMINE THE INTERMOLECULAR FORCES ALLOWED BY A MOLECULE, YOU MUST FIRST DETERMINE WHETHER IT IS POLAR OR NON-POLAR!



NOTE: LDF IS THE DEFAULT IMF. EVERYONE CAN DO IT.

CRASH COURSE
POLAR AND NON-POLAR

'Only from the alliance of the one, working with and through the other, are great things born.' ~ Antoine de Saint-Exupéry

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Learning Activities: SWBAT. . .

...define and differentiate the difference intermolecular forces available in between covalent molecules.

What differentiates covalent bonds from ionic is that...

- ∴ no ions are made,
- ∴ no ionic compounds are made. **They exist as separate, discrete molecules.**

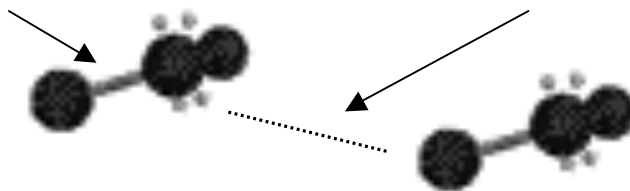


NICE SUMMARY

IT IS CRITICAL TO UNDERSTAND HOW COVALENT MOLECULES INTERACT WITH EACH OTHER.

INTERMOLECULAR FORCES:

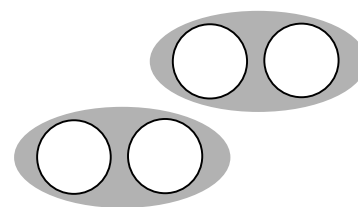
- **These are not chemical bonds! There is no transfer or sharing of electrons!**
- These forces are always much weaker than chemicals bonds.
- If enough are present, however, they can have...
- Intermolecular forces are broken before chemical bonds are ∴.



THERE ARE THREE DIFFERENT TYPES OF INTERMOLECULAR FORCES:

LONDON DISPERSION FORCES

- The only intermolecular force that substances with _____ can experience.
- Since both atoms have an equal pull on the electron cloud, it remains evenly distributed.
-

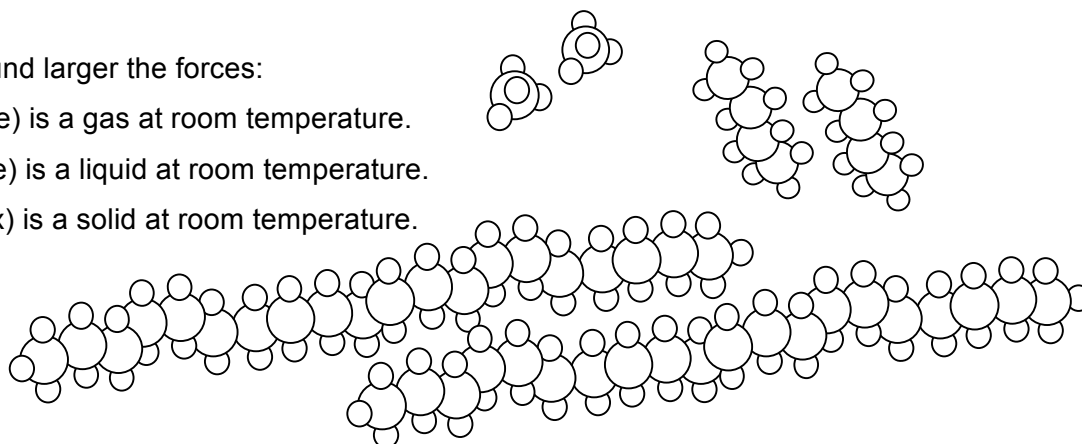


- Bigger the compound larger the forces:

CH₄ (methane) is a gas at room temperature.

C₄H₁₀ (butane) is a liquid at room temperature.

C₁₂H₂₄ (a wax) is a solid at room temperature.



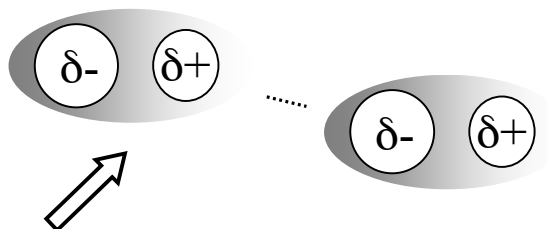
Compounds with polar covalent bonds can have stronger intermolecular interactions. Why?

- Polar molecules have an unequal distribution of the electron cloud \therefore

- Though they are still overall neutral,

they can have a _____

and _____ part of the molecule.

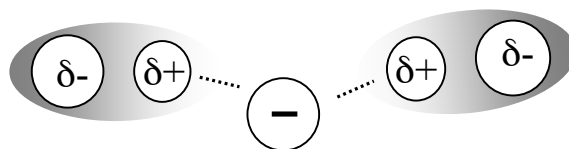


DIPOLE FORCE:

- These involve permanent charge distributions \therefore

- The geometry of the molecule is also important for dipole force creation (more on this later in the chapter).

(NOTE: The charged ends of polar molecules can also interact with charged ions.)



A stronger sub-class of dipole forces is the **HYDROGEN BOND**

- Despite the name, **THIS IS NOT A CHEMICAL BOND.**

- It is...

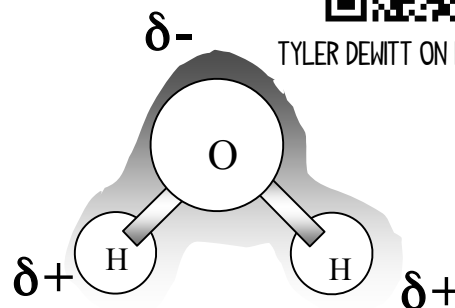
- The strongly electronegative element...

This creates stronger partial charges \therefore

- Pretty strong as intermolecular forces go, but...



TYLER DEWITT ON H BONDS



CRITICAL TO LIFE AS WE KNOW IT!

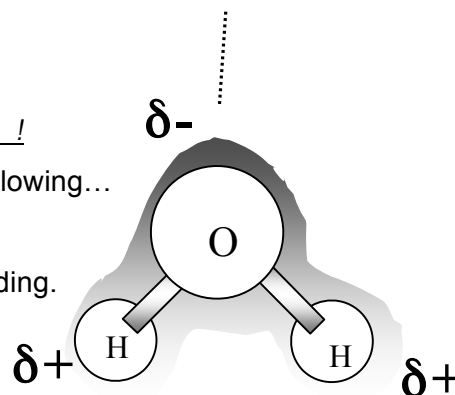
- Otherwise water would probably be a gas around _____!

- When frozen, hydrogen bonds lock water into a less dense structure, allowing...

...

- The double helix of _____ is bound together through hydrogen bonding.

This allows...



"No man suffers injustice without learning, vaguely but surely, what justice is." ~ Isaac Rosenfeld

HONORS CHEMISTRY

INTERMOLECULAR FORCES

NAME _____

Go through your notes and find two examples of each of these categories. Draw the Lewis Dot and VSEPR structure. Indicate bond types, bond angles, actual geometry if possible.

ION #1

ION #2

NON POLAR MOLECULE #1

NON-POLAR MOLECULE #2

POLAR MOLECULE #1

POLAR MOLECULE #2

POLAR MOLECULE #3
(contains requirements of H-bonding)

POLAR MOLECULE #2
(contains requirements of H-bonding)

Now, using your chosen examples, find at least two examples of each of the following intermolecular forces... if possible! (NOTE: These are listed in order of increasing strength... can you explain why?)

LONDON DISPERSION FORCE:

DIPOLE-DIPOLE FORCE:

HYDROGEN BONDING:

ION-DIPOLE FORCE:

"One of the symptoms of an approaching nervous breakdown is the belief that one's work is terribly important." - Bertrand Russell