

Name _____

Period _____

Unit 5 Bonding....James Bonding**Skills:**

- | | |
|---|----------------------------------|
| 1. Identifying Changes in Energy and Stability | 5. Covalent Lewis Structures |
| 2. Drawing Atoms, Lewis structures....Electron dot diagrams | 6. Polar and Non Polar Bonds |
| 3. Distinguish between types and properties of bonds | 7. Polar and Non Polar Molecules |
| 4. Ionic Lewis Structures | 8. Shape of Covalent Molecules |
| | 10 Intermolecular Forces |

Unit Vocabulary:**Due: Test Day**

<u>Word</u>	<u>Definition</u>
<u>Chemical Bond</u>	
<u>B.A.R.F.</u>	
<u>Metallic Bond</u>	
<u>Ionic</u>	
<u>Covalent</u>	
<u>Polar Bond</u>	
<u>Non Polar Bond</u>	
<u>Molecular Polarity</u>	
<u>Intermolecular Force</u>	
<u>Hydrogen Bonding</u>	

Unit 5 Resources:

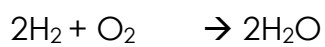
Skill 1: Identify Changes in Energy and Stability

What is a chemical bond? : _____ or _____ of _____ electrons to achieve a _____ valence shell and become _____

_____ energy (_____) in the bond

- **Bond breaking:** _____ energy (_____ energy) → _____ process
- **Bonding making:** _____ energy → _____ process

Example:



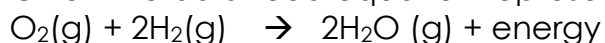
B	A	R	F

For each phrase, check either "bond breaking" or "bond forming".

		Bond Breaking	Bond Forming
a.	Stability of the chemical system increases		
b.	Energy is released		
b.	$\text{Cl} + \text{Cl} \rightarrow \text{Cl}_2$		
c.	exothermic		
d.	endothermic		
e.	$\text{N}_2 \rightarrow \text{N} + \text{N}$		
f.	Energy is absorbed		
g.	Stability of the chemical system decreases		

Practice:

Given the balanced equation representing a reaction:



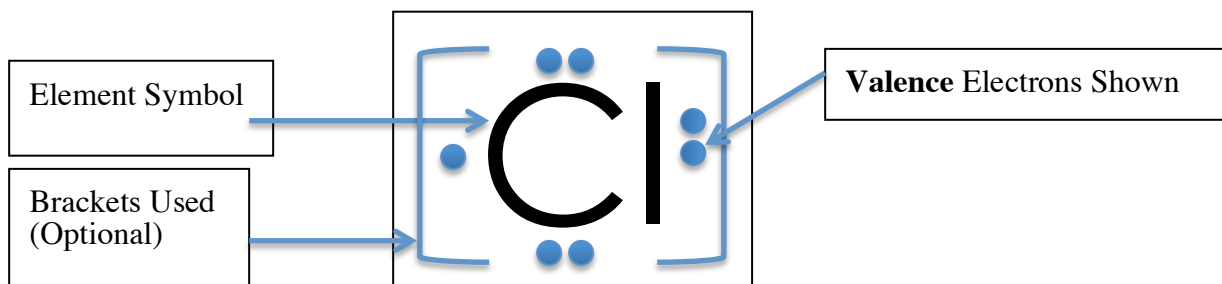
Which statement describes the energy changes in this reaction?

- 1) Energy is absorbed as bonds are formed, only.
 - 2) Energy is released as bonds are broken, only.
 - 3) Energy is absorbed as bonds are broken, and energy is released as bonds are formed.
 - 4) Energy is absorbed as bonds are formed, and energy is released as bonds are broken.
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Skill 2: Drawing Atom Lewis Structures...Electron Dot Diagrams

Lewis Dot Diagrams represent _____ which are primarily involved in _____.

Electron Dot Representation: Chlorine (Cl)



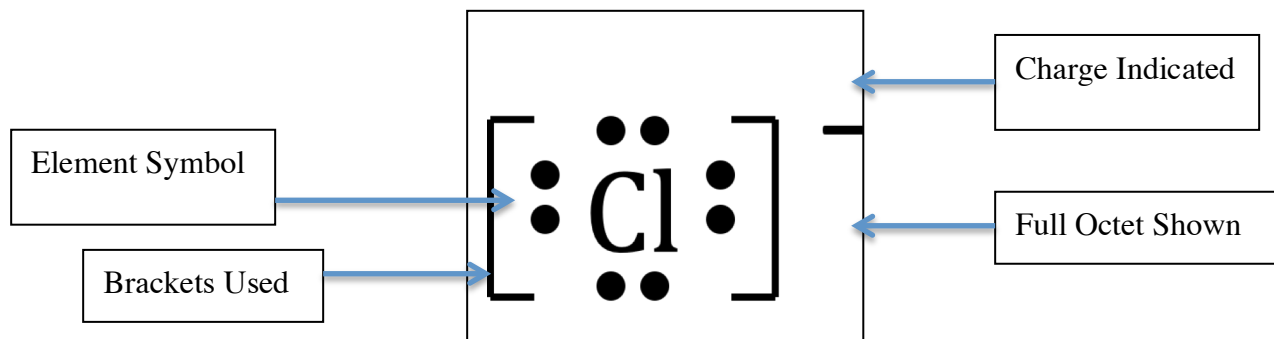
	Atom in...	Electron-dot structure		Atom in...	Electron-dot structure
a.	Group 1, Period 3	Na [•]	h.	Group 2, Period 3	
b.	Group 14, Period 3		i.	Group 2, Period 4	
c.	Group 16, Period 5		j.	Group 12, Period 6	
d.	Group 1, Period 2		k.	Group 4, Period 5	
e.	Group 17, Period 4		l.	Group 17, Period 6	
f.	Group 14, Period 3		m.	Group 13, Period 2	
g.	Group 1, Period 5		n.	Group 2, Period 2	

Skill 3: Drawing electron dot diagrams, ions

Octet Rule: Ions are formed to reach a full _____, meaning a full _____ electron shell.

What is an ion? _____

Electron Dot Representation: Chlorine Ion (Cl⁻¹)



Show the NEW electron configuration: 2-8-8

	Ion	Electron-dot structure	Electron Configuration		Ion	Electron-dot structure	Electron Configuration
a.	sodium Na ⁺	[Na] ⁺	2-8	h.	oxide O ²⁻	[O] ²⁻	2-8
b.	aluminum Al ³⁺			i.	bromide Br ⁻		
c.	calcium Ca ²⁺			j.	phosphide P ³⁻		
d.	magnesium Mg ²⁺			k.	sulfide S ²⁻		
e.	strontium Sr ²⁺			l.	iodide I ⁻		
f.	rubidium Rb ⁺			m.	fluoride F ⁻		
g.	gallium Ga ³⁺			n.	chloride Cl ⁻		

Skill 4: Types and Properties of Chemical Bonds

Observation: _____

Why do you think this occurs?

SAFETY GOOGLES MUST BE WORN AT ALL TIMES DURING LAB!

- 1) Complete an observation of color + texture
- 2) Record conductivity using probe alone and in water
- 3) Heat on burner with foil to determine relative melting point

Sample	Observation	Conductivity Alone	Conductivity in water	Melting Point (High or Low)	Type of elements involved
Paraffin Wax C ₄₄ H ₂₄ Cl ₆					
Salt NaCl					
Copper Cu					
Iron Fe					
Copper Sulfate CuSO ₄					
Ammonium Nitrate (NH ₄)(NO ₃)					
Sugar C ₆ H ₁₂ O ₆					
Water H ₂ O					

Group the compounds used by their observed properties:

Set 1	Set 2	Set 3	Set 4
Properties used to classify:	Properties used to classify:	Properties used to classify:	Properties used to classify:

Teacher Sign Off: _____

Type of Bonding	Type of Bonding	Type of Bonding	Type of Bonding

Reasoning:

What type of bonding does H₂O exhibit? _____

What evidence supports this?

In terms of bonding, explain why H₂O did not conduct electricity.

Properties

Ionic Bonding

Formed when: _____ bonds together

because of the

_____ charged ions _____

each other.

Involves: A _____ of

electrons to a _____

Typically occurs between a metal (loses electrons) and a _____

(_____ electrons).

Ionic Bonding Properties:

1. _____ melting and boiling points
2. _____ at room temperature
3. _____
4. _____ electricity in _____ and _____



Polyatomic Bonding

Ionic bonds can also exist with a metal or nonmetal **AND** a

_____.

Polyatomic ion (see Reference Tables Table _____)

A _____ bonded (_____ of electrons)

group of atoms that have a

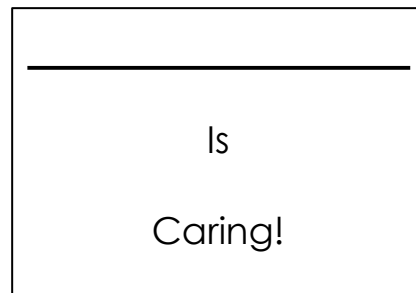
Properties:

Covalent Bonding

Formed when: two atoms _____ electrons in order to achieve a _____ arrangement of _____

Involves: two _____ electrons

Sometimes referred to as _____ bonds.



Properties of Covalent Bonds:

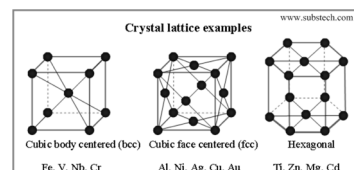
1. Relatively _____ melting and boiling points
2. Exist as a _____, _____, or _____ at STP
3. _____
4. Will _____ electricity in ANY phase
5. _____ soluble in water

Metallic Bonding

- Metals have _____ valence electrons and _____ ionization energies.
- The valence electrons of metal atoms are known as a "_____." This means that the electrons are _____ and can drift freely around the metal.
- A metallic bond consists of the _____ of the free-floating _____ electrons to the _____ positively charged metal ions. This attractive force holds the metals together.

Properties:

- _____ conductors of electricity and heat
- _____ melting and boiling points
- _____ soluble (able to dissolve) in water



Crystalline Structure of Metals

- Metal atoms in crystals are arranged in very _____ and _____ pattern

Checks for understanding:

Types of Bonds:

Match the following **compounds** to the three bond types.
Each answer may be used once, more than once, or not at all.

C) Covalent Bond

I) Ionic Bond or Polyatomic

M) Metallic Bond

___1. KBr

___2. Cu

___6. CaCl₂

___7. Br₂

___3. CO₂

___4. Pb(OH)₃

___8. Na₂O

___9. SiO₂

___5. CH₄

___10. brass (Cu + Zn)

Properties of Types of Bonds:

Match the following **statements** to the three bond types.
Each answer may be used once, more than once, or not at all.

C) Covalent Bond

I) Ionic Bond

M) Metallic Bond

___1. the strongest bond

___6. malleable and ductile

___2. conducts electricity as a solid

___7. conducts electricity when dissolved in water

___3. alternating positive and negative particles

___8. involves a transfer of electrons

___4. sharing electrons between two atoms

___9. involved in molecules and in network solids

___5. positive ions in a "sea of electrons"

9. Which element has a crystalline lattice through which electrons flow freely?

A) Bromine B) Calcium C) Carbon D) Sulfur

10. Which element has properties of good electrical conductivity and luster and exists as a liquid?

A) Hg B) Br C) I D) H₂

11. Circle those compounds containing both ionic and covalent bonds?

NaCl

CaCO₃

PCl₃

H₂SO₄

HOH

13. Explain the difference between the circled and un-circled compounds:

Skill 5: Drawing Ionic Lewis Structures:

Reminder: Determine the charge of an ion

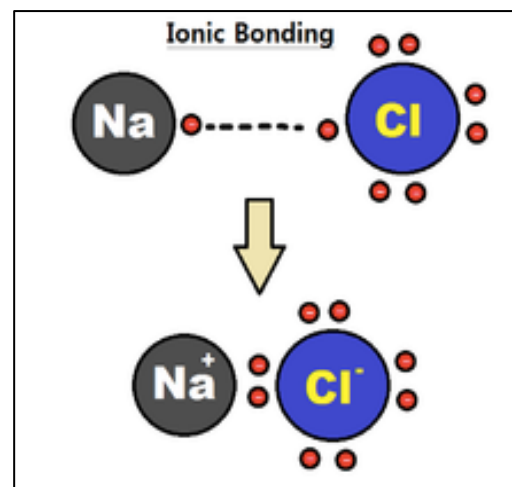
	Element	# of Valence e-	# of e- Gain or Lose	Ionic Charge
1	Cl			
2	Na			
3	Mg			
4	O			
5	N			
6	Al			
7	Xe			

Steps to Draw Ionic Lewis Structure

- 1) Determine the type of bond!
- 2) Determine the ion charge formed by both atoms.... # of electrons gained or lost
- 3) Draw Brackets around both atoms
- 4) Label ion charge states
- 5) Draw valence electrons AFTER THE TRANSFER!!

Lewis Structure: NaCl

- Both Element Symbols shown
- TRANSFER of electrons is shown
- Relative charge states are shown



Draw the Lewis structure for the following:

BaCl_2	AlI_3	LiP_3
K_2S	Na_2O	Al_2O_3

Check for understanding:

Draw an ionic bond for CaF_2

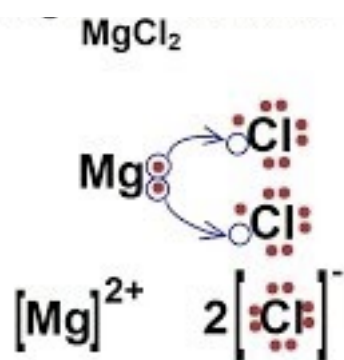


Draw an ionic bond for MgO



Practice: Drawing Ionic Lewis Structures

1. Draw the Lewis Structure for MgCl_2



2. Draw the Lewis Structure for MgS

3. Draw the Lewis Structure for KF

4. Draw the Lewis Structure for K_2O

5. Draw the Lewis Structure for Be_3N_2

6. Draw the Lewis Structure for Ca_3P_2

Steps to Draw Covalent Lewis Structure (Ball and Stick)

- 1) Draw lewis structure of each atom
- 2) Draw circles around **UNPAIRED ELECTRONS**
- 3) **Circles become bond line representing shared electrons**
- 4) Draw valence electrons around each atom
- 5) Check that both have full octet

CH ₄	HCl
<pre> H• H• •C• H• H• </pre>	

Multiple Covalent Bonds:

Bond Type	Number of Shared Electrons	Number of Shared PAIRS of e-	Example
Single Bond			HF
Double Bond			O ₂
Triple Bond			N ₂

Practice: For each, show bonding circles and final Lewis (ball and stick) Diagram

a) H ₂	b) Cl ₂
c) HCl	d) H ₂ O

Practice:

-
- | | |
|---|--|
| <p>1. Which formulas represent one ionic compound and one molecular compound?</p> <p>A) N₂ and SO₂
B) Cl₂ and H₂S
C) BaCl₂ and N₂O₄
D) NaOH and BaSO₄</p> <p>2. Which element forms an ionic compound when it reacts with lithium?</p> <p>A) K B) Fe C) Kr D) Br</p> <p>3. Based on bond type, which compound has the highest melting point?</p> <p>A) CH₃OH B) C₆H₁₄
C) CaCl₂ D) CCl₄</p> | <p>4. What is the total number of electron pairs shared between the two atoms in an O₂ molecule?</p> <p>A) 1 B) 2 C) 6 D) 4</p> <p>5. Which pair of atoms will share electrons when a bond is formed between them?</p> <p>A) Ba and I B) Br and Cl
C) K and Cl D) Li and I</p> <p>6. Which characteristic is a property of molecular substances?</p> <p>A) good heat conductivity
B) good electrical conductivity
C) low melting point
D) high melting point</p> |
|---|--|
-

Skill 7: Polar and Non Polar BONDS

Nonpolar Covalent BONDS:

_____ sharing of electrons between two _____

ELECTRONEGATIVITIES ARE THE _____.

Example: Br₂

Bond Type _____

Polar Covalent BONDS: _____ sharing of electrons between two _____

_____ pulling on electrons _____

ELECTRONEGATIVITIES differences indicate the degree of _____ character.

Example: HBr

Bond Type _____

Check for understanding: Draw covalent bonds for Cl₂ and CCl₄ and identify the BONDS as polar or nonpolar covalent.

Cl₂

Bond Type _____

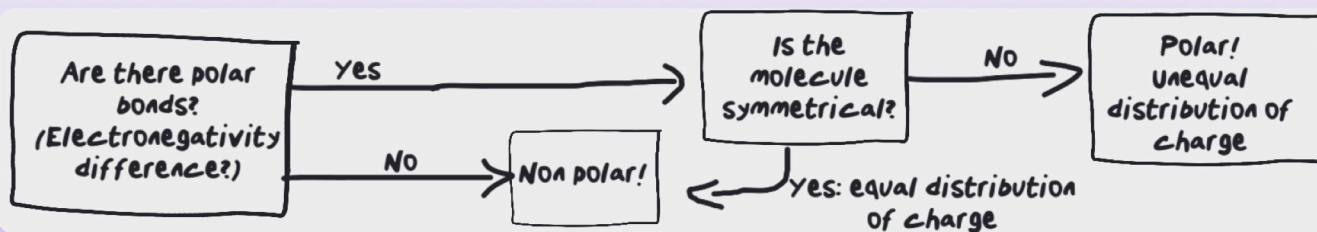
CCl₄

Bond Type _____

Skill 8: Polar and Non Polar MOLECULES:

Molecular Polarity:

Is the _____ molecule Polar or Non Polar? Look at the _____ !



HF	CCl ₄	O ₂
Bond Type _____ Molecular P. _____	Bond Type _____ Molecular P. _____	Bond Type _____ Molecular P. _____

1) In each of the following, circle the bond with the *most* ionic character:

a) C-Cl Na-Cl Cl-Cl

b) C-F N-O Si-F

2) In which compound does the **bond** between the atoms have the *least* ionic character?

1) HF 2) HCl 3) HBr 4) HI

3) Label the following molecules as polar, nonpolar or ionic.

1) HCl _____

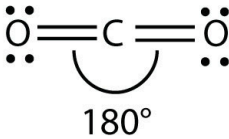
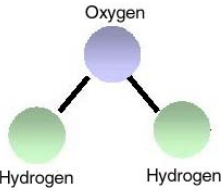
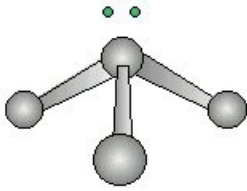
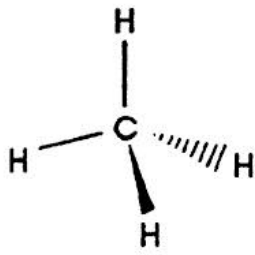
2) NaCl _____

3) CCl₄ _____

4) AlCl₃ _____

Skill 9: Shape of Covalent Molecules

SHAPES OF COVALENT MOLECULES: The shapes most commonly used are LINEAR, BENT, PYRAMID, and TETRAHEDRAL

LINEAR	BENT	PYRAMIDAL	TETRAHEDRAL
 <p>180°</p>	 <p>Oxygen Hydrogen Hydrogen</p>	 <p>Trigonal Pyramidal</p>	

Molecule	Dot Diagram	Structural Formula	Polar/Nonpolar BONDS	Polar/NP Molecule	Shape	Simulation confirmed?
HCl						
HF						
H ₂ O						
CH ₄						
NH ₃						
CCl ₄						

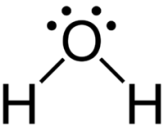
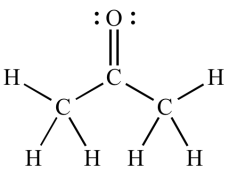
Skill 10: Identify and distinguish between intermolecular forces

CLAIM: Molecules that are more strongly attracted to other molecules will have...

- 1) _____ boiling points (In relation to size)
- 2) _____ evaporation rate
- 3) _____ surface tension
- 4) _____ molecular structure

...because the molecules are harder to separate-- it takes more energy!

EVIDENCE:

Compound	# of Drops on Penny (Indicate Most)	Rate of Evaporation (Fast or Slow)	Boiling Point (°C) Indicate higher /lower	Molecular Polarity (P/NP)	Type of IMF
Water 			100°C		
Acetone 			57°C		

_____ Forces: **Forces of attraction between molecules!**

Hydrogen "Bonding":

Strength:

Dipole-Dipole:

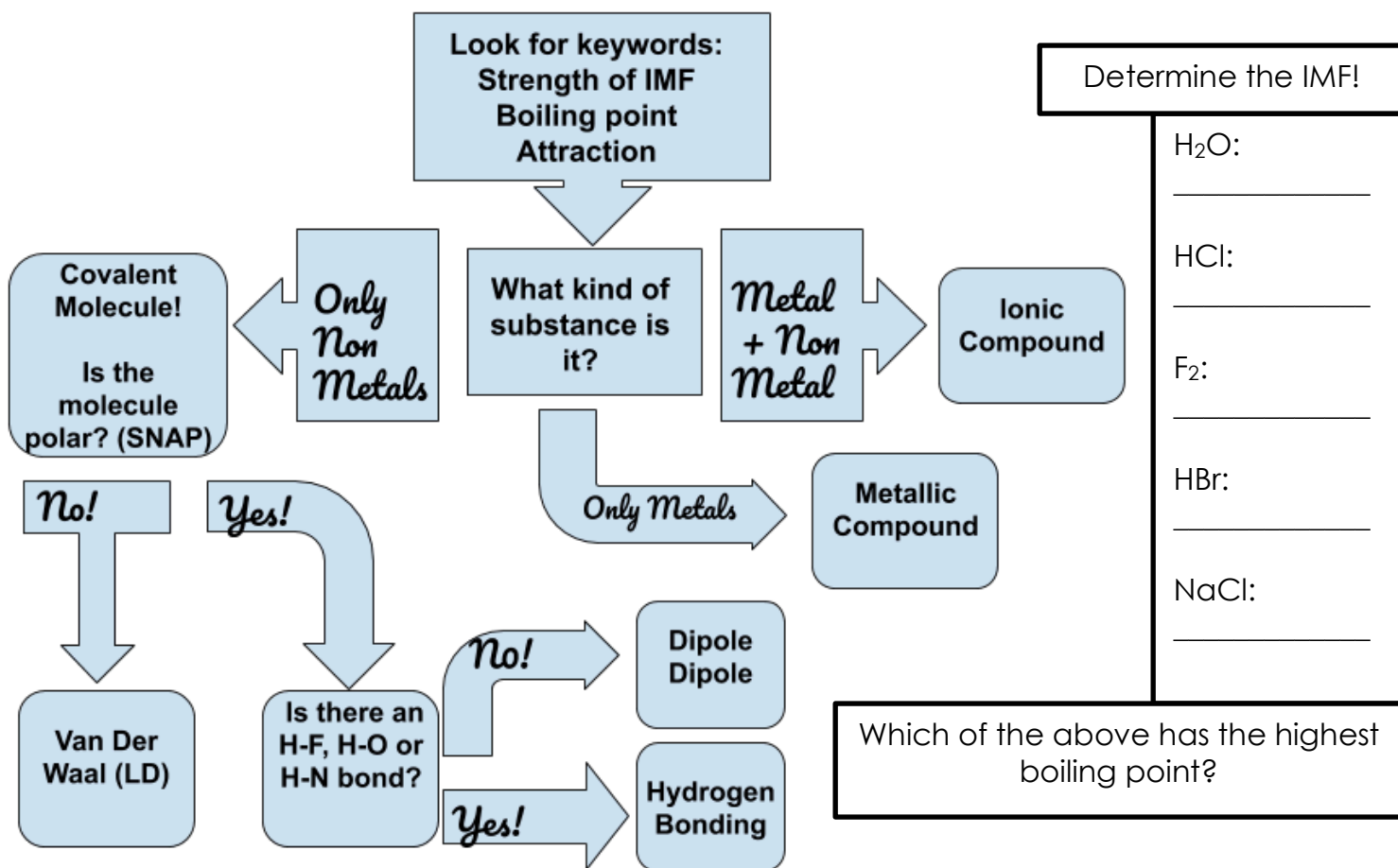
Strength:

London Dispersion

(Van der Waal Force)

Strength:

LET'S PICK AN IMF!



(Note: Ionic + Metallic Bonds are separate types of attraction and are stronger than the Hydrogen, Dipole or LD IMFs)

REASONING: Select and Complete!

_____ (Water/Acetone) has the strongest intermolecular force of attraction called _____ and therefore has the following properties...

Two pieces of evidence here!

...which demonstrates that it's molecules are _____ (**easier/harder**) to separate, because they are more _____ (**weakly/strongly**) attracted!

TEACHER
Check!