

Top 10 Concept #2: Ionic versus Covalent

Ionic compounds form bulk crystals
Covalent compounds form molecules



1. K_2O and CaO are two metal oxides that are very insoluble in water.

a. How might the melting points compare between the two salts?
 \uparrow Coulombic $K_2O < CaO$ Smaller inter nuclear dist.

b. How might the melting point of Na_2O compare relative to the previous two? (list in order of lowest to highest)
 $K_2O < Na_2O < CaO$ \uparrow Coulombic

2. Below are two models attempting to show the bonding of CaO

a. Which of these is the best model? Why?
 b. Which of the symbols is Ca^{2+} and why?
 c. Other than the term "ionic" what word might describe the force holding together this substance?

Bigger 3 energy levels O^{2-} - 2 energy levels
 Coulombic attraction

3. $NaNO_3$

a. This substance is both ionic and covalent... Justify or nullify this statement.
 $Na^+ NO_3^-$ $O=N-O$

b. When dissolving both ionic and covalent bonds are breaking. Justify or nullify.
 nullify. $NaNO_3 \rightarrow Na^+ + NO_3^-$

c. Draw a beaker of this substance dissolved. Show it relative to the water molecule.

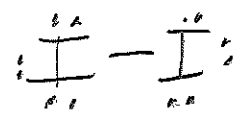
d. Label the location and type of bond in the model.
 ion-dipole

4. I_2 or elemental iodine is solid at room temperature but when heated vaporizes.

a. Substance is covalent, justify or nullify.
 Two non-metals

b. When vaporized covalent bonds are broken, justify or nullify.
 Only LDF

c. Create a Lewis dot structure for this substance.

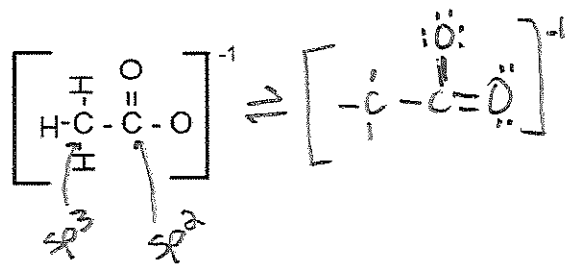


5. In the following substances complete the following

Name	Lewis structure	Electronic shape	Molecular shape	hybridization
XeCl ₂ 1 1 8 14 22		Trigonal Bipyramidal	Linear	sp ³ d
NH ₃		Tetrahedral	Trigonal Pyramidal	sp ³
NH ₄ ⁺		Tetrahedral	Tetrahedral	sp ³
CO ₃ ²⁻ 1 1 4 3(6) 18 22-2=24	2 more Resonance 	Trigonal Planar	Trigonal Planar	sp ²
SF ₆		Octahedral square bipyramidal		sp ³ d ²
PF ₅ 1 1 5 35=40		Trigonal Bipyramidal	Trigonal Bipyramidal	sp ³ d
H ₃ O ⁺		Tetrahedral	Trigonal Pyramidal	sp ³

6. The acetate ion structure is listed below.

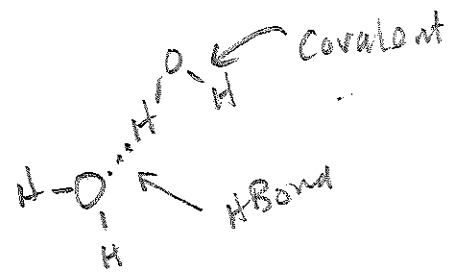
- Draw the resonance structure.
- For each carbon center, list the hybridization.



7. How do the two O-C/O=C bonds compare in length?

Same
1/2 Bond length

(#3-4) Intermolecular forces.



8. Water is a substance known to contain hydrogen bonding.
 a. Draw out two water molecules and label the intermolecular and intramolecular forces.

- b. What characteristics of water give it the ability to hydrogen bond? *Dipole moment*
 9. Student hypothesis: CO₂ has a highly electronegative atom therefore will be polar. It does not have a hydrogen, so it will be having dipole-dipole interaction with in the CO₂ molecules. Justify or nullify all aspects of this reaction. *Long answers? Electroneg diff / not symmetrize*

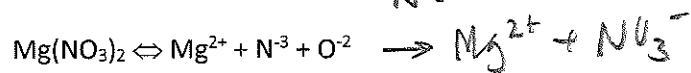
10. Iodine is a solid and fluorine is a gas at room temperature because Iodine is more massive. Justify or nullify this statement. *Linear = Symmetrical = Non polar*
More e⁻ → more LDF

11. List the factors that might cause a substance to have greater London dispersion forces.

- a. *↑ #e⁻*
 b. *↑ chain length*

12. Justify or nullify the following questions relative to Mg(NO₃)₂

- a. Magnesium and the nitrate are sharing 2 pairs of electrons. *NO - Ionic*
 b. This substance is heated to a very high temperature breaking it into Mg, N and O atoms. The bond that was broken in this process was ionic. *NO, Both Ionic & Covalent*
 c. When this substance is dissolved it can be modeled as follows. *NO*



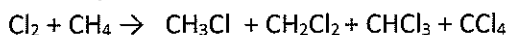
- d. Mg(NO₃)₂ can only conduct electricity when it dissolves in water, otherwise it is a non-conductor as a solid. *yes, Free moving charges = conductor.*

13. When a diamond is melted a temperature of over 4000 C. Why is such a high temperature needed? *Break covalent bonds*

14. An ice cube is placed in your hand, the warmth of you hand causes the ice to melt.

- a. Does the ice get colder, warmer, same as the ice melts? *assuming it is at 32 F*
Solid 32 F → liquid 32 F
 b. No London dispersion forces are broken/disrupted in this process? Justify/nullify. *EVERYTHING HAS LDF*

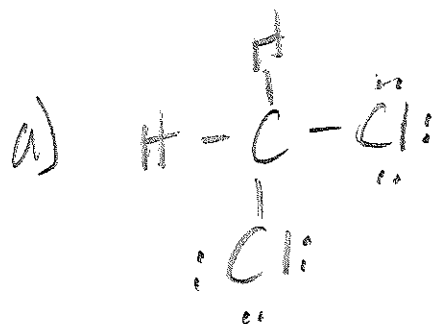
15. Dichloromethane(DCM) is a common liquid solvent used for extraction of caffeine from coffee and tea. The following reaction is used to make DCM makes a variety of products. Which are then separated via distillation.



a. Draw a Lewis structure of DCM

b. All of these substances are liquid, what force is producing this effect?

c. Which substance ^{Produced} will have the lowest boiling point?



b). $\frac{\text{CH}_3\text{Cl} / \text{CH}_2\text{Cl}_2 / \text{CHCl}_3}{\text{LDF} \rightarrow \text{Dipole-Dipole}}$
Small

$\frac{\text{CCl}_4}{\text{LDF}}$

c) CH_3Cl
↓ LDF
↓ Dipole-Dipole

Symmetrical

↑
No dipole
dipole