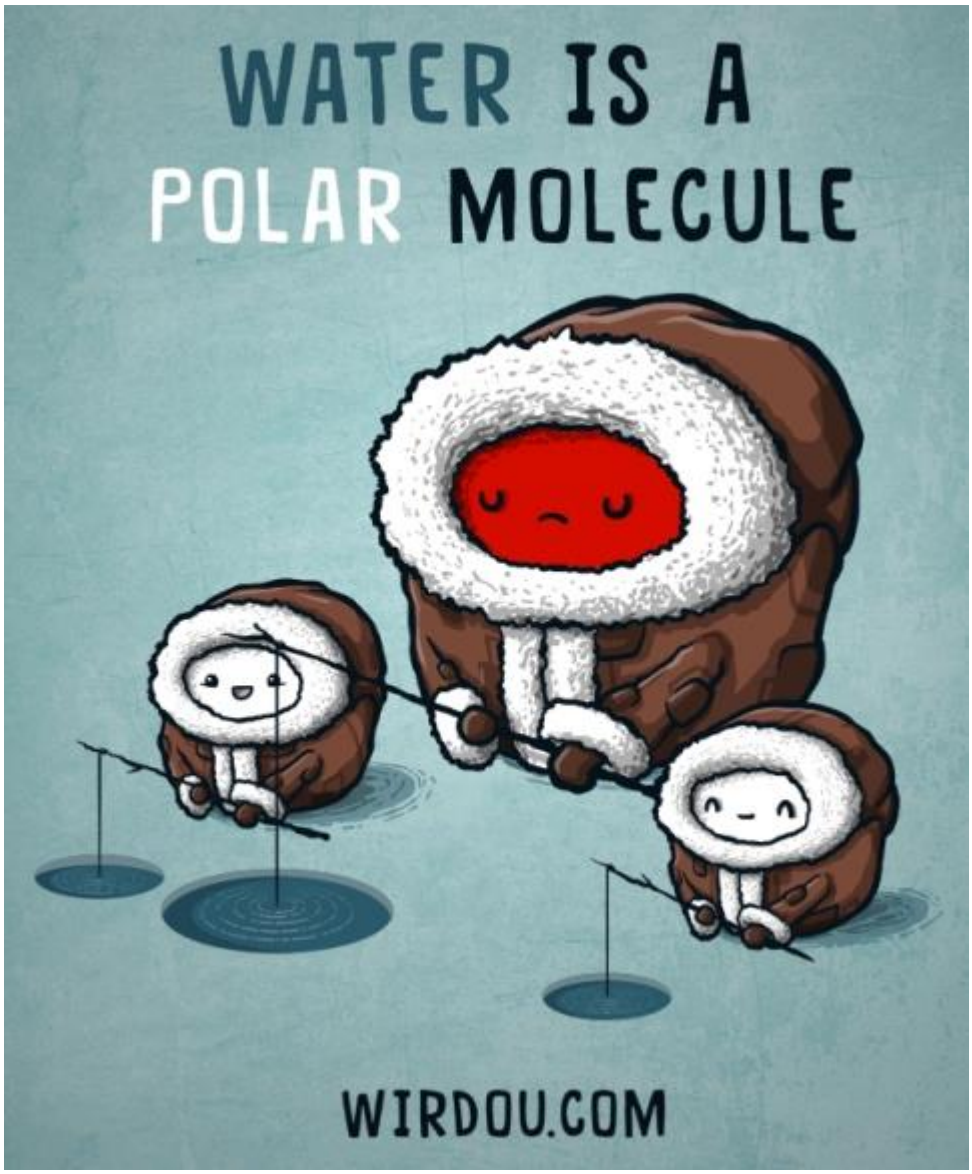
UNIT 6: Bonding
PRACTICE PACKET



Key Ideas

- ✓ Compounds can be differentiated by their chemical and physical properties. (3.1dd)
- ✓ Two major categories of compounds are ionic and molecular (covalent) compounds. (5.2g)
- ✓ Chemical bonds are formed when valence electrons are transferred from one atom to another (ionic), shared between atoms (covalent), mobile within a metal (metallic). (5.2a)
- ✓ In a multiple covalent bond, more than one pair of electrons are shared between two atoms. (5.2e)
- ✓ Molecular polarity can be determined by the shape of the molecule and the distribution of charge. Symmetrical (nonpolar) molecules include CO_2, CH_4, and diatomic elements. Asymmetrical (polar) molecules include HCl, NH_3, and H_2O. (5.2l)
- ✓ When an atom gains one or more electrons, it becomes a negative ion and its radius increases. When an atom loses one or more electrons, it becomes a positive ion and its radius decreases. (5.2c)
- ✓ When a bond is broken, energy is absorbed. When a bond is formed, energy is released. (5.2i)
- ✓ Atoms attain a stable valence electron configuration by bonding with other atoms. Noble gases have stable valence configurations and tend not to bond. (5.2b)
- ✓ Physical properties of substances can be explained in terms of chemical bonds and intermolecular forces. These properties include conductivity, malleability, solubility, hardness, melting point, and boiling point. (5.2n)
- ✓ Electron-dot diagrams (Lewis structures) can represent the valence electron arrangement in elements, compounds, and ions. (5.2d)
- ✓ Electronegativity indicates how strongly an atom of an element attracts electrons in a chemical bond. Electronegativity values are assigned according to arbitrary scales. (5.2j)
- ✓ The electronegativity difference between two bonded atoms is used to assess the degree of polarity in a bond. (5.2k)
- ✓ Metals tend to react with nonmetals to form ionic compounds. Nonmetals tend to react with other nonmetals to form molecular (covalent) compounds. Ionic compounds contain polyatomic ions have both ionic and covalent bonding. (5.2h)

LESSON 6.1: INTRO TO BONDING & TYPES OF BONDS

Objectives:

- *Identify whether a bond is being broken or formed based upon energy being absorbed or released*
- *Distinguish between the three types of bonds and Decide which type of bond is present based upon the atoms involved*
- *Classify a substance as Ionic, Covalent or Metallic based upon its properties*

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

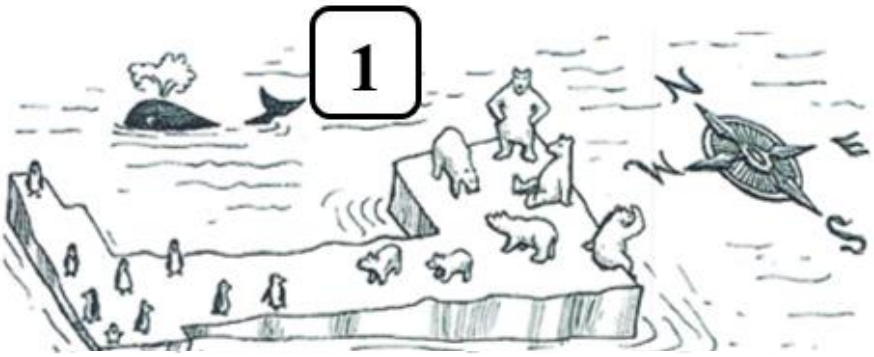
		Bond Breaking	Bond Forming
a.	Stability of the chemical system increases		
b.	Energy is released		
c.	$Cl + Cl \rightarrow Cl_2$		
d.	exothermic		
e.	endothermic		
f.	$N_2 \rightarrow N+N$		
g.	Energy is absorbed		
h.	Stability of the chemical system decreases		

TYPES OF BONDS

When an atom is unstable (has a valence shell that is not full), it will form a bond with another unstable atom. To form a bond, atoms must either share their valence electrons or transfer electrons from one atom to another. By doing so, each atom ends up with a full valence shell and becomes stable.

Why do atoms form chemical bonds?

The Periodic Table shows a general trend in electronegativity of the elements. Electronegativity is the ability of an atom to attract electrons. Electronegativity tends to rise as you move "northeast" on the periodic table, and fall as you move "southwest".



Why do you think the artist chose to represent the electronegativity of nonmetals with polar bears and metals with penguins?

2

The type of bond formed between atoms is based upon the electronegativity difference between those atoms. If the electronegativity difference is very big, like between Na and Cl, the metal will give away its valence electron(s) to the nonmetal and an ionic bond will form.

-What types of elements (Na and Cl) are involved in ionic bonding?

-How does an ionic bond form (what do the electrons do)?

-How does this cartoon accurately represent an ionic bond?

3

When two atoms bond and the electronegativity difference is not very big, the atoms are happy to share valence electrons. Sharing electrons is called covalent bonding. However, these electrons are not shared evenly! The shared electrons will spend more time near the more electronegative atom. This is called a polar covalent bond.

-What types of elements (H and Cl) are involved in polar covalent bonding?

-How does a polar covalent bond form (what do the electrons do)?

-How does this cartoon accurately represent a polar covalent bond?

4

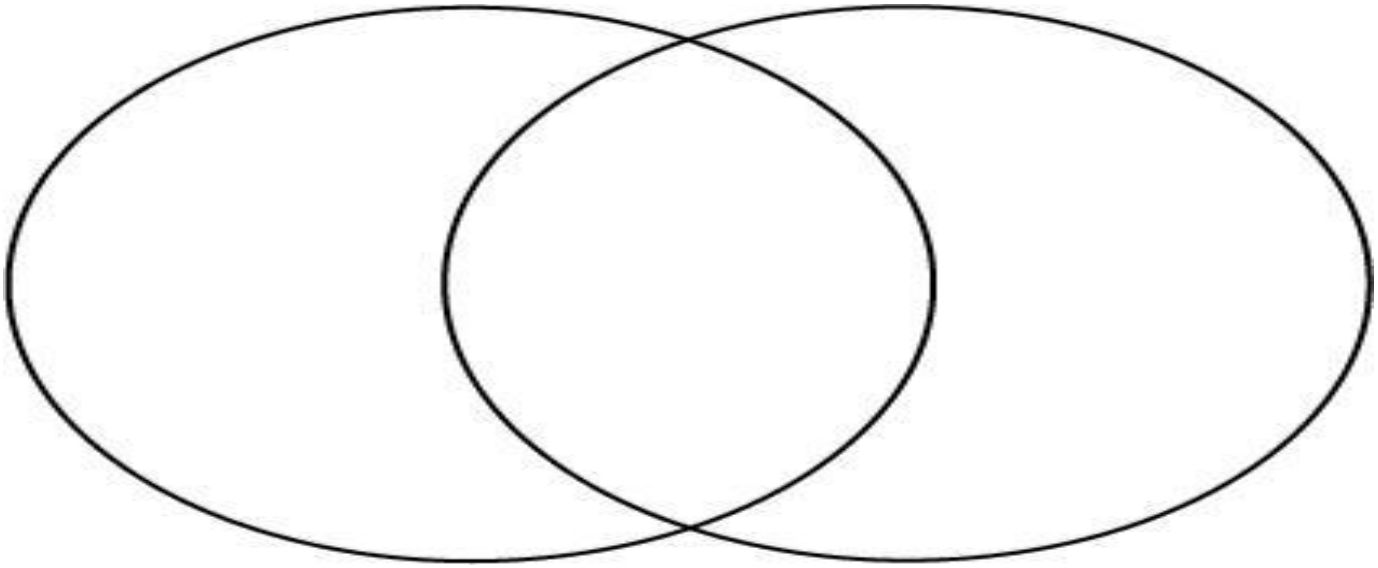
When two atoms bond and there is no electronegativity difference between them, they are able to share their valence electrons equally. This is called a nonpolar covalent bond.

-What types of elements are involved in nonpolar covalent bonding?

-How does a nonpolar covalent bond form (what do the electrons do)?

-How does this cartoon accurately represent a nonpolar covalent bond?

Complete the Venn diagram below with properties of ionic and Covalent Bonds:



Ionic Bonds **Covalent**

Bonds formed between two nonmetals are _____ and involve the _____ of electrons.

Bonds formed between two atoms of the same metal involve a sea of _____ electrons.

Bonds formed between metals and nonmetals are _____ and involve the _____ of electrons.

Describe the following as ionic, metallic, or covalent (molecular):

NaCl	____	Al	____	Lithium	____
CO_2	____	$C_6H_{12}O_6$	____	Strontium bromide	____
Au	____	Ti	____	Tin (II) chloride	____
$MgBr_2$	____	K_2O	____	Nitrogen (IV) oxide	____
Fe	____	CH_4	____	Hydrogen selenide	____
H_2O	____	H_2S	____	Copper (II) phosphate	____
$Ca_3(PO_4)_2$	____	PI_3	____	Lead (IV) nitrate	____

REGENTS PRACTICE

1. Which statement describes the energy changes that occur as bonds are broken and formed during a chemical reaction?
   A) Energy is absorbed when bonds are both broken and formed.
   B) Energy is released when bonds are both broken and formed.
   C) Energy is absorbed when bonds are broken, and energy is released when bonds are formed.
   D) Energy is released when bonds are broken, and energy is absorbed when bonds are formed.

2. Given the equation representing a reaction:
   $H + H \rightarrow H_2$
   Which statement describes the energy change in this reaction?
   A) A bond is broken as energy is absorbed.
   B) A bond is broken as energy is released.
   C) A bond is formed as energy is absorbed.
   D) A bond is formed as energy is released.

3. The bonds in BaO are best described as
   A) covalent, because valence electrons are shared
   B) covalent, because valence electrons are transferred
   C) ionic, because valence electrons are shared
   D) ionic, because valence electrons are transferred

4. A solid substance was tested in the laboratory. The test results are listed below.
   - dissolves in water
   - is an electrolyte
   - melts at a high temperature

   Based on these results, the solid substance could be
   A) Cu B) $CuBr_2$
   C) C D) $C_6H_{12}O_6$

5. Which terms describe a substance that has a low melting point and poor electrical conductivity?
   A) covalent and metallic
   B) covalent and molecular
   C) ionic and molecular
   D) ionic and metallic

6. A solid substance is an excellent conductor of electricity. The chemical bonds in this substance are most likely
   A) ionic, because the valence electrons are shared between atoms
   B) ionic, because the valence electrons are mobile
   C) metallic, because the valence electrons are stationary
   D) metallic, because the valence electrons are mobile

ASSESS YOURSELF ON THIS LESSON:

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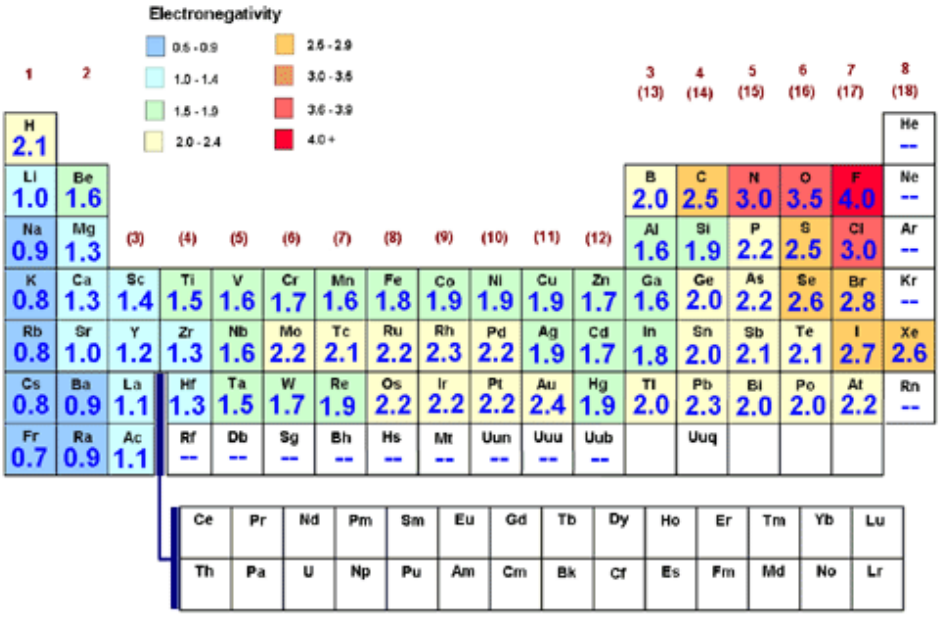
Bond Types (more practice)

Ionic Bond	between a Metal and Non-Metal	(M + NM)
Covalent Bond	between a Non-Metal and Non-Metal	(NM + NM)
Metallic Bond	between a Metal and Metal	(M+ M)

Determine if the elements in the following compounds are metals or non-metals. Describe the type of bonding that occurs in the compound.

Compound	**Element 1 (metal or non-metal?)**	**Element 2 (metal or non-metal?)**	**Bond Type**
NO_2	N = non-metal	O = non-metal	covalent
NaCl			
SO_2			
PO_4^{3-}			
$MgBr_2$			
CaO			
H_2O			
K_2O			
Cu-Zn alloy			
O_2			
$CuCl_2$			
NO_2^-			
TiO_2			
HF			
Rb_2S			
Au-Ag mixture			
Fe_2O_3			
$C_6H_{12}O_{22}$			



Difference in electronegativity

4.0		1.7		.4		0
Ionic		**Polar-covalent bond**		**Non-polar covalent bond**		
100%		**50%**		**5%**		**0%**

Percentage Ionic character

Bonding between	More electronegative element and value	Less electronegative element and value	Difference in electronegativity	Bond Type
Sulfur and Hydrogen				
Sulfur and cesium				
Chlorine and bromine				
Calcium and chlorine				
Oxygen and hydrogen				
Nitrogen and hydrogen				
Iodine and iodine				
Copper and sulfur				
Hydrogen and fluorine				
Carbon and oxygen				

LESSON 6.2: Bond Polarity

Objective:

- *Assess compounds and identify the presence polyatomic ions*
- *Describe the type of bonds present in a polyatomic ion*

1. Electronegativity values generally _____ down a group and _____ across a period.
2. Metals tend to have _____ electronegativity values and nonmetals are _____ values.

Fill in the table below determining if the substance is ionic or covalent. If it is covalent then determine the electronegativity difference to identify if the covalent bond is polar or nonpolar.

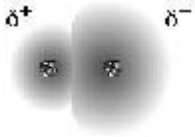
Substance	Ionic	Covalent		
		Electronegativity Difference	Polar	Non Polar
1. I_2				
2. PCl_3				
3. SiO_2				
4. Br_2				
5. CO_2				
6. NaCl				
7. CH_4				
8. N_2O_5				
9. NH_3				
10. KCl				

11. Indicate which atom will have the positive charge and which will have the negative charge in the following polar bonds:

H-Cl H-F S-F N-O

12. Organize the following in order from least to most polar bonds: HCl, HF, H_2O, NH_3, HI

13. Identify and explain each bond drawn below:

	Type of Bond	**Explanation**
		
		
		

For each statement check if it describes ionic, polar covalent, nonpolar covalent, or metallic bonds:

	Ionic	Polar Covalent	Nonpolar Covalent	Metallic
15. A transfer of electrons between two atoms				
16. Positive nuclei dispersed in a sea of mobile electrons				
17. Metals and nonmetals bonding				
18. One atom loses, and another atom gains electrons				
19. Two atoms share electrons equally				
20. Metals bonding only				
21. Electronegativity differences under 0.4				
22. A bond resulting from electrostatic charges between opposite charged particles				
23. Two atoms share electrons unequally				
24. Nonmetals bonding only				
25. Electronegativity differences over 0.4 and between 2 Non metals				

REGENTS PRACTICE

1. The *least* polar bond is found in a molecule of

   A) HI B) HF C) HCl D) HBr

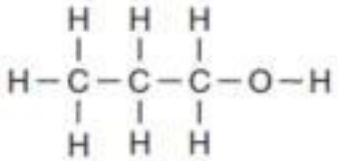
2. Which bond is most polar?

   A) C–O B) H–O C) N–O D) S–O

3. Which pair of atoms has the most polar bond?

   A) H – Br B) H – Cl
   C) I – Br D) I – Cl

4. Given the formula:



   The bond between which two atoms has the greatest degree of polarity?

   A) C and C B) C and O
   C) H and C D) H and O

5. The degree of polarity of a chemical bond in a molecule of a compound can be predicted by determining the difference in the

   A) melting points of the elements in the compound
   B) densities of the elements in the compound
   C) electronegativities of the bonded atoms in a molecule of the compound
   D) atomic masses of the bonded atoms in a molecule of the compound

6. The bonds between hydrogen and oxygen in a water molecule are classified as

   A) polar covalent B) nonpolar covalent
   C) ionic D) metallic

7. Which formula represents a nonpolar molecule?

   A) CH_4 B) HCl C) H_2O D) NH_3

8. Which type of bond exists between an atom of carbon and an atom of fluorine?

   A) ionic B) metallic
   C) polar covalent D) nonpolar covalent

ASSESS YOURSELF ON THIS LESSON:

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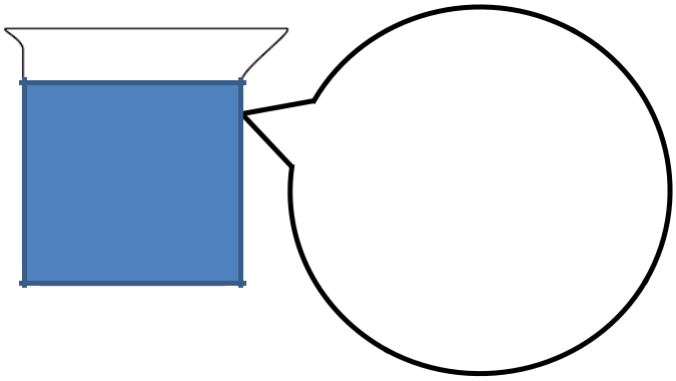
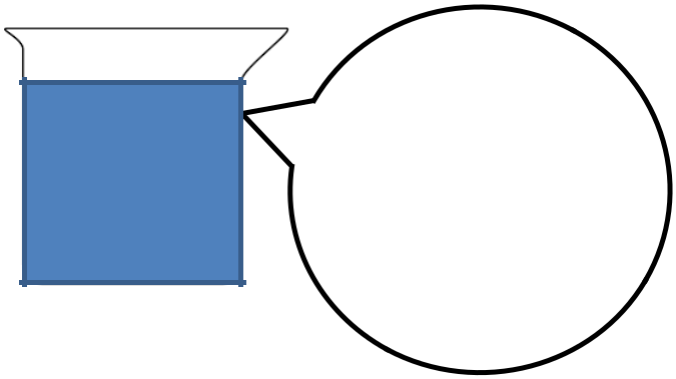
PROPERTIES OF BONDS REVIEW:

1. Imagine you shrunk yourself down to the size of a molecule and were placed inside a beaker of water. Draw what you would see <u>after you dissolved NaCl in the water</u>.



2. Why does $NaCl_{(aq)}$ conduct electricity but $NaCl_{(s)}$ does not?

3. Imagine you shrunk yourself down to the size of a molecule and were placed inside a beaker of water. Draw what you would see <u>after you dissolved $C_6H_{12}O_6$ in</u> the water.



4. Why doesn't $C_6H_{12}O_{6\,(aq)}$ conduct electricity?

5. **Indicate which type of substance is described by each statement.**

		Type of substance
a.	Can conduct electricity in the solid and liquid phases	
b.	A soft substance whose atoms are held together by covalent bonds	
c.	Low melting point and poor electrical conductor	
d.	Can conduct electricity when aqueous or molten (liquid)	
e.	Can be polar or nonpolar	
f.	Can dissolve in water to produce mobile ions	

6. Explain the following in terms of charged particles:

a. liquid mercury is a good electrical conductor

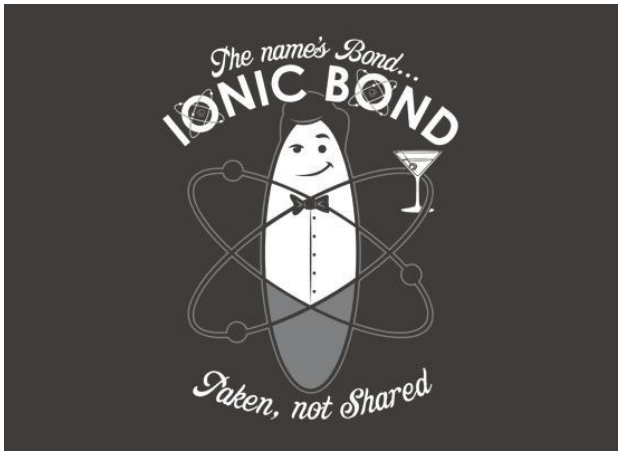
b. molten NaCl conducts electricity while solid NaCl does not

c. an aqueous solution of KBr conducts electricity while solid KBr does not

d. CH_4 is a poor electrical conductor

How do you rate your understanding so far?

4	I "get" it.
3	I am almost there
2	I need help
1	I need lots of help



LESSON 6.3: Lewis Diagrams for IONIC Compounds

Objective:

- ***Construct Lewis dot diagrams for covalent compounds***

Lewis Diagrams Review:

Element	Metal or Nonmetal	Lewis Dot Structure as an ATOM	Gain or lose electrons?	How many e-	Lewis Dot Structure of Stable ION	Becomes like which noble gas?
Lithium						
Aluminum						
Radium						
Fluorine						
Sulfur						
Phosphorous						

Recall that ***all compounds are neutral so the total charge must equal zero***. Using your chart, draw Lewis structures for the following compounds:

Lithium Fluoride	Lithium Sulfide	Lithium Phosphide
Aluminum Fluoride	Aluminum Sulfide	Aluminum Phosphide
Radium Fluoride	Radium Sulfide	Radium Phosphide

✓ Why do the metals bond with nonmetals?

✓ What determines how many atoms of the metal and nonmetal will combine to form the compound?

Complete the table below (electron dot diagrams for ions)

	Ion	Electron-dot Diagram	Electron Configuration		Ion	Electron-dot structure	Electron Configuration
a.	sodium Na^+			c.	oxide O^{2}		
b.	aluminum Al^{3+}			d.	bromide Br		

2. How many valence electrons do **<u>cations</u>** show in the Lewis dot diagrams?

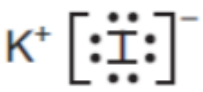
3. How many valence electrons do **<u>anions</u>** show in the Lewis dot diagrams?

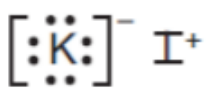
Draw the following LEWIS DOT DIAGRAMS for ionic compounds and give their formula and/or name:

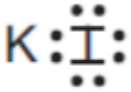
Lewis Diagram	Formula	Lewis Diagram	Name
Sodium fluoride		CsCl	
Potassium oxide		MgO	
Rubidium nitride		SrI_2	
Calcium bromide		BaS	
Strontium sulfide		Fe_2O_3	
Aluminum iodide		CuO	
Copper (I) sulfide		$NiCl_3$	

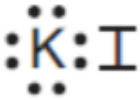
REGENTS PRACTICE

1. Which Lewis electron-dot diagram represents the bonding in potassium iodide?

A) 

B) 

C) 

D) 

2. "Which Lewis electron-dot diagram represents calcium oxide?"

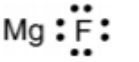
A) 

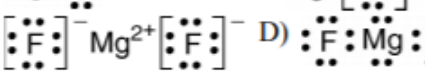
B) 

C) 

D) 

3. What is the correct Lewis electron-dot structure for the compound magnesium fluoride?

A) 

B) 

C)

D)

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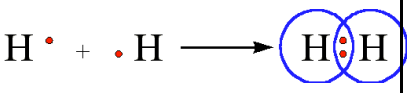
LESSON 6.4: Lewis Diagrams for COVALENT compounds

Objective:

- ***Construct Lewis dot diagrams for covalent compounds***

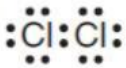
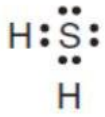
Complete the chart.

Compound	Total valence electrons	Lewis Diagram	Shared pairs of electrons	Unshared pairs of electrons
H_2	*2*		*1*	*0*
F_2				
O_2				
H_2O				
Cl_2				
NH_3				
CO_2				
CH_4				

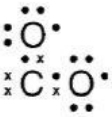
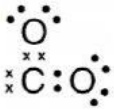
Compound	Total valence electrons	Lewis Diagram	Shared pairs of electrons	Unshared pairs of electrons
CCl_4				
N_2				
HF				
H_2S				

REGENTS PRACTICE

1. Which Lewis electron-dot diagram represents a molecule having a nonpolar covalent bond?

A) 
B) 
C) 
D) 

2. Which Lewis electron-dot diagram is correct for CO_2 ?

A) 
B) 
C) 
D) 

3. Which statement describes a multiple covalent bond?

A) Two electrons are shared.
B) Four electrons are shared.
C) Two electrons are transferred.
D) Four electrons are transferred.

4. How many pairs of electrons are shared between the nitrogen atoms in a molecule of N_2?

A) 5 B) 2 C) 3 D) 6

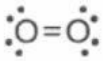
5. What is the total number of electrons shared in a double covalent bond?

A) 1 B) 2 C) 3 D) 4

6. The nitrogen atoms in a molecule of N_2 share a total of

A) one pair of electrons
B) one pair of protons
C) three pairs of electrons
D) three pairs of protons

7. Given a formula for oxygen:



What is the total number of electrons shared between the atoms represented in this formula?

A) 1 B) 2 C) 8 D) 4

ASSESS YOURSELF ON THIS LESSON:

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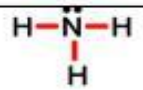
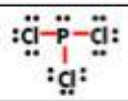
LESSON 6.5: Molecular Polarity

Objective:

Determine the polarity of a molecule

Determine the shape of a molecule

Fill in the chart below.

	Molecule	Distribution of charge? (symmetrical or asymmetrical)	Molecular Polarity (polar or nonpolar molecule)	Molecular Shape (linear, pyramidal, tetrahedral, or bent)	Bond Polarity (polar or nonpolar covalent)
a.					
b.					
c.					
d.					
e.					
f.					
g.					

1. In terms of lone pair electrons, how can you determine if a molecule is polar?

2. What molecular shapes are always polar?

3. What molecular shapes are always nonpolar?

4. How can a molecule be nonpolar if it contains polar bonds?

5. Fill in the chart below

Molecule	Dot Diagram	Distribution of Charge (symmetrical or asymmetrical)	Molecular Polarity (polar or nonpolar molecule)	Molecular Shape (linear, pyramidal, tetrahedral or bent)
CO_2				
CH_4				
NH_3				
H_2O				

REGENTS PRACTICE

1. Which formula represents an asymmetrical molecule?

   A) CH_4 B) CO_2 C) N_2 D) NH_3

2. Which formula represents a polar molecule?

   A) O_2 B) CO_2 C) NH_3 D) CH_4

3. Which phrase describes a molecule of CH_4, in terms of molecular polarity and distribution of charge?

   A) polar with an asymmetrical distribution of charge
   B) polar with a symmetrical distribution of charge
   C) nonpolar with an asymmetrical distribution of charge
   D) nonpolar with a symmetrical distribution of charge

4. Which statement explains why a CO_2 molecule is nonpolar?

   A) Carbon and oxygen are both nonmetals.
   B) Carbon and oxygen have different electronegativities.
   C) The molecule has a symmetrical distribution of charge.
   D) The molecule has an asymmetrical distribution of charge.

5. Which formula represents a nonpolar molecule?

   A) HCl B) H_2O C) NH_3 D) CH_4

ASSESS YOURSELF ON THIS LESSON:

If you missed any regents practice questions you should see me for extra help and/or watch the videos on my website

LESSON 6.7: INTERmolecular Forces (IMFs)

Objective:

Determine the type of intermolecular force that exists between covalent compounds

Fill in the table below:

	London Dispersion Forces	**Dipole-Dipole Forces**	**Hydrogen Bonds** ***only force tested on Regents*
Type of molecule			
Strength			
Example			

In terms of Intermolecular Forces, to explain the following phenomenon:

1. Why does gasoline (C_8H_{18}) remain in the liquid phase but our Bunsen burner gas made out of the same elements (CH_4) remain in the gas phase?

2. Why does dry ice (solid CO_2) sublime (go from a solid directly to a gas) at room temperature but sugar and salt don't even melt?

3. Which substance has the strongest intermolecular forces of attraction and which has the weakest?

	Molar mass	**Boiling Point (˚C)**
H_2O	18.0	100
H_2S	34.1	-62
H_2Se	81.0	-42
H_2Te	129.6	-2

4. In terms of intermolecular forces, why does water have the highest boiling point in the table above?

5. Which substance has the strongest intermolecular forces of attraction and which has the weakest?

	Molar mass	**Boiling Point (°C)**
HF	20.0	19
HCl	36.5	-84
HBr	80.9	-67
HI	12.9	-35

6. Why does HF have the highest boiling point in the table above?

7. Surface tension is a result of strong intermolecular forces. Which of the compounds in question 4 has the strongest surface tension?

8. Which of the following will have the higher boiling point? Explain your answer using intermolecular forces. NH_3 or N_2

REGENTS PRACTICE

1. Argon has a higher boiling point than neon because argon has

   A) fewer electrons in its 2nd principal energy level
   B) more electrons in its outermost principal energy level
   C) weaker intermolecular forces of attraction
   D) stronger intermolecular forces of attraction

2. The abnormally high boiling point of HF as compared to HCl is primarily due to intermolecular forces of attraction called

   A) network bonds
   B) electrovalent forces
   C) van der Waals forces
   D) hydrogen bonds

3. Which statement explains why H_2O has a higher boiling point than N_2?

   A) H_2O has greater molar mass than N_2.
   B) H_2O has less molar mass than N_2.
   C) H_2O has stronger intermolecular forces then N_2.
   D) H_2O has weaker intermolecular forces than N_2.

4. The table below shows the normal boiling point of four compounds.

Compound	Normal Boiling Point (°C)
$HF(\ell)$	19.4
$CH_3Cl(\ell)$	–24.2
$CH_3F(\ell)$	–78.6
$HCl(\ell)$	–83.7

   Which compound has the strongest intermolecular forces?

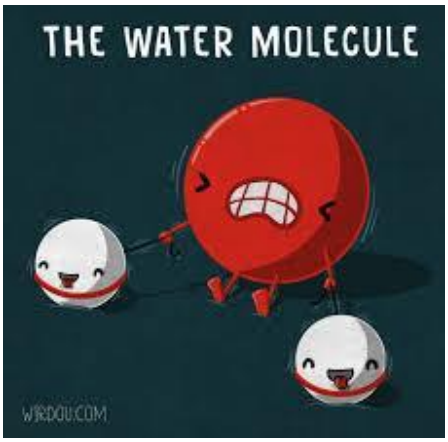
   A) $HF(\ell)$ B) $CH_3Cl(\ell)$
   C) $CH_3F(\ell)$ D) $HCl(\ell)$

5. Based on intermolecular forces, which of these substances would have the highest boiling point?

   A) He B) O_2 C) CH_4 D) NH_3

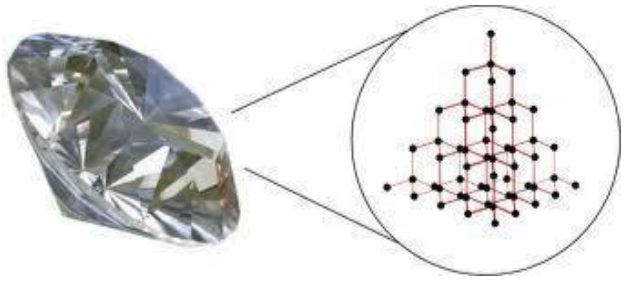
ASSESS YOURSELF ON THIS LESSON:

If you missed any regents practice questions you should see me for extra help and/or re-watch the lesson video assignment

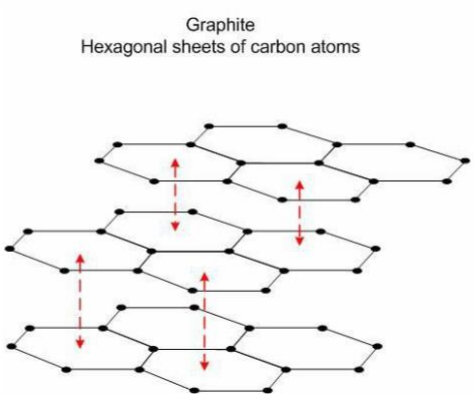


READING: NETWORK SOLIDS

The best example of a network solid is a "diamond". Look at the model of a diamond below. Note that the carbon atoms are bonded together with **covalent bonds**. The basic building unit is an **atom** of carbon. The structure has a very definite tetrahedral crystal shape, because these atoms are arranged and **held rigidly in a fixed pattern**. A diamond is very hard (a "10" on the Moh's Scale of Hardness…the highest value possible). In order to scratch a diamond, you must break 1000's of very strong covalent bonds! Similarly, to melt (or boil) a network solid, like a diamond, you must break 1000's of these covalent bonds. This involves considerable energy and is the reason for their high melting points. It is because of these high temperatures and their hardness that network solids are frequently used in industry as "abrasives" (on sandpaper and on the tips of drills for cutting tools). You don't have to worry about them melting if it gets too hot from friction or being scratched and dulled when contacting most other surfaces. Network solids have the type of properties you would expect from atoms being held together via strong covalent bonds, e.g. diamonds. They have very high melting points and are practically insoluble; are mostly nonconductors (no free electrons or ions); and they are very brittle (atoms must maintain a fixed crystal structure, if they are pushed too close together …. they repel).



Graphite is also shown below. Note that it is also pure carbon, like a diamond. However, the covalent bonds only attach carbon atoms in 2 directions, not 3 like diamonds. The **dashed lines** between the layers of covalently bonded carbon atoms represent weak **Van der Waal forces**. Graphite is a 2 dimensional network solid. The strong covalent bonds only go in "plates", in 2 directions. The "plates" are connected via weak VDW forces. Graphite STILL has a high melting point. – You must weaken/break all of its bonds (VDW and Covalent) to melt it. But since the weaker VDW forces are present and break easily, graphite is often used as a "dry lubricant". If you squirt graphite dust into a lock, it will lodge between the lock's moving metallic parts. When you put in a key and turn, the graphite structure will break apart between its "plates." VDW's break and make it turn more easily. Graphite also has free, "delocalized" electrons (it is a resonant structure… there really are no double bonds present, but free electrons) thus…graphite is a network solid that is capable of conducting electricity. This is not characteristic of most network solids. Of course, pencil lead is graphite. What bonds break when you write??? Silicon bonds like carbon to form a network structure. The computer industry depends on "silicon chips," which are made conductive by placing impurities in their structure. These then provide for free electrons and allow the chip to do its job. But, pure silicon does not conduct.



Many network solids are composed of various combinations of relatively few elements on the periodic table.

The elements B, C, Al, Si are found in many network solids. They can be pure or combine with one another or

combine with elements near them. For example, SiO_2, quartz is an example of a network solid. Corundum,

Al_2O_3, is a network and a common abrasive used on "sandpaper". Many gemstones, like diamond, are network

solids. Emerald is made of the mineral "beryl". Its formula is $Be3Al_2$ (Si_6O_{18}). Ruby is a form of corundum.

1. What is a Network solid? Give an example

2. What are some physical properties of Network solids?