Name KEY Per_____

Unit 5 (Bonding) STUDY GUIDE

make sure to get help w/ these if you need it

LEARNING TARGET CHECKLIST

Check yourself against this unit's key learning targets.

	Learning Target	YES. Got it.	Needs Review	NOPE. Not yet.
1	I can identify whether energy is required or released when bonds are broken or formed.			
2	I can identify whether a compound contains ionic or covalent bonds (or both).			
3	I can draw Lewis electron-dot diagrams for atoms, ions, and compounds (both ionic and molecular/covalent).			
4	I can name and write the correct chemical formulas for ionic compounds made from elements from the Periodic Table and/or polyatomic ions from Table E.			
5	I can determine whether a bond between two atoms is polar or nonpolar, using electronegativity differences.			
6	I can identify the 7 diatomic elements.			
7	I can determine whether a molecule is polar or nonpolar using symmetry.			
8	I can identify and describe the three types of intermolecular forces.			
9	I can determine the type of intermolecular forces present in a given molecule.			
10	I can compare the physical and chemical properties of ionic, covalent, and metallic substances.			
11	I can explain why metals and ionic compounds (in solution or liquid form) conduct electricity.			

Vocabulary

All the vocab words on page 2 of your Unit packet should be filled in besides the following five. See if you can match each word to the correct definition.

1. ___C___ conductivity
2. ___e___ polar molecule
3. ___a___ nonpolar molecule
4. ___b___ intermolecular forces
5. ___d___ hydrogen bonding

Definitions

a. a symmetrical covalent molecule
b. weak forces/attractions between molecules that hold them together
c. electrical current will flow through when **mobile charged particles** are present
d. attraction between partial positive hydrogen in one polar molecule to a F, O, or N of another molecule
e. an asymmetrical covalent molecule

Have Miss Virga check off on your vocab matches here: _____ Transfer them into page 2 (optional)

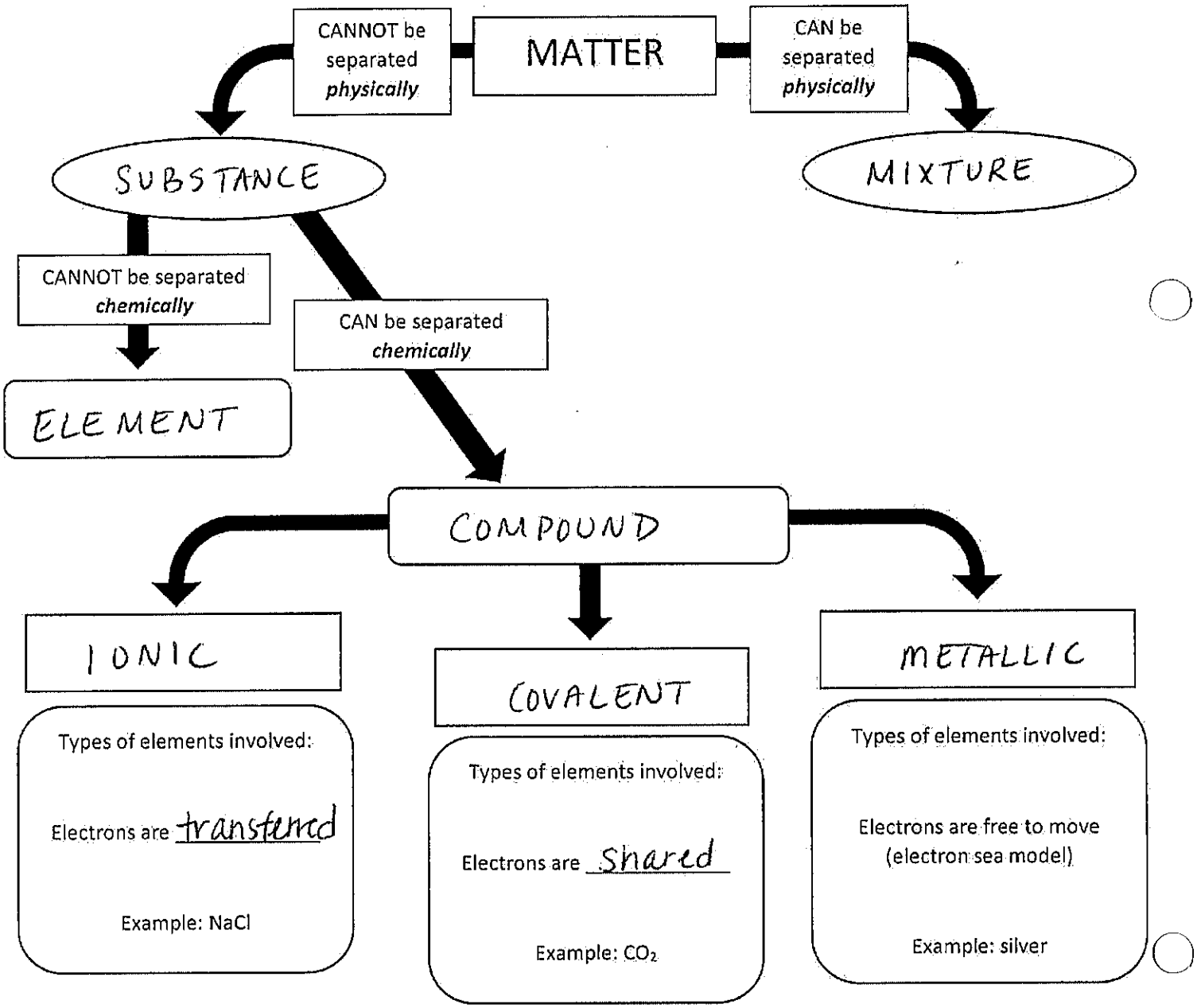
ENERGY & TYPES OF CHEMICAL BONDS

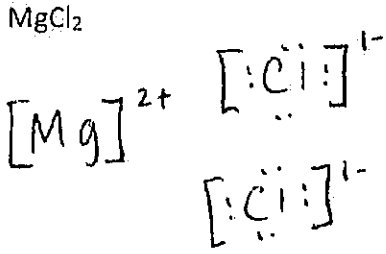
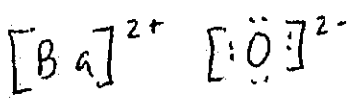
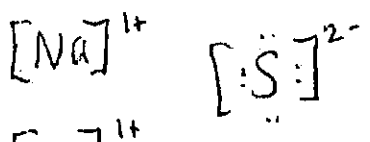
Chemical bonds form to increase **stability** of atoms.

1. In terms of valence electrons, what does it mean to be "stable" for an atom? 8 val. e⁻ (or 2 for H)
2. What happens to energy when chemical bonds are **formed** (think when two hands clap together)?

   Released OR Absorbed
3. What happens to energy when chemical bonds are **broken** (think when two hands need to be pulled apart)?

   Released OR Absorbed
4. Fill in the graphic organizer below. Word choices: substance, mixture, element, compound, ionic, covalent, metallic, ionic, transferred, shared.



	FORMULAS	NAMING	STRUCTURES
TIPS OF THE TRADE	1. The overall charge of the ions **MUST CANCEL OUT** (equal zero) 2. Use the criss cross method! STEP 1 → Write the element symbol for each element. Include its charge in the upper right hand corner (given on the Periodic Table or Table E). STEP 2 → "Criss cross" the *numbers*, and voila, you've got an ionic formula. Just reduce and simplify whenever possible.	1. Write the **positively** charged ion first (get name from P.T. or Table E). 2. Write the **negatively** charged ion second (get name from P.T. **BUT REPLACE ENDING WITH "IDE"** or get name from Table E). ***PERFORM THIS CHECK →*** *If the metal ion has **more than one charge**, include ROMAN NUMERALS!!!!*	1. Start with the chemical formula!! This will help determine the number of ions you need to draw. 2. Get charge of each ion from P.T. (upper right hand corner). 3. **IF THE ION IS POSITIVE → NO DOTS SHOWN** 4. **IF THE ION IS NEGATIVE → 8 DOTS SHOWN** 5. Double check to make sure you've drawn enough ions.
NOW YOU TRY!	Write formulas for: 1. sodium and phosphorous Na^{+1} P^{3-} Na_3P 2. magnesium and chlorine Mg^{2+} Cl^{1-} $MgCl_2$ 3. aluminum and oxygen Al^{+3} O^{-2} Al_2O_3 4. calcium and hydroxide Ca^{+2} OH^{-1} $Ca(OH)_2$ 5. lithium and sulfite Li^{+1} SO_3^{2-} $Li_2(SO_3)$ 6. potassium and nitrate K^{1+} NO_3^{1-} $K(NO_3)$	Name the following: NH_4Cl ammonium chloride $Fe(NO_3)_3$ iron (III) nitrate $TiBr_3$ titanium (III) bromide Cu_3P copper (I) phosphide $SnSe_2$ tin (IV) selenide $Pb(SO_4)_2$ lead (IV) sulfate $Mn_2^{+6}(SO_3^{-2})_3$ manganese (III) sulfite Write the formulas for the following: chromium (VI) phosphate $Cr(PO_4)_2$ Cr^{6+} PO_4^{3-} vanadium (IV) carbonate $V(CO_3)_2$ V^{4+} CO_3^{2-} tin (II) nitrite $Sn(NO_2)_2$ Sn^{+2} NO_2^{-1} chromium (III) hydroxide $Cr(OH)_3$ Cr^{3+} OH^{1-}	Draw the following: $MgCl_2$  BaO  Na_2S 

COVALENT/MOLECULAR COMPOUNDS

In covalent or molecular substances, electrons are **SHARED**. Depending on the atoms involved, they can be shared in multiple ways. Recall those ways by filling in the table below.

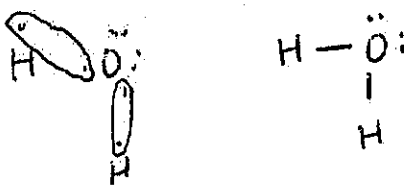
Type of Covalent Bond	Number of electron *pairs* shared	*Total* number of electrons shared
SINGLE BOND	1	2
DOUBLE BOND	2	4
TRIPLE BOND	3	6

The 7 diatomic elements are covalently bonded molecules. Write their formulas and draw each of their structures in the tables below.

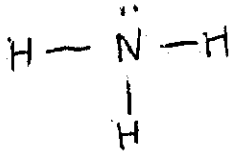
FORMULA	H_2	O_2	F_2	Br_2	I_2	N_2	Cl_2
STRUCTURE	H–H	O=O	F–F	Br–Br	I–I	N≡N	Cl–Cl

Beyond diatomic element structures, there are 5 other covalent compound that pop up a lot on the Regents exams, and you will probably see at least one of these on Miss Virga's test as well. Make sure you can draw each of them. Wondering how? ***Start with individual dot diagrams of each atom. Start sharing electrons. Clean it up by replacing circled pairs of electrons with lines. Don't forget to include "leftover" electrons.***

H_2O

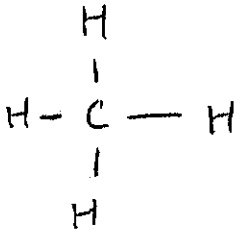


NH_3

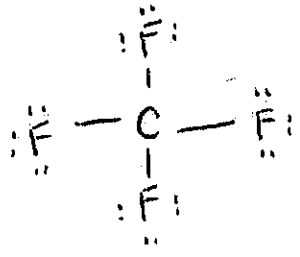


CO_2

CH_4



CF_4



POLARITY

When determining polarity of a bond or a molecule, you need to consider either differences in electronegativity or symmetry of the molecule.

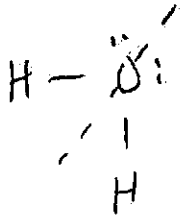
When determining polarity of a BOND: use Table S to determine differences in electronegativity. Recall that electronegativity is the relative ability of an atom to attract electrons to itself in a chemical bond. Because of the **unequal** sharing of electrons, the atom with the *higher* electronegativity will develop a negative "pole" and the other atom will develop a positive "pole"; hence it is called a polar BOND. If the two atoms have the *same* electronegativity (thus the difference is zero) then they share the electrons **equally** and the bond is nonpolar.

When determining polarity of a MOLECULE: draw the Lewis structure so you can determine if the molecule is **symmetrical** or **asymmetrical.** If the molecule is symmetrical, then there is an ***even distribution of charge*** and the molecule is NONPOLAR. If the molecule is asymmetrical, then there is an ***uneven distribution of charge***, and the molecule is POLAR.

Summarize the information in the paragraph above in the graphic organizer below:

BONDS		MOLECULES
$\Delta EN = 0$ * electrons are equally shared	Nonpolar	Symmetrical * even distribution of charge
$\Delta EN \neq 0$ * electrons are unequally shared	Polar	asymmetrical * uneven distribution of charge

Defend or refute this statement with a diagram: **Water, H_2O is a nonpolar molecule due to its symmetry.**



Water is POLAR due to its asymmetry!

INTERMOLECULAR FORCES

We have learned about three types of intermolecular forces (IMFs): van der Waals, dipole-dipole, hydrogen bonding. Each of these attractions is a result of the fact that ***opposite charges attract.***

Do IMFs occur *within* or *between* molecules? between

Fill in the missing blanks in the table below.

Strength (*weakest, moderate, strongest*)	Type of IMF	Description
weakest	van der Waals	• Only type of IMF that occurs in **NONPOLAR** molecules • a result of *temporary* positive and negative ends
moderate	dipole - dipole	• occurs in **POLAR** molecules • a result of *permanent* positive and negative ends
strongest	hydrogen bonding	• a special type of attraction that only occurs in molecules that have hydrogen **AND** fluorine, oxygen, or nitrogen

1. Base your answer to the following question on the information below and on your knowledge of chemistry.

   At standard pressure, water has unusual properties that are due to both its molecular structure and intermolecular forces. For example, although most liquids contract when they freeze, water expands, making ice less dense than liquid water. Water has a much higher boiling point than most other molecular compounds having a similar gram-formula mass.

   State the type of intermolecular force responsible for the unusual boiling point of $H_2O(\ell)$ at standard pressure. hydrogen bonding

2. 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

3. Which type of attraction occurs between nonpolar covalent molecules?

   A) hydrogen bonding
   B) van der Waals forces
   C) ion-ion attraction
   D) molecule-ion attraction

4. 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

5. Which intermolecular force of attraction accounts for the relatively high boiling point of water?

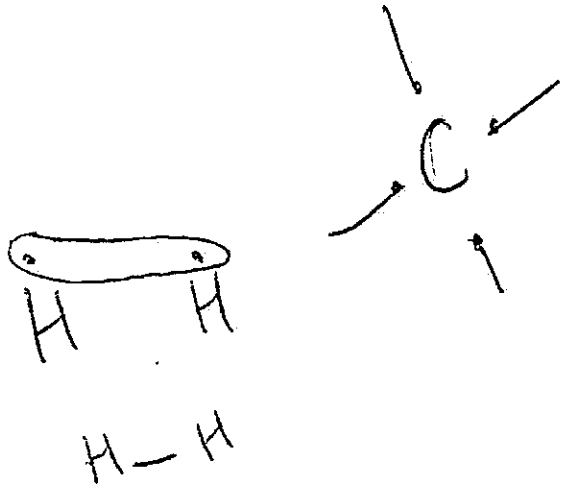
   A) hydrogen bonding
   B) covalent bonding
   C) metallic bonding
   D) ionic bonding

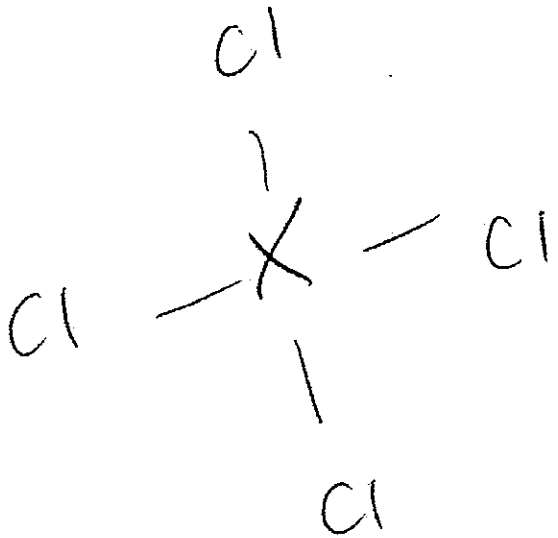
BONDING & PROPERTIES

Big Idea: Structure determines properties!

Bond Type	Covalent Molecules		Ionic Compounds	Metallic Compounds
	Nonpolar	*Polar*		
Type of IMF	Van der Waals	Dipole - dipole N, O, or F: H-bonding	attraction between ions	metallic bond
Melting/boiling point	Low	Moderate	High	High
Phase of matter at STP	G, L, S	mostly L, S	mostly S	mostly S (except mercury)
Conductivity* as a solid	None	None	None	High
Conductivity* as a liquid or aqueous solution	None	None	High	High
Likelihood to dissolve in water	Low	Mod - High	High	None

*Conductivity is a result of **mobile charged particles** (IONS or ELECTRONS) that can provide electricity with a moving path through with to flow.


H H
H–H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