Unit 5: Bonding

Chapters 7 & 8 in your text book

Name_____

Vocabulary:

1. subscript: a number to the right and slightly below a symbol; tells the number of atoms of that element present.
2. covalent compound: also known as a molecular compound, as the smallest particle of a covalent compound is a molecule. Formed when the atoms of a molecule share electrons in order to bond together.
3. ionic compound: a chemical compound formed when electrons are transferred from one atom to another. Smallest particle is an ion. Distinguished by presence of metal atom(s) in compound and at least 1 non-metal.
4. binary compound: a compound consisting of atoms of only 2 elements.
5. ion: what's left after an atom has gained or lost 1 or more electrons. A positive ion results from the *loss* of electrons while a negative ion results from the *gain* of electrons. :
6. polyatomic ion: a group of atoms covalently bonded together that possess a charge due to gain or loss of electrons. Ex: PO_4^{-3}
7. cation: a positively charged ion. Ex: Na^+
8. anion: a negatively charged ion. Ex: Cl^-
9. molecule: a group of covalently bonded atoms.
10. transition metal: an element from group 3-12
11. aqueous: dissolved in water
12. oxidation number or state: numbers assigned to the atoms in compounds or ions (including atoms in polyatomic ions) to show the general distribution of electrons among the bonded atoms. For monoatomic ions, this number is the same as the ion's charge.
13. diatomic element: an element which occurs naturally as molecules consisting of 2 atoms of the element chemically bonded together. Remember HOBrFINCl (7H club)!
14. covalent bond: a bond between two atoms that is formed by shared electrons. Atoms may share 1,2,or 3 pairs of electrons.
15. ionic bond: a bond between two atoms that is formed by transferred electrons. Each atom becomes an ion, with a charge.
16. metallic bond: a bond between two metal atoms. Atoms in a chunk of metal allow their valence electrons to freely roam throughout all the atoms in the chunk. Metals are said to have a "sea of mobile electrons" because of this. This type of bonding is what causes metals to be good conductors.
17. ion: a charged particle formed when an atom gains or loses one or more valence electrons.
18. conductivity: substances conduct electricity when charged particles (electrons or ions) are able to move freely throughout the sample.
19. double (covalent) bond: a bond that consists of 2 pairs of shared electrons.
20. triple (covalent) bond: a bond that consists of 3 pairs of shared electrons.
21. Lewis dot diagram: a diagram showing the valence electrons of one or more atoms to show how electrons are transferred or shared.
22. octet: 8 (valence) electrons—the number that makes atoms "happy" or stable.
23. octet rule: atoms will react so as to end up with an octet of valence electrons, just like a noble gas atom.
24. electronegativity: the attraction of an atom in a molecule for shared electrons in a bond
25. non-polar (covalent) bond: a covalent bond in which the electrons are shared equally between atoms.
26. polar (covalent) bond: a covalent bond in which the electrons are shared unequally between two atoms due to different electronegativities.
27. symmetrical molecule: one in which the molecule has identical parts on each side of each axis.
28. asymmetrical molecule: a molecule which lacks symmetry about at least one axis.
29. polar molecule: a molecule that has one pole or part that is partly negatively charged and one pole that is partly positively charged; thus it acts like a little magnet and intermolecular forces between polar molecules are quite large.
30. hydrogen bonding: a very strong intermolecular force (not an actual bond) between very polar molecules. In order to have hydrogen bonding between the molecules of a substance, the molecules must possess a hydrogen atom that is directly bonded to a fluorine, oxygen, or nitrogen atom. Water exhibits hydrogen bonding between molecules.
31. dipole: another way of saying a molecule is polar is to say it is a dipole.
32. VSEPR theory: (note that this is an advance topic/ term and is an EXTENSION) Valence Shell Electron Repulsion Theory. A theory that helps us to determine the shape of molecules. It says that electron pairs repel each other and want to be as far apart as possible, thus determining the molecular shape.
33. intermolecular force: an attractive force between molecules.

Learning Targets: Students will be able to answer the questions: How and why do atoms form compounds? How are the properties of a compound determined?

Essential questions: How does chemical bonding relate to buildings? Why is energy important when talking about bonding?

I CAN:

1. Recognize a compound as a chemical combination of atoms of two or more elements that can only be broken down by chemical means.
2. Identify ionic compounds by their names and formulas
3. State that chemical compounds are neutral.
4. Given a name for an ionic compound, write a formula according to the IUPAC system.
5. Given a formula for an ionic compound, write a name according to the IUPAC system.
6. Given a name for a covalent compound, write a formula according to the IUPAC system.
7. Given a formula for a covalent compound, write a name according to the IUPAC system.
8. State what must happen for an atom to become an ion.
9. State that atoms join together to form chemical compounds to achieve stability (lower energy).
10. Determine the oxidation state (charge) for each atom in a polyatomic ion
11. Distinguish among ionic, molecular and metallic substances, given their properties.
12. State that the two major types of compounds are ionic and molecular (covalent).
13. Explain what it means for a chemical bond to be ionic or covalent.
14. Define molecular polarity; state that asymmetric molecules such as H_2O, HCl, and NH_3 are polar.
15. Write Lewis dot structures for elements and simple ionic and covalent compounds.
16. State how an atom becomes and ion and how its size changes when it does.
17. State that energy is absorbed (used) when chemical bonds are broken, & released when these bonds are formed.
18. State that elements become stable (lower energy) when they attain a noble gas configuration by reacting with other elements. Noble gases do not form bonds because they already have a stable valence electron configuration.
19. Determine the noble gas configuration an atom will achieve when bonding.
20. State the physical properties expected for ionic and covalent compounds.
21. State that electronegativity indicates how strongly an atom attracts electrons in a chemical bond (electronegativity values are assigned according to an arbitrary scale)
22. State that physical properties such as conductivity, malleability, solubility, hardness, melting point and boiling point can be explained in terms of bonding types and intermolecular forces.
23. Recognize a compound as a chemical combination of atoms of two or more elements that can be broken down only by chemical means.
24. State that in metallic bonding, electrons are found in a “sea of mobile electrons.”

Calendar for unit 4 Regents Chemistry: Blue (1 & 2B) and Green (8 & 7B) Classes

12/3	**4**	5	**6**	**7**
C	**D**	E	**S**	**A**
Review/ Makeup day	Chemistry work period	Start Bonding Unit (topic 5.1) HW: Assignment #1	Topic 5.2 Naming and creating formulas for ionic compounds	Topic 5.3 Naming & formulas (ionic all) HW: Assign #2
	Periodic Table test		Lab 5.1 due 12/12 beginning of class	
10	11	12	13	14
B	C	D	E	S
5.4 Naming and formulas for covalent compounds HW: Assignment #3	Naming practice – all 5.5 ionic compound properties HW: Assignment #4	Topic 5.6 Ionic compound diagrams	Lab 5.2 Covalent Modeling lab with dot diagrams HW: Assignment #6	5.8 & Quiz on topics 5.1-5.6
Chem. work period		5.7 Dot- diagrams of cov. compds HW: Assign. #5		5.9 Polar Bonds HW: Assignment #7
17	18	19	20	21
A	B	C	D	E
Practicing with Polarity	5.10 Polarity of Molecules Summ & rv HW: Assignment #8	5.11- Intermolecular forces HW: Assignment #9	5.12 Summary of properties Assign #10 (Only evens due for test)	**Bonding unit test.**
	Chem. work period		Review for unit test	

Calendar for unit 4 Regents Chemistry: Yellow (5 &6A) class

12/3	**4**	5	**6**	**7**
C	**D**	E	**S**	**A**
Review/ Makeup day	Periodic Table test	Start Bonding Unit (topic 5.1) HW: Assignment #1	Lab 5.1 due 12/12 beginning of class	Topic 5.3 Naming and formulas with transition metals and polyatomic ions HW: Assignment #2
Chemistry work period		Topic 5.2 Naming and creating formulas for ionic compounds		Chem. work period
10	11	12	13	14
B	C	D	E	S
5.4 Naming and formulas for covalent compounds HW: Assignment #3	Naming practice – all 5.5 ionic compound properties HW: Assignment #4	5.7 Dot- diagrams of cov. compds HW: Assign. #5	Lab 5.2 Covalent Modeling lab with dot diagrams HW: Assignment #6	5.8 & Quiz on topics 5.1-5.6
	Topic 5.4 Ionic compound diagrams		Chem. work period	
17	18	19	20	21
A	B	C	D	E
5.9 Polar Bonds HW: Assignment #7	5.10 Polarity of Molecules Summ & rv HW: Assignment #8	5.11- Intermolecular forces HW: Assignment #9	Review for unit test	**Bonding unit test.**
Practicing with Polarity		5.12 Summary of properties Assign #10 (Only evens due for test)		

What are you putting in your body?

Vitamin Ingredients: The list below is from a package of "Flinstones" vitamins. Look at the ingredients and answer the following questions:

This is the most current labeling information, and may differ from labels on product packaging. If there are any differences between this website labeling and product packaging labeling, this website labeling should be regarded as the most current. (Names have been modified to follow the IUPAC naming rules).

Ingredients: Sucrose, Sodium Ascorbate, iron (II) fumarate, stearic acid, silicon dioxide, artificial flavors, maltodextrin, invert sugar, gelatin, vitamin E Acetate, niacinamide , magnesium stearate, starch, aspartame, FD&C Red #40 Aluminum Lake, pyridoxine hydrochloride, thiamine mononitrate, beta-carotene.

1. What are some things you notice about the ingredient list? Make some observations.

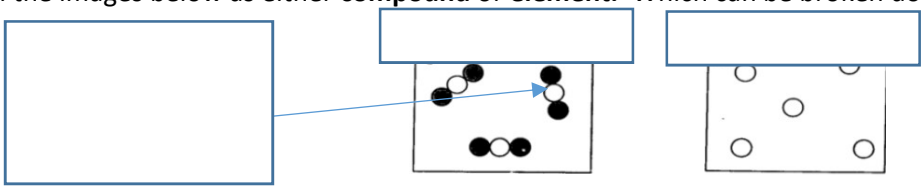
2. What are some patterns you notice in the name?

3. Are the ingredients elements, compounds, mixtures or is there a variety? If there is a variety give an example.

4. Is the vitamin an element, compound, or mixture? Explain your thinking.

Topic 5.1 **Making and breaking Bonds:** What types of chemical bonds can form or be broken?

A. Label the images below as either **compound** or **element.** Which can be broken down by chemical change? _____



B. Why do bonds form?

Chemical bonds form so that atoms can achieve lower potential energy and thus be _____.

Br + Br → Br_2

When bonds form, energy is _____ (they are _____ stable) and this is an _____ reaction.

vs.

Br_2 → Br + Br

When bonds are broken, energy is _____to do the breaking(_____). You are prying apart atoms that "wanted" to be together. This is an _____ reaction.

Unfortunately, particle diagrams can't really show electrons moving around and it is the ELECTRONS that are involved in bonding. This unit, we'll be drawing lots of lewis dot diagrams to show the movement of electrons and how new attachments are made and old ones broken.

C. **Bond Type** is determined by _____in _____.

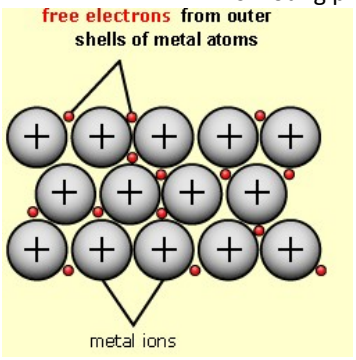
What is that again? Let's redefine:_____

_____

Two most common types of compounds:

_____ Bonds		_____ Bonds
	Who? What type of elements are involved?	
	How are the electrons involved?	
	When do these bonds form in terms of electronegativity?	
1. Good conductors of electricity in _____ _____ or _____ form because there are _____ _____. 2. _____ melting points and boiling points. 3. Soluble (_____) in water.	What are some properties of these compounds?	1. _____ conductors of electricity because there are _____ _____. 2. _____ melting points and boiling points

D. **Third kind of bonding:** Bonding in Metals-



Metallic Bonding: Who? _____

How? Metals are made up of closely packed _____,
not neutral atoms. Their electrons are _____ and
can drift _____ from one part to another in a "sea of electrons."
The "sea of electrons" explains metallic properties:

1. Metals can _____ heat and electricity
2. They have high _____ and _____ points

3.Are ductile (_____) malleable (_____)
and lustrous (_____)

EX:

Alloys-_____

_____

1. Which set of procedures and observations indicates a chemical change?

   A) Large crystals are crushed with a mortar and pestle and become powder.
   B) A cool, shiny metal is added to water in a beaker and rapid bubbling occurs.
   C) A solid is gently heated in a crucible and the solid slowly turns to liquid.
   D) Ethanol is added to an empty beaker and the ethanol eventually disappears.

2. Which particles may be gained, lost, or shared by an atom when it forms a chemical bond?

   A) electrons B) nucleons
   C) protons D) neutrons

3. What occurs as two atoms of fluorine combine to become a molecule of fluorine?

   A) A bond is formed as energy is absorbed.
   B) A bond is formed as energy is released.
   C) A bond is broken as energy is released.
   D) A bond is broken as energy is absorbed.

4. When lithium reacts with bromine to form the compound LiBr, each lithium atom

   A) gains one electron and becomes a negatively charged ion
   B) loses three electrons and becomes a positively charged ion
   C) gains three electrons and becomes a negatively charged ion
   D) loses one electron and becomes a positively charged ion

5. Given the balanced equation representing a reaction:

   $O_2 \rightarrow O + O$

   What occurs during this reaction?

   A) Energy is released as bonds are formed.
   B) Energy is absorbed as bonds are formed.
   C) Energy is released as bonds are broken.
   D) Energy is absorbed as bonds are broken.

6. Which element has an atom with the greatest tendency to attract electrons in a chemical bond?

   A) silicon B) sulfur
   C) chlorine D) carbon

7. What occurs in order to break the bond in a Cl_2 molecule?

   A) The molecule creates energy.
   B) Energy is released.
   C) The molecule destroys energy.
   D) Energy is absorbed.

8. What occurs when potassium reacts with chlorine to form potassium chloride?

   A) Electrons are shared and the bonding is ionic.
   B) Electrons are transferred and the bonding is covalent.
   C) Electrons are shared and the bonding is covalent.
   D) Electrons are transferred and the bonding is ionic.

9. A molecular compound is formed when a chemical reaction occurs between atoms of

   A) chlorine and sodium B) chlorine and yttrium
   C) oxygen and hydrogen D) oxygen and magnesium

10. As a bond between a hydrogen atom and a sulfur atom is formed, electrons are

    A) shared to form an ionic bond
    B) shared to form a covalent bond
    C) transferred to form an ionic bond
    D) transferred to form a covalent bond

11. The bonds in BaO are best described as

    A) ionic, because valence electrons are shared
    B) covalent, because valence electrons are transferred
    C) covalent, because valence electrons are shared
    D) ionic, because valence electrons are transferred

12. Which element forms an ionic compound when it reacts with lithium?

    A) Br B) K C) Fe D) Kr

Ionic Compounds: Naming and creating formulas for simple ionic compounds
How do we name the simplest ionic compounds?

What's in a name?

Objective:

- Identify some simple rules about nomenclature (naming).

The Model:

Examine the table below, and answer the following questions.

Table 2

Cation	Anion	Chemical Formula	Compound Name
Na^{+}	Cl^{-}	NaCl	sodium chloride
Ca^{+2}	O^{-2}	CaO	calcium oxide
Zn^{+2}	Cl^{-}	$ZnCl_2$	zinc chloride
Li^{+}	S^{-2}	Li_2S	lithium sulfide
K^{+}	N^{-3}	K_3N	potassium nitride

Reviewing the Model

1. Are ALL cations positive ions or negative ions?

2. Are ALL anions positive ions or negative ions?

3. What is the name of the compound formed by the combination of Li^{+} and S^{-2} ions?

Exploring the Model

4. When the name of an ionic compound is given, which ion is stated first?

5. Compare the first part of the compound name to the name of the element from the periodic table. How does the name of the cation correspond to the name of the element?

6. Compare the second part of the compound name to the name of the element from the periodic table. How does the name of the anion correspond to the name of the element?

7. From what part of the periodic table do the cations in the Model come (metals or nonmatals)?

8. From what part of the periodic table do the anions in the Model come?

Exercising Your Knowledge

9. For each of the following, predict whether the ion will likely be a cation or an anion.
    a. Magnesium ion
    b. Selenide ion
    c. Bromide ion
    d. Cesium ion

10. For each ionic compound, identify the cation and the anion.
    a. Sodium fluoride
    b. Strontium sulfide
    c. Lithium iodide
    d. Barium chloride

11. In what way did the name provide clues about the classification of each element as a cation or anion?

12. Where on the periodic table would you expect to find elements that ionize to form cations?

13. Where on the periodic table would you expect to find elements that ionize to form anions?

Summarizing Your Thoughts

14. Consider the clues you identified, and write a general rule for how you change the name of elements to cations when naming ionic compounds.

15. Consider the clues you identified, and write a general rule for how you change the name of elements to anions when naming ionic compounds.

16. Given the chemical formula of an ionic compound, list at *least* three necessary steps to give the correct name of that compound. (If needed, use a chemical formula of a compound from the table above as an example in listing the naming steps.)

Check point

Provide the IUPAC name for the following ionic compounds (use the rules you've just created to do this & then have Mrs. Young check).

Na_3N_____ Al_2S_3_____

CaO_____ BaF_2_____

Check point

Now that we've looked at how to NAME the compounds, let's look at how to determine their formulas.

Activity 4 – Predicting the correct chemical formula for ionic compounds formed from simple anions

Objective:

To learn how to predict the correct number of cations and anions in a simple salt.

The Model:

Table 3

Cation	Anion	Chemical Formula	Compound Name
Na^+	Cl^-	NaCl	sodium chloride
Zn^{+2}	Cl^-	$ZnCl_2$	zinc chloride
Na^+	S^{-2}	Na_2S	sodium sulfide
K^+	N^{-3}	K_3N	potassium nitride

Reviewing the Model

1. What is the charge on the zinc ion?
2. What is the charge on the nitride ion?
3. What is the charge on the chloride ion?
4. What is the charge on the ionic compound, sodium chloride?
5. What is the charge on the ionic compound, sodium sulfide?
6. How many potassium ions are present in K_3N?
7. What does the "2" stand for in the formula for $ZnCl_2$?

Exploring the Model

8. Sodium chloride is NaCl, and zinc chloride $ZnCl_2$. Why are there more chloride ions in the zinc compound?
9. Sodium chloride is NaCl, and sodium sulfide is Na_2S. Why are there more sodium ions in the sulfide compound?

Check point

Exercising Your Knowledge

10. How many chloride ions would combine with an Al^{+3} ion to form aluminum chloride?

11. What charge does the barium ion possess in the compound $BaCl_2$?

Summarizing Your Thoughts

12. Explain how you determined the number of chloride ions needed in aluminum chloride.

13. From Table 3 and the answers above, what do you know about the overall charge on ALL ionic compounds?

Chec kpoin t

14. List at *least* three necessary steps to obtain the correct chemical formula of any simple ionic compound.

Provide the IUPAC formula for the following ionic compounds (use the rules you've just created to do this & then have Mrs. Young check).

Sodium phosphide _____ Aluminum nitride_____

Calcium chloride_____ Barium iodide_____

Check point

Extension:

Calcium Carbonate's chemical fomula is $CaCO_3$.

Find Carbonate in your reference table (table letter _____).

Tell me here how naming this compound is DIFFERENT than what you just did…

Check point

Topic 5.3

Naming Ionic compound: Multiple charges and polyatomic ions: How can we name and create formulas for ionic compounds when the metal is complicated?

By this point you may have noticed we've ignored the middle section of the periodic table that contains metals when we are naming.

Transition Metals: found in groups _____, form _____ when dissolved and have _____ oxidation states.

These are REALLY cool elements, so let's look at how we can name them. Metals like to _____ electrons so they become _____ ions or _____. How many electrons do the transition metals lose? Let's look at manganese (Mn) as an example.

Possible charges (oxidation states) of manganese:

So how do we know which ion Mn picked? The only clue we have is the nonmetal that it bonding with. We will have to do this will all transition metals.

MnO Mn_2O_3 MnS_2 $MnBr_7$

That being said, we're going to have to add a step to our naming rules for ionic compounds.

Step 1: Name the metal
Step 2: Write the charge of the metal as Roman numerals in parentheses
Step 3: Name the nonmetal
Step 4: Change the ending of the non-metal to "ide"

Let's practice: *Provide the IUPAC name or the chemical formula for the following ionic compounds:*

1. Cu_2O
2. Tin (II) fluoride
3. Fe_2O_3
4. FeO
5. Vanadium (III) oxide
6. SnS_2
7. Molybdenum (VI) oxide
8. Pb_3N_4

What happens when there are more than 2 elements in the compound? The compounds is no longer bianary (containing 2 elements).

Polyatomic ion:

Let's look at an example of a compound formed with a polyatomic ion. I'll always try to put them in parentheses (and so should you!)

$Mg(OH)_2$

When there is a polyatomic ion in a compound there is almost ALWAYS …

We can find polyatomic ions in _____ and MOST of the ions end in_____- that is your HINT to look at table _____.

To name a compound with a polyatomic ion in it, DO NOT CHANGE the endings or mess around with roman numerals, just use table E. Name the metals as usual.

Let's practice: *Provide the IUPAC name or the chemical formula for the following ionic compounds:*

1. $Na_2(CO_3)$
2. Manganese (III) chlorate
3. $Cu(SO_4)$
4. $LiHSO_4$
5. Calcium phosphate
6. Barium hydroxide
7. Zinc Phosphate
8. $Cr(NO_2)_3$

Assignment 5.2

Provide the IUPAC name or the chemical formula for the following ionic compounds. When making formulas show ALL work (criss-cross of charges).

	Chemical Formula	Compound Name
1.	Mg_3N_2	
2.	Na_2O	
3.	Ni_3N_2	
4.	CrO_3	
5.	$MoCl_5$	
6.	VI_2	
7.	$Sr(S_2O_3)$	
8.	$Pd(NO_3)_4$	
9.		Potassium phosphide
10.		Barium Oxide
11.		Iron (III) Bromide
12.		Lead (II) Iodide
13.		Gold (III) perchlorate
14.		Calcium Chromate
15.		Aluminum carbonate

Naming Covalent Compounds

Objective
I can name a molecular compound and write a chemical formula.

Table 1

Name of compound	Chemical formula
Carbon tetrachloride	CCl_4
Dihydrogen monoxide	H_2O
Carbon dioxide	CO_2
Nitrogen trihydride	NH_3
Oxygen dichloride	OCl_2
Dinitrogen tetrabromide	N_2Br_4
Silicon dioxide	SiO_2
Phosphorous tribromide	PBr_3

In *Table 1* above, several covalently bonded molecules are listed. The names and chemical formulas have been provided. Use the information in the table to answer the following questions:

1. What do you notice about the *types of elements* in the chemical formulas? (think metal, non-metal, metalloid)

2. What do you notice about the ending of the names for the above compounds?

3. Other than a prefix, what do you notice about the names of first element in the chemical formulas compared to the periodic table?

4. Find the compound names that contain "di" as a prefix. What do you notice about their chemical formulas?

5. Find the compound names that contain "tri" as a prefix. What do you notice about their chemical formulas?

6. Predict the number of atoms based on the prefix by filing in Table 2

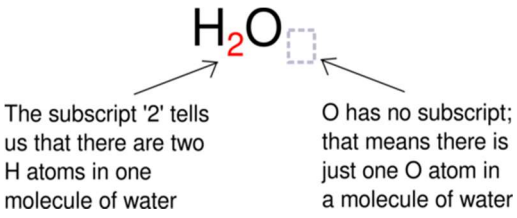
Table 2

Prefix	**Number of atoms**
Mono	
Di	
Tri	
Tetra	
Penta	
Hexa	
Hepta	
Octa	
Nona	
Deca	

7. The subscript is the little number that comes after a chemical symbol. Based on the information above and the picture below, what does the subscript indicate?

8. Using the example below, what is the subscript after the first element in each of the following compounds:

   CO_2, CCl_4 and SiO_2?



9. Find one other compound in *Table 1* that follows a similar pattern as the compounds listed in question 8. What is the name of the compound that is similar?_____

Table 3

Name of compound	**Chemical formula**
Dihydrogen monoxide	H_2O
Carbon dioxide	CO_2
Oxygen dichloride	OCl_2
Silicon dioxide	SiO_2

10. Using Table 3, does the first subscript listed in a chemical formula correspond with prefix for the first or second element?

11. Compare and contrast the name and chemical formula for compounds in Table 3: when is the prefix "mono" included in the name?

12. Write the **names** of the following *covalent* compounds:

    a. SO_3 _____

    b. N_2S _____

    c. P_2Br_4 _____

    d. CO _____

    e. SF_6 _____

    f. NO_2 _____

13. Create a 3 step process that summarizes the rules for **naming** covalent compounds.

14. Write the **formulas** of the following *covalent* compounds:

    a. nitrogen trichloride _____

    b. boron monocarbide _____

    c. dinitrogen trioxide _____

    d. phosphorus pentafluoride _____

    e. diboron tetrahydride _____

    f. oxygen difluoride _____

15. Create a 3 step process that summarizes the rules for **writing** covalent compound formulas.

Checkpoint

16. Sometimes carbon monoxide is called carbon (II) oxide. Explain how this name is generated and what it is similar to that we've already worked on.

Assignment 5.3

Name the following covalent compounds

1. SeO _____
2. BF_3 _____
3. SO_2 _____
4. PCl_5 _____
5. N_2O_5 _____
6. NO _____
7. NH_3 _____

Write the formulas for the following binary molecular compounds

8. Sulfur hexafluoride _____
9. Iodine tribromide _____
10. Arsenic tetrafluoride _____
11. Silicon disulfide _____

Naming practice time…

Ok- relax & breathe! You've done a lot of naming in the last few days. Could you instruct someone on how to…

1) Name any ionic compound made from 2 or more elements?
2) Could you explain to them how to "translate" a name into a formula?

Try it. Talk with your neighbor about the naming/ writing of the following compounds. If you're comfortable, GREAT! If not, keep at it. With good practice will come good results. Let me know how I can help.

Lithium Carbonate	Vanadium (IV) oxide	$Fe_2(SO_4)_3$
Carbon tetraiodide	ammonium oxide	P_2Se_3

Review assignment on the board for more instructions BEFORE proceeding

Topic 5.5

Ionic Compounds: Everything together. What are the physical properties of ionic compounds? How can compound properties relate to how the bonds are created?

Directions: On your own grab a textbook and **read pages 212- 215**. As you read, respond to the questions below. Remember that these are your notes and the more detailed you are the better your notes and understanding will be ☺

1. What determines the **physical** properties of ionic compounds?

2. **In your own words,** briefly explain the physical structure of ionic compounds.

3. Explain what determines the ratio of positive ions to negative ions in an ionic crystal.

4. Define **crystal lattice.**

5. In figure 7.8, three minerals are shown. Name the firs two minerals (aragonite and barite) based on the IUPAC system (i.e. the way we've been naming ionic compounds).

6. What are three physical properties of matter that depend on how strong particle attractions are?

7. What physical property depends on the availability of freely moving charged particles?

8. Do ionic compounds conduct electricity in the solid state? Why or why not?

9. Explain why ionic compounds can conduct electricity when melted into a liquid or dissolved in a solution.

10. Why do ionic crystals have high melting and boiling points?

11. Using the information in table 7.5, convert the **boiling point** of potassium bromide into Kelvin.

12. Explain why ionic compounds are hard, brittle solids.

1. Element *X* reacts with chlorine to form an ionic compound that has the formula XCl_2. To which group on the Periodic Table could element *X* belong?

A) Group 1 B) Group 2
C) Group 13 D) Group 15

2. Which compound contains both ionic and covalent bonds?

A) MgF_2 B) CH_2O
C) $CaCO_3$ D) PCl_3

3. Which formula correctly represents the compound calcium hydroxide?

A) Ca_2OH B) $Ca(OH)_2$
C) $CaOH_2$ D) CaOH

4. What is the IUPAC name for the compound FeS?

A) Iron(III) sulfide B) iron(III) sulfate
C) iron(II) sulfide D) iron(II) sulfate

5. A barium atom attains a stable electron configuration when it bonds with

A) one chlorine atom
B) two chlorine atoms
C) one sodium atom
D) two sodium atoms

6. A compound is made up of iron and oxygen, only. The ratio of iron ions to oxide ions is 2:3 in this compound. The IUPAC name for this compound is

A) iron(III) oxide B) triiron dioxide
C) iron trioxide D) iron(II) oxide

7. If *M* represents an atom of Group 2, the correct formula for a compound of this atom with chlorine is

A) MCl B) M_2Cl
C) MCl_2 D) MCl_3

8. Which polyatomic ion is found in the compound represented by the formula $NaHCO_3$?

A) acetate
B) hydrogen carbonate
C) hydrogen sulfate
D) oxalate

9. Which two substances can *not* be broken down by chemical change?

A) C and CuO B) C and Cu
C) CO_2 and Cu D) CO_2 and CuO

10. Which formula represents lead (II) phosphate?

A) Pb_4PO_4 B) $PbPO_4$
C) $Pb_2(PO_4)_3$ D) $Pb_3(PO_4)_2$

11. The correct name of the compound with the formula PbO_2 is

A) lead (I) oxide B) lead (II) oxide
C) lead (III) oxide D) lead (IV) oxide

Using the information in the following paragraph and you knowledge of chemistry, answer questions #12 and 13.In the solid phase, arsenic occurs in two forms.

One form, yellow arsenic, has a density of 1.97 g/cm^3 at STP. The other form, gray arsenic, has a density of 5.78 g/ cm^3 at STP. When arsenic is heated rapidly in air, arsenic(III) oxide is formed.

Although arsenic is toxic, it is needed by the human body in very small amounts. The body of a healthy human adult contains approximately milligrams of arsenic.

12. Write the formula for the compound produced when arsenic is heated rapidly in air.

13. Write the name of the compound Cl_4F.

14. What is the formula for phosphorous dibromide?

Topic 5.6

Ionic Compounds and Diagrams: How can we model ionic compounds with Lewis dot diagrams and why do ionic bonds form?

All elements want to bond so they have _____ valence electrons and become _____.

Sodium (Na) has ____ valence electron that it can easily lose. If it loses the electron it becomes like the stable electron configuration of _____. Chlorine (Cl) has ___ valence electrons and it can easily gain one and would achieve the stable noble gas configuration of _____. When sodium and chlorine react to form a single compound, the sodium GIVES its valence electron to Cl so that they both _____ _____.

Overall Reaction:

Na Cl → Na Cl

Steps for doing this correctly:

1) Draw the lewis dot diagrams for the individual element
2) Draw arrows to indicate where the electrons go
3) Re-draw the bonded diagram with appropriate dots, brackets and charges

Practice Problems:

Use electron dot structures to predict the formulas of the ionic compounds formed from the following elements (like we did above).

1. Potassium reacts with oxygen
   a. Start with the atoms

K O →

   b. Oxygen must have 8 electrons, therefore you need ____ potassium ions to fulfill the octet rule

   c. the formula is (count) _____

2. Aluminum reacts with oxygen (follow the same process- how do you make an octet?)

Al O →

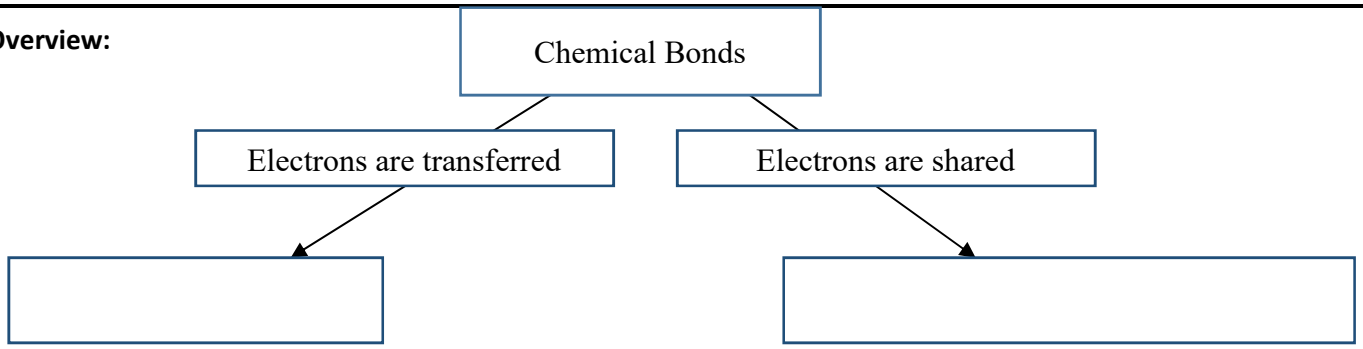
The formula is _____

Topic 5.7

Lewis dot Structures: Covalent/ Molecular Compounds.

How can we model covalent compounds using Lewis dot structures? How are these different from ionic?

A. Overview:

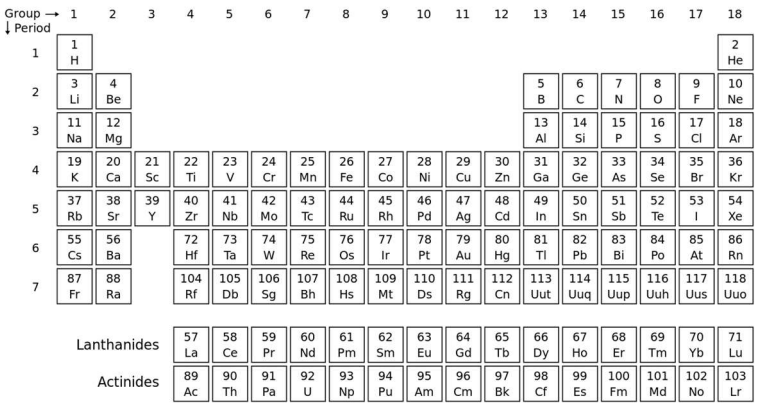


B. In covalent bonding the electrons are not completely transferred, but shared so our dot diagrams are going to look a little bit different. How are the diagrams the same?

a. The octet rule is still true:

b. Each atoms in a covalent compound wants to become _____ by getting a total of 8 valence electrons EXCEPT _____ which only needs ___.

c. Some elements have covalent bonding—these are our diatomic elements (_____).



C. Let's look at how we can draw these dot diagrams with *diatomic elements*

Diatomic element	Dot diagram of individual element	Diagram of molecule	Pairs of electrons shared	# of electrons shared
H_2				
O_2				
Br_2 (Cl_2, F_2 I_2)				
N_2				

D. How can YOU summarize this?

i. Atoms can share 1 pair of electrons (____ electrons for a _____ bond)

ii. Atoms can share 2 pairs of electrons (____ electrons for a _____ bond)

iii. Atoms can share 3 pairs of electrons (___ electrons for a _____ bond)

E. Drawing Lewis dot diagram of a molecule:

Steps	Example: H_2O
1) Make sure you are dealing with a covalent compound and NOT an ionic one	2 _____ in covalent bonding
2) Draw the Lewis structure of each individual atom first (element symbol with dots for valence electrons).	
3) Determine how many more electrons it needs to be "happy" or have an octet (except H, Be, Li, and B which only need 2 electrons to be stable) and write this above the dot structure	
4) Circle an electron in one atom and connect it with a line to the other atom and circle that electron. Do this until each atom has the number of lines equal to the number you wrote above it (step 2). NOTE that the element that needs the most bonds should be found in the center of the structure.	
5) Recount. Do all of the atoms have their correct number to reach an octet? a. ***Note each connection with 2 circled electrons counts for BOTH elements that are connected***	
6) Draw the complete lewis structure when all atoms are "happy" and have the correct number with the lines connecting as bonds (dashed line –)	
7) Draw the leftover electrons that you didn't circle around the correct atoms as necessary.	

F. Let's practice 1 more together: CO_2

Assignment 5.5

Show your **work and final Lewis dot** diagram for each molecule & then name each of the molecules (except #6)

1. CH_4 Ionic or covalent? (Circle) Work& structure: Name.

2. NH_3 Ionic or covalent? (Circle) Work& structure: Name.

3. Li_3P Ionic or covalent? (Circle) Work& structure: Name.

4. H_2S Ionic or covalent? (Circle) Work& structure: Name.

5. I_2 Ionic or covalent? (Circle) Work& structure: Name.

6. $CClBr_3$ Ionic or covalent? (Circle) Work& structure: Name. DO NOT NAME!!!!

7. FeO Ionic or covalent? (Circle) Work& structure: Name.

8. $CaBr_2$ Ionic or covalent? (Circle) Work& structure: Name.

9. HF Ionic or covalent? (Circle) Work& structure: Name.

___ 1. 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 formed as energy is absorbed.
C) A bond is formed as energy is released.
D) A bond is broken as energy is released.

___ 2. When a sodium atom reacts with a chlorine atom to form a compound, the electron configurations of the ions forming the compound are the same as those in which noble gas atoms?

A) neon and argon
B) krypton and argon
C) krypton and neon
D) neon and helium

___ 3. Which term indicates how strongly an atom attracts the electrons in a chemical bond?

A) electronegativity
B) activation energy
C) alkalinity
D) atomic mass

___ 4. Which type of bond is found between atoms of solid cobalt?

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

___ 5. The bonds in BaO are best described as

A) ionic, because valence electrons are transferred
B) covalent, because valence electrons are transferred
C) ionic, because valence electrons are shared
D) covalent, because valence electrons are shared

___ 6. The table below shows properties of two compounds at standard pressure.

Selected Properties of Two Compounds

Compound	Melting Point (°C)	Boiling Point (°C)	Electrical Conductivity
1	775	1935	good as a liquid or in an aqueous solution
2	−112.1	46	poor as a liquid

Which statement classifies the two compounds?

A) Compound 1 is ionic, and compound 2 is molecular.
B) Both compounds are ionic.
C) Compound 1 is molecular, and compound 2 is ionic.
D) Both compounds are molecular.

___ 7. In the formula XSO_4, the symbol X could represent the element

A) Na B) Al C) Ar D) Mg

___ 8. In which compound is the ratio of metal ions to nonmetal ions 1 to 2?

A) calcium oxide
B) calcium phosphide
C) calcium bromide
D) calcium sulfide

___ 9. The chemical formula for nickel (II) bromide is

A) $NiBr_2$ B) NBr_2
C) Ni_2Br D) N_2Br

___ 10. What is the name of the polyatomic ion in the compound Na_2O_2?

A) oxide B) peroxide
C) hydroxide D) oxalate

___ 11. What is the formula of titanium(II) oxide?

A) TiO B) TiO_2
C) Ti_2O_3 D) Ti_2O

12. Draw the electron- dot diagram for calcium oxide.

13. Name and draw the dot diagram of CCl_4

Topic 5.8

Ionic Compounds: Properties. Is there a relationship between number of ions and conductivity in ioninc compounds?

Part 2: Read this and do this: Now that you've gathered information about the properties of ionic compounds (from lesson 5.5) work to fill in the table and respond to the questions that follow. *Mrs. Young will do a sample with you. Once you finish this page you'll be ready for your quiz!!!*

Part 1: Conductivity

Draw the Lewis dot diagram for the following ionic compounds. Remember that the total (+) charges and (-) charges should be equal! Then write the chemical formula and determine the number of ions present in the compound.

Chemical name (show lewis "movement" of electrons here)	Lewis Dot diagram (final)	Chemical formula	Number of ions present
Potassium chloride			
Sodium sulfide			
Aluminum bromide			
Magnesium phosphide			

1. Make a hypothesis about the number of ions present and the strength of conductivity in ionic compounds:
   a. If the number of ions _____, then the conductivity _____because

   _____

   _____
2. Are ionic compounds able to conduct electricity in the solid phase?_____
3. Why or why not?_____

Part 2: Structure determines properties *take your notes here from board →*

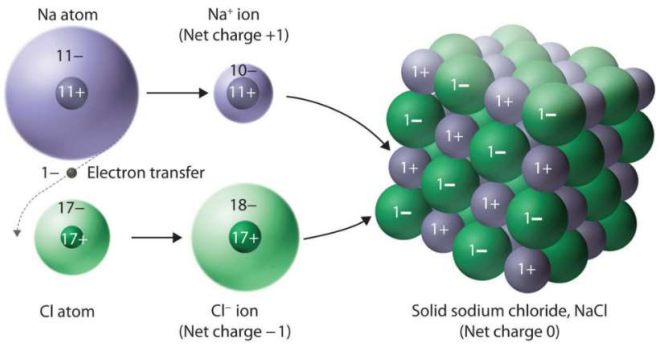


Figure 1: *The ionic compound NaCl forms when electrons from sodium atoms are transferred to chlorine atoms. The resulting Na^+ and Cl^- ions form a three-dimensional solid that is held together by attractive electrostatic interactions.*

Part 3: Covalent compounds… draw H2O- based on this structure what can you predict about the ability of this compound to conduct electricity?

How can we summarize what we've learned? Let's go back to the beginning of the unit and see if we can add anymore information to what we know.

We knew that the vitamin was composed of _____ and _____. How about creating correct IUPAC formulas for some of the names?

What are you putting in your body?

Vitamin Ingredients: The list below is from a package of "Flinstones" vitamins. Look at the ingredients and answer the following questions:

This is the most current labeling information, and may differ from labels on product packaging. If there are any differences between this website labeling and product packaging labeling, this website labeling should be regarded as the most current. (Names have been modified to follow the IUPAC naming rules).

Ingredients: Sucrose, Sodium Ascorbate, iron (II) fumarate, stearic acid, silicon dioxide, artificial flavors, maltodextrin, invert sugar, gelatin, vitamin E Acetate, niacinamide , magnesium stearate, starch, aspartame, FD&C Red #40 Aluminum Lake, pyridoxine hydrochloride, thiamine mononitrate, beta-carotene.

Create correct chemical formulas for as many of the compounds as you can:

Name from ingredient list	Formula (show "crisscross" method)

Common ions that may be useful:

Ascorbate: $C_6H_7O_6^{-1}$

Furmate: $C_4H_2O_4^{-2}$

Stearate: $C_{17}H_{35}COO^{-1}$

Overview: Covalent bonds involve the _____ of electrons. This sharing can be _____ or _____which allows covalent bonds to be **POLAR** or **NON-POLAR**.

By the end of this POGIL you will be able to determine if a bond is polar or non-polar and be able to explain what that means about electron distribution.

Introduction: Not all covalent bonds are the same! While a covalent bond involves the sharing of electrons between two metals, there are two types of covalent bonds (1) polar covalent and (2) nonpolar covalent. In this activity you will determine the difference between polar bonds and nonpolar bonds. Ultimately, the types of bonds in a covalent molecule will help determine properties of the molecule (like will it dissolve in water etc.). Therefore, it is important that you are able to distinguish between polar and nonpolar bonds.

Model 1: Examine the table below to compare polar bonds and nonpolar bonds.

Nonpolar Bonds:

Example	Electronegativity of Nonmetal 1	Electronegativity of Nonmetal 2
N_2	N = 3.0	N = 3.0
H_2	H = 2.1	H = 2.1

Polar Bonds:

Example	Electronegativity of Nonmetal 1	Electronegativity of Nonmetal 2
HCl	H = 2.1	Cl = 3.2
HF	H = 2.1	F = 4.0

1. Compare the nonpolar covalent bond examples with the polar covalent bond examples. Do you notice a significant difference between the types of atoms that participate in each bond type?

2. What does electronegatvity measure?

3. If an atom has a low electronegativity value will it be likely to attract electrons?

4. If an atom has a high electronegatvity value will it be likely to attract electrons?

5. Compare the electronegativity values of nonmetal 1 & 2 in N_2. Will the electrons in the molecule spend more time on one atom compared to the other?

6. Compare the electronegatvity values of nonmetal 1 & 2 in H_2. Will the electrons in the molecule spend more time on one atom compared to the other?

7. Compare the electronegativity values of nonmetal 1 & 2 in HCl. Will the electrons in the molecule spend more time on one atom compared to the other?

8. Compare the electronegativity values of nonmetal 1 & 2 in HF. Will the electrons in the molecule spend more time on one atom compared to the other?

9. Covalent bonding does not always involve the equal sharing of electrons between two atoms. With this in mind come up with a general definition for nonpolar covalent bond and polar covalent bond.

    a. Nonpolar covalent bond:

    b. Polar covalent bond:

10. Classify the types of bonds that exist in the covalent Lewis dot diagrams you drew on page 26 & 27 of your notes packet. Have your spokesperson raise their hand and be prepared to show Mrs. Young that you've done this and your quality control person should be on this page for you check of definitions.

STOP

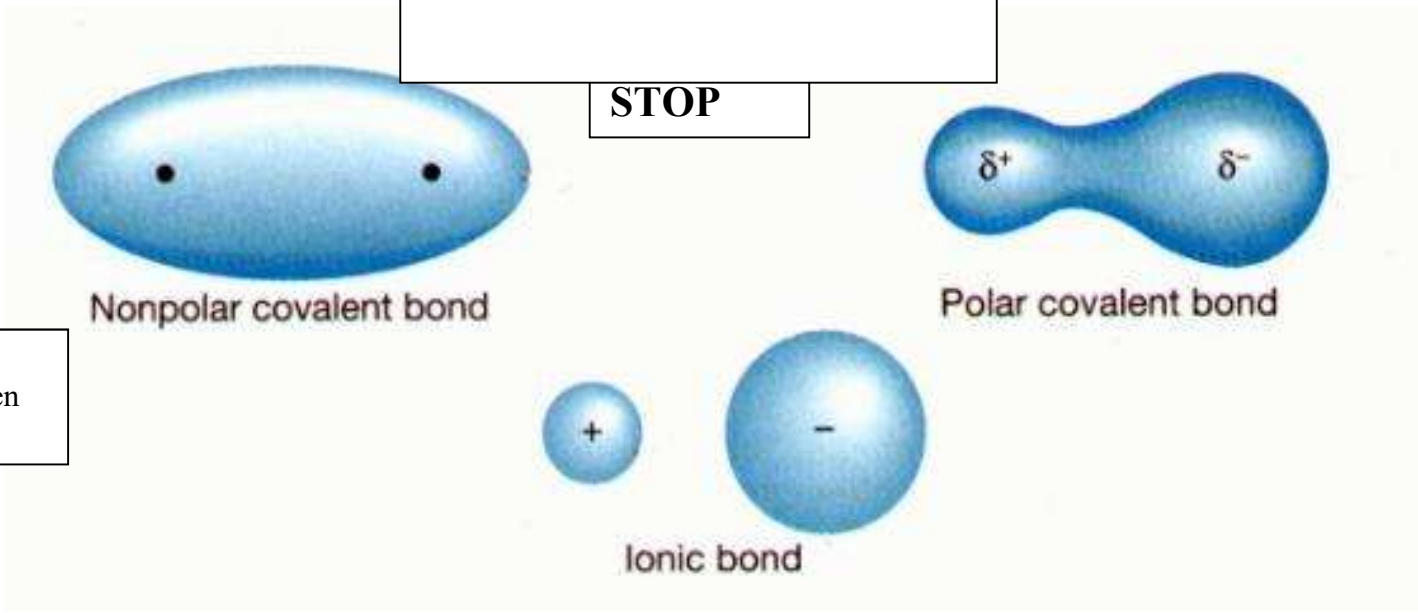
Model 2: A Closer Look at Polar Covalent Bonds

Covalent IUPAC Formula	Lewis Dot Diagram (DRAW)	Electronegativity Value of Nonmetal #1	Electronegativity Value of Nonmetal #2
HI		**H = 2.1**	**I = 2.7**
HF		**H = 2.1**	**F = 4.0**
H_2O		**H = 2.1**	**O = 3.5**

11. Explain in terms of, electronegativity and electron sharing, why the bonds Model 2 are all polar covalent.

12. Identify which atom from the examples in Model 2 the electrons will spend most of their time on.
    a. HI: _____ will possess most of the valence electrons.
    b. HF: _____ will possess most of the valence electrons.
    c. H_2O: _____ will possess most of the valence electrons.
    d. This is because…

STOP



13. The δ sign on the Lewis dot diagrams represent a partial charge. Such that a δ- represents a partial negative charge and a δ+ represents a partial positive charge**. The partial negative charge comes about because electrons will spend most of their time on the atom**. Since electrons have negative charges the atom with the majority of the electrons around it will get a partial negative charge. Examine Model 2 to fill in the following blanks.
    a. The atom with the _____(higher or lower) electronegativity value will always get a δ-.
    b. The atom with the _____ (higher or lower) electronegatvity value will always get a δ+.
14. Draw electron distributions (like the pictures above) to illustrate where the electrons spend most of their time in each covalent molecule. Use model 2's table from the previous page to help you! First draw the dot diagram and then the "bubbles"
    a. HI:
    b. HF:
    c. H_2O:
15. Which compound in model 2 will have the most polar bond? How do you know?
16. Which compound in model 2 will have the least polar bond? How do you know?

STOP

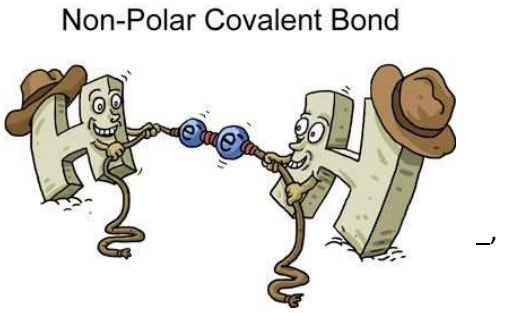
Polarity of Bonds: How do differences in electronegativity affect electron movement?

Overview: We have now looked at a model of bonding to determine what is happening with electrons. Complete the following notes based on the POGIL (p.30-32) of your notes packet.

A. Non-polar covalent bonds
   a. Electrons are _____ shared between atoms
   b. Difference in Electronegativity (ΔEN) is 0
   c. Examples:
      i. Diatomic molecules (H2, O2, Br2, F2, _____, _____,)
      ii. CS

EN value=

EN value=

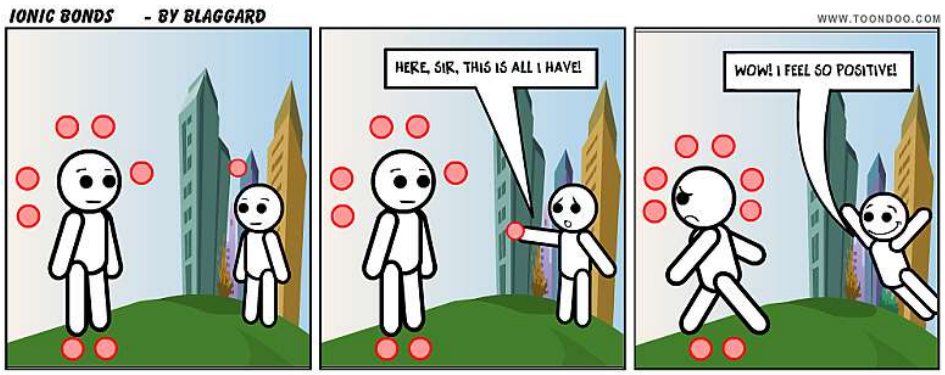


B. Polar Covalent Bonds
   a. Electrons are _____ shared between atoms
   b. The atom with the greater electronegativity _____ the electrons closer and becomes partially _____ (δ-)
   c. The atom with the lower EN becomes partially _____ (δ+)
   d. Difference in Electronegativity (ΔEN) is > 0
   e. Examples:
      i. N and H
      ii. H and F

EN value=

EN value=

C. Ionic Bonds
   a. Ionic bonds are considered completely polarized because the _____ pulls so much harder on the electrons that they are completely **transferred** from the _____ atom to the non-metal.
   b. This typically happens when the ΔEN is >2.0 (always check to see if there are the correct type of elements.
   c. You do: Label which "person" below is the metal (M) and which is the non-metal (NM) in frame 1
   d. You do: Put the charge on each person in the 3rd frame.

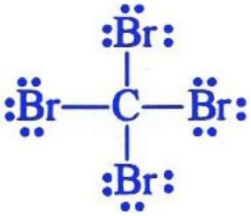


D. When you are done with A-C **check this page with the key up front** and **THEN** continue work with polarity. (see screen for instructions)

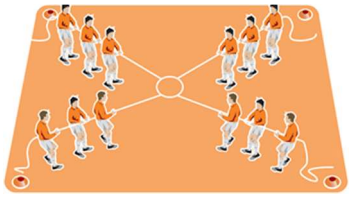
Assignment 5.7 → **Go BACK to page 22 (assign 5.5) and determine if each of the bonds in the COVALENT molecules are Polar or Non-polar.**

Polarity of Molecules: How does symmetry determine whether or not a molecule acts charged?

Overview: Do polar bonds mean a polar molecule?



1. Is the bond C-Br polar or non-polar?_____
2. BUT is the entire molecule polar?



In a polar molecule, one end of the molecule is _____ _____ and the other end is _____ _____. For example, in the H-Cl bond, the H is slightly + and the Cl is slightly negative (-). These are called charged poles or a _____.

How can we tell?

Symmetrical: _____lines of symmetry through a molecule or compound makes it…

Asymmetrical:_____lines of symmetry through a molecule or compound makes it…

Polar molecules show _____ intermolecular forces than non-polar molecules.

_____ is a very polar molecule. _____ (NH_3) is also a polar molecule.

Polar Molecules have high _____ _____ and high _____ _____ _____ because the molecules are so attracted to each other.

Let's try a few:

CO_2 H_2O

Br_2 NaBr

Assignment 5.8

Base your answers to questions **1** through **3** on the information below and on your knowledge of chemistry

The equation below represents a chemical reaction at 1 atm and 298 K.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

1. State the change in energy that occurs in order to break the bonds in the hydrogen molecules.

2. Draw a Lewis electron-dot diagram for a water molecule.

3. Compare the strength of attraction for electrons by a hydrogen atom to the strength of attraction for electrons by an oxygen atom within a water molecule.

---

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

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

Base your answers to questions **5** and **6** on the information below.

Physical Properties of CF_4 and NH_3 at Standard Pressure

Compound	Melting Point (°C)	Boiling Point (°C)	Solubility in Water at 20.0°C
CF_4	−183.6	−127.8	insoluble
NH_3	−77.7	−33.3	soluble

5. In the space provided draw a Lewis electron-dot diagram for CF_4.

6. State evidence that indicates NH_3 has stronger intermolecular forces than CF_4.

TRY this one based on your knowledge of Intermolecular forces

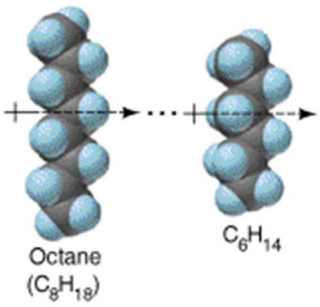
7. **Go BACK to page 22 (assign 5.5) and determine if the COVALENT molecules are Polar or Non-polar.**

Intermolecular Forces: How do special types of attractions affect the behavior of certain compounds and how do these forces attract molecules to one another?

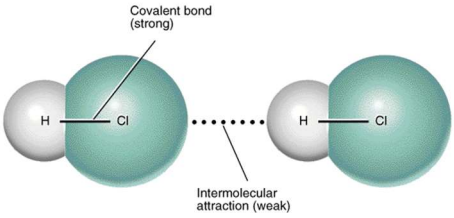
A. Overview: intermolecular forces are _____.

a. Note that these are _____, **NOT** _____.

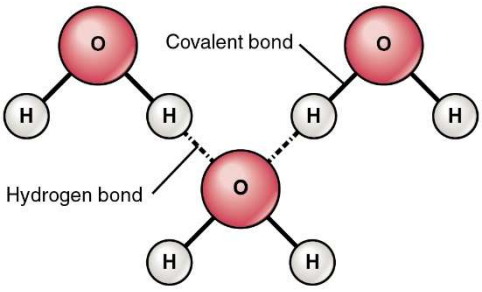
B. Types of IMF



Van der Waals forces: Usually occurs between _____ _____ and they are _____ _____.



Dipole-dipole attraction: partial _____ attraction between _____ molecules.



Hydrogen Bonding: Attraction between:

Hydrogen bonds occur when a molecule has at least one **HYDROGEN** atom that is directly attached to:

-_____ -_____ -_____

C. Importance and strength

- IMF are determined by the _____ of a substance
- The _____ of IMF determines the _____ of a substance

Ex: Compare the IMF of a solid to a liquid:

The stronger the IMF, the _____ the melting/ boiling point

***Remember from table H? Which liquid has the strongest IMF?_____

Big idea: Structure Determines properties!!!

Assignment 5.9

1. At standard pressure, CH_4 boils at 112 K and H_2O boils at 373 K. What accounts for the higher boiling point of H_2O at standard pressure?
   (1) Covalent bonding
   (2) Ionic bonding
   (3) Hydrogen bonding
   (4) Metallic bonding

2. Which compound has the strongest hydrogen bonding between its molecules?
   (1) HBr
   (2) HCl
   (3) HF
   (4) HI

3. Hydrogen bonding is a type of
   (1) Strong covalent bond
   (2) Weak ionic bond
   (3) Strong intermolecular force
   (4) Weak intermolecular force

4. Which compound has hydrogen bonding between its molecules?
   (1) CH_4
   (2) CaH_2
   (3) KH
   (4) NH_3

Surface tension is due to the forces that hold molecules together. The surface tension of water at various temperatures is given in the data table to the right.

Surface Tension at Different Water Temperatures

Water Temperature (° C)	Surface Tension (mN/m)
10.	74.2
25	72.0
50.	67.9
75	63.6
100.	58.9

5. The surface tension of liquid tetrachloromethane, CCl4, at 25°C is 26.3 millinewtons/meter. Compare the intermolecular forces between molecules of CCl_4 to the intermolecular forces between molecules of water, H_2O, at 25°C. Justify your answer with data from the table.

_____

_____

_____

organic compounds contain the element carbon. Use the data table below to respond to questions 6-7.

Organic Compound	Number of Carbons	Boiling Point (°C)
Heptane	7	98
Hexane	6	68
Pentane	5	36
Butane	4	-1

6. State the relationship between the number of carbons in an organic compound and the boiling point of a compound.

_____

_____

7. All the organic compounds listed are nonpolar molecules. State the relationship between the number of carbons in an organic compound and the strength of the van der Waals attractions between molecules.

_____

_____

Summary of properties: Do metals and non-metals keep their properties as theu form molecules and compounds?

How can we summarize each of the bonding types and connect that to the type of elements that form the bonds?

Chemical structure determines **physical properties.**

What type of bonds hold a sample together is a HUGE component of the sample's chemical structure; therefore, bond type is a key indicator of the physical properties a sample will have.

Bond Type	Covalent Molecules		Ionic Compounds	Metals	Network solids
	Non-polar	Polar			
Type of IMF					
Melting/ Boiling point					
Phase of matter @ STP					
Conductivity as a solid*					
Conductivity as a liquid or in an aqueous solution*					
Likely hood it will dissolve in water					

* Conductivity is a result of _____ ions (or _____ in metals) that can provide electricity with a moving path through which to flow.

Please note that these are general trends and certainly have exceptions! This table gives you a big-picture ides of how changing bond type can have an effect on physical properties.

1. Which two elements have the most similar chemical properties?
   (1) Beryllium and magnesium
   (2) Hydrogen and helium
   (3) Phosphorus and sulfur
   (4) Potassium and strontium

2. A sample of a substance has these characteristics:
   - Melting point of 984 K
   - Hard, brittle solid at room temperature
   - Poor conductor of heat and electricity as a solid
   - Good conductor of electricity as a liquid or in an aqueous solution

   This sample is classified as
   (1) A metallic element
   (2) A radioactive element
   (3) A molecular compound
   (4) An ionic compound

3. A solid substance was tested in the laboratory. The test results are listed below.
   - Dissolves in water
   - Aqueous solution conducts electricity
   - Melts at a high temperature

   Based on these results, the solid substance could be
   (1) Cu
   (2) $CuBr_2$
   (3) C
   (4) $C_6H_{12}O_6$

4. Which characteristic is a property of molecular substances?
   (1) Good heat conductivity
   (2) Good electrical conductivity
   (3) Low melting point
   (4) High melting point

5. The data table below represents the properties determined by the analysis of substances A, B, C, and D.

Substance	Melting Point (°C)	Boiling Point (°C)	Conductivity
A	−80	−20	none
B	20	190	none
C	320	770	as solid
D	800	1250	in solution

   Which substance is an ionic compound?
   (1) A
   (2) B
   (3) C
   (4) D

6. A chemist performs the same tests on two homogeneous white crystalline solids, A and B. The results are shown in the table below.

	Solid A	Solid B
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H_2O (grams per 100.0 g H_2O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

   The results of these tests suggest that
   (1) Both solids contain only ionic bonds
   (2) Both solids contain only covalent bonds
   (3) Solid A contains only covalent bonds and solid B contains only ionic bonds
   (4) Solid A contains only ionic bonds and solid B contains only covalent bonds

What do I need to know?

UNIT 5 TEST REVIEW CHECKLIST:

Identify where to focus/how to spend your time during this review in class.

	Unit Learning Target	YES. Got it.	Needs review	NOPE. Not yet.
1.	Recognize a compound as a chemical combination of atoms of two or more elements that can only be broken down by chemical means. 5.1			
2.	Identify ionic compounds by their names and formulas. 5.1-5.3			
3.	State that chemical compounds are neutral.			
4.	Given a name for an ionic compound, write a formula according to the IUPAC system. 5.2-5.3			
5.	Given a formula for an ionic compound, write a name according to the IUPAC system. 5.2-5.3			
6.	Given a name for a covalent compound, write a formula according to the IUPAC system 5.7			
7.	Given a formula for a covalent compound, write a name according to the IUPAC system.5.7			
8.	State what must happen for an atom to become an ion.			
9.	State that atoms join together to form chemical compounds to achieve stability (lower energy). (State that energy is absorbed (used) when chemical bonds are broken, & released when these bonds are formed.) 5.4			
10.	Distinguish among ionic, molecular and metallic substances, given their properties. 5.1 & 5.11			
11.	State that the two major types of compounds are ionic and molecular (covalent). 5.1			
12.	Explain what it means for a chemical bond to be ionic or covalent in terms of electrons and types of elements. 5.1			
13.	Define molecular polarity; state that asymmetric molecules such as H_2O, HCl, and NH_3 are polar.5.9			
14.	Define bond polarity in terms of differences in electronegativity 5.9			
15.	Write Lewis dot structures for elements and simple ionic and covalent compounds. 5.4 & 5.6			
16.	State that elements become stable (lower energy) when they attain a noble gas configuration by reacting with other elements. Noble gases do not form bonds because they already have a stable valence electron configuration. 5.1			
17.	Determine the noble gas configuration an atom will achieve when bonding.			
18.	State that electronegativity indicates how strongly an atom attracts electrons in a chemical bond (electronegativity values are assigned according to an arbitrary scale) 5.8			
19.	State that physical properties such as conductivity, malleability, solubility, hardness, melting point and boiling point can be explained in terms of bonding types and intermolecular forces. 5.11			
20.	State the physical properties expected for ionic and covalent compounds. 5.12			
21.	Recognize a compound as a chemical combination of atoms of two or more elements that can be broken down only by chemical means.			
22.	State that in metallic bonding, electrons are found in a “sea of mobile electrons.” 5.1			