VIDEO – COMPOUNDS: AN INTRODUCTION

THIS VIDEO'S QR CODE:

CONNECT, QUESTION, REFLECT

BY THE END OF THIS LESSON YOU SHOULD BE ABLE TO…

…review the difference between mixtures and compounds.

…explain why elements form compounds.

…differentiate between ionic and molecular compounds.

REVIEW: DIFFERENTIATE COMPOUNDS AND MIXTURES:

- Mixtures are…
- Compounds are…

REVIEW: RELATE THIS TO CHEMICAL AND PHYSICAL PROPERTIES:

- Properties of mixtures always reflect properties of the constituents.

  ex.)
- Since it is a physical combination, ratios of components ____________________.
- Properties of compounds often bear no resemblance to the constituents.

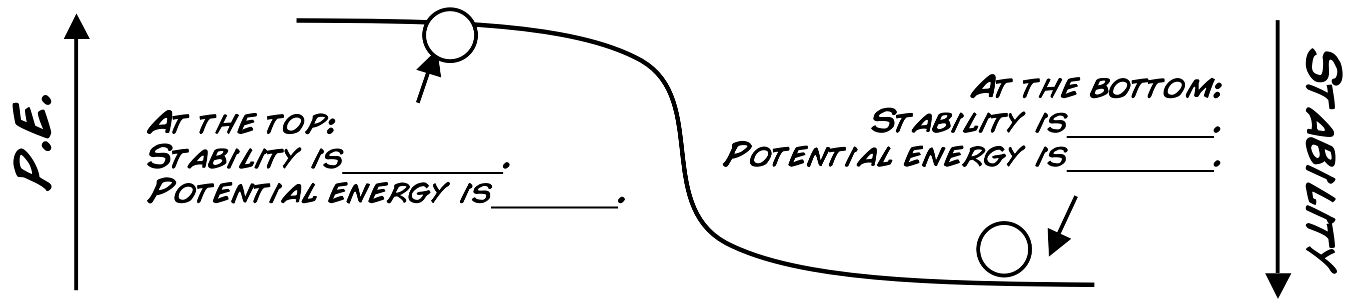
  ex.)
- Since it is a chemical combination, ratios of components ____________________.

  ex) Water is always H_2O (Law of ________________________________)

WHY DO ELEMENTS FORM COMPOUNDS IN THE FIRST PLACE?

- Very few elements are found in nature outside of compounds.
- Most elements are unstable because…
- Atoms form compounds to gain…
- When atoms achieve a full valence shell they become…
- Stability can be measured in terms of ________________________________.

THINK OF A HILL…



CONNECT, QUESTION, REFLECT

- Most lone atoms have incomplete valence shells

  ∴______________stability and_____________potential energy.
- Atoms in compounds have complete valence shells

  ∴_____________stability and______________potential energy.

- When compounds are formed, the P.E. usually goes down.
- That energy has to be conserved. The change in energy is transferred to the surroundings as heat and/or light known as ________________________________.

- You can also break chemical bonds.

  ex.)

- Breaking a bond would put system back up to higher potential (climbing back up hill). Since you are making things unstable again, you have to put in energy. This is known as a______________________________________.

BOND ENERGY:

- Usually measured in kilojoules.
- A good indicator of…

SO WHY DON'T ALL ELEMENTS TYPICALLY FORM COMPOUNDS?

- The noble gases have ____.
- They start stable, so they are **inert**.
- Gold does not have a full valence shell, but it does have a strong hold on its electrons, making it unreactive. (Note: It is not completely inert! It'll form compounds with certain substances, like certain halogens).

THERE ARE TWO MAIN TYPES OF COMPOUNDS...

CONNECT, QUESTION, REFLECT

TYPE ONE: IONIC COMPOUNDS:

- Formed when...
- The oppositely charged ions come together to form an ionic bond.

  ex)
- Sodium wants to…
- **SAY IT WITH SYMBOLS:**
- Chlorine wants to…
- **SAY IT WITH SYMBOLS:**
- The ions come together to form the ionic compound:
- **SAY IT WITH SYMBOLS:**

TYPE ONE: MOLECULAR/COVALENT COMPOUNDS:

- Not all atoms will...
- Some will instead __________________ electrons to gain a full valence shell.
- Often these involve group 14 (carbon's family) or two non-metals bonding.

  ex)

THE DIFFERENCE BETWEEN THESE COMPOUND TYPES WILL DRIVE MUCH OF WHAT WE COVER IN CHEMISTRY THIS YEAR!

DID YOU KNOW: Back in 1834, Michael Faraday discovered that metals could enter a solution at one electrode and a new metal would plate out on the other electrode. He named this mysterious, mobile species after the Greek word for 'ióv' (going) and, hence, the term 'ion' was born!

In 1916, Gilbert N. Lewis modeled certain chemical bonds as a sharing of electron pairs between atoms. This model (known as Lewis Dot Structure) is still used in chemistry classrooms to this day. In 1919, Irving Langmuir coined the term 'covalence' to 'denote the number of pairs of electrons that a given atom shares with its neighbors.'

So the term 'covalent' comes from the term 'covalence' which means to share valence electrons!

"Be kind. Everyone you meet is fighting a hard battle." ~ John Watson

IN-CLASS – COMPOUNDS: AN INTRODUCTION

PLEASE DO NOW!

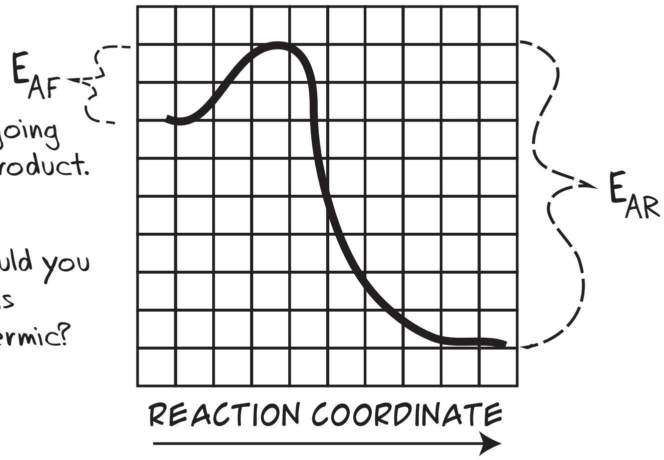
You are illustrating a chemistry book for elementary school students. Draw a diagram that differentiates covalent and ionic bonding. Label three important parts of each drawing and be sure to include the term 'valence electrons'.

After you are done, turn and explain your drawings to a partner.

Write down one question you still have about chemical compounds.

"I daresay one profits more by the mistakes one makes off one's own bat than by doing the right thing on somebody's else advice." - W. Somerset Maugham

Many reactions can be looked at from the other direction. (You could start with the products and turn them back into reactants.) Like everything else in chemistry, it still needs to obey the law of conservation of energy.



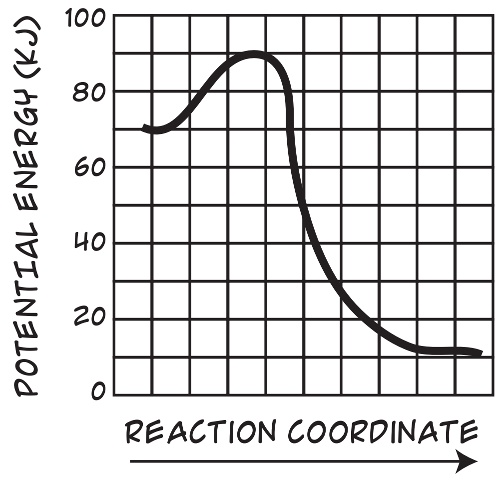
Activation energy going from reactant to product.

Activation energy going from product to reactant.

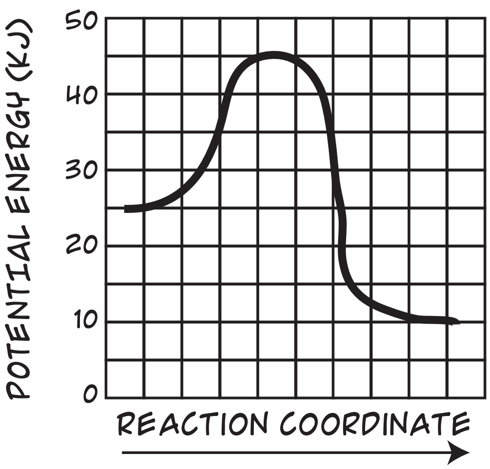
Going left to right, would you classify the reaction as exothermic or endothermic?

Going right to left, would you classify the reaction as exothermic or endothermic?

> A CATALYST is a substance that speeds up a reaction without being consumed by it. They do this by lowering the activation energy of a reaction. Biological catalysts are called...

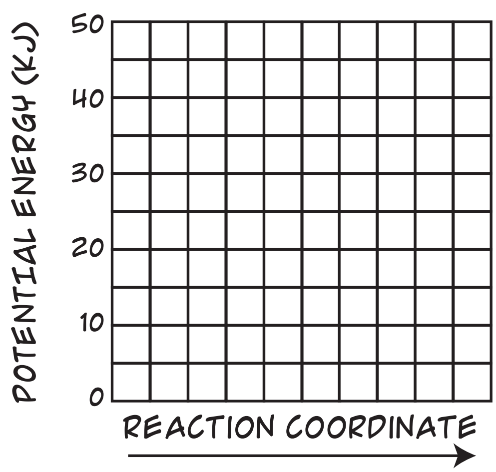


Redraw this curve to reflect a smaller activation energy, thanks to a catalyst. What did that do to the enthalpy of the reaction?



Given this diagram, what is the...
... potential energy of the reactants?
... potential energy of the products?
... activation energy?
... heat/enthalpy of reaction?
Is it exothermic or endothermic?

Draw the potential energy diagram for a reaction with a heat of reaction of + 30 KJ and an activation energy of 35 KJ.



A teacher is never a giver of truth; he is a guide, a pointer to the truth that each student must find for himself. I am not teaching you anything. I just help you to explore yourself."
-Bruce Lee

VIDEO – UNDERSTANDING IONIC COMPOUNDS

THIS VIDEO'S QR CODE:

BY THE END OF THIS LESSON YOU SHOULD BE ABLE TO…

…describe the basic structure of ionic compounds.

…explain how the crystal lattice structure affects the properties of salts.

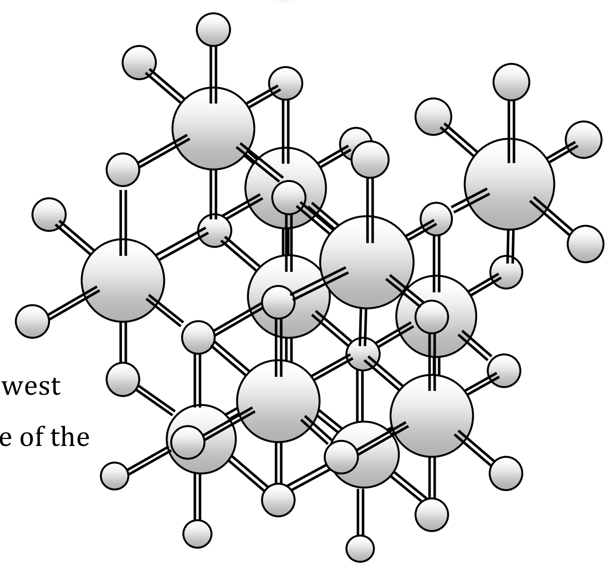
REVIEW: DEFINE THESE TERMS:

CONNECT, QUESTION, REFLECT

- **Cation:**
- **Anion:**

- Remember, ions form when atoms...
- The opposite charges of the ions attract each other and form an ionic compound.
- These are often just referred to as ____________________.
- The ions retain their individual charges, but the overall charge of the compound is ____________________.
- Much like____.
  ions in a compound retain their charges, but their charges cancel each other out.
- The chemical formula of an ionic compound represents the ________________, not the actual physical structure.

EXAMPLE: SODIUM CHLORIDE



- Each sodium ion is surrounded by...

- Each of which is surrounded by...

- This pattern continues on in all directions.
- The formula/name of this ionic compound represents the lowest common ratio of the ions and doesn't change despite the size of the crystal.

- **Crystal lattice:**
- It is an extremely stable structure, therefore has a ____________________.

- **Unit cell:**

- Sodium chloride is an example of just one type of lattice.
- Different unit cells are due mostly to different size ions fitting together.
- **Three basic types:**

simple cubic **body-centered cubic** **face-centered cubic**

CONNECT, QUESTION, REFLECT

4 FUNDAMENTAL THINGS YOU SHOULD KNOW ABOUT SALTS:

1. **Salts are ionic compounds that contain ions other H^+, OH^- or O^{2-} .**

2. **They are poor conductors of electricity unless dissolved or molten liquid. Why?**

Molten sodium chloride

Solid sodium chloride

(

Dissolved sodium chloride

CONNECT, QUESTION, REFLECT

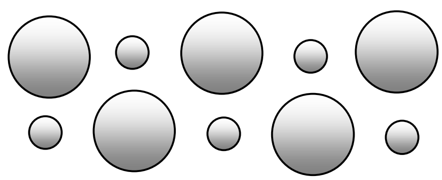
3. They do not melt or boil easily (i.e., at low temperatures).

Why?

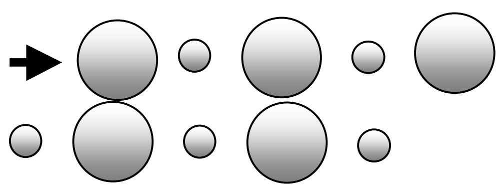
4. They are hard, yet brittle.

Why?

OPPOSITE CHARGES NEXT TO EACH OTHER INCREASES STABILITY.



SIMILAR CHARGES NEXT TO EACH OTHER CAUSES REPULSION.



DID YOU KNOW: There is a category of ionic compounds that melt at under 100° Celsius. This happens because the cation in an ionic liquid is typically some kind of giant, unwieldy organic monstrosity that cannot easily lock into the stable crystal lattice with the much smaller anion.

Discovered more than century ago, ionic liquids have been picking up a lot of steam over the decades. Their diverse and unique properties are driving the university and industrial research and application in fields as diverse as electrochemistry, inorganic chemistry, organic chemistry, analysis, biotechnology, green chemistry and clean technology.

(Application list from "An Introduction to Ionic Liquids" Michael Freemantle")

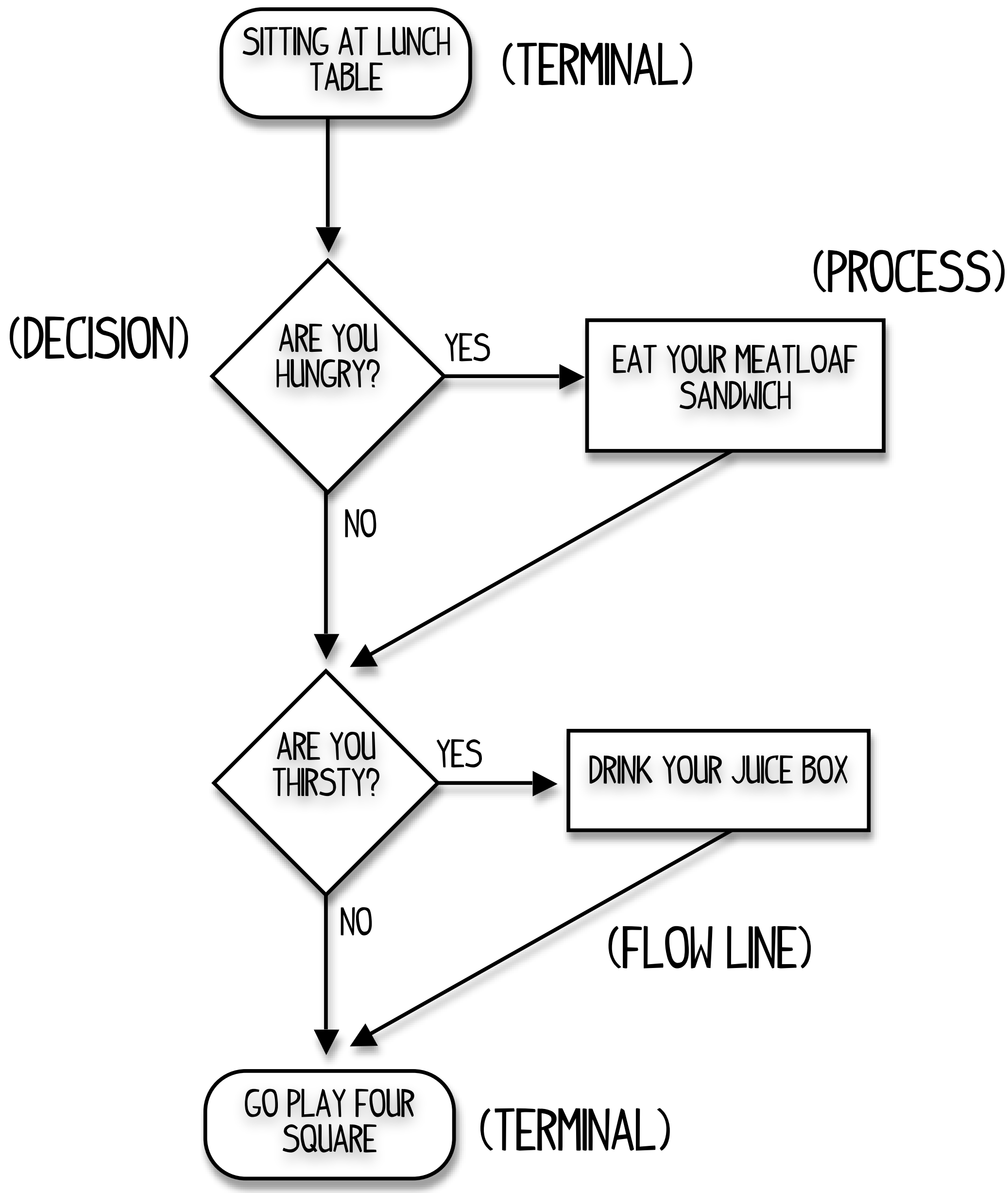
"If we did all the things we are capable of doing, we would literally astound ourselves." ~ Thomas Edison

IN-CLASS – NAMING FLOWCHART (PART 1)

An overarching goal of this unit is to create a reliable, consistent way to indentify and name (or identify and write the formula for) chemical compounds. We are going to use flowcharts to organize and analyze our ideas for naming.

Our flowchart will use the four elements: terminals (the beginning and end of the process), decisions (typically yes/no or true/false), processes (something that is done) and flow lines (showing the order of operations).

For example:



So now use this format to come up with a reliable flowchart for turning a binary ionic compound's name into a chemical formula. A good start is to list all decisions a student will have to make from start to finish:

You can be clever with your decision trees, but try to avoid having too many flow lines from one decision... often you're better off breaking that complex decision down into simpler ones!

NEED TO DETERMINE THE FORMULA FOR A BINARY IONIC COMPOUND FROM ITS NAME

When both you and a neighbor are done with your charts, share your thoughts. Feel free to incorporate good ideas into your own, but realize there are multiple paths to success.

"All human errors are impatience, a premature breaking off of methodical procedure, an apparent fencing-in of what is apparently at issue." ~ Franz Kafka

PRACTICE – NAMING IONIC COMPOUNDS (PART 1)

Write the symbols of these atoms (no charge):

1. Fluorine
2. Carbon
3. Strontium
4. Argon
5. Titanium
6. Polonium

Write the symbols and charges of these ions: ***(FYI: Although we are naming ions by themselves, ions never exist independent of their parent compounds… if there is a positive ion, then there will be a negative ion somewhere nearby.)***

1. Oxide
2. Sodium
3. Mercury (II)
4. Phosphide
5. Hydride
6. Cuprous
7. Nickelic
8. Aluminum

Write out the chemical formulas for these binary ionic compounds:

1. Cobalt (II) Iodide
2. Barium Chloride
3. Tungsten (VI) Oxide
4. Copper (II) Bromide
5. Potassium Sulfide
6. Beryllium Phosphide
7. Sodium Oxide
8. Manganous Oxide
9. Manganic Oxide
10. Aluminum Fluoride
11. Silver Chloride
12. Nickel (III) Chloride
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"We must trust to nothing but facts: these are presented to us by nature and cannot deceive. We ought, in every instance, to submit our reasoning to the test of experiment, and never to search for truth but by the natural road of experiment and observation." ~ Antoine Lavoisier

VIDEO – NAMING IONIC COMPOUNDS (PART 1)

THIS VIDEO'S QR CODE:

CONNECT, QUESTION, REFLECT

BY THE END OF THIS LESSON YOU SHOULD BE ABLE TO…

…review naming ions.

…write the formulas for monatomic ionic compounds, given the chemical name.

- **Monatomic ion:**

NAMING MONATOMIC ANIONS

- Drop the ending of the element and add '-ide'
  - Ex.) Br^{-} O^{2-}

NAMING MONATOMIC CATIONS

- If a cation has only one possible charge, then just read the name.
  - Ex.) Li^{+}

- If a cation has more than one possible charge, use roman numerals or suffixes to indicate the charge. This lets people know which ion is in your compound.
  - Ex.) Cu^{+} Cu^{2+}
  - Ex.) Mn^{2+} Mn^{4+}

NAMING IONIC COMPOUNDS (COMPOSED OF MONATOMIC IONS)

- Binary compound: A compound composed of only two elements.
- The cation is always written and named first.
  - Ex.)FeI_2 = iron (II) or ferrous iodide

- The subscripts indicate the ________________________________.
- No subscript means there is_______________ ion.
- Remember that ionic compounds must have _____________________________.
- Said another way, ionic compounds must be electrically neutral.
- The subscripts make sure that you have the right amount of each type of ion so that the charges balance each other out.

HOW DO YOU DETERMINE THE PROPER SUBSCRIPTS?

CONNECT, QUESTION, REFLECT

- **CRISS-CROSS METHOD:**

1. Write down the ion symbols (with charges) side by side, cation first.
2. Cross both superscripts down to the opposite subscripts.
3. Reduce the subscripts to the lowest common ratio if possible. Erase any '1's.

- Ex.) iron (II) iodide
- Ex.) manganese (IV) oxide

YOU DO NOT NEED CRISS-CROSS TO DETERMINE SUBSCRIPTS!

- Cross-Cross is simply a short cut you can use to make sure the charges balance out. It might be better to draw out the different ions to balance out charges...
- Ex.) iron (II) iodide Ex.) manganese (IV) oxide

- Ionic compounds are always written as ________________________________.
- These are the ______________________ ratio of atoms/ions in a compound.

WRITE DOWN THE CORRECT FORMULA TO THESE COMPOUNDS

- **Magnesium bromide**
- **Aluminum sulfide**
- **Chromic oxide**
- **Vanadium (III) chloride**
- **Titanium (IV) oxide**
- **Tungsten (VI) oxide**
- **Nickel (II) chloride**
- **Mercuric chloride**

"A hero is no braver than an ordinary person, but they are brave five minutes longer." ~ Ralph Waldo Emerson

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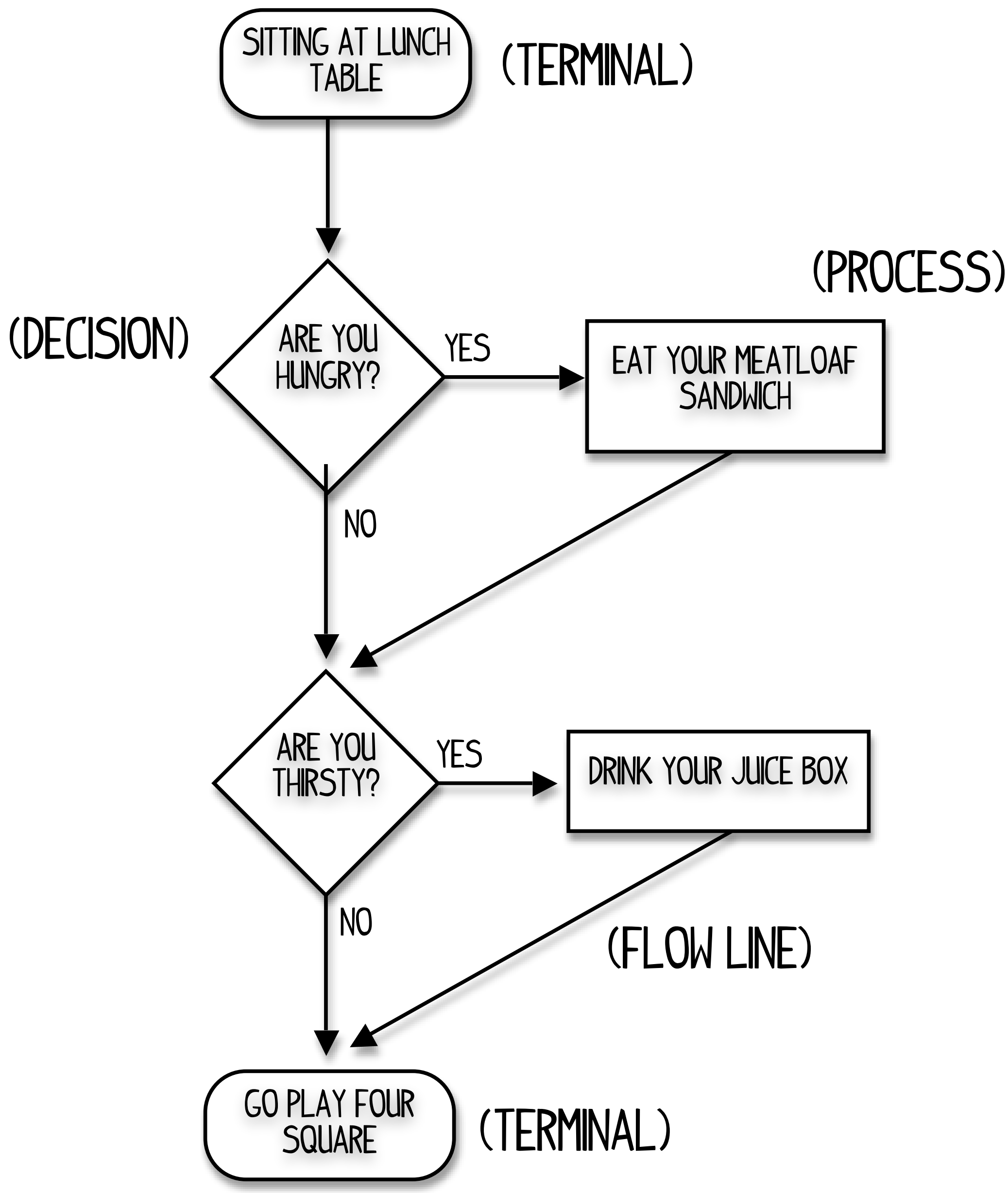

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VIDEO – NAMING IONIC COMPOUNDS (PART 2)

THIS VIDEO'S QR CODE:

CONNECT, QUESTION, REFLECT

BY THE END OF THIS LESSON YOU SHOULD BE ABLE TO…

…determine the formula name given a chemical formula.

REVIEW:

- Determine the chemical formula of vanadium (III) chloride:
- Determine the chemical formula of chromic oxide:

HOW TO GO FROM A CHEMICAL NAME FROM A CHEMICAL FORMULA:

Determining the name of a formula can be easy or slightly difficult…

- Does it avoid multiple-charge cations?
  - Simply …
  - Ex.) Al_2O_3 is named…
- Does it contain multiple-charge cations?
  - You'll need to …
  - WARNING: Reverse criss-cross will often fail you!

ONE TECHNIQUE: THE 'UP-OVER-DOWN' METHOD

1. UP:

2. OVER:

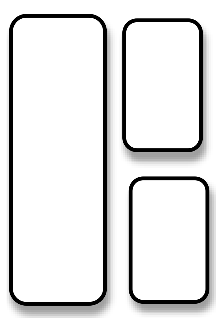
3. DOWN

Example…

$$MnO_2$$

FROM A DIFFERENT PERSPECTIVE…

- You can use the block balancing technique from the last lesson.

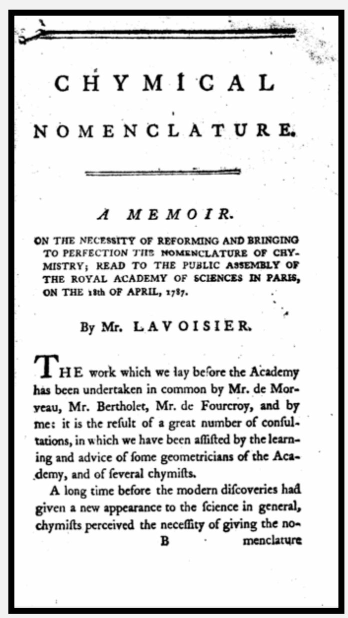


WRITE DOWN THE CORRECT NAMES TO THESE COMPOUNDS

- **PbO**
- **PbO_2**
- **Fe_3N_2**
- **FeN**
- **$CaCl_2$**
- **LiF**
- **$SnCl_2$**
- **$SnCl_4$**

DID YOU KNOW: As chemistry came into its own in the eighteen century, the need for a consistent naming convention became critical. In 1782 a French chemist named Louis-Bernard Guyton de Morveau published the first attempt at such a system. The famous Antoine Lavoisier collaborated with him and heavily promoted the idea in his equally famous textbook, "Chymical Nomenclature'.

Though a great start, the system struggled to fully incorporate many of the chemical discoveries of the coming century, including the amazing advances in organic chemistry (which was not covered in Guyton's original ideas). In 1892, 110 years after Guyton's original publication, many national chemistry societies convened in Geneva to create a more inclusive, robust standards of nomenclature.


CHYMICAL

NOMENCLATURE.

A MEMOIR.

ON THE NECESSITY OF REFORMING AND BRINGING TO PERFECTION THE NOMENCLATURE OF CHYMISTRY; READ TO THE PUBLIC ASSEMBLY OF THE ROYAL ACADEMY OF SCIENCES IN PARIS, ON THE 18th OF APRIL, 1787.

By Mr. LAVOISIER.

THE work which we lay before the Academy has been undertaken in common by Mr. de Morveau, Mr. Bertholet, Mr. de Fourcroy, and by me: it is the refult of a great number of confultations, in which we have been affifted by the learning and advice of fome geometricians of the Academy, and of feveral chymifts.

A long time before the modern difcoveries had given a new appearance to the fcience in general, chymifts perceived the neceffity of giving the no-

B menclature

After World War I, the new International Union of Pure and Applied Chemistry (IUPAC) became (in their own words) "the universally-recognized authority on chemical nomenclature and terminology." To this day the IUPAC sees it as one of their major goals to "develop recommendations to establish unambiguous, uniform, and consistent nomenclature and terminology for specific scientific fields." (Check out the cool stuff at iupac.org.)

"I don't necessarily agree with everything I say." ~ Marshall McLuhan

IN-CLASS – NAMING FLOWCHART (PART 2)

Time to continue our flowchart focusing on how to take a chemical formula and determine the name. As before, a good start is to list all decisions a student will have to make from start to finish:

Now use those questions to create a robust flowchart that handles the information from this lesson.

When both you and a neighbor are done with your charts, share your thoughts. Feel free to incorporate good ideas into your own, but realize there are multiple paths to success.

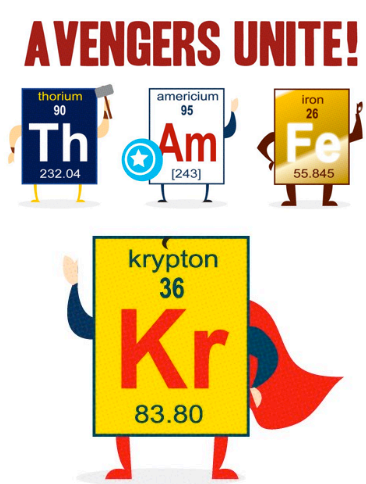
"All human errors are impatience, a premature breaking off of methodical procedure, an apparent fencing-in of what is apparently at issue." ~ Franz Kafka

PRACTICE – NAMING IONIC COMPOUNDS (PART 2)

What is the danger of reverse criss-crossing to determine the charge of component ions?

Write out the names for these binary ionic compounds:

1. FeI_3
2. TiN
3. Mg_3N_2
4. TiO_2
5. $ZnBr_2$
6. NiF_3
7. Tl_2S_3
8. K_2O
9. Mn_3N_4
10. CaS
11. CaS
12. $CrCl_3$
13. $CrBr_2$
14. CrS_2
15. AgBr
16. CsCl
17. PbO
18. Pb_3P_2
19. KF
20. FeS



Pick two of the compounds above. Show visually how the ratio of positive and negative charges balance out.

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IN-CLASS – NAMING FLOWCHART (PART 3)

Time to continue our flowchart focusing on how to incorporate polyatomics into nomenclature. As before, a good start is to list all decisions a student will have to make from start to finish:

Now use those questions to create robust flowchart that handles the information from this lesson.

WRITE THE FORMULA FOR A COMPOUND CONTAINING A POLYATOMIC GIVEN THE NAME

WRITE THE NAME OF A COMPOUND CONTAINING A POLYATOMIC GIVEN THE FORMULA

When both you and a neighbor are done with your charts, share your thoughts. Feel free to incorporate good ideas into your own, but realize there are multiple paths to success.

"The scarcest resource is not oil, metals, clean air, capital, labor, or technology. It is our willingness to listen to each other and learn from each other and to seek the truth rather than seek to be right." - Donella Meadows

IN-CLASS – GETTING TO KNOW THE POLYATOMICS

There are many non-metals commonly associated with polyatomics. But are there any patterns that could help memorize the charges and number oxygen atoms associated with the default form (-ate)?

For each of the elements listed below, research the proper formula and charge of its –ate polyatomic and write it in the space provided above the element. *(5 minutes)*

B	C	N	O	F
	Si	P	S	Cl
		As	Se	Br
				I

Find a trends/patterns that you notice that might help you memorize the formulas of these polyatomics and write it in the space below. *(5 minutes)*

TURN and TALK: Try to find someone who noticed something different. Write their observation in the space below. *(5 minutes)*

"Nature uses only the longest threads to weave her patterns,
so that each small piece of her fabric reveals the organization of the entire tapestry."
- Richard P. Feynman

PRACTICE – NAMING IONIC COMPOUNDS (PART 3)

Make up your own –ate polyatomic with a fake element, at least 3 oxygens and any negative charge. Then name and write out the formulas for the other three possible forms (i.e. more or less oxygen atoms).

Given these compounds, can you figure out what the prefixes 'bi-' and 'thio-' mean?

Sodium carbonate – Na_2CO_3

Sodium bicarbonate – $NaHCO_3$

Calcium cyanate – $Ca(CNO)_2$

Calcium thiocyanate – $Ca(SCN)_2$

Write out the chemical formulas or names of these compounds:

1. Ammonium bisulfate
2. Beryllium hydroxide
3. Stannic borite
4. Silver permanganate
5. Lithium hypobromite
6. Gallium chlorate
7. Manganic oxalate
8. Titanium (IV) peroxide
9. Hydrogen cyanide
10. NH_4NO_2
11. Cu_3AsO_4
12. $Pb(C_2H_3O_2)_2$
13. $FeCr_2O_7$
14. $Cd(NO)_2$
15. $Cr(ClO_4)_3$
16. SrS_2O_3
17. $Zn(IO_4)_2$
18. Hg_2O

"Everyone needs help from everyone." - Bertolt Brecht

VIDEO – COMPOUNDS: NAMING ACIDS

THIS VIDEO'S QR CODE:

CONNECT, QUESTION, REFLECT

BY THE END OF THIS LESSON YOU SHOULD BE ABLE TO…

… name and write the chemical formula for inorganic acids.

BASIC THINGS THAT YOU SHOULD KNOW ABOUT ACIDS:

- Considered molecule with one or more ______________ attached to the anion.
- Assume acids are found dissolved in ________________________________ .
- Acids break part in water to release ________________________________ .
- This is also known as ____________ and is the key to understanding acids.

YOU NEED TO BE ABLE TO DIFFERENTIATE TWO TYPES OF ACIDS:

ACIDS THAT DO NOT CONTAIN OXYGEN:

- The prefix ___________ and the suffix __________ are attached to the anion.
  - e.g.) HCl exists as the ionic compound _____________________ but when dissolved in water becomes ___________________.
  - e.g.) H_2S exists as the covalent compound ______________________________ but when dissolved in water becomes __________________________.
- Typically originate from monatomic anions, but occasionally from a non-oxygen containing polyatomic. CN^- (cyanide) becomes ________________________.

ACIDS THAT CONTAIN OXYGEN (ARE POLYATOMICS):

- If the polyatomic ends in '-ate' then the acid gets the suffix _________________.
  - e.g.) H_2SO_4 Polyatomic base is *sulfate*, so the acid is called _______________.
- If the polyatomic ends in '-ite' then the acid gets the suffix __________________.
  - e.g.) H_2SO_3 Polyatomic base is *sulfite* so the acid is called _________________.
- If the polyatomic has a prefix, the acid will also!
  - e.g.) Hypochlorite (ClO^-) would become ______________________.

PRACTICE: WRITE THE CORRECT CHEMICAL FORMULAS:

- **Hydroiodic acid**
- **Iodic acid**
- **Iodous acid**
- **Periodic acid**
- **Hypoiodous acid**
  - ***NOTE ONE:*** the number of hydrogen ions at the beginning of the acid must balance out (and therefore equal) the negative charge of the anion.
  - ***NOTE TWO:*** Since hydrogen only has a +1 charge, you'll never need more than one anion. This means that you shouldn't see parentheses in a typical acid.

PRACTICE: WRITE THE CORRECT CHEMICAL NAMES:

- **H_2SO_4**
- **HCl**
- **HNO_3**
- **H_3PO_4**
- **$HC_2H_3O_2$**
- ***NOTE:*** *You should commit these common acids to memory.*

DID YOU KNOW: Sulfur and phosphorus containing acids have some tricky nomenclature…

- H_2S is hydrosulfuric acid and not hydrosulfic acid as predicted from the anion sulfide.
- H_2SO_4 is sulfuric acid… not sulfic acid, as one might predict.
- H_3P is hydrophosphoric acid… not hydrophosphic acid as predicted from phosphide.
- H_3PO_4 is phosphoric acid not phosphic acid.
- H_3PO_2 is named phosphorous acid and is commonly misspelled since elemental phosphorus ends in –us as opposed to –ous. (Get ready to start misspelling phosphorus now too. ☹)

"How poor are they who have not patience! What wound did ever heal but by degrees."
~ William Shakespeare

IN-CLASS – NAMING FLOWCHART (PART 4)

Time to continue our flowchart focusing on the changes necessary to properly account for acids. As before, a good start is to list all decisions a student will have to make from start to finish:

Now use those questions to create robust flowchart that handles the information from this lesson.

WRITE THE FORMULA FOR AN ACID THAT DOES NOT CONTAIN OXYGEN GIVEN THE NAME

WRITE THE NAME OF AN ACID THAT DOES NOT CONTIAN OXYGEN GIVEN THE FORMULA

On the back, incorporate oxygen into your flowcharts.

WRITE THE FORMULA FOR AN ACID CONTAINING OXYGEN GIVEN THE NAME

WRITE THE NAME OF AN ACID CONTAINING OXYGEN GIVEN THE FORMULA

When both you and a neighbor are done with your charts, share your thoughts. Feel free to incorporate good ideas into your own, but realize there are multiple paths to success.

"Tragedy is like strong acid - it dissolves away all but the very gold of truth." - D. H. Lawrence

PRACTICE - NAMING ACIDS

Manticolium (Ma) has been discovered! Fill out the missing information…

Ion name	Ion formula	Acid name	Acid formula
Manticolide	Ma^{2-}		
Permanticolate			
Manticolate	MaO_4^{3-}		
Manticolite			
Hypomanticolite			

Write out the chemical formulas or names of these acids:

1. HBr
2. $HClO_2$
3. H_2CO_3
4. HI
5. $HBrO_4$
6. HIO_2
7. $HCNO_2$
8. H_3AsO_4
9. HNO
10. Nitrous Acid
11. Phosphoric acid
12. Perchloric acid
13. Hydrofluoric acid
14. Cyanic acid
15. Hydrosulfuric acid
16. Oxalic acid
17. Acetic acid
18. Sulfurous acid

"The only rule is work. If you work it will lead to something. It's the people who do all of the work all the time who eventually catch on to things." ~ Corita Kent

- The naming system for ionic compounds is often called the *Stock System.*
- The naming system for covalent compounds is often called the *Prefix System.*

HOW TO NAME COVALENT COMPOUNDS:

- Prefixes represent *number of each element present (noted by the subscript)*
- This is different than ionic compounds where *numbers refer to cation charges.*

PREFIX	# OF ATOMS	PREFIX	# OF ATOMS
MONO-	1	DI-	2
TRI-	3	TETRA-	4
PENTA-	5	HEXA-	6
HEPTA-	7	OCTA-	8
NONA-	9		

- Note: Final 'a' or 'o' of prefix often dropped if the second element is oxygen.
- If only one atom of first element is present, then the 'mono-' prefix is omitted.
- '-ide' suffix used same as in ionic compounds.

PRACTICE: WRITE THE CORRECT CHEMICAL NAMES:

- **CCl_4** *carbon tetrachloride*
- **SO_2** *sulfur dioxide*
- **SO_3** *sulfur trioxide*
- **ClF_3** *chlorine trifluoride*
- **PCl_3** *phosphorus trichloride*

PRACTICE: WRITE THE CORRECT CHEMICAL FORMULAS:

- **Arsenic pentafluoride** AsF_5
- **Silicon dioxide** SiO_2
- **Bromine trifluoride** BrF_3
- **Carbon monoxide** CO
- **Dintrogen pentoxide** N_2O_5

"My grandfather once told me that there are two kinds of people: those who work and those who take the credit. He told me to try to be in the first group; there was less competition there." ~ Indira Gandhi

VIDEO – COMPOUNDS: THE COVALENT KIND

THIS VIDEO'S QR CODE:

CONNECT, QUESTION, REFLECT

BY THE END OF THIS LESSON YOU SHOULD BE ABLE TO…

… differentiate covalent from ionic compounds.

... name covalent compounds correctly.

LET'S REVIEW A FEW THINGS:

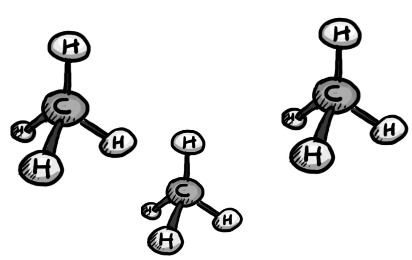
- Ionic compounds are formed when atoms ________________________.
- Those ions obtain stable octets and are attracted to each other's opposite charges forming ____________________.
- Usually happens between ________________________.
- Ionic bonds are not the only type of chemical bond that atoms can form.

SO WHAT IS A COVALENT BOND?

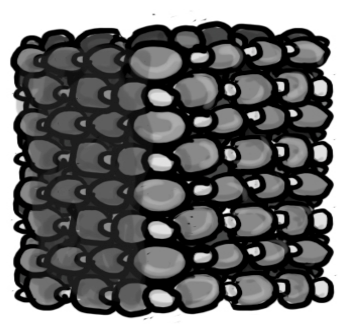
- A type of chemical bond that forms when atoms...
- NOTE! They are NOT transferring the electrons like ionic bonds do.

SO WHAT IS A COVALENT (A.K.A. MOLECULAR) COMPOUND?

- A substance consisting of atoms that are ______________________.
- Typically occur between ____________________.
- Neither atom is strong enough to pull the electrons away from the other, so ...
- They exist as ___________________ not as unit cells in some crystal lattice!
- This simple fact has gigantic ramifications for a covalent compound's properties.



MOLECULAR COMPOUNDS
DISCRETE, INDEPENDENT SPECIES

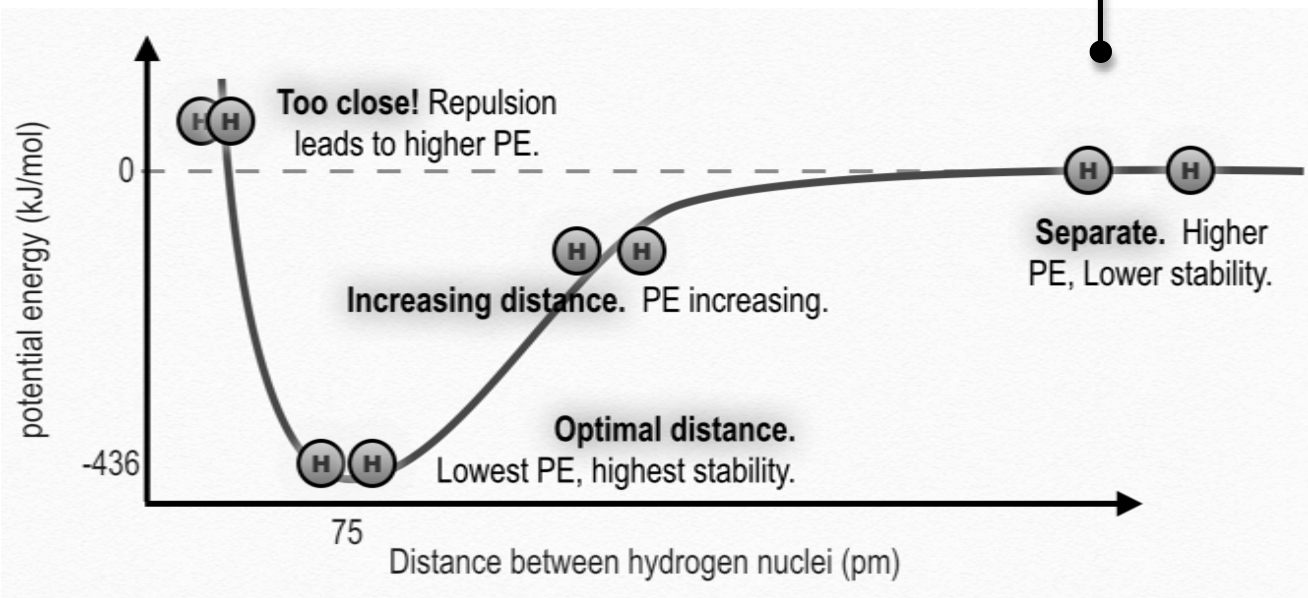


IONIC COMPOUND
GIANT INTERCONNECTED LATTICE

WHAT HAPPENS WHEN SOMETHING FORMS A COVALENT BOND?

- Electrons from one atom attract protons from other atom and vice-versa.
- Electrons from one atom repels electron from other atom.
- The nuclei also repel each other.
- These forces balance out, finding an optimal distance with the...

- Covalent bonds are more flexible than ionic.
- Can be stretched or compressed, but will return to optimal length.



IONIC & COVALENT COMPOUNDS HAVE REALLY DIFFERENT PROPERTIES

- **For example: why do ionic compounds have a higher melting point than covalent compounds?**
  - Ionic compounds have ___________________________________.
  - To melt/boil an ionic compound you have to ...
  - Covalent compounds can have strong internal bonds, but ...
  - To melt/boil a covalent compound you only have to ...
  - So when you boil water, you aren't breaking any chemical bonds, just the physical attraction between the individual water molecules.
- The naming system for ionic compounds is often called the __________________.
- The naming system for covalent compounds is often called the __________________.

HOW TO NAME COVALENT COMPOUNDS:

- Prefixes represent ____.
- This is different than ionic compounds where ______________________________.

PREFIX	# OF ATOMS	PREFIX	# OF ATOMS
MONO-		DI-	
TRI-		TETRA-	
PENTA-		HEXA-	
HEPTA-		OCTA-	
NONA-			

- Note: Final 'a' or 'o' of prefix often dropped if the second element is oxygen.
- If only one atom of first element is present, then the 'mono-' prefix is omitted.
- '-ide' suffix used same as in ionic compounds.

PRACTICE: WRITE THE CORRECT CHEMICAL NAMES:

- **CCl_4**
- **SO_2**
- **SO_3**
- **ClF_3**
- **PCl_3**

PRACTICE: WRITE THE CORRECT CHEMICAL FORMULAS:

- **Arsenic pentafluoride**
- **Silicon dioxide**
- **Bromine trifluoride**
- **Carbon monoxide**
- **Dintrogen pentoxide**

"My grandfather once told me that there are two kinds of people: those who work and those who take the credit. He told me to try to be in the first group; there was less competition there." ~ Indira Gandhi

PRACTICE – NAMING COVALENT COMPOUNDS

1. Practice naming these compounds:

Chlorine trifluoride

Phosphorus pentachloride

Sulfur dioxide

Dinitrogen pentoxide

Nitrogen dioxide

Dioxygen difluoride

Sulfur hexafluoride

Selenium monoxide

Dihydrogen monoxide

BrF_5

S_2F_2

CO

CI_4

$SeCl_2$

SO_3

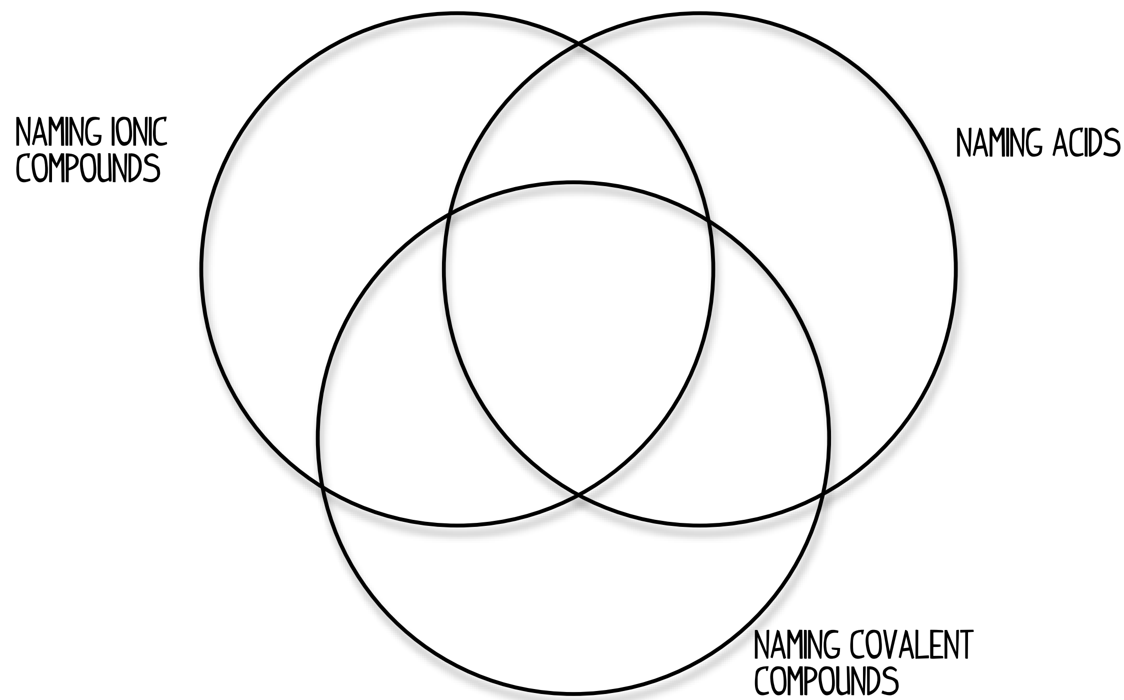
SiO_2

CS_2

XeF_6

2. Find the melting and boiling points of an ionic compound and a covalent compound. What accounts for those differences?

3. Come up with at least one thing for each part of this Venn diagram.



4. When a compound starts with a metal it's probably a:

5. When a compound starts with a non-metal it's probably a:

6. When a compound starts with hydrogen it's probably a:

"What's in a name? That which we call a rose
By any other name would smell as sweet."
— William Shakespeare

IN-CLASS – NAMING FLOWCHART (PART 5)

Time to continue our flowchart focusing on the changes necessary to properly name and write formulas for covalent compounds. As before, a good start is to list all decisions a student will have to make from start to finish:

Now use those questions to create robust flowchart that handles the information from this lesson.

WRITE THE FORMULA OF A COVALENT COMPOUND GIVEN THE NAME

WRITE THE NAME OF A COVALENT COMPOUND GIVEN THE FORMULA

On the back, you think about the decisions necessary to determine what kind of compound you have so you can determine which naming flowchart you'll use from that point.

So before you can name or determine the formula, you'll have to determine what kind of chemical is before you. How do you know whether something is a molecular/covalent compound, an ionic compound or an acid? As before, a good start is to list all decisions a student will have to make from start to finish:

Now use those questions to create robust flowchart that handles these decisions.

CATEGORIZE AN UNKNOWN COMPOUND AS IONIC, COVALENT OR ACID

"Tigers die and leave their skins; people die and leave their names." – Japanese Proverb

IN-CLASS – CAPSTONE NAMING ACTIVITY

Over the last several days you have been creating small flowcharts to cover different parts of nomenclature:

- Determining the type of compound
- Binary ionic compounds: name to formula / formula to name
- Polyatomic containing compounds: name to formula / formula to name
- Determining how to name a polyatomic with a different number of oxygen atoms in it
- Acids that do not contain oxygen atoms: name to formula / formula to name
- Acids containing oxygen atoms: name to formula / formula to name

Partner up with someone else in class. One of you will be responsible for making an all-inclusive flowchart that covers ANY name to the proper chemical formula. The other one will be responsible for making a flowchart that covers ANY formula to the proper chemical name.

You are encouraged to mirror each other's work, but modify your flowchart to deal with the challenges of your take on nomenclature.

This is a three-day project:

- Day one: Brainstorm rough draft
- Day two: Work on complete copy (due at the end of class)
- Day three: Switch and use charts

On day three, your chart will be given to someone else in another class. They will attempt to use your chart in some practice problems. They will write on your chart and problems and/or feedback.

You will be given time to incorporate those changes and turn in a final copy.

"My model for business is The Beatles: They were four guys that kept each others' negative tendencies in check; they balanced each other. And the total was greater than the sum of the parts." – Steve Jobs