Naming Compounds and Writing Formulas

Ionic Bonding

- I can define a cation and identify the types of elements that form cations.
- I can define an anion and identify the types of elements that form anions.
- I can describe an ionic compound and identify the properties of an ionic compound.
- I can draw Lewis Dot Structures for ionic compounds.

Review

- Why do atoms bond?
- Which elements are all atoms trying to be like?
- What are the two types of bonds?
- What happens to the electrons in each type of bond?

- There are two main types of bonds.
  - Ionic bonds are formed by transferring electrons.
  - Covalent bonds are formed by sharing electrons.

- Covalent bonds form between two nonmetals.
- The purpose of sharing electrons is to fill the valence shell of electrons to become like the Noble gases.

Review

- What are ions?
- How do atoms become ions?
- What kinds of ions do metals form? Nonmetals?

- In an ionic bond, a positively charged ion is attracted to a negatively charged ion.
- In other words, a metal is bonded to a nonmetal.
- Metals form positive ions.
- Nonmetals negative ions.

Ionic or Covalent?

- To identify whether or not a compound is ionic or covalent, you need to look at the first element in the bond.
- If the first element is a metal, then the bond is _____.
- If the first element is a nonmetal, then the bond is _____.

Ionic or Covalent

- Remember metals are to the left of the staircase.
- Also, please remember that hydrogen is a nonmetal that acts like a metal.

Ionic or Covalent?

Identify the following as an ionic or covalent bond:

_____ NaCl

_____ CO

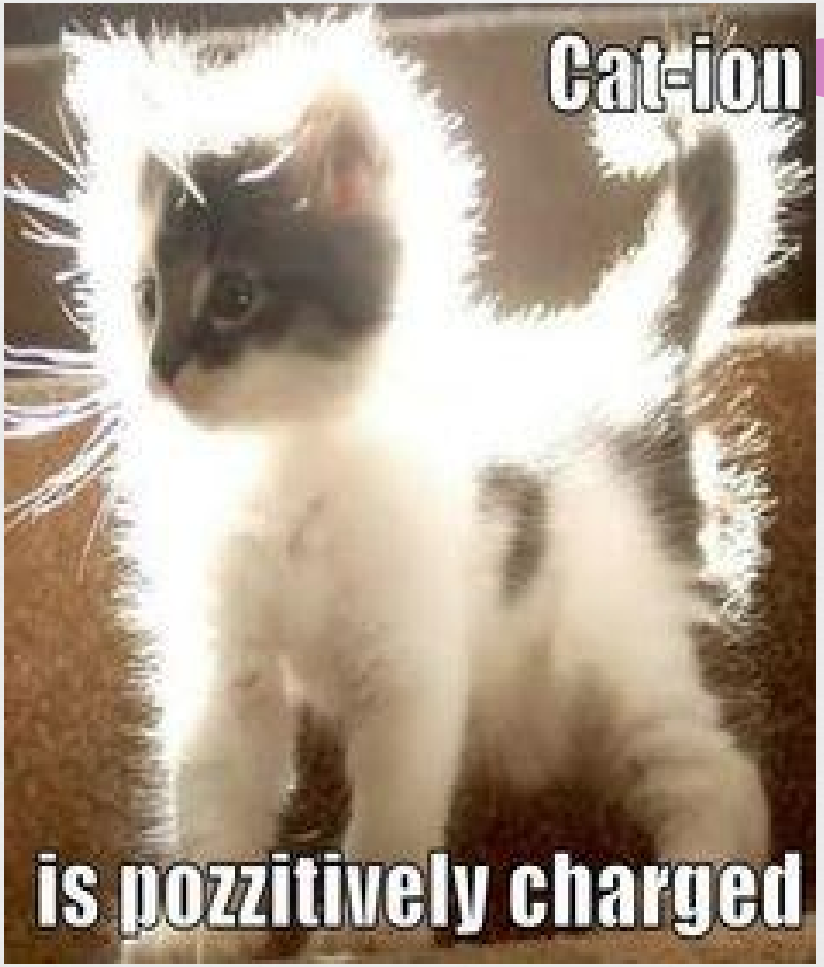
_____ H_2O

_____ MgO

_____ NO

_____ AlP

- A compound composed entirely of ions is called an ionic compound.
- All ionic compounds consist of a cation and an anion.
- A cation is another name for a positive ion.
- An anion is another name for a negative ion.


Cat-ion
is pozzitively charged

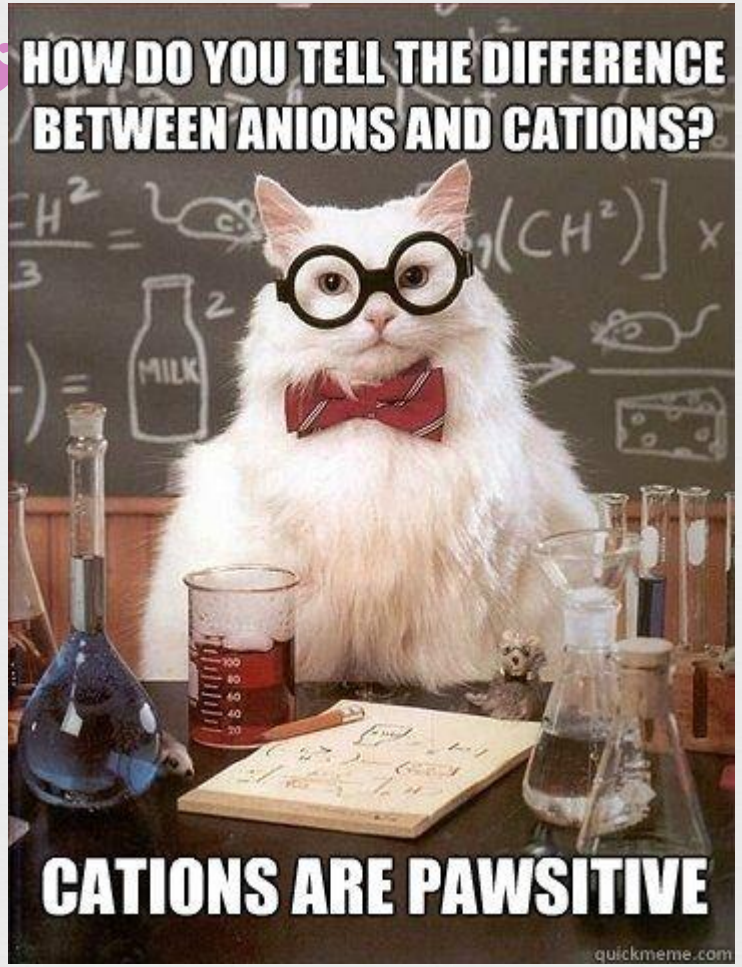

HOW DO YOU TELL THE DIFFERENCE BETWEEN ANIONS AND CATIONS?
CATIONS ARE PAWSITIVE
quickmeme.com

Table Talk

If ionic compounds are made out of ions, what do you think their overall charge is? Why?

- Ionic compounds are electrically neutral.
- Properties of ionic compounds include: high melting points, brittle solids, conduct electricity when dissolved in water.

Review

- What is the charge of Na?
- How do you know?
- What is the charge of N?
- How do you know?
- What is the charge of Fe?
- How do you know?

Octet Rule

- The representative elements form a pattern for forming ions.
- The octet rule states that atoms tend to gain, lose, or share electrons to gain a full set of valence electrons.

Octet Rule

- Most elements follow the octet rule, but transition metals do not.
- This explains why they form more than one ion.

Table Talk

Which electrons do you think participate in bonding? Why?

Valence Electrons

- The valence electrons are the only electrons that participate in bonding, they are the stars of the show!
- A Lewis Dot Diagram shows only the valence electrons for an atom.

Lewis Dot Diagrams

- Draw the Lewis Dot diagram for Na.

- Draw the Lewis Dot diagram for Cl.

Table Talk

- Using the Lewis Dot diagrams, predict how Na and Cl will react with each other.

Octet Rule

- Sometimes ionic bonding requires more than one ion of an element to complete the octet.
- How many electrons does oxygen need to complete the octet?

Octet Rule

- If oxygen reacts with potassium, how many electrons would oxygen gain?
- Is that enough?
- What is a possible solution to the problem?

Draw the reaction of oxygen and potassium using Lewis Dot Structures.

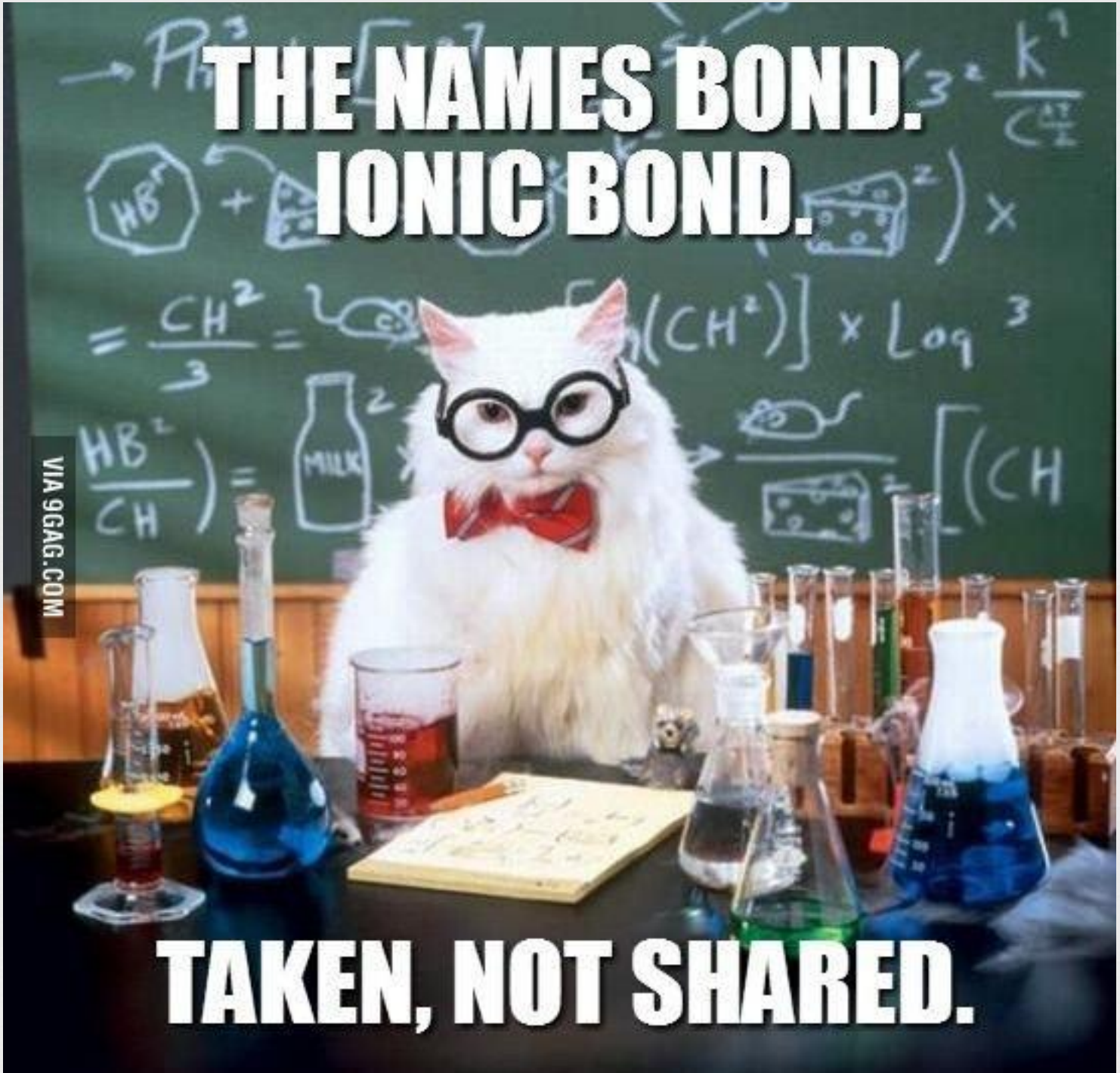
- The number of atoms required to bond is determined by how many electrons are needed to fulfill the octet rule.

Review Questions

1. Compare and contrast ionic and covalent bonds.
2. How can you tell if a compound contains an ionic or covalent bond?
3. What is a cation?
4. What types of elements form cations?
5. What is an anion?
6. What types of elements form anions?
7. Draw the reaction between sodium and phosphorus using Lewis Dot Structures.

Monatomic and Polyatomic Ions

- I can define a monatomic and polyatomic ion.
- I can name ionic compounds.


THE NAMES BOND.
IONIC BOND.
VIA 9GAG.COM
TAKEN, NOT SHARED.

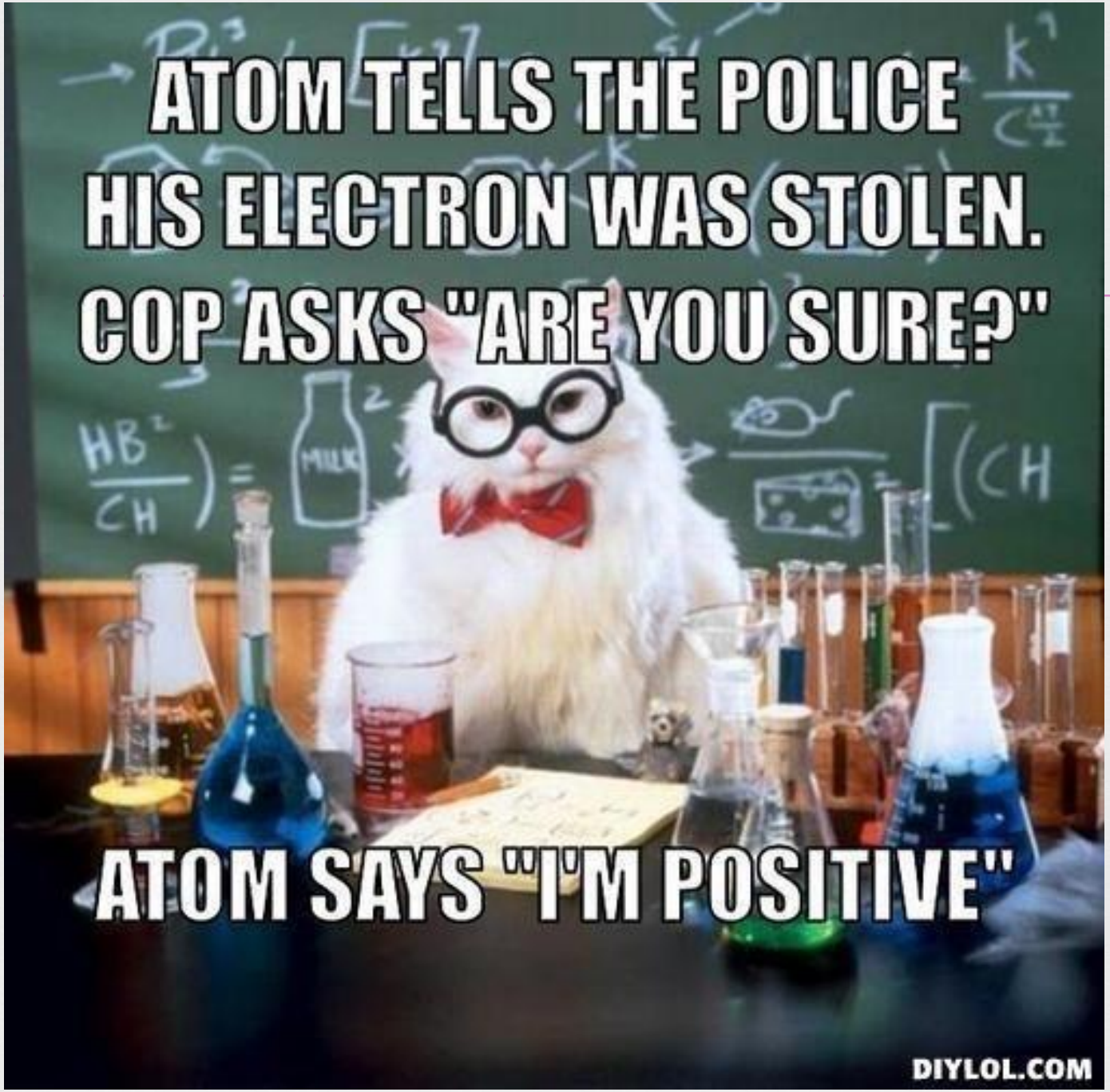
- What does the prefix mono- mean?
- How many atoms are in monoatomic ions?
- What is a cation?
- What is the name of the compound NaCl?
- Brainstorm with your table some compounds you might know.

Ions

- Monatomic ions are one atom ions.
- Polyatomic ions are made of more than one atom.
- Monatomic ions in group 1A, 2A, and 3A form positive ions.

Think about it!

- In the compound NaCl, how did we name the first element?
- In the compound MgO, how would you expect to name the first element?


ATOM TELLS THE POLICE
HIS ELECTRON WAS STOLEN.
COP ASKS "ARE YOU SURE?"
ATOM SAYS "I'M POSITIVE"
DIYLOL.COM

Positive Ions

- Positive ions are called cations.
- These ions are named based on the name of their elements, straight off the periodic table.
  - Example:
    - Ca^{+2}
    - Na^{+1}

Transition Metals

- Transition metals form more than one type of ion.
- Iron will form a +2 or +3 ion.
- How will you be able to tell which iron ion is used in a compound?

- To name these types of ions, scientists add roman numerals in parentheses behind the name.
- The Roman numeral is equal to the charge.
  - Example: Fe^{+2} is Iron (II)

Think about it!

In the compound NaCl, how did we name the second element?

In the compound MgO, how would you expect to name the second element?

Anions

- Nonmetals form anions, or negative ions.
- To name an anion, you change the ending to –ide.
  - O^{-2} is oxide
  - P^{-3} is phosphide

Name the Anion

F^{-1} _____

S^{-2} _____

Br^{-1} _____

I^{-1} _____

Binary Compounds

- Binary compounds contain the ions of only two elements.
- Therefore, they will have a first and a last name, but never a middle name.

- Remember that element symbols start with a capital letter. Each capital represents a new element.
- The cation (+) is written first, followed by the anion (-).

Examples

KCl _____

BaF_2 _____

MgO _____

$AlCl_3$ _____

Practice with your table

NaF _____

$CaCl_2$ _____

SrS_____

GaF_3 _____

What's different?

Below is a list of ionic compounds, what is different about them compared to what we learned yesterday?

barium phosphate

calcium chlorite

sodium nitrite

lithium acetate

- In addition to monatomic ions, there are also polyatomic ions.
- Polyatomic ions are made of more than one atom.
- They participate in ionic bonding as well.

- If you have more than two elements in an ionic bond, you will need to identify the polyatomic ion in the bond.

  ***Hint: Look for the total number of capital letters. If you have more than 2, you have a polyatomic ion to deal with.

- There is only one positive polyatomic ion, which is NH_4^{+1} or ammonium.
- All of the other polyatomic ions are anions (negative ions).
- In a compound, the anion is written second.

Polyatomic Ions

- To name compounds with polyatomic ions, you put the cation first, followed by the name of the polyatomic ion.
- The exception to this rule is ammonium because it is a positive polyatomic ion.

Polyatomic ions

- Ammonium is written first, followed by the negative ion.
- The majority of the time, the polyatomic ion will come second.
- The name of the polyatomic ion does not change, and comes straight off the chart.

Examples:

- Na_2SO_4 _____.
- NH_4F _____.
- $Mg(NO_3)_2$ _____.

Practice with your table

- $MgPO_4$ _____.
- Na_2SO_3 _____.
- $Ca(OH)_2$ _____.

Review Questions

1. What is written first in an ionic bond: cation or anion?
2. What is the only positive polyatomic ion?
3. How does a monatomic ion compare to a polyatomic ion?
4. How do you name cations?
5. How do you name anions?
6. When do you need to look for a polyatomic ion?

Writing Formulas for Binary Compounds

Notes

- I can write formulas for ionic compounds using the criss-cross method.

- The criss-cross method is used for writing formulas for ionic compounds.
- First, write the charges of the ions that make up the compound.
- silver (I) oxide

What do the charges need to add up to in the end?

Predict how you think that will happen.

- Next switch the charges of the two ions and bring them down to form the subscripts (numbers down low).

Example: $Ag^{+1}O^{-2}$

- Remove the positive and negative signs, and you are left with the formula for the compound.
- If a subscript is the number 1, you do not have to include it.
- What is the overall charge of ionic compounds?

- Remember that ionic compounds are neutral.
- If you multiply the subscripts and charges of each element and add them together, you should get 0.

Examples

Write the formula for the following ionic compounds:

sodium oxide _____

beryllium fluoride _____

calcium nitride _____

iron (II) chloride _____

Table Talk

Write the formulas for the following compounds

strontium bromide _____

potassium nitride _____

iron (III) oxide _____

aluminum phosphide _____

- If the charges are the same, they cancel out and no subscripts are needed.

Example

Write the formulas for the following:

Sodium chloride _____

Magnesium oxide _____

Aluminum Nitride _____

- Charges for the representative elements are the same as we talked about before.
- Charges for the transition elements are indicated by the number in parentheses and are always positive.

Example

- Iron (III) oxide _____
- silver chloride _____
- zinc (II) fluoride _____

- Writing formulas for ionic compounds with polyatomic ions requires knowing the charge of the polyatomic ion.
- If the anion does not end in -ide, you need to find the polyatomic ion on the chart.
- The only polyatomic ions that end in -ide are hydroxide and cyanide.

Write the formulas for the following:

sodium nitrate _____

magnesium sulfate _____

potassium hydroxide _____

- When writing formulas with polyatomic ions, if the charges do not cancel out, you need to add parentheses.
- You need to wrap the polyatomic ion up as a present.

- The number outside the parentheses tells you the number of polyatomic ions present.

Example

- Barium Nitrate _____
- Magnesium Hydroxide _____
- Aluminum Phosphate _____

Covalent Bonds

Notes

- I can describe a covalent bond.
- I can identify the types of elements that form covalent bonds.
- I can distinguish between a polar and nonpolar molecule.
- I can use electronegativities to determine polarity.

How are covalent bonds formed?

What types of elements form covalent bonds?

Covalent Bonds

- Covalent bonds are formed by sharing electrons.
- Covalent bonds form between two non-metals.
- Atoms united by covalent bonds form a molecule.

Covalent Bonds

- A substance formed by molecules is called a molecular substance.
- Atoms bonded with covalent bonds are often called molecular compounds.

In the following compound, how many hydrogen and oxygen atoms are present?

H_2O

How can you tell?

Molecular Formula

- A molecular formula tells you how many atoms are in a single molecule.
  - Examples:
    - O_2 =
    - $MgCl_2$ =

- What does the octet rule state?
- Do you think the octet rule applies to covalent bonds?
- How many electrons do you think a pair of atoms can share?

Octet Rule

- The octet rule describes covalent bonding just like ionic bonds.
- In a single bond, atoms share 1 electron.
- In a double bond, atoms share 2 electrons.
- In a triple bond, atoms share 3 electrons.

What would happen if atoms did not share electrons equally?

What is electronegativity?

Properties of Covalent Bonds

- Atoms are not always shared equally in covalent bonds.
- Atoms that are more electronegative pull harder on the electrons.
- When an unequal sharing of electrons occurs, molecules are polar.

Polarity

- In a polar bond, the atom with a higher electronegativity gains a slight negative charge.
- The atom with a lower electronegativity gains a slight positive charge.

- Nonpolar covalent bonds share electrons equally.

Electronegativity

Electronegativity Difference	Type of Bond
0.4 or less	Nonpolar
Between 0.4 and 2.0	Polar
2.0 and greater	Ionic

- Take the atom with the higher electronegativity and subtract the atom with the lower electronegativity.
- Look up the difference on the chart to determine the type of bond you have.

What type of bond is MgO?

What is magnesium's electronegativity?

What is oxygen's electronegativity?

What is the difference?

Type of bond _____

Examples

- Examples for electronegativity:
  - What type of bond is H_2O?
  - What type of bond is NaCl?
  - What type of bond is F_2?

Review Questions

1. How is a covalent bond formed?
2. True or false: covalent bonds follow the octet rule.
3. What happens in a polar bond?
4. What is electronegativity?
5. What happens to the electrons in a nonpolar covalent bond?

Naming Molecular Compounds

Notes

- I can name molecular compounds.

What is the difference between CO and CO_2?

How could they be named to account for the difference?

Naming

- Named similar to ionic compounds.
- Pre-fixes are added to distinguish between different compounds.
- Pre-fixes tell you how many atoms of each element are present in each molecule.

- The last element always ends in –ide.
- If there is a single atom of the first element, omit the mono- pre-fix.
- The vowel at the end of a pre-fix is often dropped if the name of an element begins with a vowel.

Name Examples

- Examples:
  - NO
  - NO_2

Pre-Fix	Meaning
Mono-	1
Di-	2
Tri-	3
Tetra-	4
Penta-	5
Hexa-	6
Hepta	7
Octa-	8
Nona-	9
Deca-	10

Writing Formulas for Covalent Bonds

- To write formulas for covalent bonds, follow the prefixes.
- The prefixes tell you what the subscript will be for the element.
- Write the formula for dihydrogen monoxide.

- Remember, it is not necessary to write 1 as a subscript.