NAME_____DATE_____CLASS_____

TEST DATE:_____

Chapter 11
Chemical Bonds

NAME_____ DATE_____ CLASS_____

Vocabulary Chapter 11

Chemical Bonds

Binary compound _____

_____ Page _____

Chemical bond _____

_____ Page _____

Chemical formula _____

_____ Page _____

Chemically stable _____

_____ Page _____

Corrosive _____

_____ Page _____

Covalent bond _____

_____ Page _____

Hydrate _____

_____ Page _____

Ion _____

_____ Page _____

Ionic bond _____

_____ Page _____

Nonpolar molecule _____

_____ Page _____

Oxidation number _____

_____ Page _____

Polyatomic ion _____

_____ Page _____

Polar molecule _____

_____ Page _____

Toxic _____

_____ Page _____

CHAPTER 11-Chemical Bonds

Aim: State a reason why chemical bonding occurs.

Compounds: Most of the matter around you is in the form of compounds. Some of the matter around you is in the form of elements. _____
_____
_____

Formulas: _____
_____

Subscripts: _____
_____

Some Familiar Compounds

Familiar Name	Chemical Name	Formula
Lye		
Vinegar		
Ammonia		
Grain alcohol		
Sand		
Battery acid		
Stomach acid		
Milk of magnesia		
Cane sugar		

The ratio of carbon atoms to hydrogen atoms to oxygen atoms in sucrose is _____.

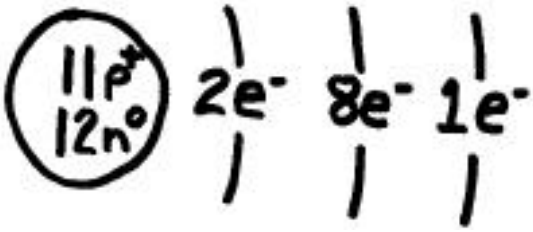
Chemically Stable Atoms:

_____

_____

Energy Level	Maximum number of e^-	Number of e^- to be stable
1		
2		
3		
4		

If an atom isn't chemically stable, it will become chemically stable.

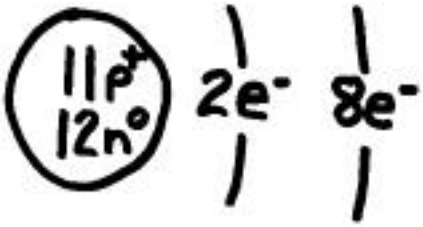


This sodium atom isn't chemically stable.

_____

_____

_____



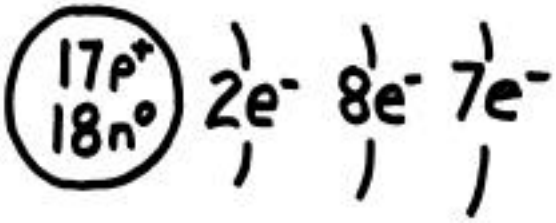
Obtaining 7 electrons isn't easy. _____

_____

_____

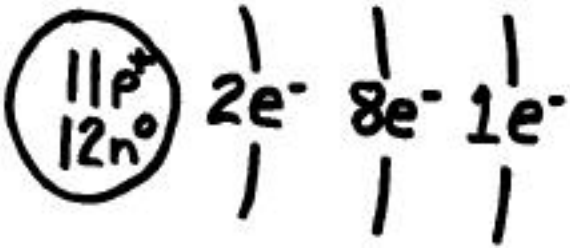
Electrons can't be found just anywhere. They are found inside other atoms. Electrons can't just be thrown away; other atoms must take them.

This chlorine atom isn't chemically stable.



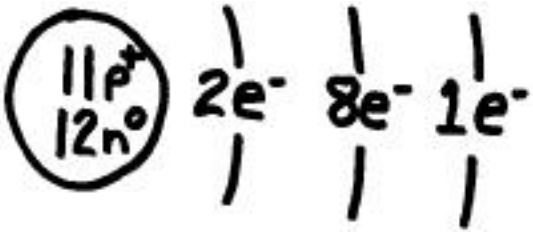
_____
_____

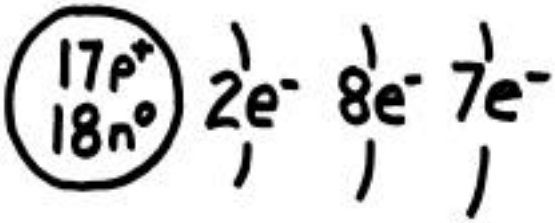
This sodium atom isn't chemically stable either.



_____
_____

These two atoms can work out a "partnership."





_____
_____

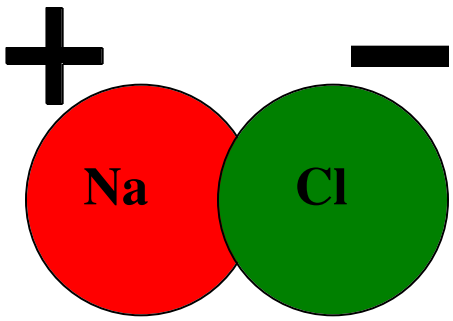
	Sodium	Chlorine
Model		
# of Protons (+)		
# of Electrons (-)		
Overall Charge		

_____

_____

_____

An ion is a _____



_____

_____

_____

_____

Assignment

1. **STUDY GUIDE "Why Atoms Combine"**
2. **REINFORCEMENT "Why Atoms Combine"**
3. **ENRICHMENT "Why Atoms Combine"**

NAME_____DATE_____CLASS_____

STUDY GUIDE Chapter 11

Why Atoms Combine

Text Pages 268-273

The definitions of several key terms about how atoms combine are given below. In the blanks, write the term from the word list that makes each definition complete.

atoms	chemical symbol	compound	electrons	force
number	ratios	elements	energy level	

1. **Chemical formula:** tells what _____ make up a

   _____ and the _____ of the atoms of those elements.

2. **Subscript:** a _____ in a chemical formula written after

   a _____ that tells how many atoms of an element are in a unit of the compound.

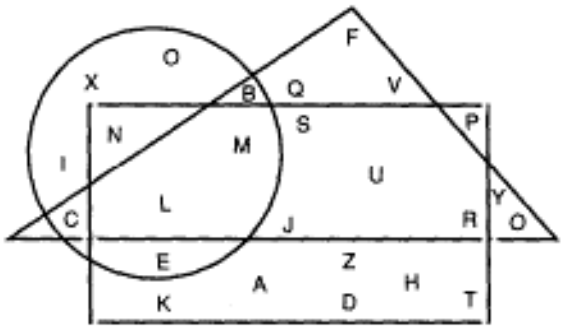
3. **Chemically stable:** condition of an atom when its outer _____ is completely filled with

   _____

4. **Chemical bond:** in a compound, the _____ that holds

   the _____ together

Use the diagram below to select eight letters to form a word found in this chapter. Use the statements as hints to help you select the correct letters. Circle each letter as you find it in the diagram. Write the word in the space provided. Then define the term.



1. The first letter must be in the triangle and in the circle, but not in the rectangle.
2. The second letter must be in the triangle only.
3. The third letter must be in the circle, triangle, and rectangle.
4. The fourth letter must be in the rectangle only.
5. The fifth letter must be in the circle only.
6. The sixth letter must be in both the rectangle and the triangle, but not in the circle.
7. The seventh letter must be in both the rectangle and circle, but not in the triangle.
8. The eighth letter must be in the part of the rectangle that is below the triangle.

The word is _____ _____ _____ _____ _____ _____ _____ _____ Definition: A _____ is
1 2 3 4 5 6 7 8

_____

NAME_____ DATE_____ CLASS_____

REINFORCEMENT Chapter 11

Why Atoms Combine

Text Pages 268-273

Each statement below contains a pair of terms or phrases in parentheses. Circle the term or phrase that makes each statement true.

1. Most of the matter around you is in the form of (elements, compounds).
2. The properties of a compound are (the same as, different from) the properties of the elements that make up the compound.
3. Na and Cl are (chemical symbols, chemical formulas).
4. NaCl and NaOH are (chemical symbols, chemical formulas).
5. H_2O is the formula for (salt, water).
6. In the formula H_2O, the number 2 is a (subscript, superscript).
7. In the formula HCl, the ratio of hydrogen atoms to chlorine atoms is (1:1, 2:1).
8. The number 2 in the formula H_20 tells you that each unit of this compound contains (2 hydrogen atoms, 2 oxygen atoms).
9. If a symbol in a chemical formula does not have a subscript after it, a unit of that compound contains (0 atoms, 1 atom) of that element.
10. In the formula Fe_20_3, the ratio of iron atoms to oxygen atoms is (3:2, 2:3).
11. An atom is chemically stable if its outer energy level (is filled with, contains no) electrons.
12. For atoms of most elements, the outer energy level is filled when it has (3, 8) electrons.
13. The noble gases do not readily form compounds because they (are, are not) chemically stable.
14. A chemical bond is a (force, chemical) that holds together the atoms in a compound.
15. Chemical bonds form when atoms lose, gain, or (share, multiply) electrons.

Complete the table below by using the formula of each compound to identify the elements that each compound contains and the ratios of those elements. The first one has been done for you as an example.

Formula	Elements in Compound	Ratios
H_2O	hydrogen, oxygen	2:1
NaOH		
NaCl		
NH_3		
H_2SO_4		
SiO_2		

NAME_____ DATE_____ CLASS_____

ENRICHMENT Chapter 11

Why Atoms Combine

Text Pages 268—273

ELECTRON DOT DIAGRAMS

The most important electrons in an atom are found in the outer energy level. These electrons are often involved in chemical reactions. These outer energy level electrons are often drawn as dots around the symbol of an element. This type of drawing is called an electron dot diagram.

In this activity, you will draw electron dot diagrams for several elements.

Procedure

1. Write the symbol for the element. This symbol will represent the nucleus and all of the electrons of that element except the outer level electrons.

   Example: chlorine = Cl

2. Determine how many outer level electrons the element has. This can be done by finding which group in the periodic table the element belongs to.

   Example: Chlorine belongs to Group 17, the halogens, which have 7 outer level electrons.

3. The top, bottom, left, and right sides of the symbol represent a place where two electrons can be placed. Draw a dot to represent each electron in the outer level of the element. It is not important which side of the element contains electrons. The electrons can be paired or unpaired.

   Example: chlorine = 

Problems

1. Write electron dot diagrams for the following elements.

   a. hydrogen_____

   b. neon_____

   c. sodium_____

   d. calcium_____

   e. aluminum_____

   f. fluorine_____

   g. argon_____

   h. potassium_____

2. Why do sodium and potassium have the same number of dots in their electron dot diagrams? What does this tell you about the chemistry of these elements?_____

   _____

   _____

Aim: Describe the difference between ionic and covalent bonds.

Ions are charged particles. _____
_____

_____
_____

_____
_____

The charge of the ion is written as a _____
_____.

Positive and negative ions _____.

The compound sodium chloride is formed (_____**)**

If magnesium and fluorine were to combine, what kinds of charges will each ion have?

Magnesium will have a charge of ___.

Fluorine will have a charge of ___.

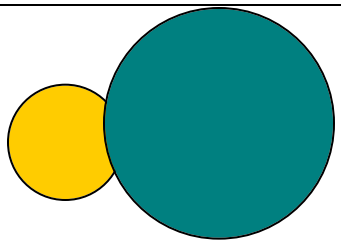
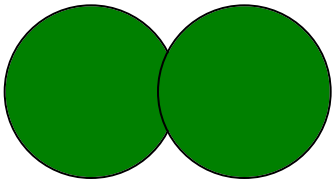
1 magnesium ion can attract ___ **fluorine ions.**

_____

Sometimes, atoms don't transfer electrons. Sometimes they share electrons. When atoms share electrons, they form covalent bonds. Once these atoms join as a result of sharing electrons, they form a particle called a molecule.

Difference between Ionic and Covalent bonding		
	Ionic	**Covalent**
Particle:		
Process:		
Bond:		
Strength:		
Product:		

Molecules can be either _____ or _____. They can have a positive end and a negative end or there may be no difference between the ends.

Polar molecule	Nonpolar molecule
	
_____ _____ _____ _____	_____ _____ _____ _____

Assignment

1. **STUDY GUIDE "Kinds of Chemical Bonds"**
2. **REINFORCEMENT "Kinds of Chemical Bonds"**

NAME_____ DATE_____ CLASS_____

STUDY GUIDE Chapter 11

Kinds of Chemical Bonds

Text Pages 276-281

In the blank, write the letter of the term that is defined by each phrase.

_____ 1. force that holds together the atoms in a compound
a. chemical formula **b.** chemical bond

_____ 2. an atom that has an electrical charge
a. element **b.** ion

_____ 3. molecule that does not have oppositely charged ends
a. nonpolar molecule **b.** ion

_____ 4. molecule that has oppositely charged ends
a. covalent molecule **b.** polar molecule

_____ 5. number and sign written by the symbol of an ion to indicate its charge
a. subscript **b.** superscript

_____ 6. force of attraction between the opposite charges of the ions in an ionic compound
a. ionic bond **b.** polar bond

_____ 7. bond that forms between atoms when they share electrons
a. covalent bond **b.** polar bond

In the blank, write the letter of the term or phase that correctly completes each statement.

_____ 8. In the symbol Na^+, the + sign is a _____ .
a. subscript **b.** superscript

_____ 9. A chloride ion, Cl^-, has _____ .
a. a negative charge **b.** no charge

_____ 10. The compound NaCl is an example of_____ .
a. an ionic compound **b.** a polar compound

_____ 11. When Na^+ and Cl^- unite to form the compound sodium chloride, the compound that forms is _____ .
a. positively charged **b.** neutral

_____ 12. Neutral particles formed as a result of the sharing of electrons are called _____ .
a. molecules **b.** ions

_____ 13. At room temperature, most covalent compounds are _____ .
a. solids **b.** liquids or gases

_____ 14. At room temperature, most ionic compounds are _____ .
a. solids **b.** liquids or gases

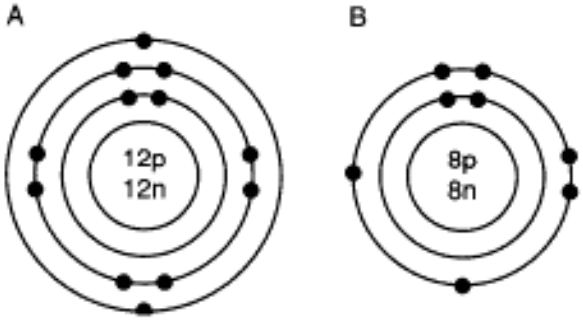
NAME_____ DATE_____ CLASS_____

REINFORCEMENT Chapter 11

Kinds of Chemical Bonds

Text Pages 276—281

Answer the questions about the diagram shown below. Write your answers in the spaces provided.



1. How many electrons will atom A lose to atom B?_____
2. What kind of chemical bond will be formed between atom A and atom B if atom A loses electrons and atom B gains these electrons?_____
3. If atom A gives up electrons to atom B, what will the electrical charge of atom A be?_____
4. If atom B gains electrons from atom A, what will the electrical charge of atom B be? Why?_____
5. What is an atom with an electrical charge called?_____
6. If atom A and atom B unite to form a compound, what will the total charge of the compound be? Why?_____

Complete the table comparing ionic compounds and covalent compounds.

Characteristic	**Ionic**	**Covalent**
How formed		
Smallest particles		
Usual state of compound at room temperature		

Aim: Write formulas and compounds from their names.

Oxidation numbers: _____
_____
_____

Mg^{+2}

Your periodic table shows common oxidation numbers at the top of each group of elements.

Oxidation numbers _____
_____

Binary compounds are _____
_____

Binary compounds are formed when a _____ and a _____ bond.

We name binary compounds with the _____ first (+ oxidation number), the _____ second (- oxidation number) and the nonmetal ends with "_____."

Some binary compounds: _____
_____

To write formulas for binary compounds, you must first know the oxidation numbers.

Your reference tables contain the following table. It includes oxidation numbers for common elements.

Oxidation Numbers of Some Elements		
1+	2+	3+
Copper (I), Cu^{+}	Barium, Ba^{2+}	Aluminum, Al^{3+}
Hydrogen, H^{+}	Calcium, Ca^{2+}	Chromium, Cr^{3+}
Lithium, Li^{+}	Copper (II), Cu^{2+}	Iron (III), Fe^{3+}
Potassium, K^{+}	Iron (II), Fe^{2+}	
Silver, Ag^{+}	Magnesium, Mg^{2+}	
Sodium, Na^{+}	Zinc, Zn^{2+}	
1−	2−	3−
Bromine, Br^{-}	Oxygen, O^{2-}	Nitrogen, N^{3-}
Chlorine, Cl^{-}	Sulfur, S^{2-}	Phosphorous, P^{3-}
Fluorine, F^{-}		
Iodine, I^{-}		

Problem: What is the formula for a compound composed of sulfur and aluminum?

Solution:

1. Write the symbol of the metal first, then write the symbol of the nonmetal.

2. Write oxidation numbers above each symbol.

3. Write subscripts so that the sum of the oxidation numbers is zero.

4. Check the formula.

Not all compounds are binary compounds.

Polyatomic ion: _____ _____. **Some polyatomic ions are a table in your reference tables.**

Some Polyatomic Ions and Their Charges			
1+	1−	2−	3−
Ammonium, NH_4^+	Acetate, $C_2H_3O_2^-$	Carbonate, CO_3^{2-}	Phosphate, PO_4^{3-}
	Chlorate, ClO_3^-	Sulfate, SO_4^{2-}	
	Hydroxide, OH^-		
	Nitrate, NO_3^-		

Problem: What is the formula for calcium nitrate?

Solution:

1. Write the symbol for calcium first, then write the symbol for the nitrate ion.

2. Write oxidation numbers above each symbol.

3. Write subscripts so that the sum of the oxidation numbers is zero.

4. Check the formula.

NOTICE: _____ _____ _____

Hydrates:

_____

_____

For example; _____ is cobalt chloride hexahydrate.

You can remove the water from these crystals by heating them.

_____

Plaster of paris is the anhydrous form of calcium sulfate dihydrate, $CaSO_4 \bullet 2H_2O$

Assignment

1. **STUDY GUIDE "Formulas and Names of Compounds"**
2. **REINFORCEMENT "Formulas and Names of Compounds"**
3. **ENRICHMENT "Formulas and Names of Compounds"**

NAME_____ DATE_____ CLASS_____

STUDY GUIDE Chapter 11

Formulas and Names of Compounds

Text Pages 282-288

Match each term in Column II with its description in Column I. Write the letter of the correct term in the space provided.

Column I	Column II
_____1. prefix meaning six	**a.** bi-
_____2. prefix meaning many	**b.** ion
_____3. prefix meaning two	**c.** binary
_____4. compound composed of two elements	**d.** anhydrous
_____5. positively or negatively charged atom	**e.** polyatomic ion
_____6. positively or negatively charged group of atoms	**f.** subscript
_____7. compound that has water chemically attached to its ions	**g.** poly
_____8. number assigned to an element to show its combining ability in a compound	**h.** oxidation number
_____ 9. without water	**i.** hydrate
_____10. number that tells how many atoms of an element are in a unit of the compound	**j.** hexa-

The words in each group below are related. Write a sentence, using all the words in the group, that shows how the words are related.

Example:

compound, properties, elements
The properties of a compound differ from the properties of the elements making up the compound.

1. hydrate, water, ions_____

_____

2. oxidation number, element, compound_____

_____

3. zero, oxidation numbers, noble gases_____

_____

4. oxidation number, Roman numeral, element _____

_____

NAME_____ DATE_____ CLASS_____

REINFORCEMENT Chapter 11

Formulas and Names of Compounds

Text Pages 282-288

Use the Periodic Table of Elements in your reference tables to identify the oxidation numbers of the elements in each group.

_____1. any element in group 1

_____2. any element in group 17

_____3. any element in group 2

_____4. any element in group 18

_____5. any element in group 16

Answer the following questions in the spaces provided. Use the Periodic Table if you need help.

1. What is the usual oxidation number of oxygen?_____
2. What is the usual oxidation number of hydrogen?_____
3. What name is given to many of the elements that have more than one oxidation number?_____
4. What is the sum of oxidation numbers in a compound?_____
5. What is an oxidation number?_____

Write the formulas for the following compounds. Use the Periodic Table of the Elements or Oxidation Number in your reference tables for help.

1. copper(II) sulfate_____
2. calcium chloride_____
3. iron (II) oxide_____
4. copper(I) oxide_____
5. sodium sulfide_____

Complete the following table by providing the name of the compound and the total number of atoms in each formula given.

Formula	Name	Number of atoms
NH_4OH		
NH_4Cl		
Ag_2O		
K_2SO_4		
$Ca(NO_3)_2$		
Na_2S		

NAME_____ DATE_____ CLASS_____

ENRICHMENT Chapter 11

Formulas and Names of Compounds

Text Pages 282-288

WRITING CHEMICAL FORMULAS WITH THE CRISSCROSS METHOD

Oxidation numbers are useful for writing chemical formulas. Use your textbook or a periodic table to find oxidation numbers for elements and polyatomic ions. In the following examples, oxidation numbers and the criss-cross method will be used for writing chemical formulas. Remember that subscripts in a formula give the ratio of atoms in a compound. After crisscrossing, simplify the ratio, if necessary.

Example 1. What is the formula for barium chloride? Solution: Barium is in Group 2. Elements in this group tend to lose two electrons, so their oxidation number is 2+. Chlorine is in Group 17. Elements in this group tend to gain one electron. Chlorine has an oxidation number of 1—. Now write the symbols in the correct order. The metal ion is written first. Write the oxidation numbers as superscripts. For oxidation number of 1+ or 1—, only the positive or negative sign is written.

$Ba^{2}+ Cl-$

Next, crisscross the numbers only and show them as subscripts. The number 1 does not need to be written.

Ba^{2+} Cl^{-}

Ba Cl_2

The correct formula for barium chloride is $BaC1_2$.

Example 2. What is the formula for magnesium phosphate? Solution: Write the parts of the formula in the correct order. Assign oxidation numbers. Write the formula for the compound by crisscrossing the superscripts. Since the phosphate ion is used more than once, place it in parentheses. The parenthese: prevent confusion between the subscripts.

Mg^{2+} $P0_4^{3-}$

Mg_3 $(P0_4)_2$

The correct formula for magnesium phosphate is $Mg_3(P0_4)_2$.

Use the crisscross method to write the chemical formulas for the compounds described below.

1. The compound ammonium selenate is used as a mothproofing agent. The selenate ion is written as SeO_4^{2-}. What is the formula for this compound?

2. Titanium oxide is used as a white paint pigment. If titanium has an oxidation number of 4+ in this compound, what is this compound's formula?

3. Zinc iodide is used as an antiseptic. What is its formula?

4. Potassium chloride is used in fertilizer, photography, and as a salt substitute. What is its chemical formula?

5. Write the correct chemical formula for a compound containing barium and oxygen. What is the name of this compound?