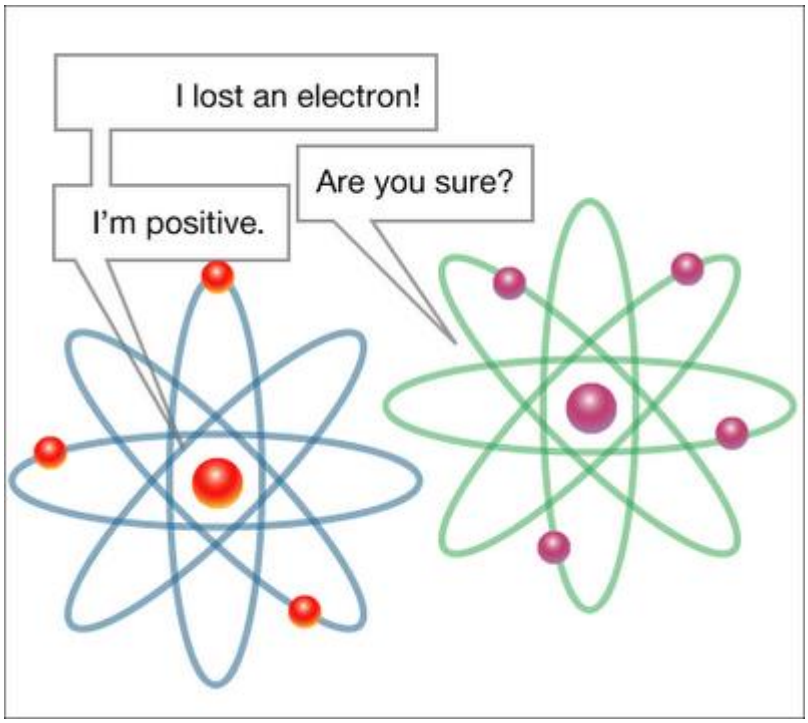
Chemistry

SCI20F

Mrs. Kornelsen



Handouts:

Please ensure you have the following handouts. You will need to keep these to use for assignments, labs, and tests. Be sure not to mark them up.

i) Common ion table
ii) Periodic table
- *Do lab safety assignment*

Learning checklist – Chemistry I

Learning increases when you have a goal to work towards. Use this checklist as guide to track how well you are grasping the material. In the center column, rate your understand of the topic from 1-5 with 1 being the lowest and 5 being the highest. Be sure to write down any questions you have about the topic in the last column so that you know what you have yet to learn.

Outcomes	Understanding	Questions?
Relate a chemicals position on the periodic table to its combining capacity (valence). Include: alkali metals, alkaline earth metals, earth metals, chalcogens, halogens, noble gases		
Explain, using the periodic table, how and why elements combine in specific ratios to form compounds. Include: ionic bonds, covalent bonds		
Write formulas and names for binary ionic compounds. Include: IUPAC guidelines and rationale for their use		
Write formulas and names of molecular compounds using prefixes. Include: mono, di, tri, and tetra		
Investigate the Law of Conservation of Mass and recognize that mass is conserved in chemical reactions		

What is Chemistry?

Chemistry is the study of matter and its changes. This includes everything in the universe from a simple hydrogen atom to very large replicating molecules in life processes. Chemistry is involved with the development of medicines, food production, consumer products such as cleaners, plastics and clothing, and new methods for protection and cleanup of the environment.

Many people think that chemistry is "too hard." Although it is challenging, any reasonably student with the right attitude and study habits can succeed in chemistry!

Today we are going to experiment with the different kinds of chemistry before we turn our attention to atoms and elements tomorrow.

A. Organic Chemistry – Making Plastic from Milk

Materials (on the front lab bench):

400 ml beaker & 50 ml beaker 	 eye dropper	 scoopula

Procedure:

1. Pour 200 ml of milk into your beaker.
2. Obtain approximately 40 ml of vinegar in your small beaker.
3. Place your beaker of milk on a hot plate. Two groups may have to share the same hot plate.
4. As the milk is warming up add the vinegar to your milk beaker using the eye dropper one drop at a time.
5. Stir your mixture frequently with the scoopula.
6. Do not let the milk boil.
7. You should see the milk curdling (clumping) in your beaker.
8. When you see a large clump forming at the bottom of the beaker use your hands to pull it out of the beaker and knead it with your hands.
9. Mould the plastic into any shape you want.
10. Place the shape on a paper towel with your name on it and put it on the side back bench.

What is happening?

Your plastic glob is actually fat, minerals, and the protein casein. The casein from the milk hardens into plastic. The combination of heat and acetic acid (vinegar) precipitates the casein, an ingredient used to make plastic, from the milk.

B. Inorganic Chemistry – Rainbow in a Tube

Materials

1000 ml graduated cylinder & 100 mL beaker 	 Mortar and pestle

- Universal Indicator bottle
- Alka-Seltzer tablets

Procedure:

1. In a 100mL beaker pour approximately 4mL (four full squirts of the eye dropper) of universal indicator.
2. Fill your 100 ml beaker to the 30ml line (approximately) with 0.1M NaOH. Note the colour.
3. Fill the beaker to 40ml with water.
4. Crush up 1/2 Alka-Seltzer tablet in the mortar and pestle.
5. Pour the crushed Alka-Seltzer tablet into the graduated cylinder. Watch the colour change.
6. What colours have you seen so far?

7. After a yellow colour forms near the top of the cylinder slowly pour in approximately 10mL of vinegar using your 25 ml graduated cylinder.

Explanation:

Universal indicator changes over the colour spectrum (ROY G BIV) from red meaning very acidic to violet meaning very basic. Sodium hydroxide is a base and therefore turns a deep violet colour. When the crushed Alka-Seltzer tablet begins to dissolve in the NaOH a gas is given off and the solution begins to turn green and then yellow. The acidic solution created by the Alka-Seltzer tablet does not have a strong enough pH to make a red color so vinegar can be added to produce an orange colour.

CHAPTER 5
REINFORCEMENT

BLM 5-1

Reviewing Element Names and Symbols

Goal • Review the names and symbols of various elements by finding them in the periodic table.

What to Do

Complete the following tables. Refer to the periodic table in Appendix C of your textbook.

1. Write the full name of the element beside each symbol.

Symbol	Element name	Symbol	Element name
Cl		Ca	
C		Mg	
Ne		Si	
N		S	
He		P	
F		K	

2. Write the correct symbol next to the name of each element.

Element name	Symbol	Element name	Symbol
sodium		gold	
lithium		silver	
aluminum		copper	
boron		cobalt	

CHAPTER 5
SKILL BUILDER

BLM 5-2

Periodic Table Scavenger Hunt

Goal • Gain further understanding of the periodic table.

What to Do

Answer each question in the space provided. Refer to the periodic table in Appendix C of your textbook.

1. (a) How many periods does the periodic table have? _____

   (b) How many groups does the periodic table have? _____

2. (a) Where are the metals found in the periodic table? _____

   (b) Where are the non-metals found in the periodic table? _____

3. (a) Which elements are found around the "staircase" of the periodic table? _____

   _____

   (b) Why are these elements at the "staircase" special? _____

   _____

   _____

4. Which metal is a liquid at room temperature? _____

5. What does the atomic number represent? _____

   _____

6. What does the atomic mass represent? _____

   _____

Chemistry In Action – Atoms

Element –

Atom –

Proton –

Neutron –

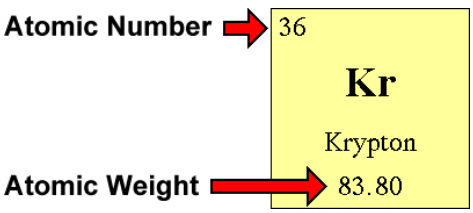
Electron –

Atomic Number –

Atomic Mass –

Neutral –

Ion –



Example:

1. How many protons does Krypton have?
2. How many electrons does Krypton have?
3. How many neutrons does Krypton have?

Summary – For any neutral element:

1.
2.
3.

One more thing – An isotope is an element with the same number of protons, but different numbers of neutrons.

Working with Atoms - Worksheet 1

1. Describe in words and with an equation how you would calculate an element's atomic mass.

2. How are elements ordered in the periodic table? Hint: Why does Hydrogen get to be first?

3. If I subtract the atomic number of an element from its atomic mass what value am I left with?

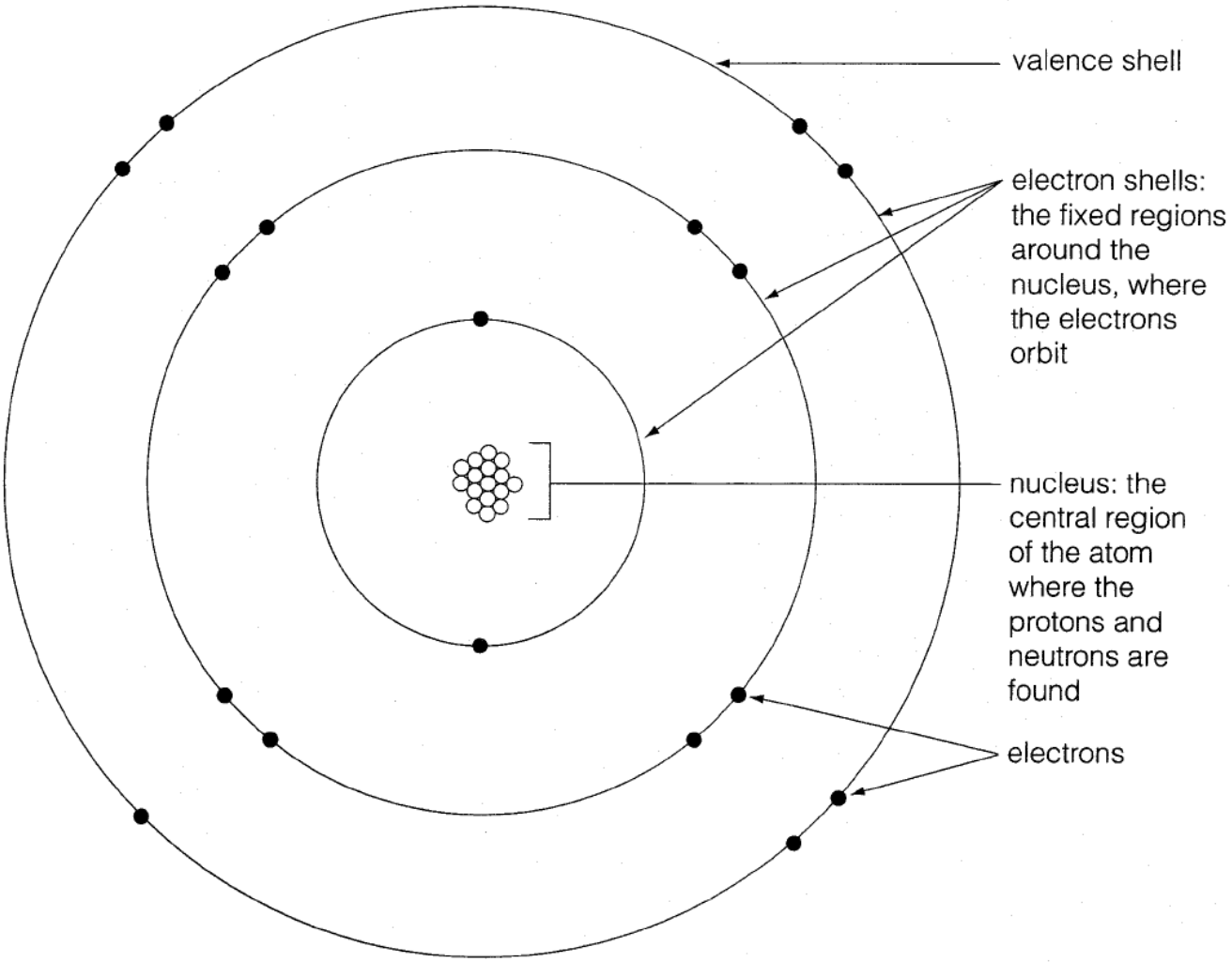
4. Complete the following table.

Symbol	Name	Atomic #	Atomic Mass	Protons	Neutrons	Electrons
Li	Lithium	3	7.0	3	4	3
Mg						
Si						
	Carbon					
	Chlorine					
	Lead					
W						
Al						
	Argon					
	Uranium					
U						
S						
	Sulfur					

CHAPTER 5
OVERHEAD MASTER

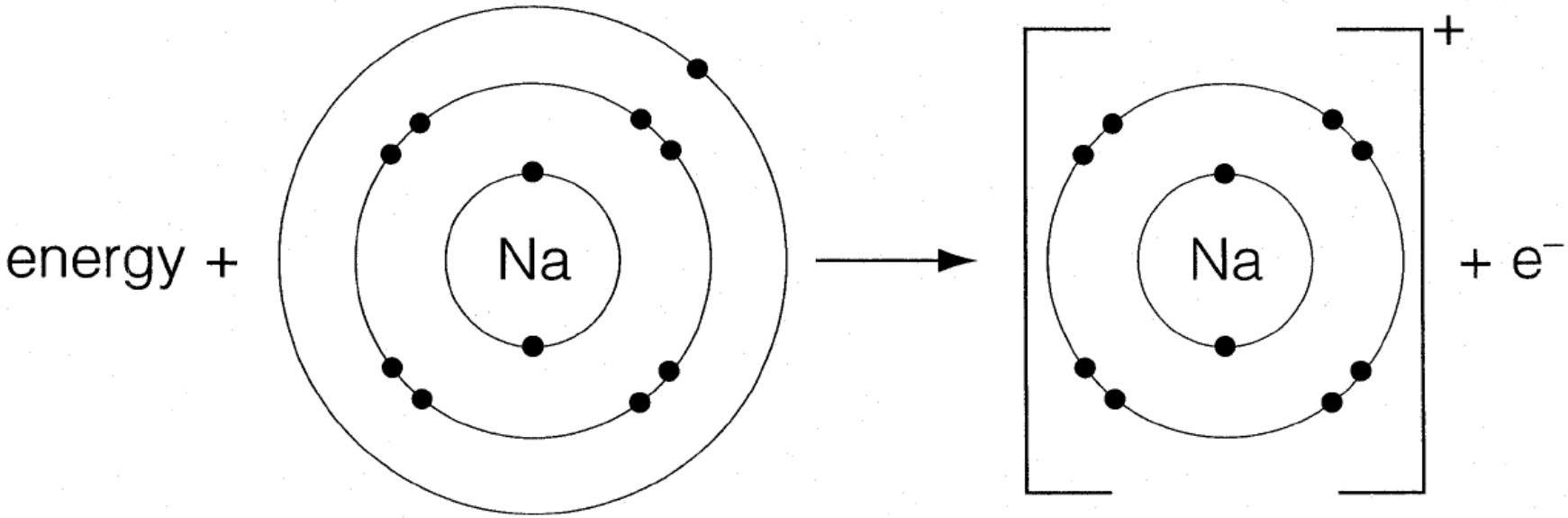
Anatomy of an Atom

BLM 5-3



- The outermost shell is called the *valence shell*. The electrons in the valence shell are called the *valence electrons*.
- The atoms of elements in Period 1 have one shell. This shell contains a maximum of 2 electrons.
- The atoms of elements in Period 2 have two shells. The valence shell contains a maximum of 8 electrons.
- The atoms of elements in Period 3 have three shells. The valence shell contains a maximum of 8 electrons.

Anatomy of an Ion



energy + Na → Na^+ + electron

Read the list of words on the left. Choose four of the terms to be the **headings** for the four boxes to the right. Choose carefully because all the words under the heading must be related in some way to the heading. You will then select words from what remain, that you feel belong under a particular heading (be prepared to explain your reason for placing each word under the particular heading). **One** word on the list **must** be chosen that will be placed in all four categories (be prepared to explain why you feel that that one word belongs under all four headings. The remaining words can only be placed under **one** of the four headings. Try to use as many of the words as you can. If there are words left over that do not seem to fit under any of your chosen headings, list them on the back of this page and tell me what you think you know about the words.

Atom
Mercury
Diatomic molecule
Families
Nucleus
Bohr model
Neon
Periodic table
Covalent
Ionic
Alkali metals
Carbon
Mass number
Alkaline earth metals
Chalcogens
Isotopes
Positive charge
Neutron
Halogens
Valence shell
Proton
Subatomic particles
Element
Water
Noble gases
Oxygen
Periods
Rows
Atomic Mass
Negative Charge
Electrons
Atomic number
Valence electron
Compound
Columns
Shells

1. _____ **2. _____**

3. _____ **4. _____**

Scientific Notation Review

Expressing the very large and the very small

Directions: Express each of the following numbers using scientific notation.

1.	**325**	_____	**21.**	**0.361**	_____
2.	**70**	_____	**22.**	**0.0428**	_____
3.	**96,400**	_____	**23.**	**0.00573**	_____
4.	**5,921**	_____	**24.**	**0.0005438**	_____
5.	**6,587,324,000**	_____	**25.**	**0.00005673**	_____
6.	**42.372**	_____	**26.**	**0.507**	_____
7.	**2.538**	_____	**27.**	**0.00483**	_____
8.	**3,621.471**	_____	**28.**	**0.0000000009**	_____
9.	**362.516**	_____	**29.**	**0.000421**	_____
10.	**4**	_____	**30.**	**0.0000054**	_____
11.	**240.000**	_____	**31.**	**0.000039256**	_____
12.	**3,752.6**	_____	**32.**	**0.06723**	_____
13.	**23,000,000,000**	_____	**33.**	**0.75140000**	_____
14.	**741,900**	_____	**34.**	**0.000000010**	_____
15.	**456.83**	_____	**35.**	**0.000023**	_____
16.	**17**	_____	**36.**	**0.000000614**	_____
17.	**3**	_____	**37.**	**0.0037004**	_____
18.	**5.000**	_____	**38.**	**0.00000038**	_____
19.	**215**	_____	**39.**	**0.01010**	_____
20.	**7,000,631**	_____	**40.**	**0.000000000001**	_____

WS 1 cont.

Translating Scientific Numbers Into Everyday Expression

Directions: Write each of the following numbers as ordinary numbers

1. 3.64×10^{4} _____ **21.** 2.97×10^{-4} _____

2. 3.9734×10^{5} _____ **22.** 3.88×10^{-2} _____

3. 6.285×10^{3} _____ **23.** 5.65×10^{-1} _____

4. 6.7978×10^{0} _____ **24.** 3.7283×10^{-4} _____

5. 5.8643×10^{2} _____ **25.** 4.763×10^{-3} _____

6. 2.973×10^{1} _____ **26.** 5.9267×10^{-1} _____

7. 3.487×10^{3} _____ **27.** 8.654×10^{-2} _____

8. 2.9265×10^{5} _____ **28.** 2.5417×10^{-3} _____

9. 8.7321×10^{4} _____ **29.** 9.865×10^{-5} _____

10. 6.14300×10^{3} _____ **30.** 8.673×10^{-7} _____

11. 2.343×10^{1} _____ **31.** 2.4863×10^{-7} _____

12. 9.5000×10^{0} _____ **32.** 2.251×10^{-1} _____

13. 8.48×10^{2} _____ **33.** 1.452×10^{-3} _____

14. $2.926847212 \times 10^{9}$ _____ **34.** 2.685×10^{-6} _____

15. 3.03×10^{7} _____ **35.** 4.92×10^{-5} _____

16. 4.29×10^{6} _____ **36.** 4.000×10^{-2} _____

17. 5.63×10^{4} _____ **37.** 7.83×10^{-3} _____

18. 3.286×10^{4} _____ **38.** 8.429×10^{-1} _____

19. 5.92000×10^{2} _____ **39.** 5.376×10^{-2} _____

20. 4.37521×10^{3} _____ **40.** 2.986×10^{-4} _____

Bohr Model Review:

Draw Bohr diagrams for the following elements. Remember the atomic # is the same as the amount of protons. We want the same amount of protons as electrons in order to balance the charge. You do not have to put protons and neutrons in the nucleus. You may just use a dot.

Hydrogen	**Helium**
Lithium	**Beryllium**
Boron	**Carbon**

Nitrogen	**Oxygen**
Fluorine	**Neon**
Sodium	**Magnesium**

The Periodic Table

The first period is the first row of the periodic table.

-
-

The second period is the second row of the periodic table.

-
-

The third period is the third row of the periodic table.

-
-

Chemical Families

- The periodic table is organized into _____.
- Each family is a _____ on the periodic table.
- Chemical Families share _____.
- Looking at the Bohr diagrams of the atoms how are all the elements in a family similar?

Valence electrons –

The Big Goal

The key to family stability or reactivity is how easy it is to get a full valence shell.

-
-

Atoms want to gain or lose electrons to reach a full valence shell.

Elements in the first period want to gain or lose electrons to have 0 electrons or ____ electrons in their outer shell.

Elements in the second or third period want to gain or lose electrons to have 0 electrons or ____ electrons in their outer shell.

Summary

-
-

-
-

Characteristic Properties

Characteristic Properties are used to distinguish different types of matter since no two different types of matter can have the same value for one of these properties.

This handout reviews the characteristic properties you need to know in this course.

1. Solubility: Many elements will dissolve easily in water. Some elements; however, will dissolve only in alcohol or some other solvent. Solubility discribes what mass of a substance will dissolve in a given quantity of solvent at a particular set of conditions. Ex. 40 g of NaCl will dissolve in 100 ml of water at 100^0C

2. Melting point: The melting point (or freezing point) of an element is the temperature at which the element changes from a liquid to a solid or from a solid to a liquid. A good example of melting occurs when ice changes to water at 0^0C (if energy is added) and freezing occurs when water changes to ice at the same temperature (if energy is taken away).

3. Boiling point: The boiling point (or condensation point) of an element is the temperature at which the element changes from a liquid to a gas or from a gas to a liquid. A good example of boiling occurs when water changes to its vapor at 100^0C (if energy is added) and condenses at the same temperature (if energy is taken away).

4. Conductivity: Two kinds of conductivity a) the ability of a substance to conduct heat from one location to another. b) the ability to conduct electricity.

5. Ductility: The ability of a pure substance to be drawn into a wire.

6. Malleability: The ability of a pure substance to be hammered into thin sheets.

7. Density: The name given to a ratio of mass over volume. D = M/V

   Mass is a measurement of the amount of material and is measured on a balance. Mass is usually measured in grams (g) in a laboratory. Volume is a measurement of the amount of space that the pure substance takes up. Volume of liquids is usually measured in ml and solids in cm^3. Liquid volume measurement is usually determined using a graduated cylinder. The volume of solids is determined using a ruler to measure the dimensions of an object if it is a cube or rectangle. If the object is an irregular shape, some form of fluid displacement is often used.

Chemical Families

Families & Examples	Properties	# of Valence Electrons	Prefers to gain or lose how many electrons?	The ion it wants to form…
Alkali Metals				
Alkali Earth Metals				
Chalcogens				
Halogens				
Noble Gases				
Hydrogen				

20F Unit II WS 11 Name _____

Reviewing the Periodic Table of Elements

Goal : Demonstrate your understanding of the basic groups and periods associated with the periodic table of elements.

What to Do

Answer each question in the space provided.

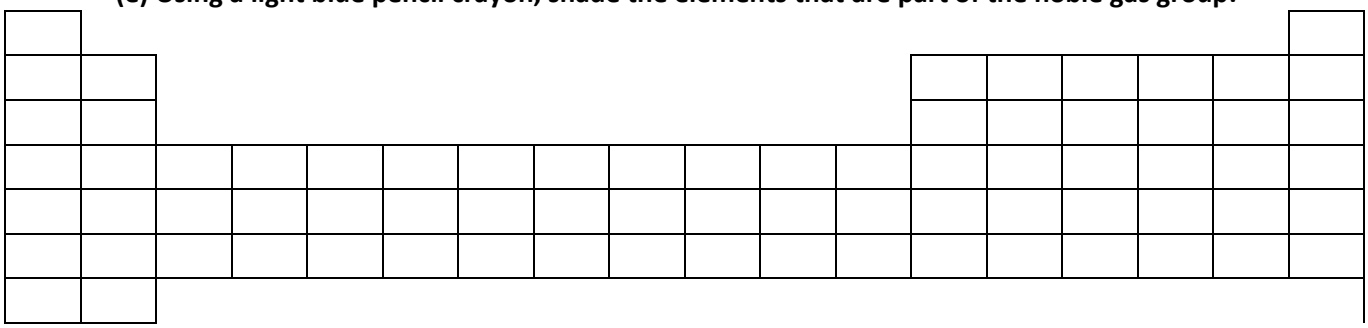
1. **(a) Write the symbols for the first 20 elements in the periodic table below. You may want to refer to the periodic table in appendix C of your textbook.**

   (b) Using a yellow pencil crayon, shade the elements that belong to the group (family) of alkali metals.

   (c) Using an orange pencil crayon, shade the elements that belong to the group of alkaline earth metals.

   (d) Using a light green pencil crayon, shade the elements that are part of the halogen group.

   (e) Using a light blue pencil crayon, shade the elements that are part of the noble gas group.



2. **Why are the groups important in the periodic table?**

_____
_____

3. **What is special about the group of noble gases?**

_____
_____

4. **Describe two patterns in the periodic table.**

_____
_____

5. **Describe what happens to the elements in a group as you move vertically down the periodic table (as you go, for example, from an alkali metal in period 1 to an alkali metal in period 2).**

_____
_____

Chemical Family Game

Chemical Families Game Questions

1. Using your periodic table, Boron wants to:
a. Lose one electron
b. Gain one electron
c. Remain the same since it is inert

2. Using your periodic table, how many valance electrons does Lithium have?

3. Why would sodium react with chlorine to form salt?

Lithium (An Alkali Metal)

Chemical Family Demo:

What will happen when I put one of the Alkali metals in water. Why? (Be specific)

**Watch videos on this reaction occurring in class*

Periodic Table Basics Name _____

1. Which elements had complete outer shells? Give the name and symbol for each.

_____ _____ _____ _____ _____ _____

2. What do you notice about the location of the elements in #1?

3. Which elements had only one valence electron?

_____ _____ _____ _____ _____ _____

4. What do you notice about the location of the elements in #3?

5. What do you notice about the number of valence electrons as you move from left to right across a row or period in the periodic table? (Na → Mg → Al → Si → P → S → Cl → Ar)

6. What do you notice about the number of energy levels or shells as you move down a group or column in the periodic table? (H → Li → Na)

7. Elements are organized into families according to their physical and chemical properties. Identify the elements that you used in Step 5 that belong to each family based on the number of valence electrons. Give the name and symbol for each element.

Alkali Metals - 1 valence electron _____ _____ & _____ _____

Alkaline Earth Metals - 2 valence electrons _____ _____ & _____ _____

Boron Family - 3 valence electrons _____ _____ & _____ _____

Carbon Family - 4 valence electrons _____ _____ & _____ _____

Nitrogen Family - 5 valence electrons _____ _____ & _____ _____

Oxygen Family - 6 valence electrons _____ _____ & _____ _____

Halides - 7 valence electrons _____ _____ & _____ _____

Noble Gases - Complete outermost shell

_____ _____, _____ _____, & _____ _____

8. What do you notice about the location of the elements in each family?

9. How would you classify hydrogen? Why?

10. Predict the number of valence electrons for each element based on its location in the Periodic Table of Elements. You will need to use the table in your textbook.

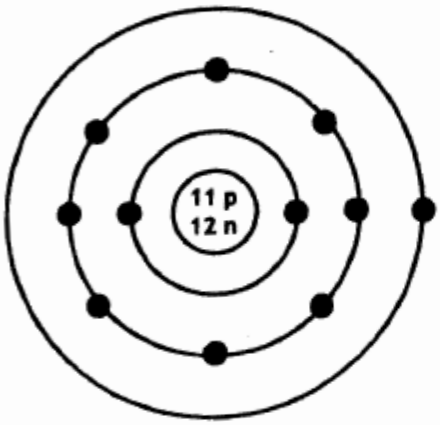
Barium = _____ Lead = _____ Xenon = _____ Potassium = _____

T. Trimpe 2002

Example 1

Sodium is an alkali metal. It is located in the first family and second period of the periodic table. Sodium has a single electron in its outer energy level since it belongs to the alkali family. When sodium combines with a non-metal to form a compound, it will lose one electron. To learn about the process of forming an ion, complete the two questions below.

Sodium atom

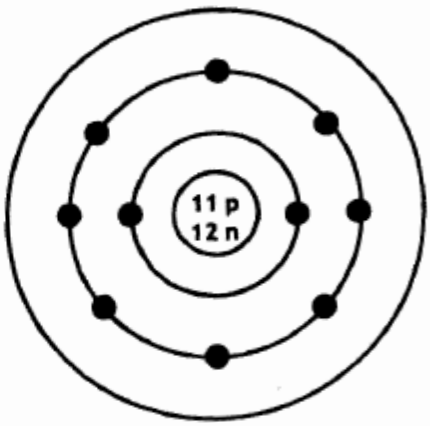


How many positive charges in the atom? _____

How many negative charges in the atom? _____

What is the residual (net) charge in the atom? _____

Sodium ion



An electron is removed from the sodium atom, forming an ion.

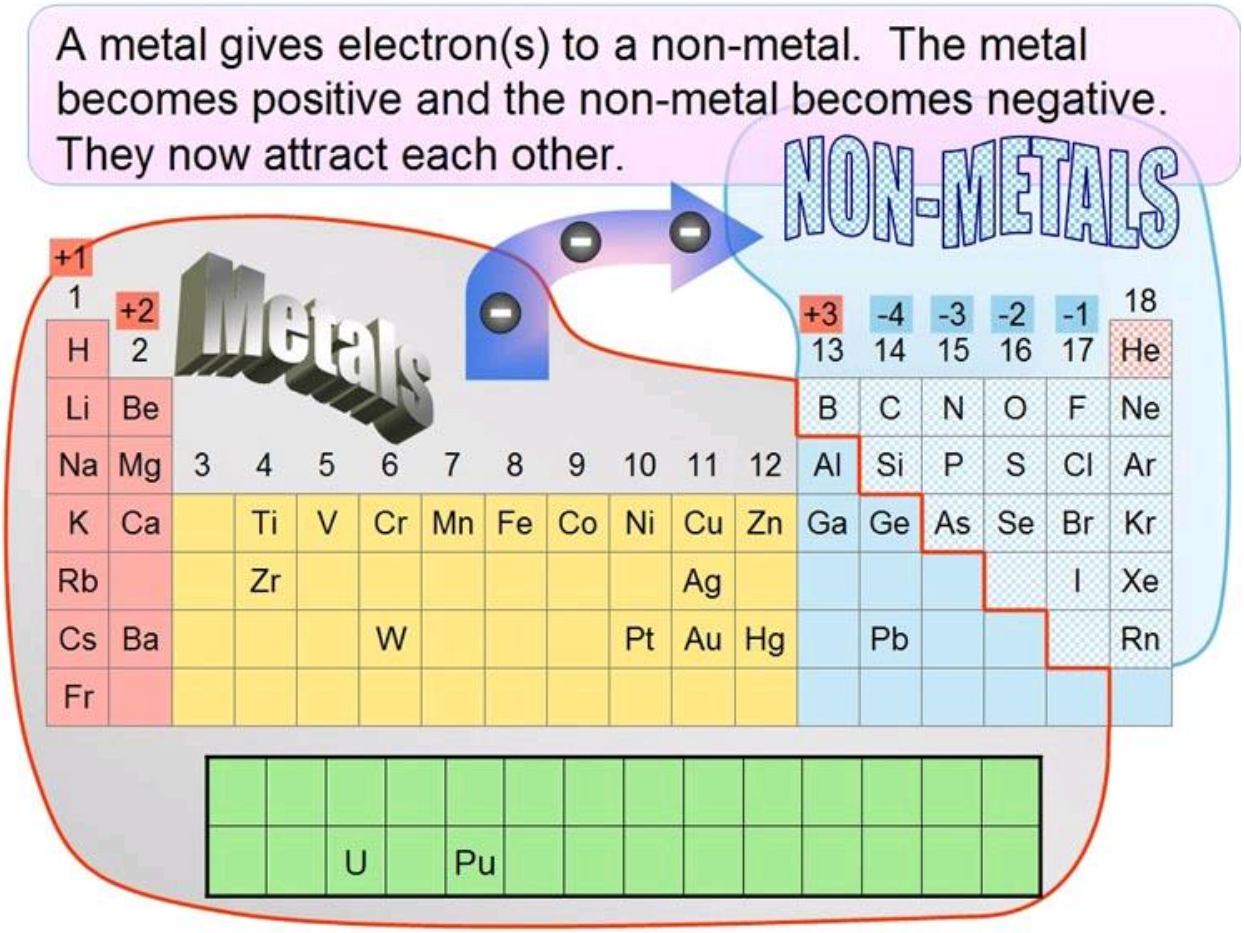
How many positive charges in the ion? _____

How many negative charges in the ion? _____

What is the residual (net) charge in the ion? _____

Metals and Non-metals

-
-



Bohr Diagrams

Remember

- Place the correct number of electrons around the nucleus.
- 2 electrons fit in the first ring.
- 8 electrons fit in the 2nd and 3rd rings.
- Pair up the electrons in the 2nd and 3rd rings.
- Spread out your electrons in different rings so that the electrons are not 'piled on top of each other'.

- Draw the Bohr model of Carbon

Ions

Ionic Symbols – if an atom has gained or lost an electron, you cannot simply use the chemical symbol (ex: Cl). You must use the ionic symbol which indicates how many electrons the atom has gained or lost (ex: Cl^-). In this case, Chlorine gained one electron.

- Example: O^{2-} -- Oxygen gained two electrons
- Example: Mg^{2+} -- Magnesium lost two electrons

Families of Ions:

15

Blackline Master 5.7c

Ionic Charges and Chemical Families, C

METALLIC ELEMENTS

Element Name	Element Symbol	Bohr Diagram of Atom	# Valence Electrons	Bohr Diagram of Ion	Ionic Symbol
sodium					
magnesium					
aluminum					

NONMETALLIC ELEMENTS

Element Name	Element Symbol	Bohr Diagram of Atom	# Valence Electrons	Bohr Diagram of Ion	Ionic Symbol
nitrogen					
oxygen					
fluorine					

Lewis Dot Diagrams

Lewis Dot Diagrams are an easier way to depict valence atoms and ions because you only need to draw the valence electrons of an atom.

From now on when you are asked to draw Bohr diagrams you can choose to use Lewis dot instead.

Draw the Bohr diagram for Chlorine……

Now draw the Lewis Dot Diagram…..Easier, eh?

Ok…try these Lewis Dot Diagrams.

- First calculate the number of valence electrons.
- Be careful of ions!!!!!

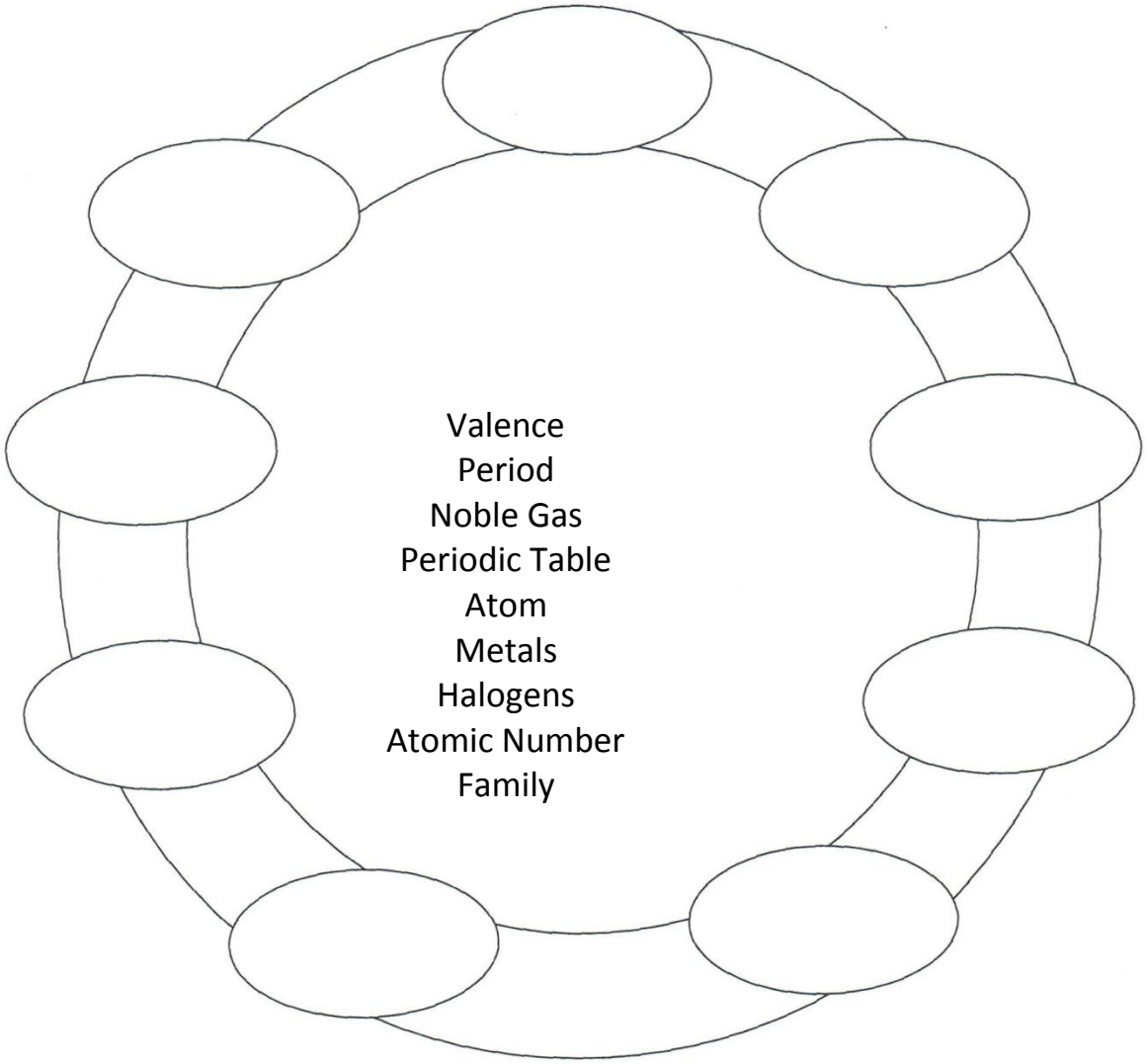
1. Hydrogen
2. Lithium
3. Na
4. Mg
5. Oxygen
6. Oxygen ion O^{2-}
7. Ca^{2+}
8. F^{-}

Electron Dot Diagrams

Element name	Symbol	Family	Electron dot diagram
Sodium			
	Ne		
Fluorine			
	Ca		
Magnesium			
	K		

Attachment 10.1

Word Cycle



Directions:

Read the list of words in the circle above. Select one word and place it in any oval. In the next oval, place another word that is related to the first. They could be synonyms, antonyms, steps in a process, examples of something, and so on. Be prepared to finish the statement "Word A is related to word B because . . . ." Write a note on the band in between the words to remind yourself of the relationship. Continue this process until you have placed all the words. Plan ahead; the last few words will be tricky to place.

20F Unit II WS 10 Name _____

Keeping an ION That Electron Date _____

Goal: Gain further understanding of how ions are formed.

Element Name	Symbol	Nearest noble gas	Electron dot diagram of charged ion	Charge
Sulphur				
	O			
Potassium				
	Cl			
Neon				
Sodium				

	F			

Chemistry Quiz

Forming Compounds

Atoms gain, lose, or share electrons to obtain full valence shells and become _____.

These atoms that have gained, lost or shared electrons are called _____.

Where do the atoms get these extra electrons?

They form chemical bonds with other atoms.

The number of electrons present remains the same, but their arrangement changes when compounds form.

Metal atoms tend to _____ electrons, while non-metal atoms tend to _____ or _____ electrons.

Members of the noble gas family are chemically _____ they _____ react.

Ionic Bonds

Bonds between a _____ and a _____

- between the left side of the periodic table and the right side

Ionic bonds result when electrons are transferred from metal atoms to non-metal atoms.

The metal atoms _____ electrons to become _____ ions, while the non-metal atoms _____ electrons to become _____ ions. The ions are held together by the attraction of opposite charges in an ionic bond.

Examples

1. Na and Cl

2. Mg and F

3. Li and S

Characteristics of Ionic Compounds

1. They have relatively _____ melting points.

   - the bond is strong because they are held together by the attraction of opposite charges
2. When melted or dissolved in water they conduct electricity. (An _____)

3. They _____ conduct electricity when solid.

Covalent Bonds (bonds between two _____)

Covalent bonds result when non-metals _____ electrons.

By overlapping their valence shells, the atoms share pairs of electrons.

This increases the number of electrons in each atom's valence shell, so that the atoms appear to have full shells.

Examples:

1. Cl and Cl

*** Note: no ions

Aside: This is called a _____ molecule. When two identical atoms combine. There are a few elements on the periodic table that always come in this form. (Remember the clown??) The diatomic elements on the periodic table are:

H O F Br I N Cl

2. H and O

3. N and F

Characteristics of Covalent (Molecular) Compounds

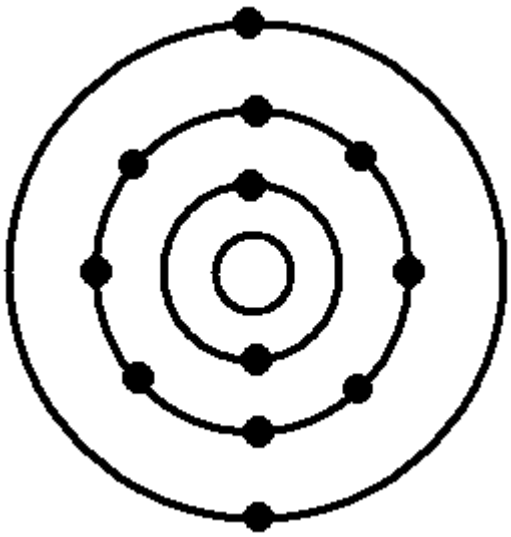
1. They have relatively _____ melting points.
2. They _____ conduct electricity when solid or when dissolved in water. (A _____ _____)

Ionic Bonding Exercise

Do the practice questions below to build your skill in writing formulas for ionic compounds.

1. Use Bohr model diagrams to illustrate the compounds formed from the following ion.
    a. Li^{1+} and Cl^{1-}
    b. Ca^{2+} and O^{2-}
    c. Na^{1+} and S^{2-}
    d. Al^{3+} and F^{1-}

2. Use the diagram below to answer the following questions.



    a. Use the periodic table to name this element.
    b. To which family does this element belong?
    c. Would you classify this element as a metal or non-metal?
    d. How many electrons would you expect this element to lose when it becomes an ion?
    e. What is the charge of this element when it becomes an ion?
    f. Would this element be more likely to combine with chlorine or lithium?
    g. Draw the ion that is normally formed from the atom depicted above.

3. Use the periodic table to complete the table.

Element	Number of Electrons Lost or Gained	Positive or Negative Ion	Charge on Ion
Sulphur			
Boron			
Calcium			
Chlorine			

Diatomic Molecules

The two hydrogen atoms form a **diatomic molecule** (i.e., two **atoms** of hydrogen share electrons to make a single **molecule** of hydrogen gas).

A list of diatomic molecules is shown below. Many of these molecules, which you recognize as gases, are important to life. The elements forming diatomic gases are unstable as single atoms and combine almost instantaneously to form stable molecules.

Note that diatomic molecules are still classified as elements even though they are molecules. While it may seem strange that a molecule is called an element rather than a compound, remember that diatomic molecules are made of only one kind of atom.

Name of Element	Symbol for one atom of the element	Formula or one molecule of the element
Hydrogen	H	$H_{2(gas)}$
Nitrogen	N	$N_{2(gas)}$
Oxygen	O	$O_{2(gas)}$
Fluorine	F	$F_{2(gas)}$
Chlorine	Cl	$Cl_{2(gas)}$
Bromine	Br	$Br_{2(liquid)}$
Iodine	I	$I_{2(solid)}$

If the diatomic elements are placed in a different order the symbols spell out a word that can help you remember these diatomic elements.

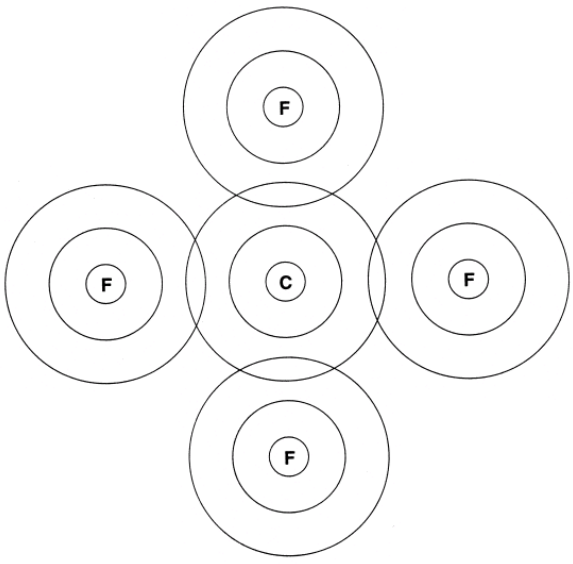
Remember **"HOFBrINCl the Clown"**

Covalent Compound Forming

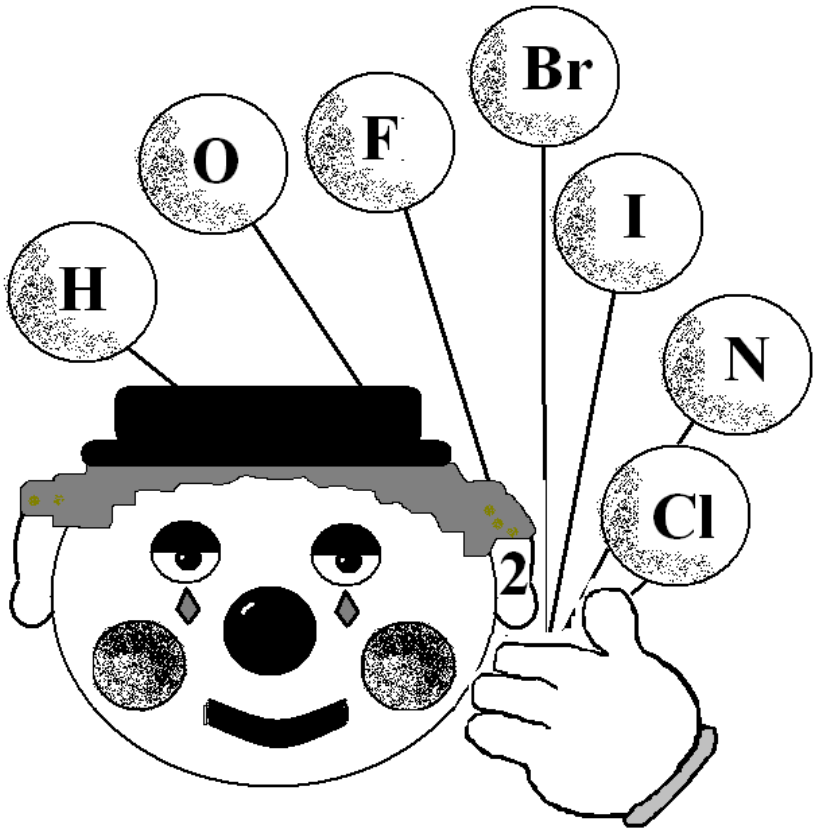
1. How does a covalent bond differ from an ionic bond?
2.
    a. What is a diatomic molecule?
    b. Name all the diatomic elements without referring to your notes or any of the pages.
3. What is the smallest unit of a covalent compound?
4. Why is it important that oxygen forms a diatomic molecule?
5. A list of pairs of atoms is shown below. Indicate whether each pair would form a compound using an ionic bond or a covalent bond.

	Type of bond
Calcium and bromine	
Hydrogen and oxygen	
Carbon and oxygen	
Lithium and oxygen	
Phosphorus and chlorine	

6. Complete the drawings below. One atom of carbon is combining with four atoms of fluorine to form one molecule of a compound.
   What kind of bond is used to make the compound?
   Place the proper number of electrons in the atoms in their proper orbits.



HOFBrINCl the Clown!



SCI 20F **Chemical Names**

Who decides how a chemical compound should be named?

_____

We will be writing the names and formulas of compounds with two different atoms. These are called _____ _____.

Writing Chemical Names:

Binary Ionic Compounds: These compounds will be composed of a _____ and a _____. There will only be _____ different atoms in each compound.

Rules:

1. Name the cation first and then the anion.
2. Name the cation (metal) directly from the periodic table.
3. Name the anion (non-metal) but drop the ending and end the name in "ide".

*** These rules are **only** for Group 1, Group 2, and Group 13 metals. There will another set of rules for the **Transition Metals!!!!!**

Examples:

Chemical Formula	Name of the Ionic Compound
1. H_2S	
2. NaCl	
3. $MgBr_2$	
4. KCl	
5. Na_2S	

Here are some examples of common roots:

Cl → chlor-
F → fluor-
Br → brom-
O → ox-
I → iod-
N → nitr-

Activity #1: Name these binary ionic compounds:

1. MgS
2. KBr
3. Ba_3N_2
4. Al_2O_3
5. NaI
6. SrF_2
7. Li_2S
8. $RaCl_2$
9. CaO
10. AlP
11. K_2S
12. LiBr
13. Sr_3P_2
14. $BaCl_2$
15. NaBr
16. MgF_2
17. Na_2O
18. SrS
19. BN
20. AlN

Binary Molecular (Covalent) Compounds: These compounds will be composed of two _____. There will only be _____ different atoms in each compound.

Rules:
When naming these compounds you will need to know the Greek prefixes:

Number of Atoms	Prefix	Number of Atoms	Prefix
1		6	
2		7	
3		8	
4		9	
5		10	

The names of these compounds will take this form:

_____ _____ _____ _____

Examples:

Chemical Formula	Name of the Molecular Compound
1. N_2O	
2. NO_2	
3. IF_7	
4. N_2O_5	
5. XeF_2	

Activity #2: Name these binary molecular (covalent) compounds:

1) As_4O_{10}
2) BrO_3
3) BN
4) N_2O_3
5) NI_3
6) SF_6
7) XeF_4
8) PCl_3
9) CO
10) PCl_5
11) P_2O_5
12) S_2Cl_2
13) ICl_2
14) SO_2
15) P_4O_{10}
16) UF_6
17) OF_2
18) ClO_2
19) SiO_2
20) BF_3

Ionic Challenge

Pick up 3 Erlenmeyer flasks from the front of the class room.

Fill them each with 100 ml of water, from the tap is fine for this.

Label them each (with a grease pencil) with the correct formulas for the following ionic compounds:
Sodium chloride
Cobalt (II) chloride
Copper (II) chloride

Come show me your formulas on your flasks and I will give you some of each chemical compound.

Swirl your flasks until all the solid has dissolved. Note the colours each solution turns.

Sodium chloride -
Cobalt (II) chloride -
Copper (II) chloride –

Challenge question: List the ions formed in each solution. Which ions are responsible for which colours? How did you figure this challenge out?

Stock System

The Stock System is used only if the metal element in the compound may have more than one charge. Example: Iron can form ions that have a charge of 2+ or 3+.

In this system, the valence of the metal element is indicated by using a Roman numeral in parenthesis following the name for the metal.

Example: Iron (II) for a valence of 2+ and Iron (III) for a valence of 3+.

Determining the Stock System name from a chemical formula may be more difficult for students. Knowing that the total charge on a compound is equal to zero, and using the known non-metal charge, students can determine the charge on the metal.

Example: Fe_2O_3

1. The non-metal ion, oxygen, has a charge of O^{2-}. As there are three oxide ions in the formula, the total negative charge in the compound is 2- x 3 = 6-.
2. The positive ions must have a charge equal to the charge of negative ions to give the compound a net charge of zero. The charge on the ion must be 6+ (? x 2 = 6+).
3. Since there are two iron ions shown, the valence on the iron is 3+. The name of the compound is iron (III) oxide.

Example: PbS_2

Total negative ions is 2- x 2 = 4-.

Therefore total positive ions must equal 4+ (? x 1 = 4+). Since there is only one lead ion, the valence on the lead is 4.

The name of the compound is lead (IV) sulfide.

SCI 20F Writing Chemical Names

Recall:

Ionic Compounds: (metal + non-metal) Name the metal. Name the non-metal ending in "ide".

Covalent Compounds: (non-metal + non-metal) First the prefix (not "mono") then the name of the first non-metal. Then, another prefix and the name of the second non-metal ending in "ide".

Name the following compounds: Be careful because the ionic and covalent compounds are mixed up!!

1. HgF_2
2. KCl
3. PF_5
4. KF
5. HCl
6. $SbCl_3$
7. As_4O_{10}
8. LiI
9. HBr
10. IF_5
11. CCl_4
12. Na_2O
13. IF_6
14. BaF_2
15. CO_2
16. MgO
17. Mg_3P_2
18. P_2O_5
19. Ca_3N_2
20. Li_2S

Ionic or Covalent?

Formula	Ionic or Covalent	Name	Draw it (Lewis or Bohr is fine)
NH_3			
CO_2			
N_2			You don't need to draw this.
SrO			
Al_2Se_3			
As_4I_7			You don't need to draw this.
PH_5			You don't need to draw this
Na_2O			

Do Ionic and Covalent Lab

20F Unit II WS 15 **Name _____** **Chemistry Match-Up**
Date _____

What to do:
Match each description in column A with the correct term in column B. Write the letter for the term on the line beside the description.

		A		B
___	1.	positively charged ion	a)	atomic number
___	2.	term used by chemists to describe the # of bonds that an atom forms in a compound.	b)	periods
			c)	valences
			d)	ion
___	3.	charged atom		
			e)	cation
___	4.	bonds formed between anions and Cations	f)	anion
			g)	ionic bond
___	5.	bond formed by atoms that share a pair of electrons	h)	diatomic molecule
			i)	molecule
___	6.	number of protons or electrons in a neutral atom	j)	covalent bond
___	7.	neutral particle that is composed of two or more atoms		
___	8.	horizontal rows of the periodic Table		
___	9.	negatively charged atom		
___	10.	molecule that contains two atoms		

Ionic Compounds

Ionic compounds form when electrons are transferred from metal atoms to non-metal atoms so that the atoms obtain the stable electron arrangements of the nearest noble gases.

RULES for Naming Binary Ionic Compounds

1. Name the positive ion first by writing the full name of the metallic element.
2. Name the non-metal ion next by dropping the last syllable(s) of the name of the element and adding the suffix "ide."
   Example: reaction between sodium and chlorine forms -> sodium chloride **Example:** given the chemical formula SrS —> strontium sulfide

RULES for Writing Chemical Formulas for Binary Ionic Compounds

1. Using the name of the binary compound, write the symbols and charge for the ions involved. Write the ion charge as a superscript. **Example:** aluminum Oxide — Al^{3+} O^{2-}

2. Put the charges of each ion as the subscript of its partner "cross the charge." **Example:** Al_2^{3+} O_3^{2-}
3. As a check to ensure the formula is written correctly, multiply the charge for each ion by the subscript for the same ion. The total positive charge should equal the total negative charge and the net charge per ionic formula should be zero. **Example:**

   $A1^{3+}$ x 2 = 6+
   O^{2-} x 3 = 6-
   6 + 6- = 0

4. Write the final chemical formula without the charges.
   Final Answer: Al_2O_3

Note:

1. The subscript "1" is not used.
Example: lithium bromide — Li^{1+} Br^{1-}
Li_1^{1+} Br_1^{1-}
Final Answer: LiBr

2. Reduce and simplify the ratio.
Example: Magnesium Sulfide — Mg^{2+} S^{2-}
$Mg_2^{2+}S_2^{2-}$
Mg_2S_2
Final Answer: MgS

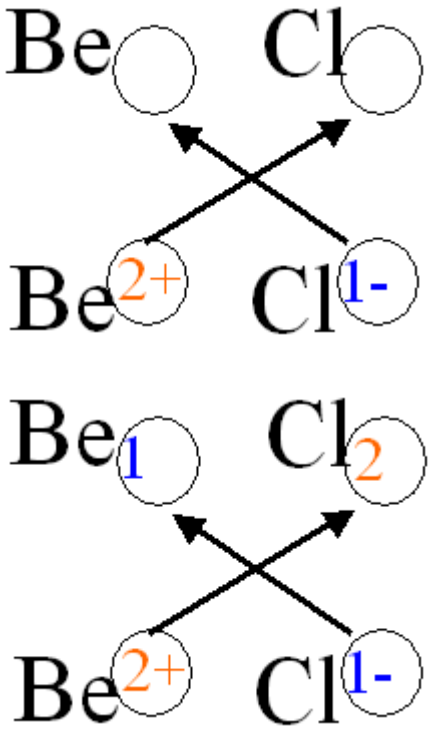
Writing Formulas for Ionic Compounds using the Criss-Cross Method

When writing correct formulas for these ionic compounds, there are several rules to follow. Beryllium and chlorine will be used as examples.

Rule 1: Write the symbol of the **metallic** element **first**. In the example, Be is written first. The **nonmetal**, chlorine, is written **second.**

Be^{2+} Cl^{1-}

Rule 2: Place the ionic charge number(valence number) of one element at the base (as a subscript) of the other element as shown below. Use only the valence number, not the charge(+ or -). This is where the name crisscross comes from.



The formula becomes $BeCl_2$.

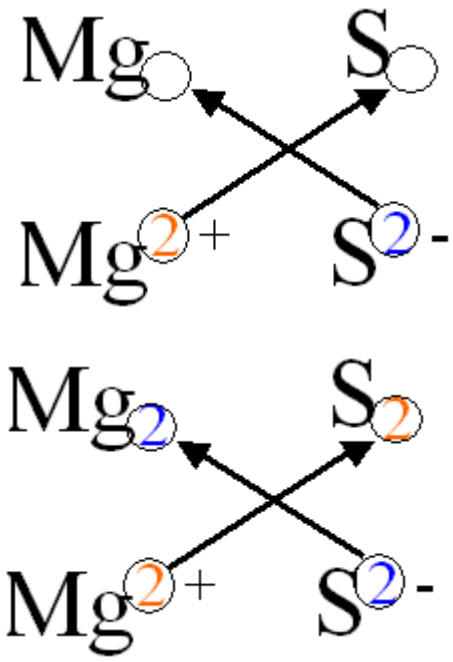
Note that the valence number of beryllium is placed as a subscript to Cl and the valence number of chlorine has been placed as a subscript to beryllium. Notice also that the beryllium subscript of 1 has been left out.

Rule 3: If a subscript has a value of one, leave it out. Notice that Be has no subscript in the example.

Rule 4: Reduce the subscripts when necessary by the greatest common factor. Formulas for ionic compounds are written so that the formula unit contains the **smallest** number of positive ions and negative ions required to make the formula unit neutral.

For example, when magnesium combines with sulfur, the formula might appear as Mg_2S_2, but it should be reduced to MgS by dividing both subscripts by two.

Mg^{2+} S^{2-}



Ionic Bonding: Lowest Common Multiple Method

Identify the ions from the name. For example, aluminum oxide contains the positive aluminum ion $Al^{3+}$and and the negative oxide ion O^{2-}. You can find these valences in the charts provided earlier.
Write the ions in two columns, the positive ion on the left side and the negative column on the right side.

Positive Ion	Negative ion
Al^{3+}	O^{2-}

Keep adding ions to each side until the total charge of the ions in each column is the same. Then, the formula is obvious. It simply is the number of each ion required to balance the positive and negative charges.

Positive Ion	Negative ion

Notice that the charge of 6 is the **lowest common multiple** of 2 and 3, the sizes of the charges on the ions.

Since the total charge is 0, we have the correct number of each ion. Therefore the formula is Al_2O_3.

Let's try another binary ionic compound called barium oxide.

From the name the positive ion is Barium, Ba^{2+}, and the negative ion is oxide, O^{2-}.

Positive Ion	Negative ion

The lowest common multiple of 2 and 2 is 2.

You can see that only one of each ion is needed to balance the charge. The formula unit contains on of each ion, Ba^{2+} and O^{2-}.

Therefore the formula is BaO.

This method does away with reducing subscripts.

Ionic Compound Forming Questions:

Answer the questions in a word processing document or on a sheet of paper. Then check your answers with the key on the next page.

1. Write formulas for the following compounds that are named using the Stock method. You will need to use the periodic table plus the table of combining capacity or valence.

Name	**Formula**
Magnesium nitride	
Lithium sulfide	
Strontium bromide	
Aluminum chloride	
Potassium phosphide	
Barium oxide	
Chromium (III) sulfide	
Tin (IV) nitride	

Tin (II) oxide	
Bismuth(V) fluoride	
Manganese(II) bromide	
Iron(III) chloride	
Lead(IV) oxide	

2. Name the following binary ionic compounds.

    a. These questions are straight forward with no metal ions with more than one possible valence.

Formula	**Name**
MgS	
KBr	
Ba_3N_2	
Al_2O_3	
NaI	
SrF_2	
Li_2S	
$SrCl_2$	
CaO	
AlP	

    b. These questions require the use of the Stock system for the names of metal ions with more than one possible valence.

Formula	**Name**
Cr_2S_3	
$FeBr_2$	
Pb_3N_2	
Co_2O_3	
CuI	
CuF_2	
CuS	
$CoCl_2$	
PbO	
CrP	

3. Use Bohr atoms to illustrate the formation of the following compounds.

   Beryllium fluoride

   Lithium chloride

4. Write formulas for compounds formed from the following sets of ions.
   a. Li^{1+} and Cl^{1-}
   b. Ca^{2+} and O^{2-}
   c. Na^{1+} and S^{2-}
   d. Al^{3+} and I^{1-}
   e. Ba^{2+} and F^{1-}

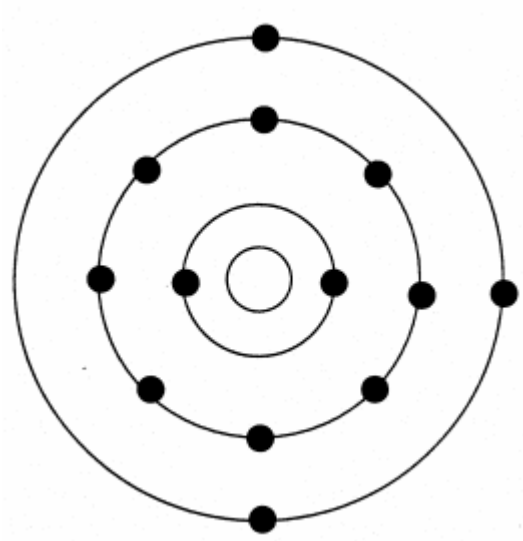
5. Write formulas for compounds formed from the following elements. (Hint: You will need to look up the valences in the periodic table.)
   a. Sodium and bromine
   b. Potassium and oxygen
   c. Aluminum and sulfur

d. Barium and chlorine
e. Lithium and oxygen
f. Silver and chlorine

6. Write formulas for the following compounds.

Name	**Formula**
Potassium chloride	
Sodium oxide	
Calcium bromide	
Magnesium oxide	
Aluminum fluoride	

7. Use the diagram below to answer the following questions.

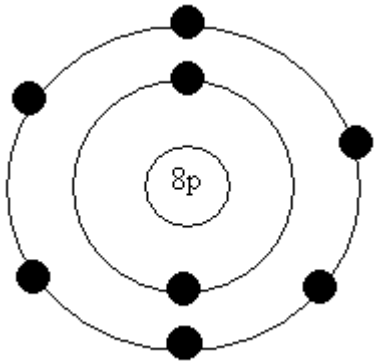


a. Use the periodic table to name this element.
b. What family does this element belong to?
c. Would you classify this element as a metal or non-metal?
d. How many electrons would you expect this element to lose when it becomes an ion?
e. What is the charge of this element when it becomes an ion?
f. Would this element be more likely to combine with chlorine or lithium?
g. Draw the ion that is normally formed from the atom depicted on the previous page.

8. Complete the table.

Element	Number of Electrons Lost or Gained	Positive or Negative Ion	Charge on Ion
Sulfur			
Boron			
Calcium			
Chlorine			

9. Use the Bohr diagram of the element below to answer the following questions.



a. Use the periodic table to name this element.
b. What family does this element belong to?
c. Would you classify this element as a metal or non-metal?
d. How many electrons would you expect this element to gain when it becomes an ion?
e. What is the charge of this element when it becomes an ion?
f. Would this element be more likely to combine with sodium or calcium?

Ionic Formula Forming

Hints:

- **Look up the elements on the periodic table**
- **How many valence electrons does the metal (listed first) want to lose?**
- **How many valence electrons does the non-metal (listed second) want to gain?**
- **How can you combine these elements to make it work?**
- **For the transition metals that do not have set electron shells their ionic charge is listed in brackets after their name. ie. Copper (II) means Cu^{2+} and that copper lost 2 electrons.**

Aluminum sulfide example

- Al wants to lose 3 e-
- Its ion is Al 3+
- S wants to gain 2 e-
- Its ion is S 2-
- We must balance the charges to get a neutral compound.
- The lowest common multiple of 3 & 2 is 6.
- We need 6+ from Al – so 2 Al.
- We need 6- from S – so 3 S.
- Formula is written with

1) lithium oxide _____

2) aluminum sulfide _____ **Al_2S_3**_____

3) iron (III) phosphide _____

4) manganese (III) fluoride _____

5) lead (IV) nitride _____

6) potassium oxide _____

7) silver bromide _____

8) nickel (II) selenide _____

- **The next formulas are more difficult because they are polyatomic ions.**
- **You can find their ion charges on your common ion table.**

9) copper (II) acetate _____

10) sodium hydroxide _____

11) beryllium nitrate _____

12) nickel (III) sulfite _____

13) zinc phosphate _____

14) copper (II) bicarbonate _____

15) manganese (IV) carbonate _____

Molecular Compounds

Binary molecular compounds contain atoms of two non-metal elements, covalently bonded by sharing electrons.

Following IUPAC guidelines, molecular compounds are named using a prefix system. A Greek prefix is used to indicate the number of each type of atom in the molecule. The prefixes are:
mono = 1
di = 2
tri = 3
tetra = 4
penta = 5
hexa = 6

RULES for naming binary molecular compounds

1. The first non-metal name is written in full.

2. The second non-metal element is named with the suffix "ide" ending.

3. Assign a prefix to each element expressing the number of atoms present in the molecule. The prefix mono is used only with the second element in the compound. When the second element is oxygen, the vowel "o" in mono is dropped and the nam becomes monoxide rather than monooxide. Similarly, the "a" in tetra, penta, or hexa is also dropped.

Example: CO_2 is written as carbon dioxide

N_2O_5 is written as dinitrogen pentaoxide

RULES for writing binary molecular compounds

1. Both non-metal symbols are followed by a subscript indicating the number of atoms present. The number 1 is not written, as it is understood to be present.

Example: carbon tetrachloride = CCL_4

silicon hexafluoride = SiF_6

2. When determining which non-metal element to place first in the compound, the general rule is to read across the periodic table from left to right. The element that appears first is usually written first. There are exceptions to this general rule.

Example: H_2S = hydrogen sulfide

NF_3 = nitrogen trifluoride

Covalent Compounds: Writing Formulas

Writing formulas for covalent compounds follows the same pattern as ionic compounds. When both covalent and ionic bonds are formed, they make use of electrons in the outer shells (valence electrons).

If you are given the names of two non-metallic elements, find their combining capacities or valences in the periodic table or charts.
Here we use a different definition of valence. **Valence refers to the number of hydrogen atoms to which the given atom can bond.**

For example, carbon can form 4 bonds with H. Therefore the valence of C is 4. No sign is attached to this valence.

Combining capacity or valences we have used up to now included a positive or negative sign. By this new definition, the number of the combining capacity or valence is used to make the formula for a binary covalent compound.

For carbon, the **combining capacity** in the periodic table is **4+**.

We just use the **4** to represent the valence.

Here is a chart of valences for non-metallic elements according to the number of bonds each atom can make with hydrogen.

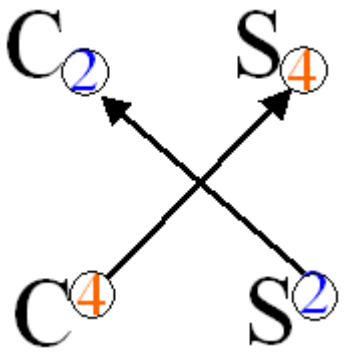
Combining capacities or Valances of Nonmetal Atoms

4	**3**	**2**	**1**
			H
C	**N**	**O**	**F**
Si	**P**	**S**	**Cl**
	As	**Se**	**Br**
			I

Write the formula of the compound formed between carbon and sulfur.

1. **Write both symbols, left-most element in the periodic table first, with valence numbers as shown.**
   C^4 S^2

2. **Use the crisscross method to exchange valence numbers and place them as subscripts as shown in the diagram below.**



3. **Reduce the formula**
   $C_2S_4 = C_1S_2$

4. **The subscript "1" is dropped.**
   CS_2 is the finished formula.

Questions

Write formulas for the following element pairs. Use the periodic table or the valence chart for reference.

a. Nitrogen – hydrogen _____
b. Carbon – chlorine _____
c. Nitrogen – bromine _____
d. Phosphorus – sulfur _____
e. Carbon – oxygen _____
f. Hydrogen – sulfur _____

Write formulas for the following element pairs. Use the periodic table or the valence chart for reference.

a. Nitrogen – hydrogen
   NH_3 Valences – N is 3 and H is 1

b. Carbon – chlorine
   CCl_4 Valences – C is 4 and Cl is 1

c. Nitrogen – bromine
NBr_3 Valences – N is 3 and Br is 1

d. Phosphorus – sulfur
P_2S_3 Valences – P is 3 and S is 2

e. Carbon – oxygen
CO_2 Valences – C is 4 and O is 2
This formula must be reduced

f. Hydrogen – sulfur
H_2S Valences – H is 1 and S is 2

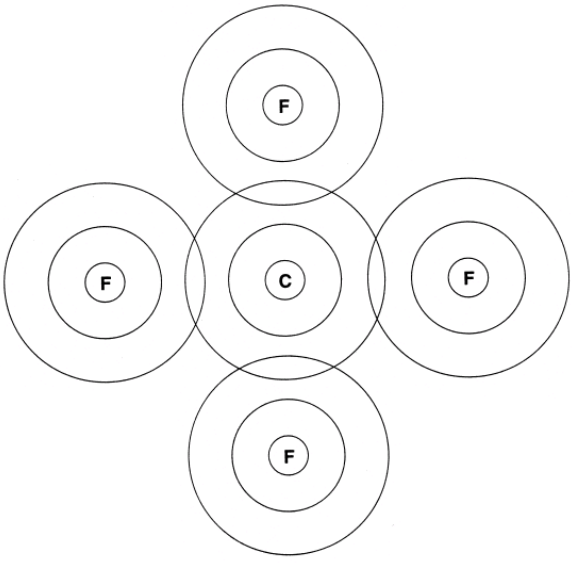
Do "The Bonding Game"

Covalent Compound Forming

1. How does a covalent bond differ from an ionic bond?
2.
    a. What is a diatomic molecule?
    b. Name all the diatomic elements without referring to your notes or any of the pages.
3. What is the smallest unit of a covalent compound?
4. Why is it important that oxygen forms a diatomic molecule?
5. A list of pairs of atoms is shown below. Indicate whether each pair would form a compound using an ionic bond or a covalent bond.

	Type of bond
Calcium and bromine	
Hydrogen and oxygen	
Carbon and oxygen	
Lithium and oxygen	
Phosphorus and chlorine	

6. Complete the drawings below. One atom of carbon is combining with four atoms of fluorine to form one molecule of a compound.
   What kind of bond is used to make the compound?
   Place the proper number of electrons in the atoms in their proper orbits.



20F Unit II WS 16 - Writing Ionic Formulas Involving Polyatomic Ions

Write the formulas for the following compounds

1. sodium chlorate
2. barium chlorate
3. sodium hydrogen carbonate
4. calcium nitrate
5. barium sulfate
6. aluminum chlorate
7. aluminum nitrate
8. aluminum nitrite
9. lithium phosphate
10. strontium phosphate
11. calcium acetate
12. aluminum sulfate
13. calcium carbonate
14. ammonium chloride
15. ammonium sulfide
16. ammonium sulfate
17. ammonium phosphate
18. copper(I) carbonate
19. iron(III) nitrate

Write the names for the following binary ionic compounds:

1. $ZnSO_4$
2. $Al(NO_3)_3$
3. $(NH_4)_2SO_4$
4. $Zn(OH)_2$
5. HNO_3
6. $BaSO_4$
7. $Al(ClO_3)_3$
8. $AgNO_3$
9. $Ca(ClO_3)_2$
10. $CdSO_4$
11. Na_2SO_3
12. $BaCO_3$
13. $NaNO_2$
14. $SnSO_4$
15. $Sn(CO_3)_2$
16. $FeCO_3$
17. $NaC_2H_3O_2$
18. $Pb(NO_3)_4$
19. Cu_3PO_4
20. $Cu_3(PO_4)_2$

Covalent Compounds Exercises

1. Write names for the following binary covalent compounds.

PBr_3	
HF	
CF_4	
P_2O_3	

2. Write formulas for the following binary covalent compounds

Phosphorus pentasulfide	
Nitrogen monoxide	
Carbon tetraiodide	
Nitrogen dioxide	

3. Write formulas for the following compounds

Carbon tetrafluoride	
Nitrogen monoxide	
Dinitrogen tetroxide	
Silicon disulfide	

4. Write the names for the following compounds

H_2S	
As_2O_3	
CBr_4	
OI_2	
N_2O_4	

5. Why is it difficult to write correct formulas for the following compounds: chalk, gasoline, alcohol, and rust?

6.
    a. In what way are ionic and covalent bonds similar?
    b. In what ways are ionic and covalent bonds different?

7. What combining capacity would you expect for each of the following elements? Use your periodic table as a guide.

Bismuth	
Boron	
Silicon	
Tellurium	
Astatine	

8. Is Cs_3N the formula of a covalent compound? _____
   Is C_3N_4 the formula of a covalent compound? _____
   How did you make your decision?

9. State a rule for predicting which element combinations form covalent compounds.

10. How many atoms of hydrogen combine with the following elements to form a covalent compound? When naming the compound, include both the chemical name and the common name where applicable.

	Atoms of Hydrogen	Formula of Compound	Name of Compound
Carbon			
Boron			
Nitrogen			
Oxygen			

Ionic or Covalent Cont'd

Name	Ionic or Covalent	Formula	Draw it (Lewis or Bohr is fine)
Dihydrgen monosulfide			
Trichlorine pentafluoride			You don't need to draw this.
Sodium fluoride			
Vanadium (II) chromate			You don't need to draw this.
Iron (II) chloride			
Iron (III) bromide			You don't need to draw this.
Barium nitride			
Triboron tetracarbide			You don't need to draw this.
Sulfur dioxide			You don't need to draw this

Carbon dioxide			You don't need to draw this
Copper (II) acetate			You don't need to draw this.

If you can do this you are well on your way to acing the first chemistry unit.
If you can't you need to see me for help and more practice.

Compound Cheat Sheet

H_2O NH_3 Cl_2 CaF_2

Compounds – any combination of two or more atoms. They can be the same atom combined together (Cl_2) or different atoms (NH_3).

Element – one atom of a pure substance found on the periodic table. It is not combined with anything.

Subscripts – the little number after an atom in a compound that tells us how many of that element are present in our compound. For example there are two hydrogens in H_2O, there are three hydrogens in NH_3, and one calcium in $CaCl_2$.

Practice:

1) How many carbons are in CH_4? _____
2) How many magnesium are in $PbMg_2$? _____
3) How many chlorine are in Cl_2? _____
4) How many oxygen in H_2O? _____

Ok it gets a little tougher……..

Coefficients – the number in front of a compound that tells us how many of that compound we have.

Examples: $2CO_2$ $4F_2$ $7NO$ $LiCl$ $101SO_2$

Above we have two carbon dioxide compounds (CO_2), seven nitrogen oxide compounds (NO), one hundred and one sulfur dioxides (SO_2), and only one lithium chloride (LiCl). If there is no coefficient we assume we have just one.

Practice:

$2H_2O$ $8NaCl$ $4MgO$ O_2 $12LiF$

5) How many water compounds do we have above? _____
6) How many Oxygen compounds do we have above? _____
7) How many compounds of sodium chloride do we have above?_____

Ok it only gets one step more difficult……

If I have coefficients and subscripts I multiply them together to find out how many total atoms of each element I have.

In $2H_2O$ I have four hydrogens (2-coefficient x 2-subscript = 4) and two oxygens (2-coefficient x 1 = 2).

Practice:

$2Al_3S_2$ 8NaCl $4Li_2O$ O_2 $5NH_3$

8) How many sodium are in 8NaCl? _____
9) How many Oxygen are in O_2? _____
10) How many lithium are in $4Li_2O$?_____
11) How many oxygen are in $4Li_2O$?_____
12) How many aluminum are in $2Al_3S_2$? _____
13) How many sulfur are in $2Al_3S_2$? _____
14) How many nitrogen are in $5NH_3$? _____
15) How many hydrogen are in $5NH_3$? _____