

PERIODIC TABLE OF THE ELEMENTS

- The periodic table is composed of **periods** (rows) and **groups or families** (columns).
- Elements in the same family have similar properties, and are commonly referred to by their traditional names.
- Elements in groups **1-2** and **13-18** are referred to as **main-group** or **representative elements**.
- The group of metals in between the main group elements are called the **transition metals**.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18											
Alkali Metals	Alkali-Earth Metals	Transition Metals										C	Si	Ge	Sn	Pb	N	P	As	Sb	Bi	O	S	Se	Te	Po	Halogens	Noble Gases

No common names

ELEMENTS & COMPOUNDS

Pure substances may be classified according to the particles they contain into:

I. MOLECULAR SUBSTANCES

- are made up of molecules

MOLECULE: a group of atoms (identical or different) chemically bonded together

- contain nonmetallic atoms only

II. IONIC SUBSTANCES

- are made up of ions

ION: electrically charged particle obtained from an atom by adding or removing electrons

- contain metals and nonmetals

Element s:

Diatomic molecules:

H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂

Compound s:

H₂O, NH₃, CO₂

Cati ons:

- Positive ions
- Formed by losing electrons

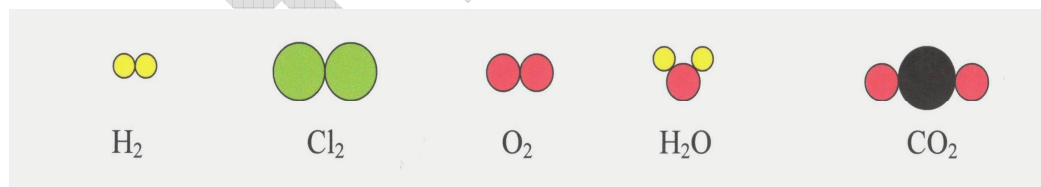
Anion s:

- Negative ions
- Formed by gaining electrons

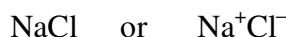
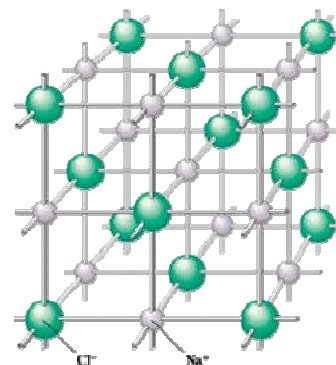
Polvat o mic:

P₄, S₈

- Molecular Substances are represented by **molecular formulas**
- Molecular formulas give the exact number and type of atoms in a molecule



- Ionic Substances are represented by **ionic formulas**
- Ionic formulas give the smallest whole number ratio of the ions.



(There is a 1:1 ratio between the SodiumIons and the ChlorideIons)

FORMULA OF IONIC COMPOUNDS

- An ionic compound is composed of **cations** and **anions** arranged in a crystalline structure.

CATIONS are positive ions formed by removal of electrons from metallic atoms.

Exa mp les:

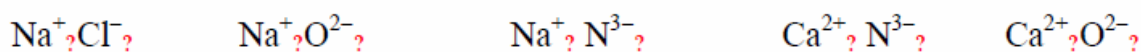
Na^+	Ca^{2+}	Al^{3+}
11 protons	20 protons	13 protons
10 electrons	18 electrons	10 electrons
sodium ion	calcium ion	aluminum ion

ANIONS are negative ions formed by gaining of electrons by nonmetallic atoms.

Exa mp les:

N^{3-}	O^{2-}	Cl^-
7 protons	8 protons	17 protons
10 electrons	10 electrons	10 electrons
nitride ion	oxide ion	chloride ion

- In an ionic compound, the cations and the anions combine in the smallest whole-number ratio which mutually neutralizes the overall charge.
- All ionic compounds are **electrically neutral** as a whole.



NOMENCLATURE OF IONIC COMPOUNDS

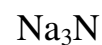
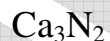
- Chemical nomenclature is based on rules set forth by the **International Union of Pure and Applied Chemists (IUPAC)**.

Binary Compounds:

- Binary compounds are those that contain only two elements.
- All binary compounds names end in **"ide"**.
- Binary ionic compounds contain:

Metallic cation		Nonmetallic Anion	
Cation (+) is always written first		Anion (-) is always written second	
Name of cation = name of metallic atom		Name of anion \neq name of nonmetallic atom	
Na sodium atom	Na ⁺ sodium ion	Cl chlorine atom	Cl ⁻ chloride ion

Examples:

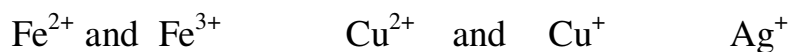
sodium chlor**ide**sodium ox**ide**sodium nitr**ide**

IONIC CHARGES

- In order to write correct formulas for Binary Ionic Compounds, the charges of ions (both cations and anions) must be known.
- Many of these charges are readily obtained by the use of a periodic table.
- For the main-group elements, the charges depend on the group numbers as outlined below:

CHARGES OF CATIONS			CHARGES OF ANIONS			
Charge of cation = Group No.			Charge of anion = 8 – Group No.			
1A	IIA	IIIA	IVA	VA	VIA	VIIA
Li ⁺	Be ²⁺		C ⁴⁻	N ³⁻	O ²⁻	F ⁻
Na ⁺	Mg ²⁺	Al ³⁺		P ³⁻	S ²⁻	Cl ⁻
K ⁺	Ca ²⁺	Ga ³⁺		As ³⁻	Se ²⁻	Br ⁻
Rb ⁺	Sr ²⁺	In ³⁺			Te ²⁻	I ⁻
Cs ⁺	Ba ²⁺	Tl ³⁺				
Exceptions:			Sn ²⁺ , Sn ⁴⁺			
Exceptions:			Tl ⁺ Pb ²⁺ , Pb ⁴⁺			

- For cations from Transition Metals the most common ionic charge is 2+
- There are many other charges and exceptions. Some of these charges must be memorized.



IONIC CHARGES

- Writing formulas of ionic compounds is based on the knowledge of the ionic charges. (Recall that the charges must balance).

Examples:

Write correct ionic charges and formulas for the following binary ionic compounds shown below:

aluminum fluoride



Ionic charges

Formulas:

potassium sulfide



magnesium bromide





Ionic charges

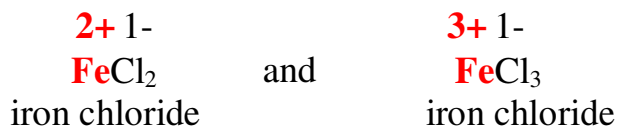
Formulas:





IONIC NOMENCLATURE

- Some metallic atoms may form more than one cation and therefore more than one compound with the same anion.



- Note that the usual nomenclature rules do not distinguish between the two different compounds.
- To distinguish between such compounds, two common nomenclature systems are presently in use:

	$2+$ FeCl_2	$3+$ FeCl_3
Old System	<ul style="list-style-type: none"> “ous” ending for the lower charge <p style="text-align: center;">ferrous chloride</p>	<ul style="list-style-type: none"> “ic” ending for the higher charge <p style="text-align: center;">ferric chloride</p>
Stock System Roman numeral indicates the cation's charge	iron (II) chloride	iron (III) chloride

Examples:

- Name the compounds listed below, using the old system and the stock system:



Old system:

Stock system:

- Write formulas for the following compounds:

ferric oxide

chromium (VI) oxide

lead (II) sulfide

NOMENCLATURE OF MOLECULAR COMPOUNDS

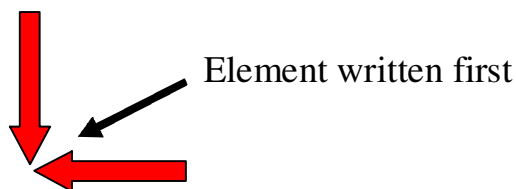
Binary Molecular Compounds

Contain: 2 nonmetals
 Examples: CO
 carbon monoxide

CO₂
 carbon dioxide

IUPAC RULES:

1. The element written first is the one more to the left and lower down on the Periodic Table.



Exception: NH₃

2. Prefixes are used to indicate the number of atoms of each kind in the molecule.

1	mono:	CO	(monocarbon monoxide)	 often omitted
2	di	CO ₂	(carbon dioxide)	
3	tri	SO ₃	(sulfur trioxide)	
4	tetra	CCl ₄	(carbon tetrachloride)	
5	penta	PCl ₅	(phosphorus pentachloride)	
6	hexa	SF ₆	(sulfur hexafluoride)	
7	hepta	ICl ₇	(iodine heptachloride)	
8	octa			
9	nona			
10	deca	P ₄ O ₁₀	(tetraphosphorus decaoxide)	

Examples:

1. Name the following compounds:

HCl _____ H₂O _____ H₂O₂ _____

N₂O₅ _____ AsBr₃ _____ HF _____

2. Give the formula for the following compounds:

dihydrogen sulfide _____ carbon disulfide _____ dinitrogen tetroxide _____