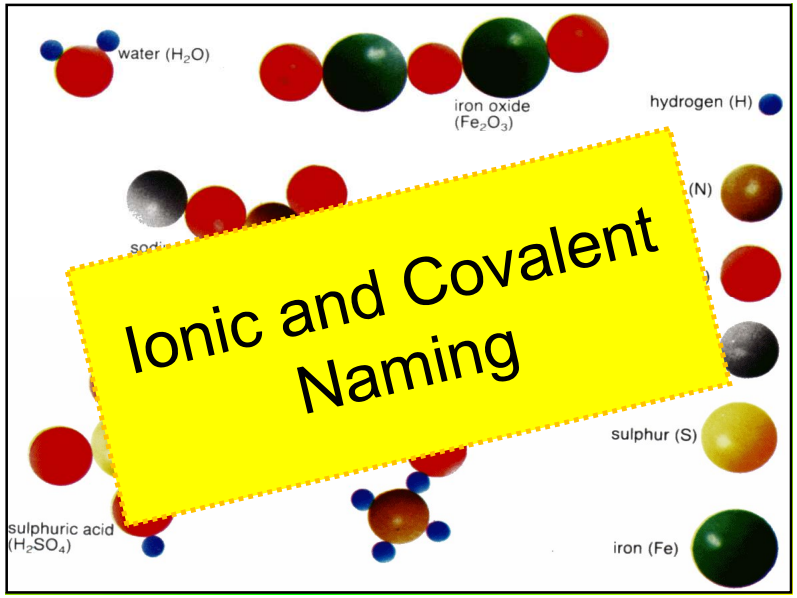


What are 3 ways that atoms can form bonds?

1. Ionic bonds

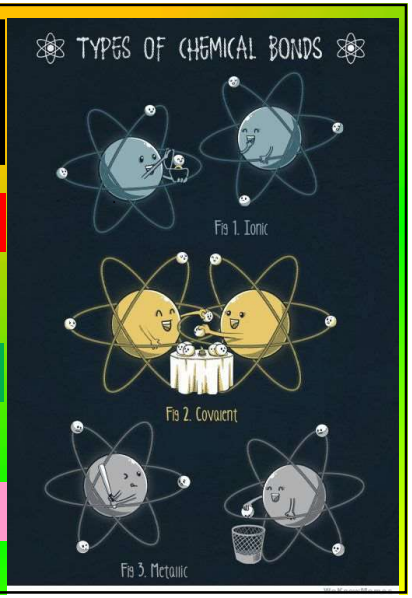
Transferring electrons

2. Covalent bonds

Sharing electrons

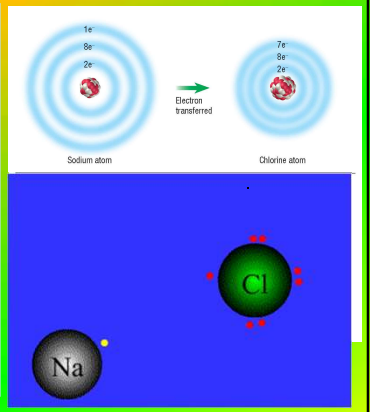
3. Metallic bonds

Many free electrons

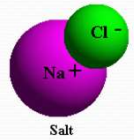


Binary Ionic Bonds

- **Bond between 2 ions that transfer valence electrons**
- **Metals to nonmetals**
- **Na and Cl**



Properties of Ionic Compounds



- Stronger bonds
- High melting points
- Conduct electricity when in solution or in a molten state
  - Generally dissolve in water
- Generally crystalline solid at room temp.

Writing Binary Ionic Formulas

Steps for writing chemical formulas using oxidation numbers

- 1. Write the chemical symbols for the *cation* (first) and *anion* (second). *Metal 1st Nonmetal 2nd*
- 2. Write the oxidation number (Charge) on top of the Chemical Symbols for the cation and anion. The 1 is understood.
- 3. Kris cross the oxidation numbers writing each number as a subscript for the other atom or polyatomic ion.
- 4.Reduce Subscripts if they can be reduced

Example

Mg^{+2} I^{-}

MgI_2

magnesium iodide

$Ca_2O_2 = Ca_{2/2}O_{2/2} = CaO$

$Pb_2O_4 = Pb_{2/2}O_{4/2} = PbO_2$

Writing Binary Ionic Formulas

1. sodium chloride 2. magnesium oxide 3. potassium sulfide

1.	Na	Cl	1.	Mg	O	1.	K	S
2.	Na^{+1}	Cl^{-1}	2.	Mg^{+2}	O^{-2}	2.	K^{+1}	S^{-2}
3.	Na^{1}	Cl^{1}	3.	Mg^{2}	O^{2}	3.	K^{1}	S^{2}
4.	Na	Cl	4.	Mg	O	4.	K_2	S
5.	**NaCl**		5.	**MgO**		5.		**K_2S**

Rules for Naming Binary Ions

1. The names of metals do not change.
2. Changing the name of nonmetals:
   - Root of element name + *-ide* = name of ion

Examples:

The name of chlorine's ion:

chlor- + -ide = chloride

The name of nitrogen's ion:

nitr- + -ide = nitride

Common Anions

Charge	Formula	Name
1−	H^-	Hydride ion
	F^-	Fluoride ion
	Cl^-	Chloride ion
	Br^-	Bromide ion
	I^-	Iodide ion
	CN^-	Cyanide ion
	OH^-	Hydroxide ion
2−	O^{2-}	Oxide ion
	O_2^{2-}	Peroxide ion
	S^{2-}	Sulfide ion
3−	N^{3-}	Nitride ion

Rules for Naming Ions

Examples of naming ions:

The name of calcium's ion:

calcium

(The names of metals don't change!)

The name of oxygen's ion:

ox- + -ide = oxide

The name of aluminum's ion:

aluminum

(The names of metals don't change!)

Common Anions

Charge	Formula	Name
1−	H^-	Hydride ion
	F^-	Fluoride ion
	Cl^-	Chloride ion
	Br^-	Bromide ion
	I^-	Iodide ion
	CN^-	Cyanide ion
	OH^-	Hydroxide ion
2−	O^{2-}	Oxide ion
	O_2^{2-}	Peroxide ion
	S^{2-}	Sulfide ion
3−	N^{3-}	Nitride ion

Rules for Naming Ions

Write the name of each of the ions.

sulfur: sulfide

nitrogen: nitride

potassium: potassium

oxygen: oxide

lithium: lithium

bromine: bromide

chlorine: chloride

hydrogen: hydrogen (+), hydride (-)

Name the following Ions

1. NaF — sodium fluoride

2. MgO — magnesium oxide

3. $SrCl_2$ — strontium chloride

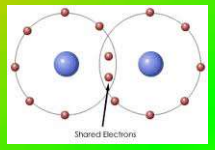
4. Li_2S — lithium sulfide

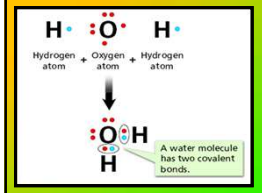
5. CaO — calcium oxide

6. KI — potassium iodide

Binary Covalent Bonds

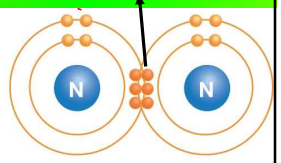
- Two nonmetals.
- **Share** electrons





(c) Triple bonds

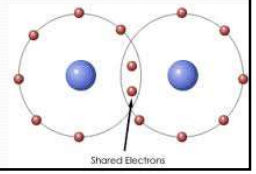
- A double bond is when atoms share two pair (4) of electrons.
- A triple bond is when atoms share three pair (6) of electrons.



Molecular nitrogen N_2

Properties of Covalent Compunds

- Weaker bonds
- Low melting and boiling points
- Do NOT conduct electricity when in solution
  - Generally don't dissolve in water.
- Generally gases or liquids at room temperature

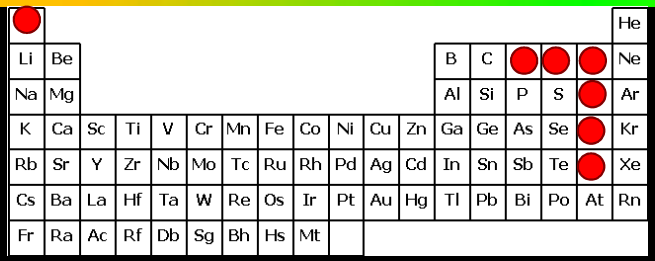


Covalent Bonds

There are 7 elements that exist in nature as *diatomic* molecules.

What elements exist as diatomic molecules?

H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2



Binary Covalent Bonds

Binary Covalent Compounds

What does binary mean? Binary means 2.

Binary covalent compounds are between 2 different nonmetals.

Naming Covalent Bonds

- To show the correct ratio of elements, we use prefixes.
- Remove the -o or a from a prefix before adding it element. Leave -i alone.

Prefix	Number
mono	1
di	2
tri	3
tetra	4
penta	5
hexa	6
hepta	7
octa	8
nona	9
deca	10

Naming Covalent Bonds

How would you write each of the prefixes in front of oxide?

mono- monoxide
di- dioxide
tri- trioxide
tetra- tetroxide
penta- pentoxide
hexa- hexoxide
hepta- heptoxide
octa- octoxide
nona- nonoxide
deca- decoxide

Naming Binary Covalent Bonds

Step 1: Write the name of the first nonmetal.

Step 2: Write the name of the second nonmetal changing its ending to *-ide*.

Step 3: Add prefixes to specify how many of each element are present.

dinitrogen tetroxide

N_2O_4

Covalent Bonds

Rules for Using Prefixes

Rule 1: Prefixes are only for BINARY COVALENT compounds.

Rule 2: The prefix *mono-* is never used on the first element of a binary covalent compound. It is assumed that there is only 1.

Example: CO_2 is carbon dioxide, and not ~~monocarbon dioxide.~~

Rule 3: Remove the -o or -a from a prefix before adding it to oxide.

Example: CO is carbon monoxide, and not ~~carbon monooxide.~~

Name the binary covalent compounds

CO_2: carbon dioxide

CS_2: carbon disulfide

PBr_3: phosphorous tribromide

PBr_5: phosphorous pentabromide

P_2S_5: diphosphorous pentasulfide

N_2S: dinitrogen monosulfide

SiS_2: silicon disulfide

NBr_3: nitrogen tribromide

N_2Cl_4: dinitrogen tetrachloride

Writing Covalent Bonds formulas

Because of the prefixes, it is very easy to go from the name of a binary covalent compound to its formula.

Step 1: Write the symbol of the first nonmetal and the subscript that matches the prefix.

Step 2: Write the symbol of the second nonmetal and the subscript that matches the prefix.

dinitrogen tetrafluoride

N F

N_2F_4

Covalent Bonds

Write the formulas of the binary covalent compounds

What is the formula of each of the binary covalent compounds named below.

carbon tetrachloride CCl_4

phosphorous pentachloride PCl_5

dinitrogen monoxide N_2O

carbon monosulfide CS

boron trihydride BH_3

disulfur hexabromide S_2Br_6

silicon disulfide SiS_2

phosphorous triiodide PI_3

nitrogen trichloride NCl_3

iodine heptafluoride IF_7

dinitrogen tetroxide N_2O_4

phosphorous trichloride PCl_3

carbon monoxide CO

iodine monochloride ICl

tetrasulfur tetranitride S_4N_4

dihydrogen monoxide H_2O

chlorine pentafluoride ClF_5

nitrogen dioxide NO_2

Review

Decide whether the compounds are ionic or covalent.

SrO I	NCl_3 C	KF I	AgCl I
N_2O_4 C	CBr_3 C	$AlCl_3$ I	$NaNO_3$ I
CaF_2 I	IF_7 C	CO C	Fe_2O_3 I

Metallic Bonds

- The bonding between atoms within metals.
- The sharing of many free electrons.
  - Sea of electrons
- Metals are flexible and conduct electric current well
  - Their atoms and electrons can move freely throughout a metal's packed structure.