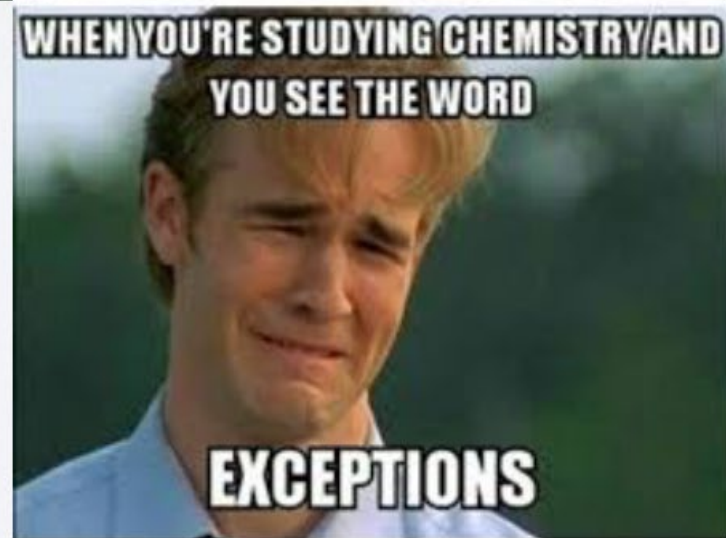
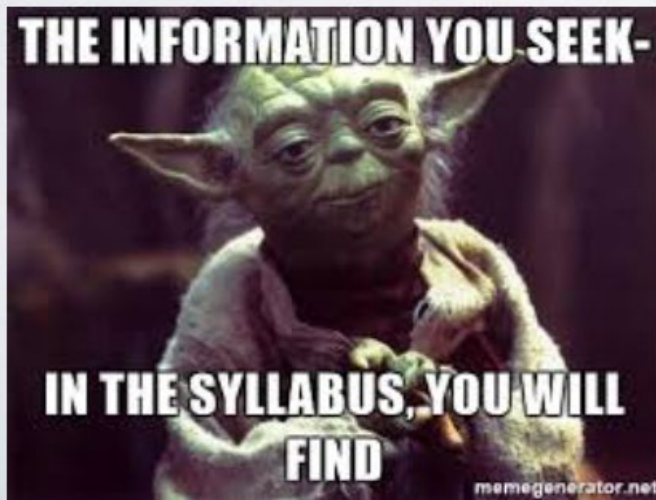
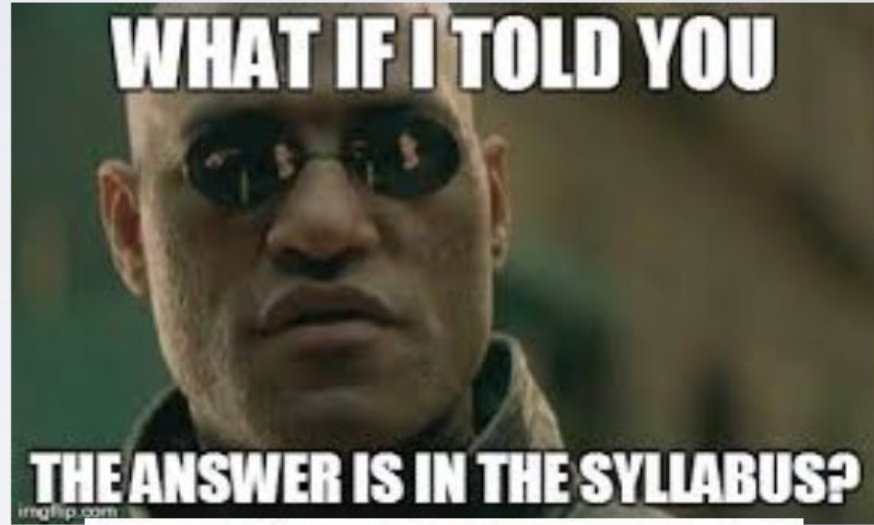
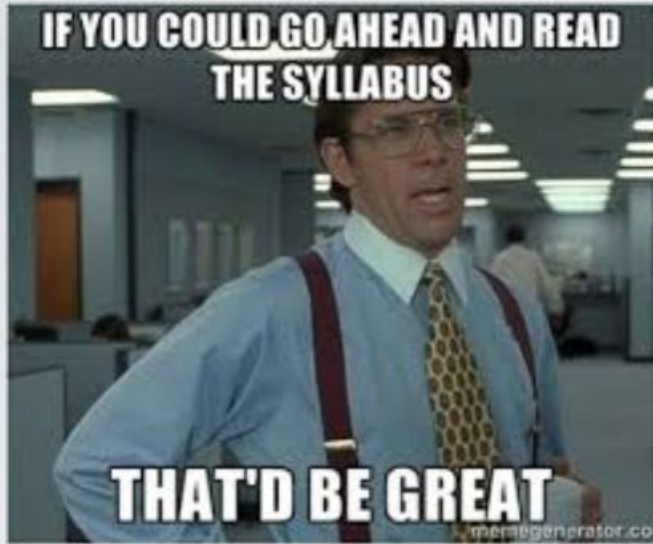

Chem 200

All emails sent to
chem200@sdsu.edu

Office hours held virtually
through the MSLC.
Tues 9.00 am to 11.00 am

PLEASE READ THE SYLLABUS



IMPORTANT ANNOUNCEMENTS

1. Email chem200@sdsu.edu ONLY unless its regarding lab or discussion which then you need to email your respective TA.
2. Follow the directions in adding OWL that Theresa provided you in Module 1.0 > Adding OWL (READ). She made a video and has a pdf file with directions.
3. **There is no course key for OWL.**
4. **Read the announcements and emails that Theresa, Megan, or your TAs sends out.**
5. Again read the syllabus. A lot of questions are being asked that are in the syllabus. For example, emailing when the lab will be and what will take place can be answered by the syllabus. In the syllabus there is a lab schedule, read, use it, and print it out.
6. And for good measure read the announcements before sending out emails. The majority (98%) of questions can be answered by: the syllabus, videos Theresa has made, and in the announcements.

SUPPLEMENTAL INSTRUCTION (SI)

- Study sessions lead by former CHEM 200/202 students that excelled in the previous semesters class.
- Occur 15+ times a week.
- Free to access, no reporting to faculty.

THE MATH AND SCIENCE LEARNING CENTER (MSLC)

Students are encouraged to make use of The Mathematics and Statistics Learning Center (MSLC) for free STEM tutoring, located in the Love Library, Room 328. For a full list of courses tutored, please visit the MSLC website: <https://mlc.sdsu.edu/>.

The MSLC is supported by your student success fee. We strongly encourage you to use this wonderful, free resource. Some students believe that they shouldn't need to ask for help, but research has shown that the average grade for students who attend the MLC is almost one full grade higher than those who don't seek such support.

TEXTBOOK

- **Openstax Chemistry**
- **PDF is Free!***
- **Redshelf (in Canvas) is an interactive ebook for FREE!**
- Free for Kindle
- Available from iBooks (\$4.99)



Molecular Formula

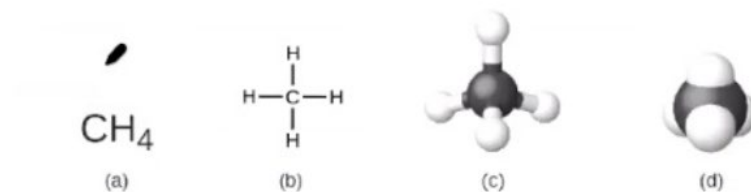


Figure 2.16 A methane molecule can be represented as (a) a molecular formula, (b) a structural formula, (c) a ball-and-stick model, and (d) a space-filling model. Carbon and hydrogen atoms are represented by black and white spheres, respectively.

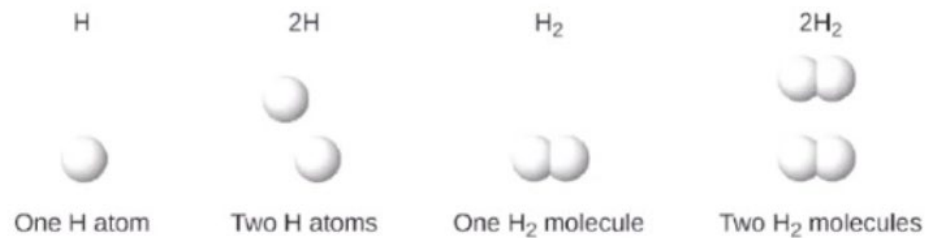
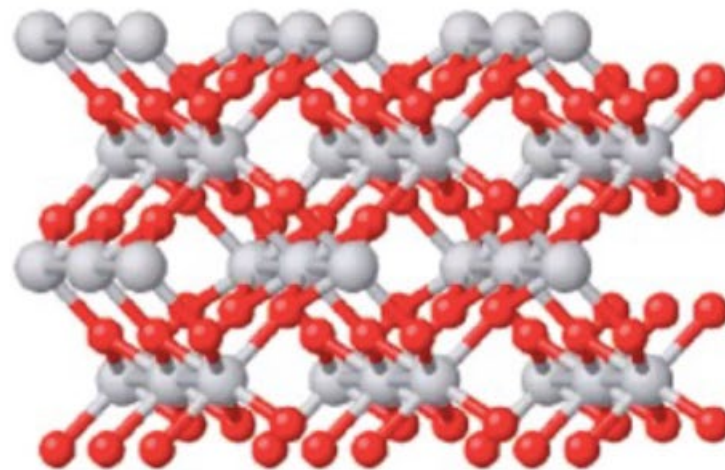


Figure 2.18 The symbols H, 2H, H₂, and 2H₂ represent very different entities.

Empirical Formula



(a)



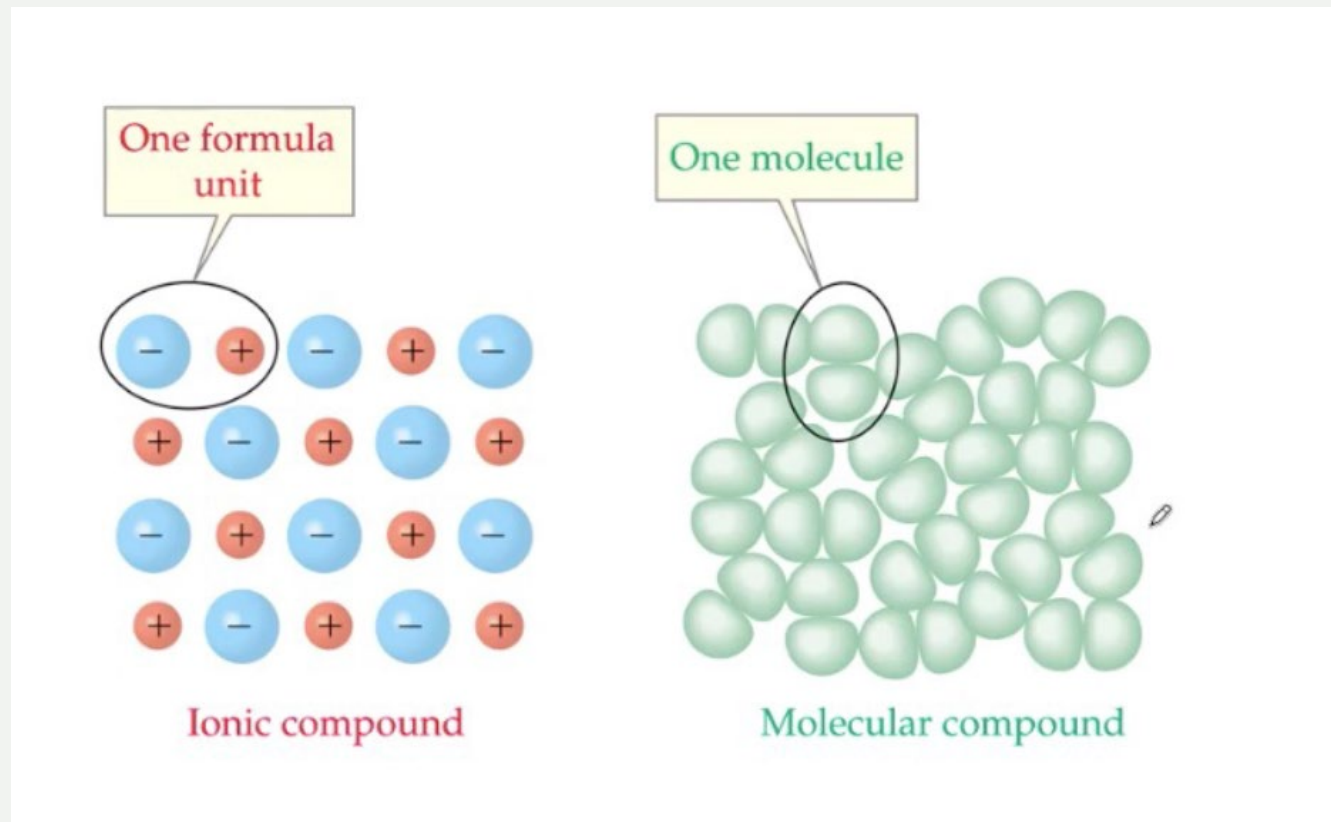
(b)

Figure 2.19 (a) The white compound titanium dioxide provides effective protection from the sun. (b) A crystal of titanium dioxide, TiO_2 , contains titanium and oxygen in a ratio of 1 to 2. The titanium atoms are gray and the oxygen atoms are red. (credit a: modification of work by "osseous"/Flickr)

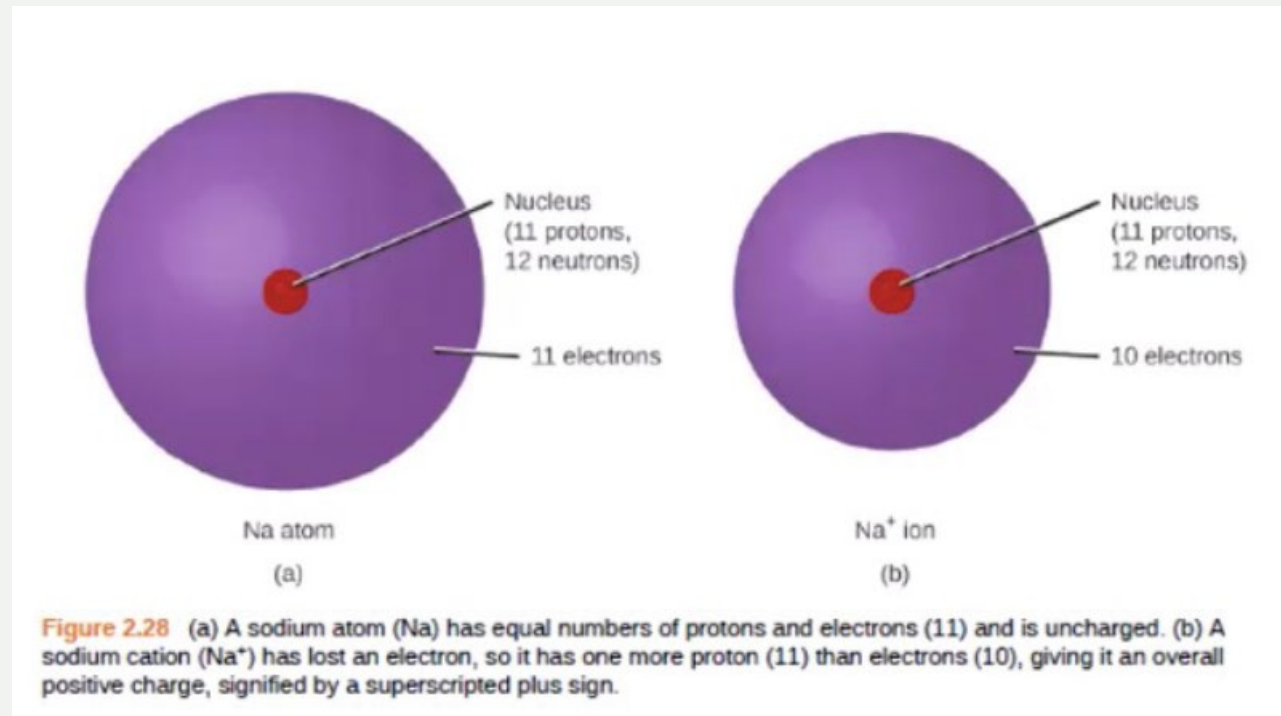
Molecular vs. Empirical Formula

- Molecular Formula:
 - The actual number of atoms that make up each molecule
 - Empirical Formula:
 - The lowest whole number ratio of atoms
 - Ionic compounds don't have molecular formulas, only empirical ones
-

Ionic and Molecular Compounds



Ionic Compounds



Polyatomic Ions

Common Polyatomic Ions

Name	Formula	Related Acid	Formula
hydrogen sulfate	HSO_4^-		
sulfite	SO_3^{2-}	sulfurous acid	H_2SO_3
hydrogen sulfite	HSO_3^-		
phosphate	PO_4^{3-}	phosphoric acid	H_3PO_4
hydrogen phosphate	HPO_4^{2-}		
dihydrogen phosphate	H_2PO_4^-		
perchlorate	ClO_4^-	perchloric acid	HClO_4
chlorate	ClO_3^-	chloric acid	HClO_3
chlorite	ClO_2^-	chlorous acid	HClO_2
hypochlorite	ClO^-	hypochlorous acid	HClO
chromate	CrO_4^{2-}	chromic acid	$\text{H}_2\text{Cr}_2\text{O}_4$
dichromate	$\text{Cr}_2\text{O}_7^{2-}$	dichromic acid	$\text{H}_2\text{Cr}_2\text{O}_7$
permanganate	MnO_4^-	permanganic acid	HMnO_4

Table 2.5

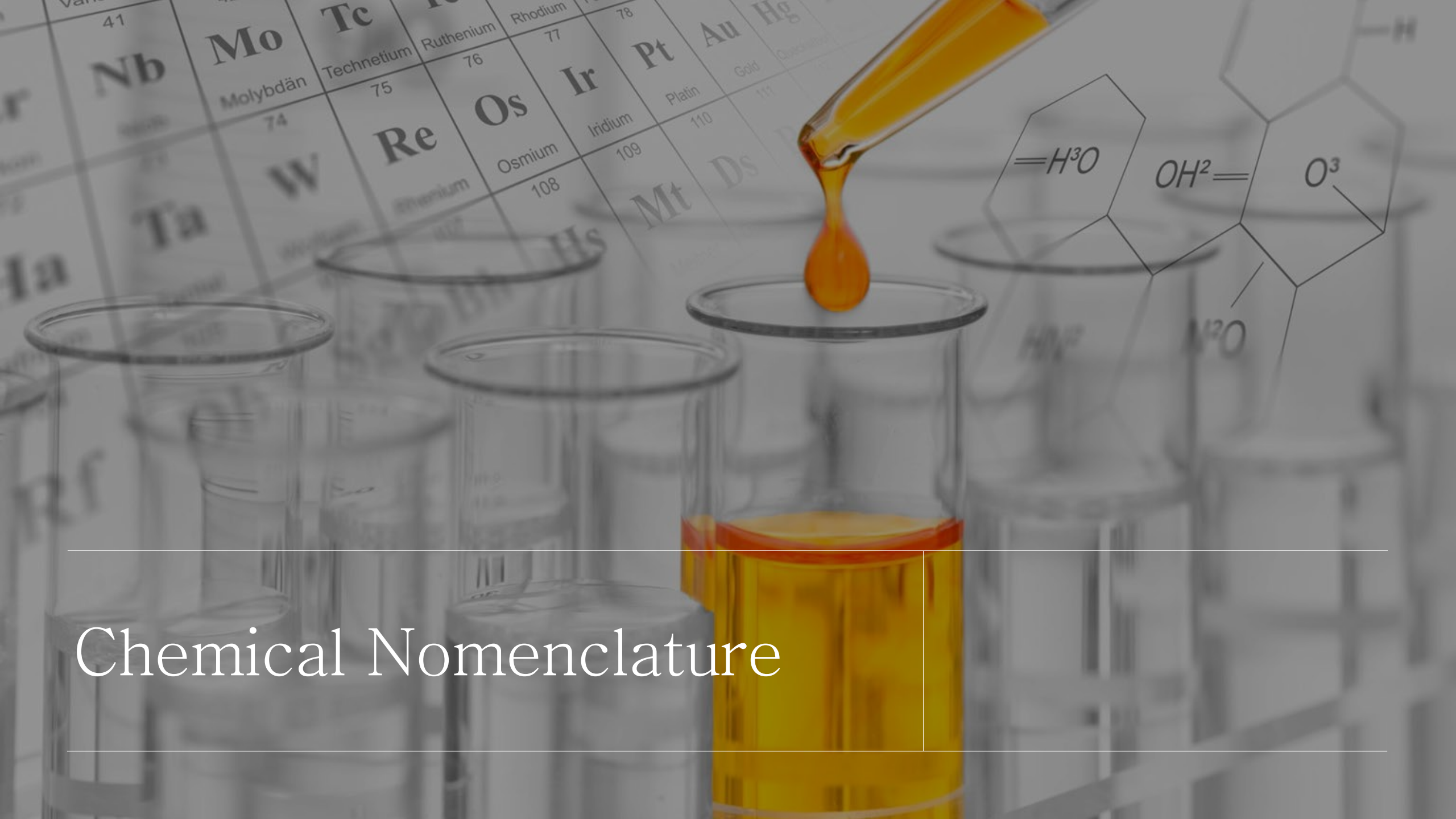
Common Polyatomic Ions

Name	Formula	Related Acid	Formula
ammonium	NH_4^+		
hydronium	H_3O^+		
oxide	O^{2-}		
peroxide	O_2^{2-}		
hydroxide	OH^-		
acetate	CH_3COO^-	acetic acid	CH_3COOH
cyanide	CN^-	hydrocyanic acid	HCN
azide	N_3^-	hydrazoic acid	HN_3
carbonate	CO_3^{2-}	carbonic acid	H_2CO_3
bicarbonate	HCO_3^-		
nitrate	NO_3^-	nitric acid	HNO_3
nitrite	NO_2^-	nitrous acid	HNO_2
sulfate	SO_4^{2-}	sulfuric acid	H_2SO_4

Table 2.5

Lecture Participation: What is the Empirical Formula of Glucose?

The Molecular formula for Glucose is $C_6H_{12}O_6$. What is its empirical formula?



Chemical Nomenclature

Covalent and Ionic Bonds

Water molecule

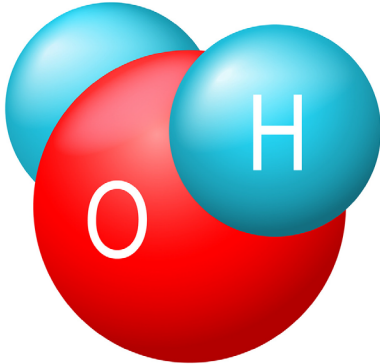
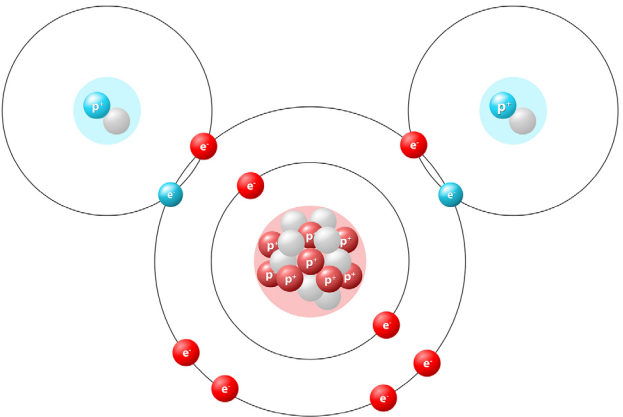
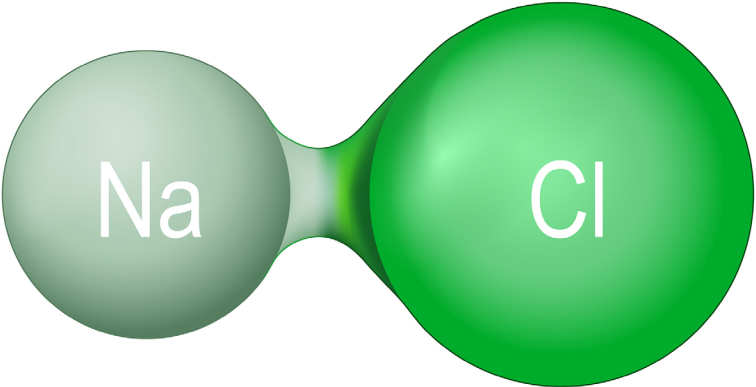
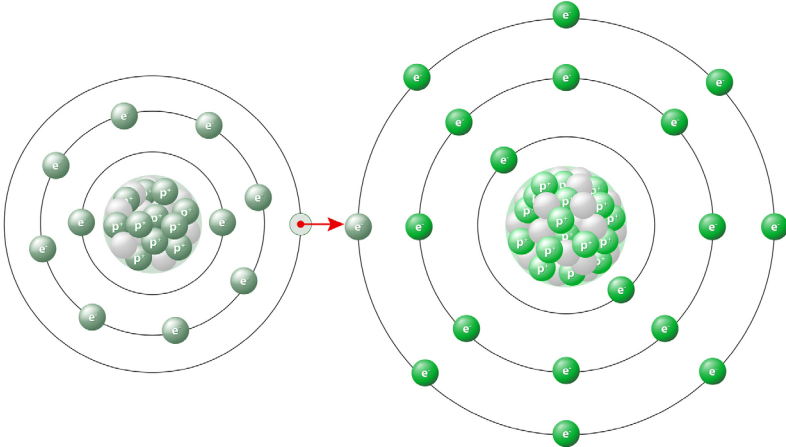


Table salt



Covalent bond



Ionic bond

Ionic compounds

Ionic compounds are formed between a metal and a non-metal. The ionic bond is produced by the electrostatic attraction between the positive and negative ions.

A periodic table with three colored boxes at the top: a blue box labeled 'Metal' covering the left side, a green box labeled 'Metalloid' covering the diagonal line from Boron to Astatine, and a yellow box labeled 'Nonmetal' covering the right side. The elements are color-coded according to these categories.

Metal										Metalloid					Nonmetal				
H																	He		
Li	Be											B	C	N	O	F	Ne		
Na	Mg											Al	Si	P	S	Cl	Ar		
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe		
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn		
Fr	Ra	Ac-Lr																	
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu					
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr					

Type I: The cation has a determined charge

Some cations always have the same charge.

These cations form "Type I" Ionic Compounds.

+1 Charge: Group 1 Metals, Silver (Ag^+), and Ammonium (NH_4^+)

+2 Charge: Group 2 Metals, Zinc (Zn^{2+}), and Cadmium (Cd^{2+})

+3 Charge: Aluminum (Al^{3+}), and Gallium (Ga^{3+})

Name of Cation Name of Anion+ide

Examples



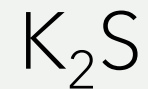
Magnesium Nitride



Calcium Fluoride



Sodium Iodide



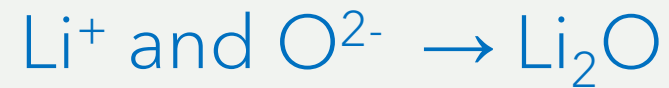
Potassium Sulfide

EXAMPLES

Potassium
Chloride



Lithium Oxide



Barium Phosphide



Knowledge check

What is the formula for Sodium Nitride?

What is the name of MgCl_2 ?

Type II: The cation can form Ions with different charges

Many metals can form ions with different charges. For example, both Fe^{2+} and Fe^{3+} can form a compound with oxygen, so saying "iron oxide" is not specific. These are Type II Cations

Roman numerals are used to designate the charge of the cation. To determine the charge of the cation you must balance the known charge of the anion.

Name of Cation (Roman Numeral) Name of Anion+ide

Examples:



Since oxygen is always O^{2-} , the iron must be Fe^{2+} to balance the charge



Since oxygen is always O^{2-} there is a total negative charge of -6. The iron ions must have a total charge of +6. Since there are two of them, the iron must be Fe^{3+} to balance the charge.



Since chloride is always Cl^- , there is a total negative charge of -2. Since there is only one for them, the Lead must be Pb^{2+} to balance the charge.



Since chloride is always Cl^- , there is a total negative charge of -4. Since there is only one for them, the Lead must be Pb^{4+} to balance the charge.

Knowledge Check

What is the formula for Copper (II) Oxide?

What is the name of Pb_3N_4 ?

Ionic compounds with polyatomic Ions

Both Type I and Type II cations can form Ionic compounds with polyatomic ions.

Common Polyatomic Ions	
Nitrite	NO_2^-
Nitrate	NO_3^-
Sulfite	SO_3^{2-}
Sulfate	SO_4^{2-}
Phosphite	PO_3^{3-}
Phosphate	PO_4^{3-}
Carbonate	CO_3^{2-}
Hydroxide	OH^-

Hypochlorite	ClO^-
Chlorite	ClO_2^-
Chlorate	ClO_3^-
Perchlorate	ClO_4^-
Permanganate	MnO_4^-
Acetate	$\text{C}_2\text{H}_3\text{O}_2^-$
Hydrogen carbonate	HCO_3^-
Ammonium	NH_4^+
Iodate	IO_3^-

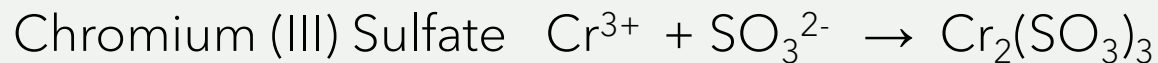
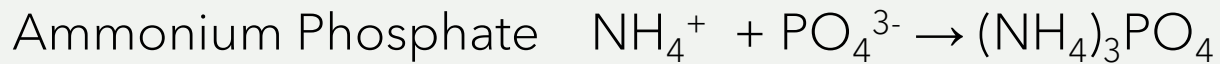
Ionic compounds with polyatomic Ions

The names of the polyatomic ions do not change when they are part of a compound. You must know the correct charge of the polyatomic ion in order to balance the charge of the cation.

Paratheses are used to indicate multiple polyatomic ions.

Name of Cation Name of Anion

Examples:



Knowledge Check

What is the formula for Potassium Sulfite?

What is the name of $\text{Zn}_3(\text{PO}_4)_2$?

K_2SO_3 , Zinc Phosphate

Common Polyatomic Ions	
Nitrite	NO_2^-
Nitrate	NO_3^-
Sulfite	SO_3^{2-}
Sulfate	SO_4^{2-}
Phosphite	PO_3^{3-}
Phosphate	PO_4^{3-}
Carbonate	CO_3^{2-}
Hydroxide	OH^-
Hypochlorite	ClO^-
Chlorite	ClO_2^-
Chlorate	ClO_3^-
Perchlorate	ClO_4^-
Permanganate	MnO_4^-
Acetate	$\text{C}_2\text{H}_3\text{O}_2^-$
Hydrogen carbonate	HCO_3^-
Ammonium	NH_4^+
Iodate	IO_3^-

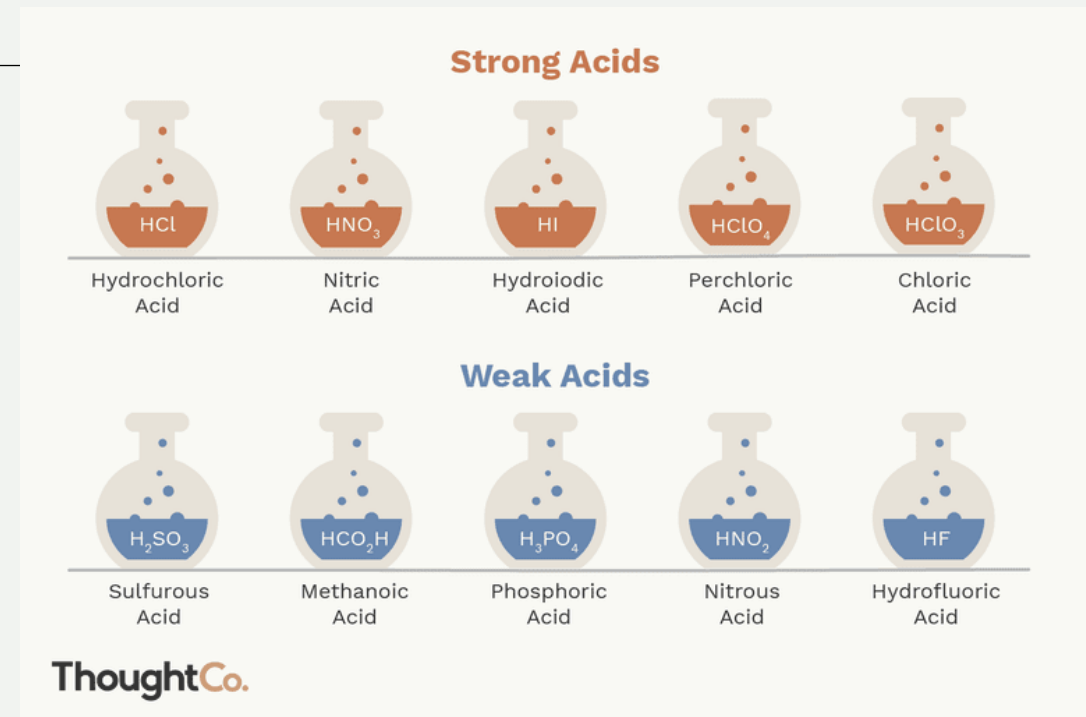
Acids

Ionic compounds containing one or more acidic proton (The cation is H^+)

There are two types of acids we will discuss:

Binary Acids- formed between Hydrogen and a single Element

Oxyacids- formed between Hydrogen and an oxygen containing polyatomic ion



Binary acids

Hydro Name of Anion-ic Acid

HCl	Hydrochloric Acid
HBr	Hydrobromic Acid
H ₂ S	Hydrosulfuric Acid

Note: it is not incorrect to say "hydrogen chloride", "hydrogen bromide", etc.

Oxyacids

"-ate goes to -ic, -ite goes to -ous"

Name of Anion-ic Acid

Name of Anion-ous Acid

H_3PO_4	Phosphoric Acid
H_3PO_3	Phosphorous Acid
HNO_2	Nitrous Acid
HNO_3	Nitric Acid
HClO	Hypochlorous Acid
HClO_3	Chloric Acid

Remember: Hydrogen is the cation in these compounds. You determine the number of hydrogen by balancing the charge of the anion.

Knowledge Check

What is the formula for perchloric acid?

What is the name of H_2SO_3 ?

Covalent compounds

Covalent compounds are held together by covalent bonds. The charges do not balance the way they do in ionic compounds.

NO, N₂O, N₂O₂, and NO₂ are all examples of covalent compounds between nitrogen and oxygen so saying "Nitrogen Oxide" is not specific.

Numerical prefixes for covalent compounds

Numerical prefixes are added to the names of covalent compounds to indicate the number of atoms present

The prefix "mono-" is not used for the first atom named in a compound.

NO Nitrogen Monoxide

N₂O Dinitrogen Monoxide

N₂O₂ Dinitrogen Dioxide

NO₂ Nitrogen Dioxide

Number

Prefix

1

mono-

2

di-

3

tri-

4

tetra-

5

penta-

6

hexa-

7

hepta-

8

octa-

9

nona-

10

deca-

More examples of covalent compounds

PCl_4	Phosphorous Tetrachloride
CO	Carbon Monoxide
CO_2	Carbon Dioxide
P_4O_{10}	Tetraphosphorous decaoxide

Knowledge check

What is the formula for Disulfur Trioxide?

What is the name of N_2O_5 ?
