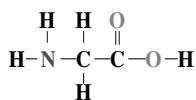
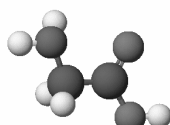


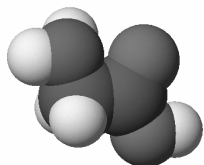
Molecular Modeling



Drawing of glycine



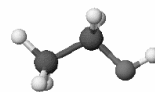
Ball & stick



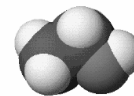
Space-filling

MAR

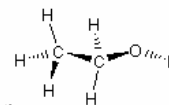
3D Perspectives: Ethanol



Ball and Stick



Space Filling



Perspective

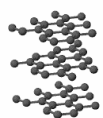
Ethanol = CH₃CH₂OH

MAR

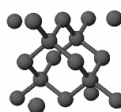
Comparison of Formula Types

Compound	Molecular	Empirical	Structural
Water	H ₂ O	H ₂ O	HOH
Hydrogen Peroxide	H ₂ O ₂	HO	HOOH
Ethylene	C ₂ H ₄	CH ₂	H ₂ CCH ₂
Ethane	C ₂ H ₆	CH ₃	H ₃ CCH ₃
Ethanol	C ₂ H ₆ O	C ₂ H ₆ O	H ₃ CCH ₂ OH
Dimethyl ether	C ₂ H ₆ O	C ₂ H ₆ O	H ₃ COCH ₃

MAR



graphite



diamond



MAR

Buckyball (C₆₀) or Buckminsterfullerene

Allotropes of Elements

Most elements exist as individual atoms - **monatomic**

Allotropes are different versions of the same element

Carbon exists naturally as graphite, diamond and buckyballs.

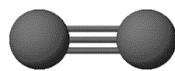
Seven elements exist as **diatomics** (next slide)

Also carbon graphene

The Seven Diatomic Elements

Have
No
Fear
Of
Ice
Clear
Brew

Most elements are monatomic - they exist as individual atoms - but there are these seven exceptions:



Nitrogen, N₂

MAR

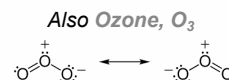
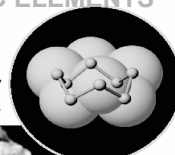


White P₄ and polymeric red phosphorus

MAR

OTHER ELEMENTS THAT EXIST AS POLYATOMIC ELEMENTS

S₈ sulfur molecules

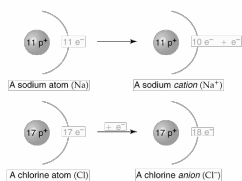
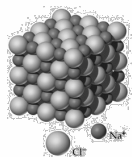


IONS AND IONIC COMPOUNDS

IONS are atoms or groups of atoms with a positive or negative charge.

Taking away electron(s) creates a **CATION** with a positive charge

Adding electron(s) creates an **ANION** with a negative charge.



MAR

IONS AND IONIC COMPOUNDS

CATIONS have protons > electrons

ANIONS have electrons > protons

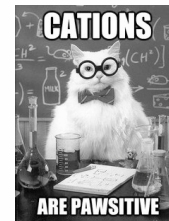
Remember:

CATS have **PAWS**

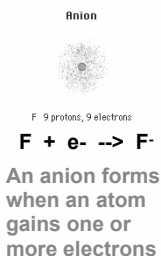
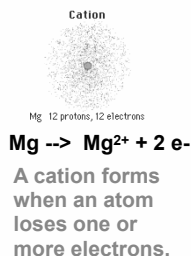
CATIONS are **PAWSitive**



MAR



Formation of Cations and Anions



MAR

Charges on Metals

Fixed charge metals include:

*Groups IA, IIA & "stairs" (next slide)

*charge = group number (mostly)

Na⁺ sodium ion
Mg²⁺ magnesium ion
Al³⁺ aluminum ion
Ag⁺ silver ion

		Al ³⁺ 13
	Zn ²⁺ 30	Ga ³⁺ 31
Ag ¹⁺ 47	Cd ²⁺ 48	In ³⁺ 49

the stairs

All other metals ("variable charge" metals) --> use Roman number to represent charge on metal

Fe²⁺ iron(II) ion
Fe³⁺ iron(III) ion
V³⁺ vanadium(III) ion

MAR

No ferrous or ferric nomenclature!

The Fixed Charge "Stairs" Metals

- Start with Al (which is +3)
- Go backwards down the "stairs"
- Decrease charge after each "stair"

		Al ³⁺ 13
	Zn ²⁺ 30	Ga ³⁺ 31
Ag ¹⁺ 47	Cd ²⁺ 48	In ³⁺ 49

These, and Groups IA and IIA, are the "fixed charge metals", and we always know their ionic charge

MAR

NONMETALS

NONMETAL + n e⁻ -----> Xⁿ⁻
where charge = Group no. - 8

webelements.com: group no. - 18

Group 4A	Group 5A	Group 6A	Group 7A
C ⁴⁻ , carbide	N ³⁻ , nitride	O ²⁻ , oxide	F ⁻ , fluoride
		S ²⁻ , sulfide	Cl ⁻ , chloride
			Br ⁻ , bromide
			I ⁻ , iodide

Name derived by adding -ide to stem



MAR

A "Quick and Dirty" Guide to Ionic Charges

Groups IA, IIA or "the stairs": *fixed charge metals*
Charge = positive
Magnitude = group # mostly!

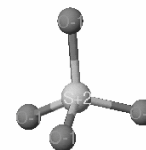
Groups VA, VIA or VIIA: *fixed charge nonmetals*
Charge = negative
Charge = group # - 8

All Other Metals: **Difficult to predict**, use **Roman number** to represent **positive charge**, *these are the "Variable Charge metals"*

MAR

POLYATOMIC IONS

Groups of atoms with a charge.
MEMORIZE the names and formulas in your text and the "Nomenclature" lab.



Charge	Formula	Name	Formula	Name
1-	H ⁻	Hydride ion	CH ₃ COO ⁻ (or C ₂ H ₃ O ₂ ⁻)	Acetate ion
	F ⁻	Fluoride ion	ClO ₂ ⁻	Chlorate ion
	Cl ⁻	Chloride ion	ClO ₃ ⁻	Perchlorate ion
	Br ⁻	Bromide ion	NO ₂ ⁻	Nitrate ion
	I ⁻	Iodide ion	MnO ₄ ⁻	Permanganate ion
	CN ⁻	Cyanide ion		
2-	OH ⁻	Hydroxide ion		
	O ²⁻	Oxide ion	CO ₃ ²⁻	Carbonate ion
	O ₂ ²⁻	Peroxide ion	CrO ₄ ²⁻	Chromate ion
	S ²⁻	Sulfide ion	Cr ₂ O ₇ ²⁻	Dichromate ion
3-			SO ₄ ²⁻	Sulfate ion
	N ³⁻	Nitride ion	PO ₄ ³⁻	Phosphate ion

* The most common ions are in boldface.

MAR

Formulas and Names of Some Common Polyatomic Ions

Formula	Name	Formula	Name
CATIONS: Positive Ion			
NH ₄ ⁺	ammonium ion		
ANIONS: Negative Ions			
Based on a Group 4A element		Based on a Group 7A element	
CN ⁻	cyanide ion	ClO ⁻	hypochlorite ion
CH ₃ CO ₂ ⁻	acetate ion	ClO ₂ ⁻	chlorite ion
CO ₃ ²⁻	carbonate ion	ClO ₃ ⁻	chlorate ion
HCO ₃ ⁻	hydrogen carbonate ion (or bicarbonate ion)	ClO ₄ ⁻	perchlorate ion
Based on a Group 5A element		Based on a transition metal	
NO ₂ ⁻	nitrite ion	CrO ₄ ²⁻	chromate ion
NO ₃ ⁻	nitrate ion	Cr ₂ O ₇ ²⁻	dichromate ion
PO ₄ ³⁻	phosphate ion	MnO ₄ ⁻	permanganate ion
HPO ₄ ²⁻	hydrogen phosphate ion		
H ₂ PO ₄ ⁻	dihydrogen phosphate ion		
Based on a Group 6A element		Note: many O containing anions have names ending in -ate (or -ite).	
OH ⁻	hydroxide ion		
SO ₃ ²⁻	sulfite ion		
SO ₄ ²⁻	sulfate ion		
HSO ₄ ⁻	hydrogen sulfate ion (or bisulfate ion)		

MAR

Introducing: Nick the Camel!

Nick the Camel Brat ate Icky Clam for Supper in Phoenix



MAR

Nick the Camel

Nick the Camel Brat ate Icky Clam for Supper in Phoenix



	Oxygen	Charge	Polyatomic Ion
Nick = Nitrate	3	-1	NO ₃ ⁻
Camel = Carbonate	3	-2	CO ₃ ²⁻
Brat = Bromate	3	-1	BrO ₃ ⁻
Icky = Iodate	3	-1	IO ₃ ⁻
Clam = Chlorate	3	-1	ClO ₃ ⁻
Supper = Sulfate	4	-2	SO ₄ ²⁻
Phoenix = Phosphate	4	-3	PO ₄ ³⁻

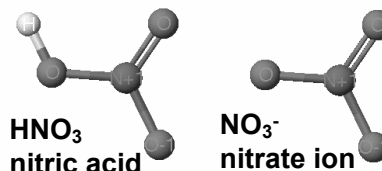
Did Nick have Crepes for dessert too? :)

Crepes = chromate	4	-2	CrO ₄ ²⁻
-------------------	---	----	--------------------------------

MAR

MAR

Some Common Polyatomic Ions



Many polyatomic ions related by a hydrogen ion (H⁺) to an acid

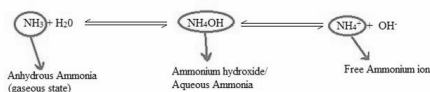
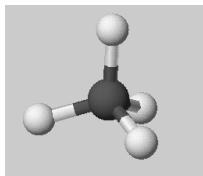
Potassium nitrate somewhat common!

Some Common Polyatomic Ions

NH_4^+ is the ammonium ion

One of the few common polyatomic cations

ammonia (NH_3) plus acid (H^+) gives the ammonium cation:

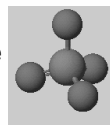


MAR

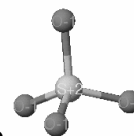
MAR

Some Common Polyatomic Ions

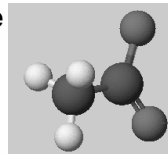
PO_4^{3-} phosphate



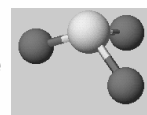
SO_4^{2-} sulfate



CH_3CO_2^- acetate

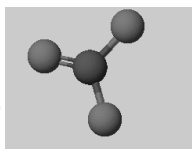


SO_3^{2-} sulfite

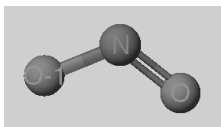


Some Common Polyatomic Ions

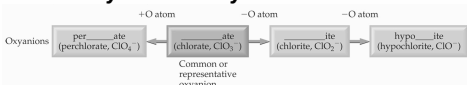
NO_3^- nitrate



NO_2^- nitrite



Common System in Polyatomic Nomenclature:



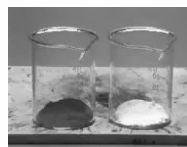
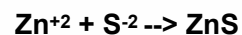
See: "Common Polyatomic Ions and the Corresponding Acids" handout

MAR

MAR

COMPOUNDS FORMED FROM IONS

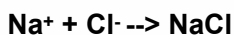
CATION + ANION \rightarrow COMPOUND



A neutral compd. requires equal number of + and - charges.

COMPOUNDS FORMED FROM IONS

CATION + ANION \rightarrow COMPOUND



A neutral compd. requires equal number of + and - charges.

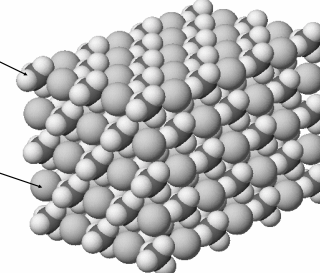


IONIC COMPOUNDS

ammonium chloride, NH_4Cl

NH_4^+

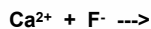
Cl^-



MAR

MAR

Some Ionic Compounds



Name = calcium fluoride

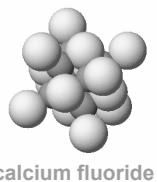


Name = magnesium nitrate



Name = iron(II) phosphate

also: FePO_4 Name = iron(III) phosphate, etc.



calcium fluoride

MAR

Properties of Ionic Compounds

Forming NaCl from Na and Cl₂



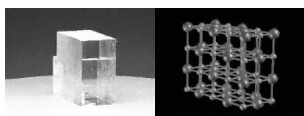
A metal atom can transfer an electron to a nonmetal.

The resulting cation and anion are attracted to each other by electrostatic forces.



MAR

Electrostatic Forces



The oppositely charged ions in ionic compounds are attracted to one another by **ELECTROSTATIC FORCES**.

These forces are governed by **COULOMB'S LAW**.

MAR

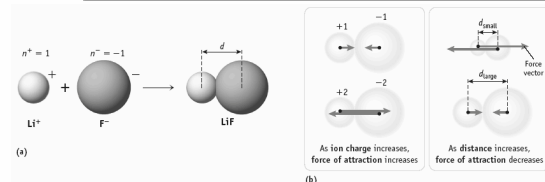
Electrostatic Forces

charge on + and - ions charge on electron

COULOMB'S LAW

$$\text{Force} = -k \frac{(n^+e)(n^-e)}{d^2}$$

proportionality constant distance between ions



MAR

Electrostatic Forces

charge on + and - ions charge on electron

COULOMB'S LAW

$$\text{Force} = -k \frac{(n^+e)(n^-e)}{d^2}$$

proportionality constant distance between ions

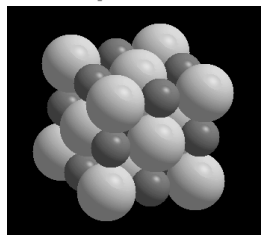
As ion charge increases, the attractive force _____.

As the distance between ions increases, the attractive force _____.

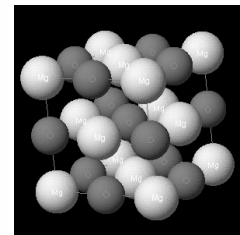
This idea is important and will come up many times in future discussions - see *handout*

MAR

Importance of Coulomb's Law



NaCl, Na⁺ and Cl⁻, m.p. 804 °C

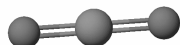
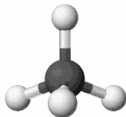
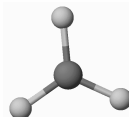


MgO, Mg²⁺ and O²⁻, m.p. 2800 °C

MAR

Molecular (Covalent) Compounds

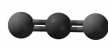
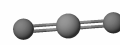
Compounds without Ions

NO₂ nitrogen dioxideCO₂ carbon dioxideCH₄ methaneBCl₃ boron trichloride

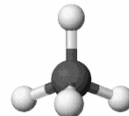
MAR

MAR

Naming Molecular (Covalent) Compounds

NO₂ nitrogen dioxideCO₂ Carbon dioxide

Covalent compounds formed from **two or more nonmetals**; use **Greek prefixes**

CH₄ methaneBCl₃ boron trichloride

Ionic compounds generally involve a **metal and nonmetal** (NaCl) - **do not use Greek prefixes with metals!**

Greek Prefixes

1	<i>mono</i>	6	<i>hexa</i>
2	<i>di</i>	7	<i>hepta</i>
3	<i>tri</i>	8	<i>octa</i>
4	<i>tetra</i>	9	<i>nona</i>
5	<i>penta</i>	10	<i>deca</i>



MAR

MAR

Three Types of Compound Naming

Fixed charge metal + nonmetal (ionic) No Greek prefixes or Roman numbers
Al₂O₃ - aluminum oxide

Variable charge metal + nonmetal (ionic) Use Roman numbers
Fe₂O₃ - iron(III) oxide

Watch variable charge: FeO = iron(II) oxide, etc.

Nonmetal + nonmetal (covalent) Use Greek prefixes
P₂O₃ - diphosphorus trioxide

Also P₂O₅, = diphosphorus pentoxide, etc.

ACIDS

Acids create **hydrogen ions** in water, acidic H⁺ listed **first** in compound

Some acids include:

HCl

hydrochloric

HNO₃

nitric

HClO₄

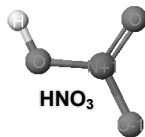
perchloric

H₂SO₄

sulfuric

HBrO

hypobromous



MAR

more in Chapter Four and Nomenclature Lab

MAR

BASES

Bases are metal hydroxides, creating OH⁻ in water

Some bases include:

NaOH

sodium hydroxide

KOH

potassium hydroxide

LiOH

lithium hydroxide

Ca(OH)₂

calcium hydroxide

Fe(OH)₃

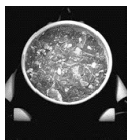
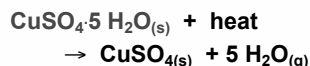
iron(III) hydroxide

more in Chapter Four and Nomenclature Lab

Hydrated Compounds

When prepared in water and isolated as solids, many ionic compounds have water molecules trapped in the lattice.

"Waters of hydration" result in beautiful colors



MAR

Hydrated Compounds

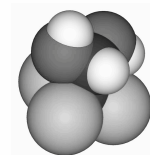
Nomenclature: use Greek prefix + "hydrate" after regular name

$\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ = copper(II) sulfate pentahydrate

$\text{MgSO}_4 \cdot 7 \text{H}_2\text{O}$ = magnesium sulfate heptahydrate

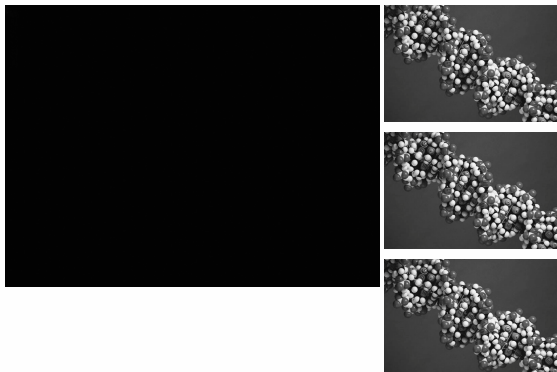
$\text{NiCl}_2 \cdot 6 \text{H}_2\text{O}$ = nickel(II) chloride hexahydrate

CuSO_4 *without water* called "anhydrous" copper(II) sulfate



MAR

ATOMS OVERWHELMING YOU?

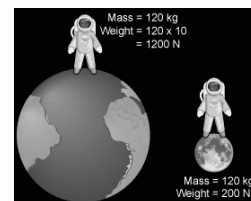


MAR

MOLECULAR WEIGHT AND MOLAR MASS

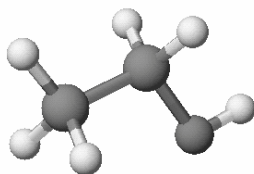
Molecular weight is the sum of the atomic weights of all atoms in the molecule.

Molar mass = molecular weight in grams



MAR

What is the molar mass of ethanol, $\text{C}_2\text{H}_6\text{O}$?



1 mol contains

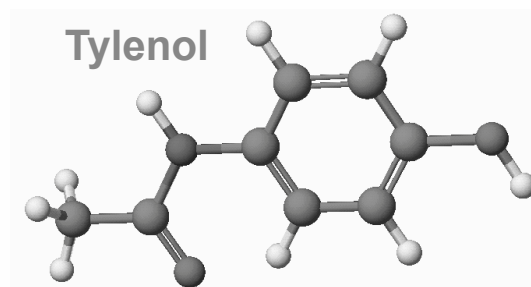
2 mol C (12.01 g C/1 mol) = 24.02 g C

6 mol H (1.01 g H/1 mol) = 6.06 g H

1 mol O (16.00 g O/1 mol) = 16.00 g O

TOTAL = molar mass = 46.08 g/mol

MAR

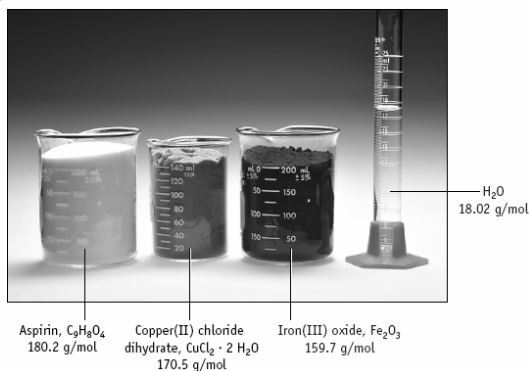


Formula = $\text{C}_8\text{H}_9\text{NO}_2$

Molar mass = 151.16 g/mol

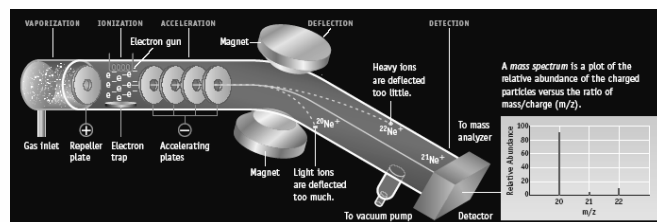
MAR

Molar Mass



MAR

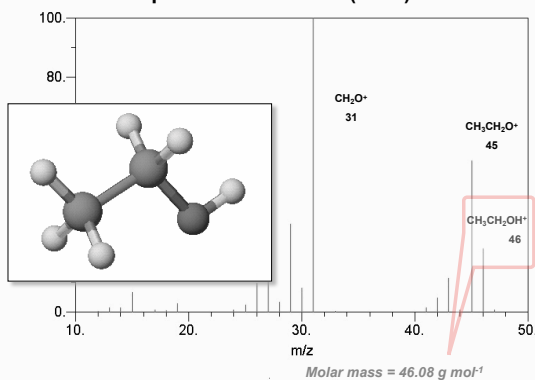
How to Determine a Formula?



Mass spectrometer

MAR

Mass Spectrum of Ethanol (NIST)



MAR

How many moles of alcohol (ethanol) are present in a "standard" can of beer if there are 21.3 g of C_2H_6O ?

- (a) Molar mass of $C_2H_6O = 46.08 \text{ g/mol}$
 (b) Calc. moles of alcohol

$$21.3 \text{ g} \cdot \frac{1 \text{ mol}}{46.08 \text{ g}} = 0.462 \text{ mol}$$

0.46223958...

MAR

How many molecules of alcohol (ethanol) are present in a "standard" can of beer if there are 21.3 g of C_2H_6O ?

We know there are 0.462 mol of C_2H_6O .

$$0.462 \text{ mol} \cdot \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = 2.78 \times 10^{23} \text{ molecules}$$

2.78216...E23

MAR

How many atoms of C are present in a "standard" can of beer if there are 21.3 g of C_2H_6O ?

We know there are 2.78×10^{23} molecules. Each molecule contains 2 C atoms. Therefore, the number of C atoms is

$$2.78 \times 10^{23} \text{ molecules} \cdot \frac{2 \text{ C atoms}}{1 \text{ molecule}} = 5.56 \times 10^{23} \text{ C atoms}$$

5.56E23

MAR

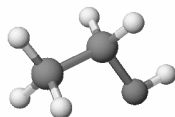
$2.78 \times 10^{23} \times 2 = 5.56 \times 10^{23}$ atoms in the 21.3 g of ethanol!

Empirical and Molecular Formulas

A pure compound always consists of the same elements combined in the same proportions by weight.

Therefore, we can express molecular composition as **PERCENT BY WEIGHT**

Ethanol, C₂H₆O
52.13% C, 13.15% H,
34.72% O

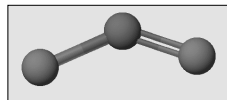


MAR

Percent Composition

Consider the nitrogen-oxygen family of compounds:

NO₂, nitrogen dioxide, and NO, nitrogen monoxide (or *nitric oxide*)



Structure of NO₂



Chemistry of NO, nitrogen monoxide

MAR

Percent Composition

Consider NO₂, Molar mass = ?

What is the weight percent of N and of O?

To find the **weight percent** of an element in a compound:

$$\text{Wt. \% X} = \frac{\text{g of X in compound}}{\text{molar mass of compound}} \cdot 100\%$$

In water (H₂O):

$$\text{Wt. \% O} = \frac{16.00 \text{ g O}}{18.02 \text{ g H}_2\text{O}} \cdot 100\% = 88.79 \%$$

$$\%H = 100 - 88.79 = 11.21\%$$

MAR

MAR

Percent Composition

Consider NO₂, Molar mass = ?

What is the weight percent of N and of O?

$$\text{Wt. \% N} = \frac{14.01 \text{ g N}}{46.01 \text{ g NO}_2} \cdot 100\% = 30.45 \%$$

$$\text{Wt. \% O} = \frac{2(16.00 \text{ g O})}{46.01 \text{ g NO}_2} \cdot 100\% = 69.55 \%$$

Test yourself: What are the weight percentages of N and O in N₂O₄?

Determining Formulas

In chemical analysis we first determine the % by weight of each element in a given amount of pure compound and derive the **EMPIRICAL** or **SIMPLEST** formula.

Weight percentages lead to empirical formulas (but *not* molecular formulas!)

PROBLEM: A compound of B and H is 81.10% B. What is its empirical formula?



MAR

MAR

A compound of B and H is 81.10% B. What is its **empirical formula**?

Calculate the number of moles of each element in 100.0 g of sample.

$$81.10 \text{ g B} \cdot \frac{1 \text{ mol}}{10.81 \text{ g}} = 7.502 \text{ mol B}$$

$$18.90 \text{ g H} \cdot \frac{1 \text{ mol}}{1.008 \text{ g}} = 18.75 \text{ mol H}$$



A compound of B and H is 81.10% B. What is its empirical formula?

Take the ratio of moles of B and H. Always divide by the smaller number.

$$\frac{18.75 \text{ mol H}}{7.502 \text{ mol B}} = \frac{2.499 \text{ mol H}}{1.000 \text{ mol B}} = \frac{2.5 \text{ mol H}}{1.0 \text{ mol B}}$$

But we need a whole number ratio.

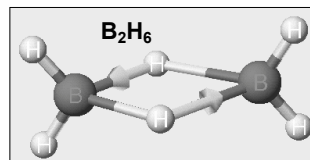
$$2.5 \text{ mol H} / 1.0 \text{ mol B} = 5 \text{ mol H to 2 mol B}$$

$$\text{EMPIRICAL FORMULA} = \text{B}_2\text{H}_5$$

MAR

The compound has an *empirical* formula of B_2H_5 . What is its molecular formula?

Is the molecular formula B_2H_5 , B_4H_{10} , B_6H_{15} , B_8H_{20} , etc.?



B_2H_6 is one example of this class of compounds.

MAR

The compound has an empirical formula (EF) of B_2H_5 . What is its molecular formula?

To solve, need the molar mass of the compound using a mass spectrometer (a separate experiment)

Next, determine molar mass of the empirical formula

Compare molar mass of the compound to the molar mass of the empirical formula to get a whole number ratio of empirical formula units in the molecular formula

MAR

The compound has an empirical formula (EF) of B_2H_5 . What is its molecular formula?

Example:

A compound has an empirical formula of CH_2 and a molar mass of 28.1 g mol^{-1} . Find the molecular formula.

Molar mass compound (28.1 g mol^{-1}) given via outside experiment.

Molar mass empirical formula (CH_2) =

$$12.01 + 2 \times 1.01 = 14.03 \text{ g mol}^{-1}$$

Now compare molar mass compound to molar mass of empirical formula:

$$\frac{28.1 \text{ g/mol}}{14.03 \text{ g/mol of CH}_2} = \frac{2 \text{ units of CH}_2}{1 \text{ mol}}$$

$$\text{Molecular formula} = (\text{CH}_2)_2 = \text{C}_2\text{H}_4$$

MAR

The compound has an empirical formula (EF) of B_2H_5 . What is its molecular formula?

In the boron problem,

Molar mass of compound (from mass spectrometer, a separate experiment) = 53.3 g/mol

Molar mass of empirical formula (B_2H_5) = 26.67 g/mol

$$(2 \times 10.81 + 5 \times 1.01 = 26.67 \text{ g/mol of EF})$$

Now find ratio of these masses.

$$\frac{53.3 \text{ g/mol}}{26.67 \text{ g/mol of B}_2\text{H}_5} = \frac{2 \text{ units of B}_2\text{H}_5}{1 \text{ mol}}$$

$$\text{Molecular formula} = (\text{B}_2\text{H}_5)_2 = \text{B}_4\text{H}_{10}$$

MAR

Determining a Molecular Formula: Overview

First, convert percent by mass element values into moles (assume 100 g), then compare the moles to get the empirical formula (EF)

$$\frac{18.75 \text{ mol H}}{7.502 \text{ mol B}} = \frac{2.499 \text{ mol H}}{1.000 \text{ mol B}} = \frac{2.5 \text{ mol H}}{1.0 \text{ mol B}}$$

$$2.5 \text{ mol H} / 1.0 \text{ mol B} = 5 \text{ H to 2 B} = \text{B}_2\text{H}_5$$

Next, find the molar mass (MM) of the compound, then compare MM of compound to MM of EF

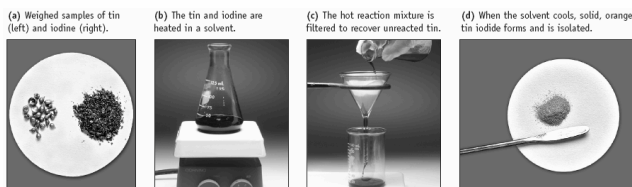
$$\frac{53.3 \text{ g/mol}}{26.67 \text{ g/mol of B}_2\text{H}_5} = \frac{2 \text{ units of B}_2\text{H}_5}{1 \text{ mol}}$$

$$\text{Molecular formula} = (\text{B}_2\text{H}_5)_2 = \text{B}_4\text{H}_{10}$$

MAR

Determine the formula of a compound of Sn and I using the following data.

Tin and Iodine Compound



Mass of Sn in the beginning = 1.056 g
 Mass of iodine (I₂) used = 1.947 g
 Mass of Sn remaining = 0.601 g

MAR

Find the mass of Sn that combined with 1.947 g I₂.

Mass of Sn initially = 1.056 g

Mass of Sn recovered = 0.601 g

Mass of Sn used = 0.455 g

Find moles of Sn used:

$$0.455 \text{ g Sn} \cdot \frac{1 \text{ mol}}{118.7 \text{ g}} = 3.83 \times 10^{-3} \text{ mol Sn}$$

MAR

Tin and Iodine Compound

Now find the number of moles of I₂ that combined with $3.83 \times 10^{-3} \text{ mol Sn}$

Mass of I₂ used = 1.947 g

$$1.947 \text{ g I}_2 \cdot \frac{1 \text{ mol}}{253.81 \text{ g}} = 7.671 \times 10^{-3} \text{ mol I}_2$$

But we need mol of I for formula, not I₂, so convert:

$$7.671 \times 10^{-3} \text{ mol I}_2 \cdot \frac{2 \text{ mol I}}{1 \text{ mol I}_2} = 1.534 \times 10^{-2} \text{ mol I}$$

So $1.534 \times 10^{-2} \text{ mol}$ of iodine atoms were used in this reaction

MAR

Tin and Iodine Compound

Now find the ratio of number of moles of moles of I and Sn that combined.

$$\frac{1.534 \times 10^{-2} \text{ mol I}}{3.83 \times 10^{-3} \text{ mol Sn}} = \frac{4.01 \text{ mol I}}{1.00 \text{ mol Sn}}$$

Empirical formula is SnI₄
tin(IV) iodide

MAR

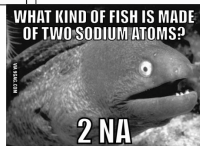
End of Chapter 2 Part 2



See also:

- Chapter Two Part 2 Study Guide
- Chapter Two Part 2 Concept Guide
- Important Equations (following this slide)
- End of Chapter Problems (following this slide)

MAR



MAR

Important Equations, Constants, and Handouts from this Chapter:

$$1 \text{ mole} = 6.022 \times 10^{23}$$

- be able to find the molar mass of any compound using the periodic table
- be able to convert grams of a compound into moles and/or molecules
- understand how to calculate empirical formula (EF) and molecular formula (MF) using the molar mass and mass percentages

Nomenclature: Greek prefixes, Roman numbers, nonmetal + nonmetal, fixed charge metal + nonmetal, variable charge metal + nonmetal, polyatomic ions, acids, bases, hydrated compounds, the 7 diatomics, cations, anions, covalent, ionic, the "stairs", Coulomb's Law

End of Chapter Problems: *Test Yourself*

See practice problem set #3 and self quizzes for
nomenclature examples and practice

- Determine the molar mass for aluminum chloride, iron(III) oxide and phosphorus tribromide.
- How many grams in 0.0255 mol of propanol (C_3H_7OH)? How many molecules? How many atoms of C?
- Calculate the weight percent of lead in PbS , lead(II) sulfide. What mass of lead (in grams) is present in 10.0 g of PbS ?
- Succinic acid has an empirical formula is $C_2H_3O_2$ and a molar mass is 118.1 g/mol. What is its molecular formula?
- A new compound containing xenon and fluorine was isolated by shining sunlight on a mixture of Xe (0.526 g) and F_2 gas. If you isolate 0.678 g of the new compound, what is its empirical formula?
- Direct reaction of iodine (I_2) and chlorine (Cl_2) produces an iodine chloride, I_xCl_y , a bright yellow solid. If you completely used up 0.678 g of iodine and produced 1.246 g of I_xCl_y , what is the **empirical formula** of the compound? A later experiment showed that the molar mass of I_xCl_y was 467 g/mol. What is the **molecular formula** of the compound?

MAR

End of Chapter Problems: *Answers*

- 133 g/mol, 160. g/mol, 271 g/mol
- 1.53 g C_3H_7OH , 1.54×10^{22} molecules, 4.62×10^{22} atoms C
- 86.59%, 8.66 g Pb
- $C_4H_6O_4$
- XeF_2
- ICl_3 , I_2Cl_6

Be sure to view practice problem set #3 and self quizzes for
nomenclature examples and practice

MAR