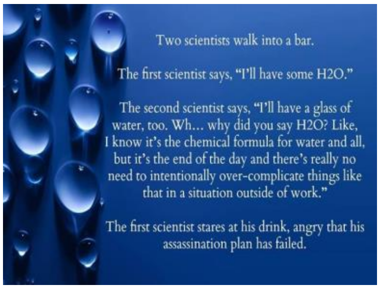
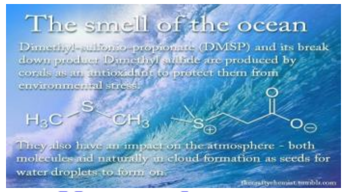
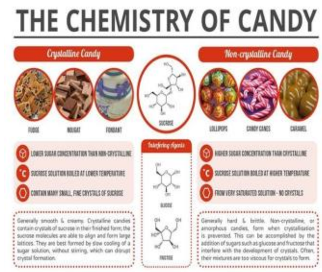
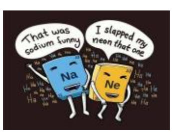




Nomenclature

The language of chemistry





Assigning Oxidation States

The concept of oxidation numbers (or oxidation states) was devised as a simple way of keeping track of electrons in reactions. We use the following rules for assigning oxidation numbers:

Free Elements (Na, O_2, etc.)	0
Group 1 Elements in a compound[1]	+1
Group 2 Elements in a compound	+2
Group 3 Elements in a compound	+3
"O" in a compound[2]	-2
"F" in a compound	-1

[1]Exception to this rule occurs for hydrogen in hydrides (e.g. LiH, where the oxidation state of hydrogen is –1).

[2]Exception to this rule occurs in peroxides (e.g. H_2O_2, where the oxidation state of oxygen is –1).

***NOTE*: Three transition metals, Cd^{2+}, Zn^{2+} and Ag^{+}, are understood to exist in these oxidation states (numbers); therefore, Roman numerals are NOT included in parentheses. Also note that the mercury(I) ion is written as a diatomic ion (dimer): Hg_2^{+2}.**

Practice

Determine the oxidation state of each underlined atom:

K<u>Mn</u>O_4, <u>Cl</u>O_4^-, and <u>S</u>$_2O_3^{2-}$.

Chemical Bonds

Bonds "glue"

Ionic	Covalent	Metallic
▪ e- transfer	▪ sharing	▪ "sea" of e-
▪Crystal lattice	▪ "molecules"	▪ e- are delocalized.
▪ ions (+ -)	▪ hypothetical charge	
▪ Na + Cl → $Na^+ Cl^-$	▪ H + H → H H	
▪ "salts"	. orbital overlap	
▪ very strong bonds generally between metals and non metals.	▪ Bonding e- are localized between two atoms	
▪ Solids at room temp.	▪ Formed between two nonmetals	
▪ Poor conductors of electricity in a solid state		

<u>Common Polyatomic Ions</u> – *YOU MUST MEMORIZE THESE*!!!

acetate	$C_2H_3O_2^-$	hydrogen phosphate	HPO_4^{2-}
ammonium	NH_4^+	hydrogen sulfate	HSO_4^-
carbonate	CO_3^{2-}	hydroxide	OH^-
chromate	CrO_4^{2-}	nitrate	NO_3^-
hypochlorite	ClO^-	nitrite	NO_2^-
chlorite	ClO_2^-	oxalate	$C_2O_4^{2-}$
chlorate	ClO_3^-	permanganate	MnO_4^-
perchlorate	ClO_4^-	peroxide	O_2^{2-}
cyanide	CN^-	phosphate	PO_4^{3-}
dichromate	$Cr_2O_7^{2-}$	sulfate	SO_4^{2-}
dihydrogen phosphate	$H_2PO_4^-$	sulfite	SO_3^{2-}
hydrogen carbonate	HCO_3^-	thiocyanate	SCN^-

Nomenclature

Binary → Ionic (Metal and Nonmetal; Transition Metal and Nonmetal), Covalent (Nonmetal and Nonmetal)

Metal and Nonmetal

1. Cation is named first and the anion is named second.
2. Monatomic cation takes its name from the name of the element.
3. A monatomic anion is named by taking the first part of the element name and adding the *-ide* suffix.

<u>examples</u>:

NaCl sodium chloride
MgO magnesium oxide
Li_3N lithium nitride

Transition Metal and Nonmetal

Metals that can form more than one type of positive ion have Roman numerals in parentheses (no space) to indicate the charge of the cation.

<u>examples</u>:

$CoBr_2$ cobalt(II) bromide
$CrCl_3$ chromium(III) chloride

Nonmetal and Nonmetal

1. The first element is named using its full name.
2. The second element is named by taking the first part of the element name and adding the *-ide* suffix.
3. Prefixes are used to denote the numbers of atoms present (note: *mono-* is NEVER used to name the first element).

<u>examples</u>:

N_2O dinitrogen monoxide
NO_2 nitrogen dioxide
N_2O_3 dinitrogen trioxide

Non-binary - ionic compounds that contain *polyatomic* ions

Naming Acids

There are two main types of acids that we will encounter at the onset of this course, binary acids, and oxoacids.

1. Binary Acids – certain compounds of H with other nonmetal atoms.

Examples:
- $HF(aq)$ = hydrofluoric acid
- $HCl(aq)$ = hydrochloric acid
- $HBr(aq)$ = hydrobromic acid
- $HI(aq)$ = hydroiodic acid
- $H_2S(aq)$ = hydrosulfuric acid

2. Oxoacids – Hydrogen with two other nonmetals, one of which is oxygen.

Examples:
- $HClO$ = hypochlorous acid
- $HClO_2$ = chlorous acid
- $HClO_3$ = chloric acid
- $HClO_4$ = perchloric acid

- HNO_2 = nitrous acid
- HNO_3 = nitric acid

Naming Hydrates and Simple Organic Compounds

Hydrates are ordinary chemical substances that have associated with them a certain number of water molecules. For example, $CuSO_4 \bullet 5H_2O$ is read *copper(II) sulfate pentahydrate*. As we will see in section 2, when determining the overall molecular weight of this particular compound, you ADD five water molecules to the initial $CuSO_4$ (as opposed to multiply, where the "•" is commonly misinterpreted by beginner chemistry students; more on this later)!

When dealing with organic (or carbon-containing) compounds, we refer to the following prefixes:

Number of Carbons	Prefix
1	Meth-
2	Eth-
3	Prop-
4	But-
5	Pent-
6	Hex-
7	Hept-
8	Oct-
9	Non-
10	Dec-

Naming Simple Organic Compounds

Compounds containing only carbon and hydrogen are called hydrocarbons. Hydrocarbons that contain only carbon-carbon single bonds are called **alkanes**. The simplest alkane is methane (CH_4), followed by ethane (C_2H_6 or CH_3CH_3), etc. The names of the alkanes are composed of two parts: a prefix indicating the number of carbon atoms, and the suffix "-ane" indicating that the molecule contains only carbon-carbon single bonds.

Hydrocarbons that contain only carbon=carbon double bonds are called **alkenes**. The simplest alkene is ethene (C_2H_4 or CH_2CH_2) followed by propene (C_3H_6).

Lecture Questions

1. Name each of the following compounds:

A.	$HClO_4$ (s) & (aq)	E.	$KMnO_4$
B.	$Ca_3(PO_4)_2$	F.	$K_2Cr_2O_7$
C.	AlI_3	G.	SiF_4
D	V_2O_5	H.	$Ca(HSO_3)_2$

2. Write formulas for the following compounds:

A. chromium(III) carbonate	B. potassium chlorate
C. octane	D. cobalt(II) chloride heptahydrate
E. sodium hydroxide	F. potassium hypochlorite
G. aluminum hydroxide	H. Lead(IV) oxide
I. peroiodic acid	J. Nitrous acid

Workshop on Nomenclature – Page 1

1. Name each of the following compounds:

A.	$Al_2(SO_4)_3$	I.	$CH_3CH_2CH_2CH_2CH_3$
B.	$Pb(NO_3)_2$	J.	$Li_2C_2O_4$
C.	$BaSO_3$	K.	TiO_2
D.	$NaNO_2$	L.	$BaCl_2 \bullet 8H_2O$
E.	$NaCl$	M.	NO
F.	$MgCl_2$	N.	$NaHSO_4$
G.	$RbBr$	O.	N_2F_4
H.	CsF	P.	$FePO_4$

2. Write formulas for the following compounds:

A. potassium dichromate	G. ammonium acetate
B. sulfur hexafluoride	H. ammonium hydrogen sulfate
C. sodium dihydrogen phosphate	I. cobalt(III) nitrate
D. lithium nitride	J. mercury(I) chloride
C. hydrogen cyanide	I. ammonium chromate
D. sodium peroxide	J. copper(I) bromide
E. copper(II) acetate	K. germanium dioxide
F. carbon tetrafluoride	L. butane

Workshop on nomeclature – page 2

3. The formulas and common names for several substances are given below. What are the systematic names for these substances?

A.	sugar of lead	$Pb(C_2H_3O_2)_2$
B.	blue vitrol	$CuSO_4$
C.	quicklime	CaO
D.	milk of magnesia	$Mg(OH)_2$
E.	laughing gas	N_2O

4. Writing Names and Formulas of Compounds

A.	Calcium hydroxide	____________________
B.	Nickel(II) phosphate	____________________
C.	Beryllium iodide	____________________
D.	Chromium(III) sulfide	____________________
E.	Diphosphorus tetroxide	____________________
F.	Aluminum oxide	____________________
G.	Ammonium nitrate	____________________
H.	Phosphorus pentachloride	____________________

Workshop on Nomenclature – page 3

5. Name each of the following compounds.

A. Na_3PO_4	________________________________
B. PF_5	________________________________
D. $FeBr_3$	________________________________
E. Cu_2O	________________________________
F. $Cr(OH)_3$	________________________________
G. Rb_2SO_4	________________________________
H. N_2O	________________________________
I. HI (aq)	________________________________
J. KH	________________________________
K. Cr_2O_3	________________________________
L. $MgSO_4 \bullet 6H_2O$	________________________________
M. $CH_3CH_2CH_3$	________________________________