

You will be required to memorize the Polyatomic Ions, Nomenclature and Solubility Rules along with Strong Acids and Bases. Although some people do not like to use the term memorization, you will note that memorization will become easier with use.

Within the first few days of AP Chemistry you will be given a test on the ions, solubility rules and strong acids and bases.

I recommend the purchase of the Princeton Review's AP Chemistry review book and McGraw Hill 5 Steps to a 5. These are great practice problem books but are not required for the course.

Graded summer assignment:

Assignment refers to online modules. When logged into ONboard for AP Chemistry, click on ONboard Assessments and Modules. You will complete all 7 modules. Each module will be worth 100 points and each will count as a quiz grade. After the last module is complete, I will average all of your grades for a test grade. Each module has a due date and if the module is not completed by the date due, the assignment will be given a zero. No calculator should be used.

Module	Due Date
1	June 21
2	June 28
3	July 5
4	July 12
5	July 19
6	July 26
7	August 2

If you are a senior and took Honors Chemistry in your sophomore year, it would be beneficial to review the material that was taught. I will refer to the material that was covered in the Honors class and will not spend much time on those concepts. If you took CP chemistry, additional work will be listed on the next page.

If you have any questions over the summer you are welcome to email me at stodaro@pinewoodprep.com.

Have a good understanding of this material because it will act as a foundation for the rest of the course. One of the goals in AP Chemistry is to become an independent learner and thinker, therefore, you are responsible for what you do or do not complete. So, do not wait until the last minute to begin working!

Have a wonderful summer!

I have read and understand the expectations of the Summer Assignment.

(student signature and date)

I have read and understand the expectations of the Summer Assignment.

(parent / guardian signature and date)

Additional work for CP students which must be completed and emailed to me by July 15th, 2019 at stodaro@pinewoodprep.com.

Using the Honors textbook (Modern Chemistry by Holt, Rinehart, and Winston) you will read each of the chapters listed below. You must then complete and email me your answers to the Standardized Test Prep Questions at the end of each of the chapters. You will treat these as a test, which means you may not refer to the chapter as you are answering the questions.

Chapter	Page for Standardized Test Prep
1	25
2	63
3	93
4	129
5	171
6	215
7	257
8	295
9	325
10	357
11	397
12	431
13	463
14	495
15	527
21	707
22	747

TABLE OF STRONG ACIDS

Completely Ionized in Water to Give One (or more)
Protons per Acid Molecule

HI	$H^+(aq) + I^-(aq)$
HBr	$H^+(aq) + Br^-(aq)$
HClO ₄	$H^+(aq) + ClO_4^-(aq)$
HCl	$H^+(aq) + Cl^-(aq)$
HClO ₃	$H^+(aq) + ClO_3^-(aq)$
H ₂ SO ₄	$H^+(aq) + HSO_4^-(aq)$ (<i>HSO₄⁻ is a weak acid that contributes additional protons</i>)
HNO ₃	$H^+(aq) + NO_3^-(aq)$

TABLE OF STRONG BASES

Completely Ionized in Water to Give One (or more)
Hydroxides per Base Molecule

NaOH	$Na^+(aq) + OH^-(aq)$
KOH	$K^+(aq) + OH^-(aq)$
LiOH	$Li^+(aq) + OH^-(aq)$
RbOH	$Rb^+(aq) + OH^-(aq)$
CsOH	$Cs^+(aq) + OH^-(aq)$
Ca(OH) ₂	$Ca^{2+}(aq) + 2OH^-(aq)$ (<i>but not very soluble</i>)
Ba(OH) ₂	$Ba^{2+}(aq) + 2OH^-(aq)$ (<i>but not very soluble</i>)
Sr(OH) ₂	$Sr^{2+}(aq) + 2OH^-(aq)$ (<i>but not very soluble</i>)

AP Chemistry: Course Syllabus 2019-2020

Pinewood Preparatory School, Stephanie Todaro (stodaro@pinewoodprep.com), 843-873-1643

Course Overview

The intent of this course is to provide you with the material normally covered in the first year of college chemistry in preparation for the advanced placement exam in chemistry. A college text is used and the pace is rapid, so you should have a strong foundation in the basic concepts of the composition of matter and the "language" of chemistry (symbols, formulas and equations) as well as a good understanding of the principles of algebra. Concepts build upon concepts, so do not be surprised to see material from 1st semester appear on a test in 2nd semester.

Course Website & Resources

RenWeb will house your homework as well as links to important resources and documents.

Textbook

Chemistry The Molecular Nature of Matter and Change 7th ed. by Silberberg & Amateis; McGraw Hill, 2015

Supplies

The following is a supply list needed for AP Chemistry.

- 3-ring binder
- Folder
- Calculator
- Writing utensil
- Bound notebook for lab

Parent/Student Form

After reading over the syllabus, please have both the student and a parent sign below acknowledging that you have read and understand the course setup. Turn the form into Mrs. Todaro.



Mrs. Todaro's AP Chemistry Syllabus Agreement Form 2019-2020

Student: _____

Parent: _____



Grading

High	Low	Letter
100	90	A
89	80	B
79	70	C
69	60	D
59	50	F

Section	Percentage
Tests	55%
Labs	30%
Quizzes	15%

Homework

You will have homework every night, which may consist of reading and taking notes, problems from the text, and worksheets.

If I do not assign homework it is expected that you do something (i.e. reading) every night on your own.

Labs

All lab reports are due on the due date by the time indicated. THERE ARE NO EXCEPTIONS! Unless you are absent for a school related event or due to an excused absence.

Late lab reports may be turned in one day late for the highest grade of a 70. After one day, you will receive a zero.

Absences

You are responsible for missed class notes and it is your duty to meet with a classmate to retrieve them.

Assignments are due upon return to school if you were present when it was assigned, or by a date set with me. If you were absent when an assignment was made, you have the amount of days you missed from the assignment date to finish the work and have it turned in. Copies of any handouts will be located in the chemistry room.

Labs cannot be made up. A formal lab report will be required for any missed labs. The teacher will provide the data and give the rubric for the lab report

A missed test must be taken as soon as possible. You have the amount of days you were absent to gather the material, ask questions, and take the test. The test can be taken at a time agreed upon by the teacher and student.

Course of Study

The following is a layout of the units that we will be covering in the course.

FIRST SEMESTER

Chapter #	Chapter Title	Page #
1	Keys to the Study of Chemistry	2-39
2	The Components of Matter	40-89
7	Quantum Theory and Atomic Structure	286-321
8	Electron Configuration and Chemical Periodicity	322-357
9	Models of Chemical Bonding	358-393
10	The Shapes of Molecules	394-427
11	Theories of Covalent Bonding	428-453
4	Three Major Classes of Chemical Reactions	138-197
3	Stoichiometry of Formulas and Equations	90-137
5	Gases and the Kinetic-Molecular Theory	198-249
12	Intermolecular Forces: Liquids, Solids, and Phase Changes	454-515
13	The Properties of Mixtures: Solutions and Colloids	516-567

LABS:

Lab Number	Lab Name
1	Separation of a Mixture by Filtration
2	Paper chromatography of Acid / Base Indicators
3	**What Makes Hard Water Hard?
4	Cu to Cu
5	Formula of Hydrate
6	MW of a Volatile Liquid
7	Charles' Law
8	**Sticky Question: How Do You Separate Molecules That Like to Stay Together?
9	Predicting Solubility Rules / Reactions (Inquiry)
10	**What Is the Relationship Between the Concentration of a Solution and the Amount of Transmitted Light Through the Solution?

PROBLEM SETS:

Chapter 1 #44, 45a, 52, 54, 56, 60, 70, 84

Chapter 2 #12, 20, 26, 47, 63, 120, 127

Chapter 7 #3, 9, 63

Chapter 8 #9, 10, 15, 16, 17, 23, 27, 37, 48, 53, 56, 58, 59, 68, 81, 92

Chapter 9 #2, 6, 17, 26, 43, 45

Chapter 10 #2, 6, 19, 40, 57

Chapter 11 #5, 7, 40, 57

Chapter 4 #5, 7, 8, 16, 24, 35, 73, 84, 103, 131, 138, 146

Chapter 3 #48, 49, 55, 76, 80, 138

Chapter 5 #32, 47, 49, 61, 74, 77, 78, 86, 104, 113, 126, 134

Chapter 12 #4, 15, 16, 18, 19, 28, 33, 34, 37, 39, 43, 49, 53, 100

Chapter 13 #3, 9, 32, 56, 60, 70a&b, 80, 88, 122

SECOND SEMESTER

Chapter #	Chapter Title	Page #
16	Kinetics: Rates and Mechanisms of Chemical Reactions	674-729
17	Equilibrium: The Extent of Chemical Reactions	730-775
18	Acid-Base Equilibria	776-825
19	Ionic Equilibria in Aqueous Systems	826-875
6	Thermochemistry: Energy Flow and Chemical Change	250-285
20	Thermodynamics: Entropy, Free Energy, and the Direction of Chemical Reactions	876-917
21	Electrochemistry: Chemical Change and Electrical Work	918-975

LABS:

Lab Number	Lab Name
1	Rate of Reaction: Thiosulfate and Acid
2	**Can We Make the Colors of the Rainbow? An Application of Le Châtelier's Principle
3	Standardization of NaOH and % KHP
4	**How Much Acid Is in Fruit Juices and Soft Drinks?
5	**The Hand Warmer Design Challenge: Where Does Heat Come From?
6	Preparation and Properties of Buffers
7	Hydrolysis of Salts
8	**How Can We Determine the Actual Percentage of H ₂ O ₂ in a Commercial (Drugstore) Bottle of Hydrogen Peroxide?
9	Electrochemistry / reactivity series
10	**The Preparation and Testing of an Effective Buffer: How Do Components Influence a Buffer's pH and Capacity?

PROBLEM SETS:

Chapter 16 #5, 11, 14, 23, 25, 34, 41, 43, 46, 48, 61, 66, 67, 70, 72, 82, 98

Chapter 17 #16, 18, 25, 29, 35, 43, 47, 51, 60, 63, 71, 77, 85, 86, 98

Chapter 18 #5, 7, 9, 23, 39, 41, 47, 59, 64, 68, 70, 87, 88, 89, 99, 120, 138, 147, 157

Chapter 19 #1, 2, 4, 11, 17, 23, 39, 40, 41, 42, 45, 46, 48, 50, 56, 66, 70, 74, 119

Chapter 6 #19, 24, 34, 39, 54, 67, 77, 79

Chapter 20 #14, 16, 22, 33, 41, 51, 53, 67, 79, 81, 86, 89

Chapter 21 #10, 22, 27, 38, 56, 60, 89, 105

Non-Lab Activities

1. Students will graph and interpret several data sets on atomic properties (atomic radius, first ionization energy and electronegativity) in order to arrive at the periodic table from the jumps in the graphs
2. Students will prepare models of the various electron pair arrangements, and complete a table which shows the Lewis structure, electron pair geometry, molecular structure, and use that information to predict the presence or absence of a dipole moment.
3. Students will identify and balance chemical reactions using a variety of techniques on a series of quizzes from the reactions problem from previous AP exams. (Old NIE's quizzes)
4. Students will demonstrate their knowledge of the determination of kinetics by displaying the solution to the following problem to the class.
The thermal decomposition of an organic nitrile produced the following data:

$t / (10^3 \text{ s})$	0	2.00	4.00	6.00	8.00	10.00	12.00	∞	
[nitrile] / (mol L ⁻¹)		1.10	0.86	0.67	0.52	0.41	0.32	0.25	0.00

Determine the order of the reaction and the rate constant.
5. Students will explore an animation on heating and cooling curves (www.kentchemistry.com, select heating curves) and answer a series of questions regarding their observations of particulate motion in the various phases.
6. Activity: Acid-Base Reactions taken from College Board AP Chemistry Guided Inquiry Activities for the Classroom Curriculum Module
7. Students solve a stoichiometry problem on the amount of carbon dioxide produced in the burning of a tankful of gasoline (assumed to be octane) with information of the size of the gas tank of the vehicle, the density of octane (0.7028 g mL⁻¹), and a variety of other conversion factors. Following the solution of this problem, a discussion of what happens to this carbon dioxide will ensue encompassing the greenhouse effect, whether the burning of fossil fuels contributes to global climate change, and if something should be done about the burning of fossil fuels (especially given current estimates for the amount of fossil fuel remaining in the earth and the students' estimated lifetime).

Pinewood AP Course Guidelines

Students are expected to complete all coursework according to the posted schedule **including** the Summer Assignment. (See the Summer Assignment document.)

- Upon a second late or missed assignment, a parent conference will be scheduled.
- Upon a third late or missed assignment, the student may be removed from the course and will receive a grade according to school policy (i.e., WP or WF if after the first quarter).
- Upon a second missed/make-up test (due to excused or unexcused absence), a parent conference will be scheduled.
- Upon a third missed/make-up test (due to excused or unexcused absence), the student may be removed from the course and will receive a grade according to school policy (i.e., WP or WF if after the first quarter).

I have read and understand the expectations of the course.

(student signature and date)

I have read and understand the expectations of the course.

(parent / guardian signature and date)

AP Chemistry Ion Sheet -- Chemical Nomenclature

You have a choice: (a) You can memorize this list. (b) You can memorize some acid formulas and names and use them to predict the names and formulas of the polyatomic anions. In the following list: (a) The first name given is the IUPAC or Stock System name. (b) The second name is a traditional name.

I. Monatomic Anions (-ide suffix):

hydride	H ⁻¹
fluoride	F ⁻¹
chloride	Cl ⁻¹
bromide	Br ⁻¹
iodide	I ⁻¹
astatide	At ⁻¹
oxide	O ⁻²
sulfide	S ⁻²
selenide	Se ⁻²
telluride	Te ⁻²
nitride	N ⁻³
phosphide	P ⁻³
arsenide	As ⁻³
carbide	C ⁻⁴
silicide	Si ⁻⁴

II. Polyatomic Anions (-ite/-ate suffix)

polyatomic anions with hydrogen:

hydrogen carbonate/bicarbonate	HCO ₃ ⁻¹
hydrogen sulfate/bisulfate	HSO ₄ ⁻¹
hydrogen sulfite/bisulfite	HSO ₃ ⁻¹
monohydrogen phosphate	HPO ₄ ⁻²
dihydrogen phosphate	H ₂ PO ₄ ⁻¹
hydrogen oxalate/binoxalate	HC ₂ O ₄ ⁻¹
hydrogen phthalate/biphthalate	HC ₈ H ₄ O ₄ ⁻¹

polyatomic anions with sulfur:

thiocyanate	SCN ⁻¹
thiosulfate	S ₂ O ₃ ⁻²

monovalent polyatomic anions:

nitrate	NO ₃ ⁻¹
nitrite	NO ₂ ⁻¹

perchlorate	ClO ₄ ⁻¹
chlorate	ClO ₃ ⁻¹
chlorite	ClO ₂ ⁻¹
hypochlorite	ClO ⁻¹

perbromate	BrO ₄ ⁻¹
bromate	BrO ₃ ⁻¹
bromite	BrO ₂ ⁻¹
hypobromite	BrO ⁻¹

periodate	IO ₄ ⁻¹
iodate	IO ₃ ⁻¹
iodite	IO ₂ ⁻¹
hypoiodite	IO ⁻¹

permanganate	MnO ₄ ⁻¹
manganate	MnO ₃ ⁻¹

cyanate	OCN ⁻¹
acetate	C ₂ H ₃ O ₂ ⁻¹
hydroxide	OH ⁻¹
cyanide	CN ⁻¹

divalent polyatomic anions:

sulfate	SO ₄ ⁻²
sulfite	SO ₃ ⁻²

chromate	CrO ₄ ⁻²
chromite	CrO ₃ ⁻²
dichromate	Cr ₂ O ₇ ⁻²

carbonate	CO ₃ ⁻²
oxalate	C ₂ O ₄ ⁻²
phthalate	C ₈ H ₄ O ₄ ⁻²
peroxide	O ₂ ⁻²

tri- and tetravalent polyatomic anions:

perborate	BO ₄ ⁻³
borate	BO ₃ ⁻³

phosphate	PO ₄ ⁻³
phosphite	PO ₃ ⁻³

arsenate	AsO ₄ ⁻³
arsenite	AsO ₃ ⁻³

silicate	SiO ₄ ⁻⁴
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AP Chemistry Ion Sheet -- Chemical Nomenclature

You have a choice: (a) You can memorize this list. (b) You can learn to use the periodic chart to predict the positive charges of the metal and metalloid cations. In the following list: (a) The first name given is the IUPAC or Stock System name. (b) The second name is a traditional name.

I. Monatomic Cations

monovalent cations: (Table 8-1 and 8-2)

hydrogen	H ⁺¹
lithium	Li ⁺¹
sodium	Na ⁺¹
potassium	K ⁺¹
rubidium	Rb ⁺¹
cesium	Cs ⁺¹
francium	Fr ⁺¹

ammonium	NH ₄ ⁺¹
silver	Ag ⁺¹
copper (I) or cuprous	Cu ⁺¹
gold (I) or aurous	Au ⁺¹
mercury (I) or mercurous (Hg ⁺¹) in	Hg ₂ ⁺²

divalent cations: (Table 8-1 and 8-2)

beryllium	Be ⁺²
magnesium	Mg ⁺²
calcium	Ca ⁺²
strontium	Sr ⁺²
barium	Ba ⁺²
radium	Ra ⁺²
zinc	Zn ⁺²
cadmium	Cd ⁺²
copper (II) or cupric	Cu ⁺²
mercury (II) or mercuric	Hg ⁺²
chromium (II) or chromous	Cr ⁺²

manganese (II) or manganous	Mn ⁺²
iron (II) or ferrous	Fe ⁺²
cobalt (II) or cobaltous	Co ⁺²
nickel (II) or nickelous	Ni ⁺²
tin (II) or stannous	Sn ⁺²
lead (II) or plumbous	Pb ⁺²

trivalent cations (Table 8-1 and 8-2)

aluminum	Al ⁺³
gold (III) or auric	Au ⁺³
chromium (III) or chromic	Cr ⁺³
manganese (III) or manganic	Mn ⁺³
iron (III) or ferric	Fe ⁺³
cobalt (III) or cobaltic	Co ⁺³
nickel (III) or nickelic	Ni ⁺³
cerium (III) or cerous	Ce ⁺³
arsenic (III) or arsenous	As ⁺³
antimony (III) or antimonous	Sb ⁺³
bismuth (III) or bismuthous	Bi ⁺³

tetra- & pentavalent cations (Table 8-2)

tin (IV) or stannic	Sn ⁺⁴
lead (IV) or plumbic	Pb ⁺⁴
cerium (IV) or ceric	Ce ⁺⁴
arsenic (V) or arsenic	As ⁺⁵
antimony (V) or antimonic	Sb ⁺⁵
bismuth (V) or bismuthic	Bi ⁺⁵

Handout Table 8-2: Positive Ions Whose Charges Vary

IUPAC Name	root	Traditional Name	
		-ous ending	-ic ending
copper (I) and (II)	cupr-	Cu ⁺¹	Cu ⁺²
gold (I) and (III)	aur-	Au ⁺¹	Au ⁺³
mercury (I) and (II)	mercur-	Hg ₂ ⁺²	Hg ⁺²
chromium (II) and (III)	chrom-	Cr ⁺²	Cr ⁺³
manganese (II) and (III)	mangan-	Mn ⁺²	Mn ⁺³
iron (II) and (III)	ferr-	Fe ⁺²	Fe ⁺³
cobalt (II) and (III)	cobalt-	Co ⁺²	Co ⁺³
nickel (II) and (III)	nickel-	Ni ⁺²	Ni ⁺³
tine (II) and (IV)	stann-	Sn ⁺²	Sn ⁺⁴
lead (II) and (IV)	plumb-	Pb ⁺²	Pb ⁺⁴
cerium (III) and (IV)	cer-	Ce ⁺³	Ce ⁺⁴
arsenic (III) and (V)	arsen-	As ⁺³	As ⁺⁵
antimony (III) and (V)	antimon-	Sb ⁺³	Sb ⁺⁵
bismuth (III) and (V)	bismuth-	Bi ⁺³	Bi ⁺⁵

AP Chemistry -- Acids and the Nomenclature of Ions

I. Binary Acids and Monatomic Anions:

Binary Acids are those molecular compounds beginning with hydrogen and ending with another nonmetal or possibly a metalloid. Note that HCN, hydrocyanic acid is also included in this group. To make the acids into monatomic anions, remove the hydrogens -- one at a time. Each hydrogen removed leaves the anion with a -1 charge.

Binary Acid Naming Rule = *hydro* prefix - **root of 2nd element** -*ic* suffix *acid*

Anion Naming Rule = drop the prefix and the word acid, change the suffix to *-ide*

	<u>acid formula</u>	<u>acid name</u>	<u>ion formula</u>	<u>ion name</u>
Examples:	HF	hydrofluoric acid	F ⁻¹	fluoride
	HCl	hydrochloric acid	Cl ⁻¹	chloride
	HBr	hydrobromic acid	Br ⁻¹	bromide
	HI	hydroiodic acid	I ⁻¹	iodide
	HCN	hydrocyanic acid	CN ⁻¹	cyanide
	H ₂ S	hydrosulfuric acid	HS ⁻¹	hydrogen sulfide or bisulfide
			S ⁻²	sulfide
	HN ₃	hydrazoic acid	N ₃ ⁻¹	azide

II. Ternary Acids or Oxy-Acids:

Ternary acids contain three or more elements. They start with hydrogen, end with oxygen, and have another nonmetal or metalloid in between. To make the acids into polyatomic anions, remove the hydrogens -- one at a time. Each hydrogen removed leaves the anion with a -1 charge. Each ternary acid belongs to a family of potentially four members. One member of the family is designated the "**parent acid.**" You must **memorize** the names and formulas of the common parent acids.

Ternary Acid Family Naming Rules:

HIO ₄	(add an oxygen to parent)	add <i>per-</i> prefix to parent name:	periodic acid
** HIO₃ parent acid **			iodic acid
HIO ₂	(remove one oxygen)	change suffix to <i>-ous</i> :	iodous acid
HIO	(remove a second oxygen)	add <i>hypo-</i> prefix to <i>-ous</i> name:	hypoiodous acid

Anion Naming Rule = drop the word acid
change *-ic* suffix to *-ate*
change *-ous* suffix to *-ite*

	<u>acid formula</u>	<u>acid name</u>	<u>ion formula</u>	<u>ion name</u>
Examples:	HIO ₄	periodic acid	IO ₄ ⁻¹	periodate
	HIO ₃	iodic acid	IO ₃ ⁻¹	iodate
	HIO ₂	iodous acid	IO ₂ ⁻¹	iodite
	HIO	hypoiodous acid	IO ⁻¹	hypoiodite

(H₃AsO₄ = arsenic acid H₂AsO₄⁻¹ = dihydrogen arsenate HAsO₄⁻² = monohydrogen arsenate)

III. Table 8-3: Common Parent Ternary Acids (Memorize these names and formulas!)

carbonic acid	H_2CO_3	dichromic acid	$\text{H}_2\text{Cr}_2\text{O}_7$	cyanic acid	HOCN
boric acid	H_3BO_3	phosphoric acid	H_3PO_4	thiocyanic acid	HSCN
silicic acid	H_4SiO_4	arsenic acid	H_3AsO_4	oxalic acid	$\text{H}_2\text{C}_2\text{O}_4$
nitric acid	HNO_3	chloric acid	HClO_3	phthalic acid	$\text{H}_2\text{C}_8\text{H}_4\text{O}_4$
sulfuric acid	H_2SO_4	bromic acid	HBrO_3	acetic acid	$\text{HC}_2\text{H}_3\text{O}_2$
thiosulfuric acid	$\text{H}_2\text{S}_2\text{O}_3$	iodic acid	HIO_3	sulfamic acid	$\text{H}(\text{NH}_2)\text{SO}_3$
chromic acid	H_2CrO_4	manganic acid	HMnO_3		

AP Chemistry -- Inorganic Nomenclature Rules

I. Binary Molecular Nomenclature

These rules apply to molecular compounds of only two elements. To be classified molecular, the compound must begin with a nonmetal or metalloid.

IUPAC Naming Rule: cation name () anion name [a Roman numeral is always included]

The first element in the formula is considered to be the cation and is named using the name of the nonmetal or metalloid present in the formula. Use the appropriate anion name (-ide, -ite, -ate) for the second element in the formula.

SO_2 = sulfur (IV) oxide SO_3 = sulfur (VI) oxide

Traditional Naming Rule: prefix (if > 1) cation name prefix anion name

SO_2 = sulfur dioxide SO_3 = sulfur trioxide

***Special Case #1:** Binary Transition Metal Compounds (IIIB-VIIB) may be named by this molecular prefix rule once we have used up the traditional -ous and -ic cation suffixes.

Mn_2O_5 = manganese (V) oxide (IUPAC) = dimanganese pentoxide (Traditional)

***Special Case #2:** Sometimes two different molecular compounds may have the same Roman Numeral in their IUPAC name. These formulas are always whole number multiples of some simplest formula. We resolve this by adding a third word indicating the multiple: dimer, trimer, tetramer, pentamer and so on.

NO_2 = nitrogen (IV) oxide N_2O_4 = nitrogen (IV) oxide dimer N_3O_6 = nitrogen (IV) oxide trimer

Table of Standard Numerical Prefixes:

mono-	1	octa-	8
di-	2	nona-	9
tri-	3	deca-	10
tetra-	4	undeca-	11
penta-	5	dodeca-	12
hexa-	6	trideca-	13
hepta-	7	tetradeca-	14

II. Ionic Nomenclature

These rules apply to ionic compounds of only two or more elements. To be classified ionic, the compound must begin with a metal or metalloid.

IUPAC Naming Rule: cation name () anion name

[The cation Roman Numeral is used **only** if more than one cation charge is possible! If there is only one charge -- **DON'T** use a Roman Numeral]

The first element in the formula is the cation and is named using the name of the respective element. Use the appropriate anion name (-ide, -ite, -ate) for the second element in the formula.

CaCl_2 = calcium chloride

FeCl_2 = iron (II) chloride

Traditional Naming Rule: cation root name with -ous or -ic suffix anion name

This is used only if the cation has more than one charge. The cation of lower charge is assigned the -ous suffix, the cation of higher charge is assigned the -ic suffix.

$\text{Ce}(\text{NO}_3)_3$ = cerous nitrate

$\text{Ce}(\text{NO}_3)_4$ = ceric nitrate

***Special Case #3:** Hydrated Ionic Compounds may be named by this rule to show the amount of water present. This may be used with both IUPAC and Traditional names. Name the cation with () or -ous/-ic suffixes, name the anion, add to the name **numeric prefix-hydrate** to show the correct number of waters.

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

Solubility Rules

The following rules are used in several chemistry-related topics, such as predicting reactions and quantitative analysis. You will learn these topics this year in AP Chemistry but if you don't know your solubility rules, you'll have a really hard time. Solubility rules must be committed to memory.

Soluble		Exceptions (Insoluble)
ammonium	NH_4^+	
Potassium ¹	K^+	
Sodium ¹	Na^+	
nitrate	NO_3^-	
acetate	$\text{C}_2\text{H}_3\text{O}_2^-$	
Chloride ²	Cl^-	Ag^+ , Hg_2^{+2} , Pb^{+2}
sulfate	SO_4^{-2}	Ba^{+2} , Pb^{+2} , Hg_2^{+2} , Ag^+
chlorate	ClO_3^-	
perchlorate	ClO_4^-	

1 all Group I metals

2 Also, binary compounds of Br- and I- with metals are soluble. Exceptions are the same as with Chloride.

Insoluble		Exceptions (Soluble)
Hydroxide	OH^-	*, Ba^{+2} , Ca^{+2} , Sr^{+2}
Oxide	O^{-2}	*, Ba^{+2} , Ca^{+2} , Sr^{+2}
Phosphate	PO_4^{-3}	*
Carbonate	CO_3^{-2}	*
Sulfide	S^{-2}	*
Sulfite	SO_3^{-2}	*
Silicate	SiO_3^{-2}	*
Silver	Ag^+	NO_3^-

* Group IA metals and NH_4^+

All strong acids and strong bases will ionize, or separate into its ions when reacting with water, completely. The only strong acids are: HCl, H_2SO_4 , HClO_4 , HI, HBr, and HNO_3 . The strong bases are: NaOH, LiOH, KOH, Li_2O .

When you look at the solubility chart, you will notice that other bases, such as $\text{Ca}(\text{OH})_2$ and $\text{Ba}(\text{OH})_2$, are said to be soluble as well. However, except for the strong bases listed, all other bases are only SLIGHTLY soluble. Slightly soluble compounds mean that they will ionize only a little bit. To be safe, all bases, except for the strong bases listed above, should not be turned into its ions.

Also if one part of a compound is soluble but the other isn't, then the whole compound is insoluble. For example, in AgClO_3 , ClO_3^- is soluble but Ag^+ is not. Therefore, the whole compound is insoluble.