

AP Chemistry Summer Assignment 2015

AP Chemistry is an extremely challenging course. While it is definitely not about memorization, having these items memorized is essential for success for learning the concepts covered in the course. I have include several resources in this packet.

1. There is a list of ions that you must know on the first day. Utilize the suggestions for making the process of memorization easier. For instance, most of you will remember that most of the monatomic ions have charges that are related directly to their placement on the periodic table. There are naming patterns that greatly simplify the learning of the polyatomic ions as well. I have include a sheet of flashcards for the polyatomic ions that you must learn. I strongly suggest you cut them out and begin memorizing them immediately. Use the hints on the common ions sheet to help you reduce the amount of memorizing that you must do.

****There will be an test on the first day of class to assess your knowledge of polyatomic ions... BE PREPARED!!**

2. Memorize the solubility rules and be able to identify whether a substance will break into ions when dissolved in water.

****There will be an test on the first day of class to assess your knowledge of solubility rules... BE PREPARED!!**

3. There are a number of questions that are meant to help you review the material that you learned in Honors Chemistry 2 will be expected to know as we begin AP Chemistry.

Also included is a copy of the Periodic Table used in AP Chemistry. Notice this is not the table that you used before. The AP table is the same that the College Board allows you to use on the AP Chemistry Exam. Notice that it has the symbols for the elements but not the written names. You need to take that into consideration when studying for the aforementioned quiz!

Do not let the fact that there are no flash cards for the monatomic ions suggest to you that monatomic ions are not important. They are every bit as important as the polyatomic ions. If you have trouble identifying the charges of monatomic ions (or the naming system) then I suggest you make yourself some flashcards for those as well.

I look forward to seeing you all at the beginning of the next school year. If you need to contact me during the summer, you can email me and I will get back to you.

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1. Nomenclature

Rules for Naming Ionic Compounds (metal + nonmetal)

A. Balance Charges (charges should net zero)

B. Cation is always written first (in name and formula)

C. Change the ending of the anion to *-ide* (unless polyatomic ion, then named as given)

I. Name these binary compounds of two non metals

IF₇ _____ N₂O₅ _____ XeF₂ _____

N₂O₄ _____ As₄O₁₀ _____ SF₆ _____

PCl₃ _____ S₂Cl₂ _____

II. Name these binary compounds with a fixed charge metal.

AlCl₃ _____ MgO _____ BaI₂ _____

KI _____ SrBr₂ _____ Na₂S _____

CaF₂ _____ Al₂O₃ _____

III. Name these binary compounds of cations with variable charges. (use roman numerals)

CuCl₂ _____ Fe₂O₃ _____ SnO _____

PbCl₄ _____ Cu₂S _____ HgS _____

AuI₃ _____ CoP _____

IV. Name these compounds with polyatomic ions.

Fe(NO₃)₃ _____ NaOH _____ Cu₂SO₄ _____

Ca(ClO₃)₂ _____ KNO₂ _____ NaHCO₃ _____

NH₄NO₂ _____ Cu₂Cr₂O₇ _____

Acids- For simplicity the acids we will be concerned with naming are really just a special class of ionic compounds where the cation is always H⁺. So, if the formula has hydrogen written first, then this usually indicates that the hydrogen is a H⁺ cation and that the compound is an acid. When dissolved in water, acids produce H⁺ ions (also called protons, since removing the single electron from a neutral hydrogen atom leaves behind one proton).

Rules for Naming an Acid

A. When the name of an anion ends in *-ide*, the acid name begins with *hydro-*, the stem of the anion has the suffix *-ic* and it is followed by the word *acid*.

***-ide* becomes hydro_____ic acid**

Example: Cl is the Chloride ion so HCl = hydrochloric acid

HCl _____

H₂S _____

HI _____

HF _____

B. When the anion name ends in *-ite*, the stem of the anion has the suffix *-ous* and it is followed by the word *acid*.

-ite* becomes _____ *ous acid

Example: ClO₂⁻ is the chlorite ion, so HClO₂ = chlorous acid

C. When the anion name ends in *-ate*, the stem of the anion has the suffix *-ic* and it is followed by the word *acid*.

-ate* becomes _____ *ic acid

Example: ClO₃⁻ is the chlorate ion, so HClO₃ = chloric acid

I like to remember - "I ate something and got sick. I spend nite at the house.

I. Name the following acids using the correct naming rules.

HClO₄ _____

H₂SO₄ _____

HC₂H₃O₂ _____

H₃PO₄ _____

HNO₂ _____

H₂CrO₄ _____

H₂C₂O₄ _____

H₂CO₃ _____

II. Name these compounds appropriately.

Hint: Some of these compounds are covalently bonded (nonmetal + nonmetal) so you will have to use prefixes to indicate how many of each element is in the compound: *mono-*, *di-*, *tri-*, *tetra-*, *penta-*, *hexa-*, *hepta-*, *octa-*, *nona-*, *deca-*.

CO _____

NH₄CN _____

HIO₃ _____

Nl₃ _____

AlP _____

OF₂ _____

LiMnO₄ _____

HClO _____

SO₂ _____

CuCr₂O₇ _____

K₂O _____

HF _____

FeF₃ _____

KC₂H₃O₂ _____

MnS _____

III. Write the chemical formula.

Tin (IV) phosphide _____

copper (II) cyanide _____

Magnesium hydroxide _____

sodium peroxide _____

sulfurous acid _____

lithium silicate _____

potassium nitride _____

chromium (III) carbonate _____

gallium arsenide _____

cobalt (II) chromate _____

zinc fluoride _____

dichromic acid _____

3. Solubility rules

I. Review solubility rules and identify each of the following compounds as soluble (S) or insoluble (I) in water. You must memorize the solubility rules given in this packet. *You may want to spend time memorizing the solubility rules before you complete the next two sections, try them without using your solubility chart, and then check them using the chart.*

Na_2CO_3 _____

CoCO_3 _____

$\text{Pb}(\text{NO}_3)_2$ _____

K_2S _____

BaSO_4 _____

$(\text{NH}_4)_2\text{S}$ _____

AgI _____

$\text{Ni}(\text{NO}_3)_2$ _____

KI _____

FeS _____

PbCl_2 _____

CuSO_4 _____

Li_2O _____

$\text{Mn}(\text{C}_2\text{H}_3\text{O}_2)_2$ _____

$\text{Cr}(\text{OH})_3$ _____

AgClO_3 _____

$\text{Sn}(\text{SO}_3)_4$ _____

FeF_2 _____

II. Write out the balanced chemical equation for each of the following double replacement reactions. Predict whether each of these double replacement reactions will give a precipitate or not based on the solubility of the products. If yes, identify the precipitate.

silver nitrate and potassium chloride

magnesium nitrate and sodium carbonate

strontium bromide and potassium sulfate

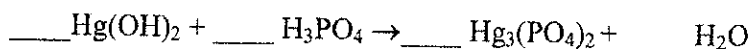
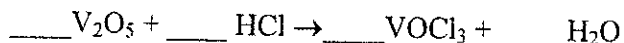
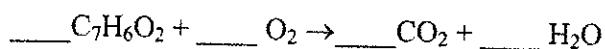
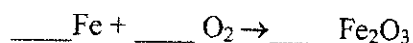
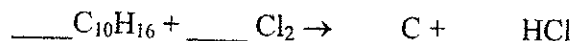
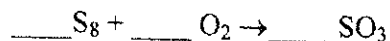
cobalt (III) bromide and potassium sulfide

ammonium hydroxide and copper (II) acetate

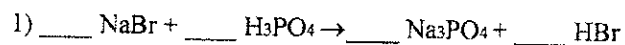
lithium chlorate and chromium (III) fluoride

4. Balancing Equations

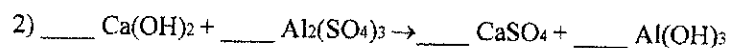
I. Balance the following equations with the lowest whole number coefficients.



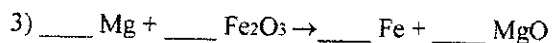
II. Balance the following equations and indicate the type of reaction taking place:



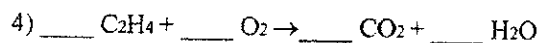
Type of reaction: _____



Type of reaction: _____



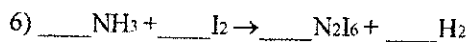
Type of reaction: _____



Type of reaction: _____



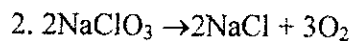
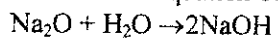
Type of reaction: _____



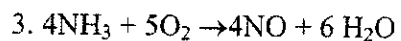
Type of reaction: _____

5. Stoichiometry and Limiting Factor

1. Given the equation below, what mass of water would be needed to react with 10.0g of sodium oxide?

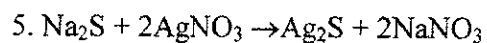


What mass of sodium chloride is formed along with 45.0g of oxygen gas?



What mass of water will be produced when 100.0g of ammonia is reacted with excess oxygen?

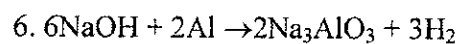
4. If the reaction in #3 is done with 25.0g of each reactant, which would be the limiting factor?



If the above reaction is carried out with 50.0g of sodium sulfide and 35.0g of silver nitrate, which is the limiting factor?

What mass of the excess reactant remains?

What mass of silver sulfide would precipitate?

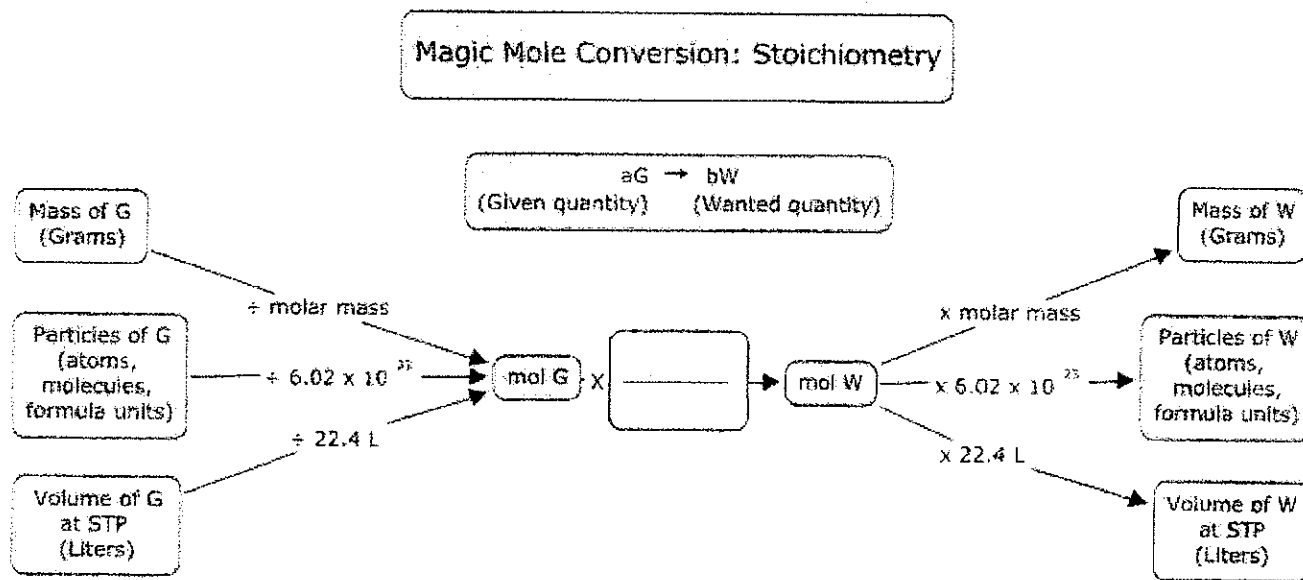


What volume of hydrogen gas (measured at STP) would result from reacting 75.0g of sodium hydroxide with 50.0g of aluminum?

You will need to memorize these rules for the rest of the year... start memorizing over the summer!

SOLUBILITY RULES

1. Salts of ammonium (NH_4^+) and Group IA are always soluble.
2.
 - a. All chlorides (Cl^-) are soluble except AgCl , Hg_2Cl_2 , and PbCl_2 which are insoluble.
 - b. All bromides (Br^-) are soluble except AgBr , Hg_2Br_2 , HgBr_2 , and PbBr_2 which are insoluble.
 - c. All iodides (I^-) are soluble except AgI , Hg_2I_2 , HgI_2 , and PbI_2 which are insoluble.
3. Chlorates (ClO_3^-), nitrates (NO_3^-), and acetates (CH_3COO^-) are soluble.
4. Sulfates (SO_4^{2-}) are soluble except CaSO_4 , SrSO_4 , BaSO_4 , Hg_2SO_4 , HgSO_4 , PbSO_4 , and Ag_2SO_4 which are insoluble.
5. Phosphates (PO_4^{3-}), and carbonates (CO_3^{2-}) are insoluble except NH_4^+ and Group IA compounds.
6. All metallic oxides (O^{2-}) are insoluble except NH_4^+ and Group IA compounds.
7. All metallic hydroxides (OH^-) are insoluble except NH_4^+ and Group IA and Group IIA from calcium down.
8. All sulfides (S^{2-}) are insoluble except NH_4^+ and Groups IA and IIA.



INFORMATION IN THE TABLE BELOW AND IN THE TABLES ON PAGES 3-5 MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1	H	1.008	3	Li	6.941	11	B	10.811	19	K	39.098	27	Co	58.933	35	Br	79.904	53	I	126.905	81	Tl	204.387	89	Ac	227.033
2	He	4.003	4	Be	9.012	12	C	12.011	20	Ca	40.078	28	Ni	58.708	36	Kr	83.80	54	Xe	131.29	82	Pb	207.2	90	Th	232.038
3			5	B	10.811	13	N	14.007	21	Sc	44.956	29	Cu	63.546	37	Rb	85.468	55	Ba	137.327	83	Bi	208.980	91	Pa	231.036
4			6	C	12.011	14	O	15.999	22	Ti	47.88	30	Zn	65.38	38	Sr	87.62	56	La	138.905	84	Po	209	92	U	238.029
5			7	N	14.007	15	F	18.998	23	V	50.942	31	Ga	69.723	39	Y	88.906	57	Ce	140.12	85	At	210	93	Np	237.048
6			8	O	15.999	16	Ne	20.180	24	Cr	51.996	32	Ge	72.64	40	Zr	91.224	58	Pr	140.908	86	Rn	222	94	Pm	243
7			9	F	18.998	17	Na	22.990	25	Mn	54.938	33	As	74.922	41	Nb	92.906	59	Ba	140.12	87	Fr	223	95	Sm	247.077
8			10	Ne	20.180	18	Mg	24.305	26	Fe	55.845	34	Se	78.96	42	Mo	95.94	60	La	140.908	88	Ra	226	96	Eu	254.088
9			11	Na	22.990	19	Al	26.982	27	Co	58.933	35	Br	79.904	43	Tc	98.906	61	Ce	140.12	89	Ac	227	97	Gd	260.105
10			12	Mg	24.305	20	Si	28.086	28	Ni	58.708	36	Kr	83.80	44	Ru	101.07	62	Pr	140.908	90	Th	232	98	Dy	267.103
11			13	Al	26.982	21	P	30.974	29	Cu	63.546	37	Rb	85.468	45	Rh	102.91	63	Ba	140.12	91	Pa	231	99	Ho	269.101
12			14	Si	28.086	22	S	32.06	30	Zn	65.38	38	Sr	87.62	46	Pd	106.42	64	La	140.908	92	U	238	100	Er	270.106
13			15	P	30.974	23	Cl	35.453	31	Ga	69.723	39	Y	88.906	47	Ag	107.87	65	Ce	140.12	93	Np	237	101	Tm	272.105
14			16	S	32.06	24	Ar	39.948	32	Ge	72.64	40	Zr	91.224	48	Cd	112.41	66	Pr	140.908	94	Pm	243	102	Yb	270.107
15			17	Cl	35.453	25	K	39.098	33	As	74.922	41	Nb	92.906	49	In	114.82	67	Ba	140.12	95	Sm	247	103	Lu	272.105
16			18	Ar	39.948	26	Ca	40.078	34	Se	78.96	42	Mo	95.94	50	Sn	118.71	68	La	140.908	96	Eu	254	104	Hf	277.103
17			19	K	39.098	27	Sc	44.956	35	Br	79.904	43	Tc	98.906	51	Sb	121.76	69	Ce	140.12	97	Gd	260	105	Ta	288.106
18			20	Ca	40.078	28	Ti	47.88	36	Kr	83.80	44	Ru	101.07	52	Te	127.60	70	Pr	140.908	98	Th	232	106	W	294.101
19			21	Sc	44.956	29	V	50.942	37	Rb	85.468	45	Rh	102.91	53	Ir	192.22	71	Ba	140.12	99	Pa	231	107	Re	300.106
20			22	Ti	47.88	30	Cr	51.996	38	Sr	87.62	46	Pd	106.42	54	Pt	195.08	72	La	140.908	100	U	238	108	Os	309.106
21			23	V	50.942	31	Mn	54.938	39	Y	88.906	47	Ag	107.87	55	Au	196.967	73	Ce	140.12	101	Np	237	109	Ir	312.217
22			24	Cr	51.996	32	Fe	55.845	40	Zr	91.224	48	Cd	112.41	56	Hg	200.59	74	Pr	140.908	102	Pm	243	110	Pt	317.217
23			25	Mn	54.938	33	Co	58.933	41	Nb	92.906	49	In	114.82	57	Tl	204.387	75	Ba	140.12	103	Sm	247	111	Au	318.917
24			26	Fe	55.845	34	Ni	58.708	42	Mo	95.94	50	Sn	118.71	58	Pb	207.2	76	La	140.908	104	Eu	254	112	Hg	320.61
25			27	Co	58.933	35	Cu	63.546	43	Tc	98.906	51	Sb	121.76	59	Bi	208.980	77	Ce	140.12	105	Gd	260	113	Tl	320.426
26			28	Ni	58.708	36	Zn	65.38	44	Ru	101.07	52	Te	127.60	60	Po	209	78	Pr	140.908	106	Th	232	114	Pb	327.455
27			29	Cu	63.546	37	Ga	69.723	45	Rh	102.91	53	Ir	192.22	61	At	210	79	Ba	140.12	107	Pa	231	115	Bi	329.415
28			30	Zn	65.38	38	Ge	72.64	46	Pd	106.42	54	Pt	195.08	62	Rn	222	80	La	140.908	108	U	238	116	Po	339.453
29			31	Ga	69.723	39	As	74.922	47	Ag	107.87	55	Au	196.967	63	Fr	223	81	Ce	140.12	109	Np	237	117	At	349.453
30			32	Ge	72.64	40	Se	78.96	48	Cd	112.41	56	Hg	200.59	64	Ra	226	82	Pr	140.908	110	Pm	243	118	Fr	349.453
31			33	As	74.922	41	Br	79.904	49	In	114.82	57	Tl	204.387	65	Ac	227	83	Ba	140.12	111	Sm	247	119	Rn	354.453
32			34	Se	78.96	42	Kr	83.80	50	Sn	118.71	58	Pb	207.2	66			84	La	140.908	112	Eu	254	120	Fr	354.453
33			35	Br	79.904	43	Rb	85.468	51	Sb	121.76	59	Bi	208.980	67			85	Ce	140.12	113	Gd	260	121		354.453
34			36	Kr	83.80	44	Sr	87.62	52	Te	127.60	60	Po	209	68			86	Pr	140.908	114	Th	232	122		354.453
35			37	Rb	85.468	45	Y	88.906	53	Ir	192.22	61	At	210	69			87	Ba	140.12	115	Pa	231	123		354.453
36			38	Sr	87.62	46	Zr	91.224	54	Pt	195.08	62	Rn	222	70			88	La	140.908	116	U	238	124		354.453
37			39	Y	88.906	47	Nb	92.906	55	Au	196.967	63	Fr	223	71			89	Ce	140.12	117	Np	237	125		354.453
38			40	Zr	91.224	48	Mo	95.94	56	Hg	200.59	64	Ra	226	72			90	Pr	140.908	118	Pm	243	126		354.453
39			41	Nb	92.906	49	Tc	98.906	57	Tl	204.387	65	Ac	227	73			91	Ba	140.12	119	Sm	247	127		354.453
40			42	Mo	95.94	50	Ru	101.07	58	Pb	207.2	66			74			92	La	140.908	120	Eu	254	128		354.453
41			43	Tc	98.906	51	Rh	102.91	59	Bi	208.980	67			75			93	Ce	140.12	121	Gd	260	129		354.453
42			44	Ru	101.07	52	Pd	106.42	60	Po	209	68			76			94	Pr	140.908	122	Th	232	130		354.453
43			45	Rh	102.91	53	Ag	107.87	61	At	210	69			77			95	Ba	140.12	123	Pa	231	131		354.453
44			46	Pd	106.42	54	Cd	112.41	62	Rn	222	70			78			96	La	140.908	124	U	238	132		354.453
45			47	Ag	107.87	55	In	114.82	63	Fr	223	71			79			97	Ce	140.12	125	Np	237	133		354.453
46			48	Cd	112.41	56	Sn	118.71	64	Ra	226	72			80			98	Pr	140.908	126	Pm	243	134		354.453
47			49	In	114.82	57	Sb	121.76	65	Ac	227	73			81			99	Ba	140.12	127	Sm	247	135		354.453
48			50	Sn	118.71	58	Te	127.60	66			74			82			100	La	140.908	128	Eu	254	136		354.453
49			51	Sb	121.76	59	I	126.905	67			75			83			101	Ce	140.12	129	Gd	260	137		354.453
50			52	Te	127.60	60	Xe	131.29	68			76			84			102	Pr	140.908	130	Th	232	138		354.453
51			53	I	126.905	61	Fr	223	69			77			85			103	Ba	140.12	131	Pa	231	139		354.453
52			54	Xe	131.29	62	Ra	226	70			78			86			104	La	140.908	132	U	238	140		354.453
53			55	Fr	223	63	Ac	227	71			79			87			105	Ce	140.12	133	Np	237	141		354.453
54			56	Ra	226	64			72			80			88			106	Pr	140.908	134	Pm	243	142		354.453
55			57	Ac	227	65			73			81			89			107	Ba	140.12	135	Sm	247	143		354.453
56			58			66			74			82			90			108	La	140.908	136	Eu	254	144		354.453
57			59			67			75			83			91			109	Ce	140.12	137	Gd	260	145		354.453
58			60			68			76			84			92			110	Pr	140.908	138	Th	232	146		354.453
59			61			69			77			85			93			111	Ba	140.12	139	Pa	231	147		354.453
60			62			70			78			86			94			112	La	140.908	140	U	238	148		354.453
61			63			71			79			87			95			113	Ce	140.12	141					

From the table:

Cations	Name
H ⁺	Hydrogen
Li ⁺	Lithium
Na ⁺	Sodium
K ⁺	Potassium
Rb ⁺	Rubidium
Cs ⁺	Cesium
Be ²⁺	Beryllium
Mg ²⁺	Magnesium
Ca ²⁺	Calcium
Ba ²⁺	Barium
Sr ²⁺	Strontium
Al ³⁺	Aluminum

Anions	Name
H ⁻	Hydride
F ⁻	Fluoride
Cl ⁻	Chloride
Br ⁻	Bromide
I ⁻	Iodide
O ²⁻	Oxide
S ²⁻	Sulfide
Se ²⁻	Selenide
N ³⁻	Nitride
P ³⁻	Phosphide
As ³⁻	Arsenide

Type II Cations	Name
Fe ³⁺	Iron(III)
Fe ²⁺	Iron(II)
Cu ²⁺	Copper(II)
Cu ⁺	Copper(I)
Co ³⁺	Cobalt(III)
Co ²⁺	Cobalt(II)
Sn ⁴⁺	Tin(IV)
Sn ²⁺	Tin(II)
Pb ⁴⁺	Lead(IV)
Pb ²⁺	Lead(II)
Hg ²⁺	Mercury(II)

Ions to Memorize

Cations	Name
Ag ⁺	Silver
Zn ²⁺	Zinc
Hg ₂ ²⁺	Mercury(I)
NH ₄ ⁺	Ammonium

Anions	Name
NO ₂ ⁻	Nitrite
NO ₃ ⁻	Nitrate
SO ₃ ²⁻	Sulfite
SO ₄ ²⁻	Sulfate
HSO ₄ ⁻	Hydrogen sulfate (bisulfate)
OH ⁻	Hydroxide
CN ⁻	Cyanide
PO ₄ ³⁻	Phosphate
HPO ₄ ²⁻	Hydrogen phosphate
H ₂ PO ₄ ⁻	Dihydrogen phosphate
NCS ⁻	Thiocyanate
CO ₃ ²⁻	Carbonate
HCO ₃ ⁻	Hydrogen carbonate (bicarbonate)
ClO ⁻	Hypochlorite
ClO ₂ ⁻	Chlorite
ClO ₃ ⁻	Chlorate
ClO ₄ ⁻	Perchlorate
BrO ⁻	Hypobromite
BrO ₂ ⁻	Bromite
BrO ₃ ⁻	Bromate
BrO ₄ ⁻	Perbromate
IO ⁻	Hypoiodite
IO ₂ ⁻	Iodite
IO ₃ ⁻	Iodate
IO ₄ ⁻	Periodate
C ₂ H ₃ O ₂ ⁻	Acetate
MnO ₄ ⁻	Permanganate
Cr ₂ O ₇ ²⁻	Dichromate
CrO ₄ ²⁻	Chromate
O ₂ ²⁻	Peroxide
C ₂ O ₄ ²⁻	Oxalate
NH ₂ ⁻	Amide
BO ₃ ³⁻	Borate
S ₂ O ₃ ²⁻	Thiosulfate

"From the Table"

These are ions can be organized into two groups.

1. Their place on the table suggests the charge on the ion, since the neutral atom gains or loses a predictable number of electrons in order to obtain a noble gas configuration. This was a focus in first year chemistry, so if you are unsure what this means, get help BEFORE the start of the year.
 - a. All Group 1 Elements (alkali metals) lose one electron to form an ion with a 1+ charge
 - b. All Group 2 Elements (alkaline earth metals) lose two electrons to form an ion with a 2+ charge
 - c. Group 13 metals like aluminum lose three electrons to form an ion with a 3+ charge
 - d. All Group 17 Elements (halogens) gain one electron to form an ion with a 1- charge
 - e. All Group 16 nonmetals gain two electrons to form an ion with a 2- charge
 - f. All Group 15 nonmetals gain three electrons to form an ion with a 3- charge

Notice that cations keep their name (sodium ion, calcium ion) while anions get an "-ide" ending (chloride ion, oxide ion).

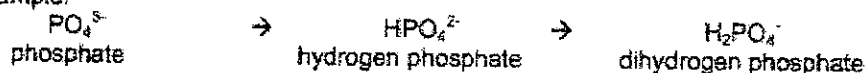
2. Metals that can form more than one ion will have their positive charge denoted by a roman numeral in parenthesis immediately next to the name of the

Polyatomic Anions

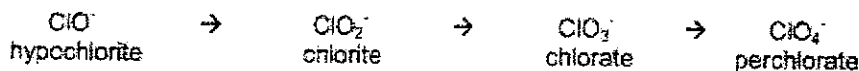
Most of the work on memorization occurs with these ions, but there are a number of patterns that can greatly reduce the amount of memorizing that one must do.

1. "ate" anions have one more oxygen than the "ite" ion, but the same charge. If you memorize the "ate" ions, then you should be able to derive the formula for the "ite" ion and vice-versa.
 - a. sulfate is SO_4^{2-} , so sulfite has the same charge but one less oxygen (SO_3^{2-})
 - b. nitrate is NO_3^- , so nitrite has the same charge but one less oxygen (NO_2^-)
2. If you know that a sulfate ion is SO_4^{2-} then to get the formula for hydrogen sulfate ion, you add a hydrogen ion to the front of the formula. Since a hydrogen ion has a 1+ charge, the net charge on the new ion is less negative by one.

a. Example:



3. Learn the hypochlorite \rightarrow chlorite \rightarrow chlorate \rightarrow perchlorate series, and you also know the series containing iodite/iodate as well as bromite/bromate.
 - a. The relationship between the "ite" and "ate" ion is predictable, as always. Learn one and you know the other.
 - b. The prefix "hypo" means "under" or "too little" (think "hypodermic", "hypothermic" or "hypoglycemia")
 - i. Hypochlorite is "under" chlorite, meaning it has one less oxygen
 - c. The prefix "hyper" means "above" or "too much" (think "hyperkinetic")
 - i. the prefix "per" is derived from "hyper" so perchlorate (hyperchlorate) has one more oxygen than chlorate.
 - d. Notice how this sequence increases in oxygen while retaining the same charge:



Sulfite	Sulfate	Hydrogen sulfate
Phosphate	Dihydrogen Phosphate	Hydrogen Phosphate
Nitrite	Nitrate	Ammonium
Thiocyanate	Carbonate	Hydrogen carbonate
Borate	Chromate	Dichromate
Permanganate	Oxalate	Amide
Hydroxide	Cyanide	Acetate
Peroxide	Hypochlorite	Chlorite
Chlorate	Perchlorate	Thiosulfate

HSO_4^-	SO_4^{2-}	SO_3^{2-}
HPO_4^{2-}	H_2PO_4^-	PO_4^{3-}
NH_4^+	NO_3^-	NO_2^-
HCO_3^-	CO_3^{2-}	NCS^- SCN^-
$\text{Cr}_2\text{O}_7^{2-}$	CrO_4^{2-}	BO_3^{3-}
NH_2^-	$\text{C}_2\text{O}_4^{2-}$	MnO_4^-
$\text{C}_2\text{H}_3\text{O}_2^-$ CH_3COO^-	CN^-	OH^-
ClO_2^-	ClO^-	O_2^{2-}
$\text{S}_2\text{O}_3^{2-}$	ClO_4^-	ClO_3^-