Weis

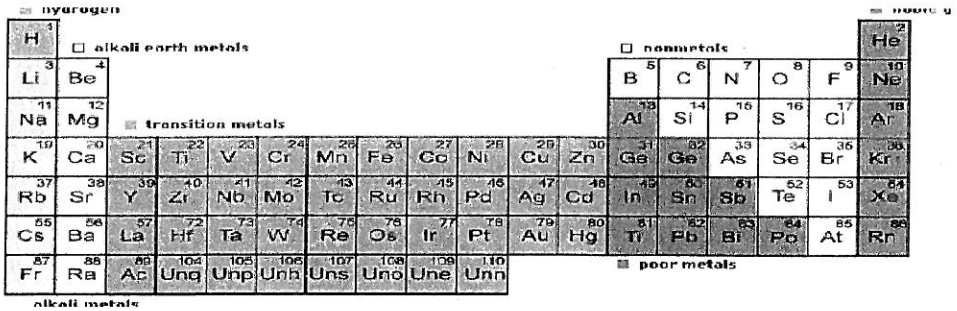
Chapters 7 & 9 (Bonding & Formula Naming) Weis

www.youtube.com/watch?v=kji_eVdUd9s

1. ION FORMATION

ELEMENT	ELECTRON CONFIGURATION	DOT DIAGRAM	ION (use format X^{n+} or X^{n-} where X is the Element symbol and n is the number of the charge)
sodium	$[Ne]\ 3s^1$	$\dot{N}a$	Na^{1+}
calcium	$[Ar]\ 4s^2$	$\dot{\dot{C}}a$	Ca^{2+}
aluminum	$[Ne]\ 3s^2 3p^1$	$\dot{A}l\cdot$	Al^{3+}
chlorine	$[Ne]\ 3s^2 3p^5$	$\cdot\ddot{C}l\cdot$	Cl^{1-}
oxygen	$1s^2 2s^2 2p^4$	$\cdot\ddot{O}\cdot$	O^{2-}
nitrogen	$1s^2 2s^2 2p^3$	$\cdot\dot{N}\cdot$	N^{3-}

2. THE PERIODIC TABLE & ION FORMATION



CATIONS : element name and "ion" (alkali = +1, alkaline earth = +2, Al = +3, Zn = +2, Ag = +1)

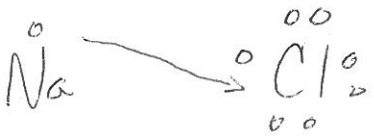
TRANSITION/POST TRANSITION METALS (Roman number represents the number of the charge)

ANIONS (monatomic anions all end in –ide)

Cations		Transition/ Post Transition Metals		Anions	
Name	**Symbol**	**Name**	**Symbol**	**Name**	**Symbol**
sodium ion	Na^{1+}	copper (I) ion	Cu^{1+}	nitride	N^{3-}
beryllium ion	Be^{2+}	cobalt (II) ion	Co^{2+}	fluoride	F^{1-}
aluminum ion	Al^{3+}	tin(IV) ion	Sn^{4+}	oxide	O^{2-}
silver ion	Ag^{1+}	iron (III) ion	Fe^{3+}	arsenide	As^{3-}
				sulfide	S^{2-}

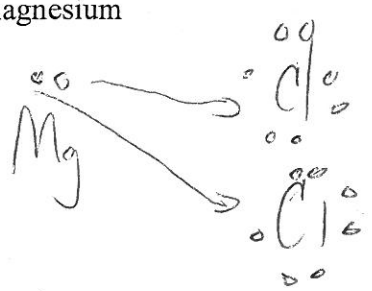
IONIC BONDING – BINARY COMPOUNDS

sodium chlorine



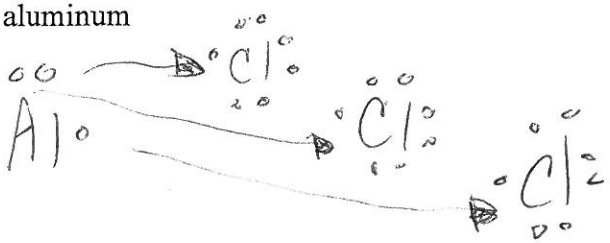
$Na^+ + Cl^- \rightarrow NaCl$

magnesium



$Mg^{2+} + 2Cl^- \rightarrow MgCl_2$

aluminum



$Al^{3+} + 3Cl^- \rightarrow AlCl_3$

WRITE THE FORMULA FOR:

a. lithium fluoride LiF

b. calcium bromide $CaBr_2$

c. magnesium phosphide Mg_3P_2

d. barium oxide BaO

e. iron(III) chloride $FeCl_3$

f. lead (II) nitride Pb_3N_2

g. potassium nitride K_3N

h. tin(IV) oxide SnO_2

NAME THE COMPOUNDS BELOW:

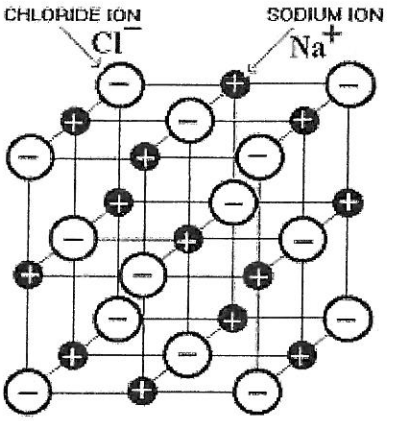
a. Li_2O Lithium oxide

b. MgF_2 Magnesium Fluoride

c. Ca_3P_2 Calcium phosphide

d. SrI_2 Strontium Iodide

PROPERTIES OF IONIC COMPOUNDS:

PROPERTY	EXPLANATION
1. made from metal ion and nonmetal ion	metals give e⁻ (pos. charge results) while nonmetals take e⁻ (neg. charge results) forming ions which attract each other
2. very high melting point/boiling point	strong attraction causes this
3. crystalline structure at room temperature	 SODIUM CHLORIDE LATTICE STRUCTURE
3. many dissolve in water	If ions are more attracted to the water than to each other, they will dissolve
4. conduct electricity when melted or dissolved	when melted or dissolved, ions form an can move freely, conducting electricity.

TERTIARY COMPOUNDS

Polyatomic Ions:

Nitrate	**NO_3^-**	**Sulfate**	**SO_4^{2-}**
Hydroxide	**OH^-**	**Sulfite**	**SO_3^{2-}**
Nitrite	**NO_2^-**	**Carbonate**	**CO_3^{2-}**
Cyanide	**CN^-**	**Phosphate**	**PO_4^{3-}**
Acetate	**$C_2H_3O_2^-$**	**Ammonium**	**NH_4^+**
Permanganate	**MnO_4^-**	**Chlorate**	**ClO_3^-**

WRITE THE FORMULA FOR:

a. lithium sulfate

Li_2SO_4

b. calcium hydroxide

$Ca(OH)_2$

c. copper(II) cyanide

$Cu(CN)_2$

d. strontium nitrate

$Sr(NO_3)_2$

e. chromium(III) phosphate

$CrPO_4$

f. manganese (IV) carbonate

$Mn(CO_3)_2$

g. barium chlorate

$Ba(ClO_3)_2$

h. aluminum permanganate

$Al(MnO_4)_3$

NAME:

a. $MgBr_2$

Magnesium bromide

b. $Ca(CN)_2$

Calcium cyanide

c. Na_3PO_4

sodium phosphate

d. $Al(OH)_3$

aluminum hydroxide

e. $ZnSO_4$

zinc sulfate

f. Cs_2CO_3

Cesium carbonate

g. $KClO_3$

potassium chlorate

h. $Mg_3(PO_4)_2$

Magnesium phosphate

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BOUT THE METALS THAT HAVE MORE THAN ONE OXIDATION .! (Transition Metals)

a. Write in the charges for the ions you are sure of (the anion)
b. Work backwards to find the charge of the metal ion (the cation)

a. CuS $Cu^{2+}\ S^{2-}$ Copper(II) Sulfide

b. FeP $Fe^{3+}\ P^{3-}$ Iron (III) phosphide

c. $FeSO_4$ $Fe\ SO_4^{2-}$ Iron (II) Sulfate

d. $CuNO_3$ $Cu\ NO_3^{-}$ Copper (I) Nitrate

e. NiI_3 $Ni\ I_3^{-1}$ Nickel (III) Iodide

f. $Cr(MnO_4)_4$ $Cr(MnO_4)_4^{-1}$ Chromium(IV) permanganate

g. $Pb(NO_3)_2$ $Pb(NO_3)_2^{-1}$ Lead (II) Nitrate

h. $Pb(SO_4)_2$ $Pb(SO_4)_2^{-2}$ Lead (IV) sulfate

i. $Sn(CO_3)_2$ $Sn(CO_3)_2^{-2}$ Tin (IV) Carbonate

j. $Sn(NO_3)_2$ $Sn(NO_3)_2^{-1}$ Tin (II) Nitrate

k. $Cu_3(PO_4)_2$ $Cu_3(PO_4)_2^{3-}$ Copper (II) Phosphate

l. Cu_3PO_4 $Cu_3PO_4^{-3}$ Copper (I) phosphate

TRY: First, determine whether each compound below needs a roman numeral. Then name the compound.

COMPOUND	ROMAN NUMERAL?	NAME
CuI_2	Y	Copper (II) Iodide
MnS_2	Y	Manganese (IV) sulfide
V_2O_3	Y	Vanadium (III) Oxide
$Mn(OH)_4$	Y	Manganese (IV) hydroxide
Na_2SO_4	N	Sodium Sulfate

COMPOUND	ROMAN NUMERAL?	NAME
$NiCO_3$	Y	Nickel (II) Carbonate
$BaSO_3$	N	Barium Sulfite
$Fe(CN)_3$	Y	Iron (III) Cyanide
AgCl	N	Silver Chloride

Write the formula for each compound in the chart below:

	NAME	FORMULA
1	manganese (VI) hydroxide	$Mn(OH)_4$
2	chromium (III) fluoride	CrF_3
3	iron (II) nitrate	$Fe(NO_3)_2$
4	cobalt (II) sulfate	$CoSO_4$
5	zinc cyanide	$Zn(CN)_2$
6	aluminum oxide	Al_2O_3
	tin(IV) phosphate	$Sn_3(PO_4)_4$
8	lithium fluoride	LiF
9	calcium sulfite	$CaSO_3$
10	Iron (III) hydroxide	$Fe(OH)_3$
11	barium phosphide	Ba_3P_2

IONIC FORMULAS PRACTICE PROBLEMS

1. Write the formula for each compound below:

a. magnesium iodide MgI_2

b. aluminum oxide Al_2O_3

c. sodium sulfate Na_2SO_4

d. aluminum hydroxide $Al(OH)_3$

e. rubidium phosphide Rb_3P

f. barium nitrate $Ba(NO_3)_2$

g. nickel (III) hydroxide $Ni(OH)_3$

h. lead(IV) carbonate $Pb(CO_3)_2$

2. Name each compound below. Don't worry about roman numerals until you get to g & h:

a. $AlPO_4$ Aluminum Phosphide

b. BeF_2 Beryllium fluoride

c. Na_2SO_4 Sodium Sulfate

d. MgI_2 Magnesium Iodide

e. $Ca(NO_3)_2$ Calcium Nitrate

f. $ZnBr_2$ Zinc Bromide

** g. Fe_2S_3 Iron(III) Sulfide

** h. FeS Iron (II) Sulfide

NAMING BINARY MOLECULAR COMPOUNDS

1. Naming Molecular Compounds

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

Try naming:

C_3Cl_6 Tricarbon hexachloride

C_5F_{10} Pentacarbon decafluoride

Si_2O_7 disilicon heptaoxide

PCl_5 phosphorus pentachloride

Write the formula for:

dichlorine monoxide Cl_2O

carbon tetrafluoride CF_4

tetracarbon octabromide C_4Br_8

2. How do I know whether to write an ionic formula or a molecular formula?

Starts w/ a metal — Starts w/ a non metal.

(exception ionic compounds starting with ammonium (NH_4^+))

Try:

1 calcium phosphate $Ca_3(PO_4)_2$

2 iron (III) nitrite $Fe(NO_2)_3$

3 CCl_4 Carbon tetrachloride

4 $PbSO_4$ Lead(II) sulfate

5 carbon dioxide CO_2

6 diphosphorus pentoxide P_2O_5

7 $BaCl_2$ Barium chloride

8 C_3I_8 tricarbon octaiodide

NAMING MOLECULAR COMPOUNDS

Name _____

Name the following covalent compounds.

1. CO_2 carbon dioxide
2. CO carbon monoxide
3. SO_2 sulfur dioxide
4. SO_3 sulfur trioxide ← NOT sulfite!
5. N_2O di Nitrogen monoxide
6. NO Nitrogen monoxide
7. N_2O_3 di nitrogen trioxide
8. NO_2 Nitrogen dioxide
9. N_2O_4 di nitrogen tetraoxide
10. N_2O_5 di nitrogen pentoxide
11. PCl_3 phosphorus trichloride
12. PCl_5 phosphorus pentachloride
13. NH_3 nitrogen trihydride
14. SCl_6 sulfur hexachloride
15. P_2O_5 diphosphorus pentoxide
16. CCl_4 carbon tetrachloride
17. SiO_2 silicon dioxide
18. CS_2 carbon disulfide
19. OF_2 Oxygen difluoride
20. PBr_3 phosphorus tribromide

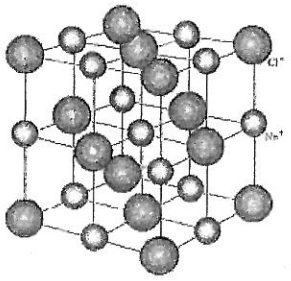
PROPERTIES OF MOLECULAR COMPOUNDS

Contain covalent bonds:

non-metals ONLY

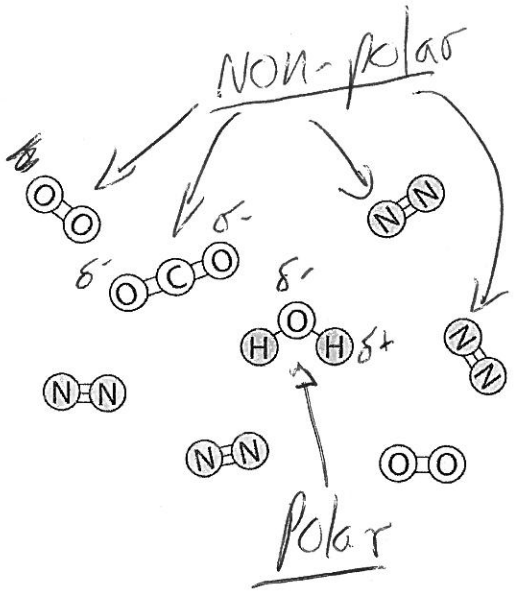
molecule vs. ionic crystal

IONIC:



Remember back...

MOLECULAR:



Polar Molecular Compounds:

Ex: H_2O melt: 0°C boil: 100°C

Medium melting/boiling point

Do not conduct electricity

Dissolve in water, alcohol (other polar covalent compounds)

Nonpolar Molecular Compounds:

Ex: CO_2 melt: -56.6 °C (goes right into vapor)

Low melting/boiling point

Do not conduct electricity

Dissolve in gasoline (other nonpolar covalent molecules)

MIXED NAMING/FORMULA WRITING PRACTICE

Steps:
1. Does the compound begin with a metal or a nonmetal?
2. If it begins with a metal – it is ionic. Do not use prefixes in name, *use charges to determine formula.*
3. If it begins with a nonmetal – it is molecular. Do not use charges, *use the prefixes!*

1. Identify each compound below as ionic or molecular. Decide whether to use prefixes or charges, then name the compound.

FORMULA	Ionic or Molecular?	Charges or Prefixes?	NAME
NaF	I	C	sodium fluoride
$BaSO_4$	I	C	Barium sulfate
PCl_5	M	P	phosphorus pentachloride
K_3PO_4	I	C	potassium phosphate
Si_3N_4	M	P	trisilicon tetranitride
BH_3	M	P	boron trihydride
$PbCl_2$	I	C	lead (II) chloride
$Cu(NO_3)_2$	I	C	copper (II) nitrate
SF_2	M	P	sulfur difluoride

2. Determine whether each compound below is ionic or molecular. Decide whether to use prefixes or charges, then write its formula.

NAME	Ionic or Molecular?	Charges or Prefixes?	FORMULA
barium iodide	I	C	BaI_2
aluminum nitrate	I	C	$Al_2(NO_3)_3$
potassium cyanide	I	C	KCN
tetraphosphorus decoxide	M	P	P_4O_{10}
calcium acetate	I	C	$Ca(C_2H_3O_2)_2$
iron (III) sulfite	I	C	~~$Fe()SO_3$~~ $Fe_2(SO_3)_3$
carbon monosulfide	M	P	~~CO~~ CS
oxygen difluoride	M	P	OF_2
manganese (IV) bromide	I	C	$MnBr_4$
carbon tetraiodide	M	P	CI_4
dihydrogen monoxide	M	P	H_2O
silver phosphate	I	C	Ag_3PO_4
aluminum iodide	I	C	AlI_3
dinitrogen pentoxide	M	P	N_2O_5

AMING ACIDS (hint: acids start with "H")

BINARY: Contains exactly two elements.

1. use the prefix ***hydro-*** to name the hydrogen part of the acid
2. add the suffix ***–ic***

EXAMPLES: HCl Hydrochloric Acid HBr Hydrobromic acid

Oxyacids: (contain oxygen)

1. use the root of the anion
2. if it is an ***–ate*** anion, use the ***–ic*** ending
3. if it is an ***–ite*** anion, use the ***–ous*** ending

EXAMPLES: H_2SO_4 sulfuric acid HNO_3 nitric acid

H_2SO_3 sulfurous acid HNO_2 nitrous acid

TRY: Complete the chart below:

FORMULA	ANION	NAME
H_2CO_3	CO_3^{2-}	carbonic acid
$HC_2H_3O_2$	$C_2H_3O_2^-$	acetic acid
H_2SO_3	SO_3^{2-}	sulfurous acid
H_3P	P^{3-}	hydrophosphoric acid
H_2S	S^{2-}	hydrosulfuric acid
H_3N	N^{3-}	hydronitric acid
HNO_2	NO_2^-	nitrous acid
$HMnO_4$	~~MM~~ MnO_4^-	permanganic acid
H_2SO_4	SO_4^{2-}	sulfuric acid
HF	F^{-1}	hydrofluoric acid
H_3PO_4	PO_4^{3-}	phosphoric acid
H_3P	P^{3-}	hydrophosphoric acid

MIXED NAMING WITH ACIDS

STEP 1: Does the compound begin with a metal, nonmetal or hydrogen?
a. If it begins with a metal – IONIC – use charges, no prefixes.
b. If it begins with a nonmetal other than H – use prefixes, no charges
c. If it begins with H – use acid naming system.

NAME	IONIC, MOLECULAR OR ACID	FORMULA
barium nitride	I	Ba_3N_2
iron (III) phosphate	I	$FePO_4$
sulfur trioxide	M	SO_3
oxalic acid	A	$H_2C_2O_4$
phosphorous acid	A	H_3PO_3
Boron trichloride	M	BCl_3
copper(I) phosphate	I	Cu_3PO_4
hydroiodic acid	A	HI
sulfurous acid	A	H_2SO_3
diarsenic pentoxide	M	As_2O_5
cesium permanganate	I	$CsMnO_4$
Iron (III) chromate	I	$Fe_2(CrO_4)_3$
oxygen (dioxide ")	M	O_2