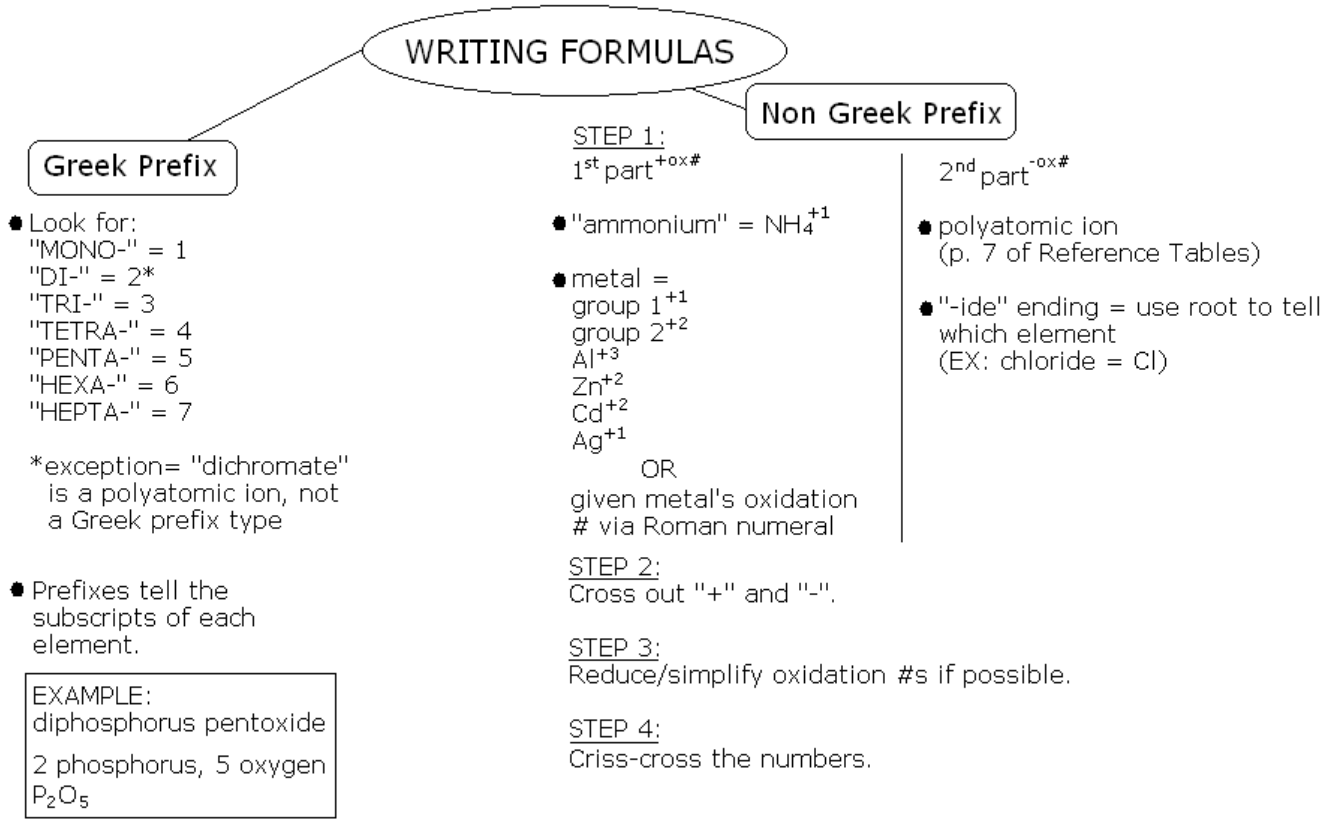
WRITING FORMULAS NOTES



EXAMPLES:

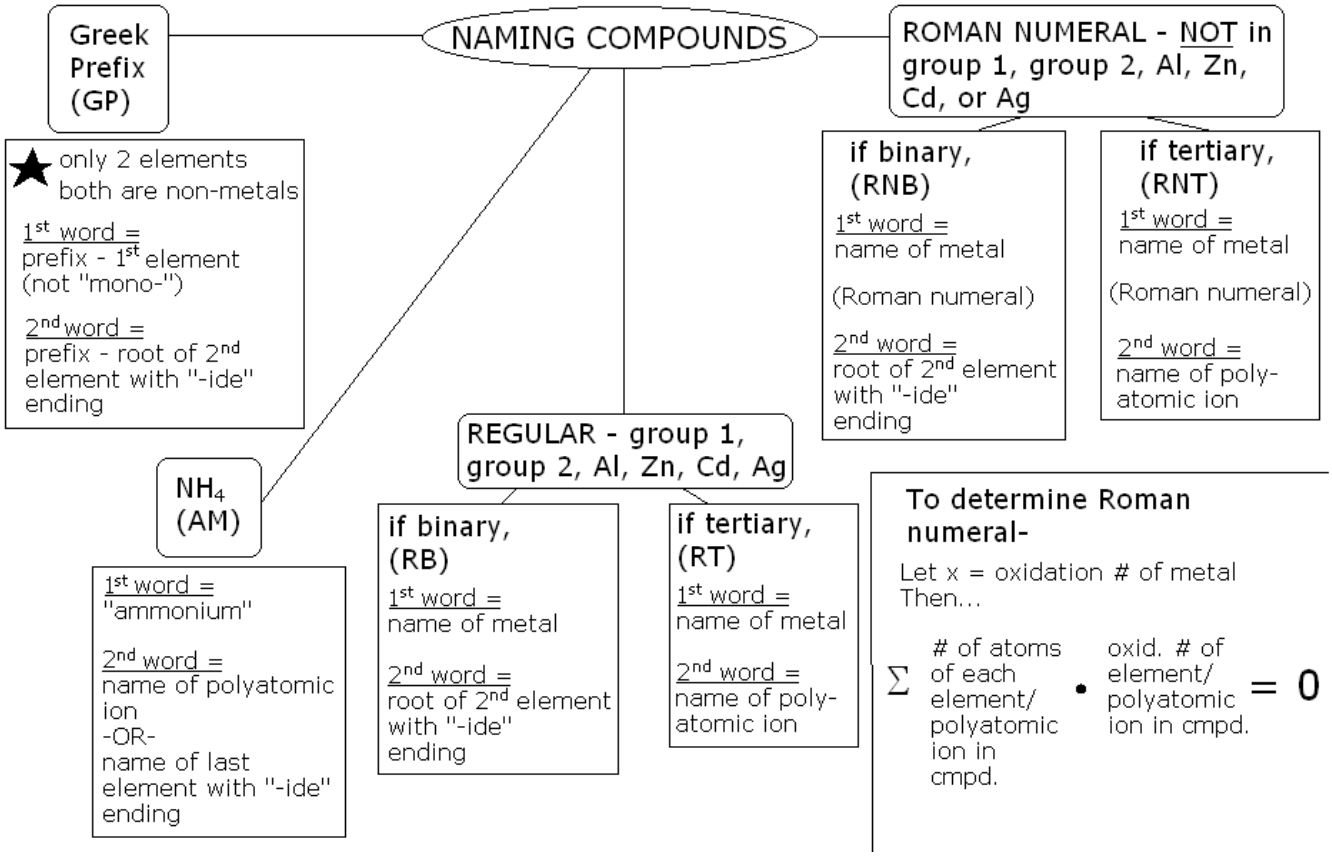
1. carbon tetrachloride
2. calcium oxide
3. iron (III) bromide
4. lead (II) nitrate
5. aluminum hydroxide
6. ammonium chromate

WRITING FORMULAS WORKSHEET

1. sodium nitrate
2. aluminum sulfide
3. iron (III) sulfate
4. strontium hydroxide
5. copper (I) phosphate
6. cesium carbonate
7. nickel (II) oxide
8. silicon dioxide
9. potassium bromide
10. zinc chlorate
11. barium acetate
12. iron (II) phosphide
13. magnesium chromate
14. calcium nitride

15. silver sulfite
16. sodium hydrogen carbonate
17. copper (II) chloride
18. ammonium dichromate
19. rubidium bromate
20. lead (II) permanganate
21. beryllium chlorite
22. cadmium iodide
23. phosphorus trichloride
24. lithium nitrite
25. tin (IV) sulfite
26. chromium (III) iodate
27. manganese (II) perchlorate
28. cobalt (II) hypochlorite
29. zinc selenide
30. magnesium cyanide

NAMING COMPOUNDS NOTES



EXAMPLES:

1. P_2O_5
2. $MgSO_4$
3. $CuCl_2$
4. $(NH_4)_3PO_4$
5. $FeCO_3$
6. K_2O

POLYATOMIC IONS (LISTED ALPHABETICALLY)

Name	Formula		Name	Formula		Name	Formula
acetate	$C_2H_3O_2^{-1}$		dichromate	$Cr_2O_7^{-2}$		nitrite	NO_2^{-1}
ammonium	NH_4^{+1}		hydrogen carbonate (or bicarbonate)	HCO_3^{-1}		perchlorate	ClO_4^{-1}
bromate	BrO_3^{-1}		hydrogen sulfate	HSO_4^{-1}		permanganate	MnO_4^{-1}
carbonate	CO_3^{-2}		hydroxide	OH^{-1}		phosphate	PO_4^{-3}
chlorate	ClO_3^{-1}		hypochlorite	ClO^{-1}		sulfate	SO_4^{-2}
chlorite	ClO_2^{-1}		iodate	IO_3^{-1}		sulfite	SO_3^{-2}
chromate	CrO_4^{-2}		nitrate	NO_3^{-1}		thiocyanate	SCN^{-1}
cyanide	CN^{-1}						

NAMING COMPOUNDS WORKSHEET

1. NaCl
2. $Ba_3(PO_4)_2$
3. $Al(MnO_4)_3$
4. $Ni(ClO)_2$
5. $CuSO_4$
6. $ZnCr_2O_7$
7. MgSe
8. $LiBrO_3$
9. $(NH_4)_3PO_4$
10. $AgHCO_3$
11. $Pb(NO_3)_2$
12. $Fe(C_2H_3O_2)_3$
13. K_2CO_3
14. $Co(ClO_4)_2$
15. $Be(NO_2)_2$
16. Cu_2CrO_4
17. $SrSO_3$
18. $Al(OH)_3$
19. $RbNO_2$
20. N_2O
21. $FeBr_2$
22. $AgClO_2$
23. N_2O_3
24. CaI_2
25. $Cu(ClO_3)_2$
26. SO_2

OXIDATION NUMBERS NOTES

- Any uncombined element (element not in a compound) has an oxidation number of 0.
- Fluorine always has an oxidation number of -1 in a compound.
- Oxygen has an oxidation number of -2 in all compounds except when it is part of a binary compound with a halogen.
- Hydrogen has an oxidation number of +1 except when it is in a binary compound with a metal.
- The algebraic sum of the oxidation numbers in a compound is zero.
- The algebraic sum of the oxidation numbers in a polyatomic ion is the charge on the ion.
- To find the oxidation number of another element in a compound, use this general formula:

Σ (# of each element in cmpd · oxidation # of each element) = 0

Let x = unknown oxidation number

EXAMPLE: Find the oxidation number of carbon (C) in Na_2CO_3.

x = carbon's oxidation number Na = +1 O = -2

$(2 \cdot +1) + (1 \cdot x) + (3 \cdot -2) = 0$

Na C O

$2 + x - 6 = 0 \rightarrow x - 4 = 0 \rightarrow$ x = +4 is carbon's oxid. # in Na_2CO_3

Find the oxidation number of the underlined element in each compound.

1. $K\underline{Mn}O_4$
2. $\underline{Mn}O_2$
3. $Li\underline{N}O_3$
4. $Ca(\underline{N}O_2)_2$
5. $Na\underline{Cl}O$
6. $Ba(\underline{Cl}O_4)_2$

OXIDATION NUMBERS WORKSHEET

1.	HCl	Cl:	2.	H_2SO_3	S:
3.	KNO_3	N:	4.	H_2SO_4	S:
5.	$Fe(OH)_3$	Fe:	6.	$KMnO_4$	Mn:
7.	Mg_3N_2	N:	8.	Li_2CO_3	C:
9.	$KClO_3$	Cl:	10.	PbO_2	Pb:
11.	$Al(NO_3)_3$	N:	12.	MnO_2	Mn:
13.	S_8	S:	14.	SO_3	S:
15.	$NaHSO_4$	S:	16.	Na:	Na:
17.	NH_3	N:			

PERCENT COMPOSITION NOTES

PERCENT COMPOSITION: the percentage by mass of each element in a compound

FORMULA FOR % COMPOSITION:

$$\% \text{ composition} = \frac{\text{mass of element in compound}}{\text{molar mass of compound}} \times 100$$

EXAMPLE 1:

Find the % composition of copper (I) sulfide, Cu_2S.

~ Finding % composition means that you have to find the % of each element in the cmpd.

molar mass of Cu_2S: % Cu = _____ x 100 = % S = _____ x 100 =

Cu: __ x _____ =

S: __ x _____ =

MM of Cu_2S =

EXAMPLE 2:
Find the percent of oxygen in calcium phosphate, $Ca_3(PO_4)_2$.
molar mass of $Ca_3(PO_4)_2$: % O = _____ x 100 =

Ca: __ x _____ =
P: __ x _____ =
O: __ x _____ =
MM of $Ca_3(PO_4)_2$ =

PERCENT COMPOSITION WORKSHEET
Determine the percent composition of each of the following compounds.

1. $KMnO_4$ K = Mn = O =

2. HCl H = Cl =

3. $Mg(NO_3)_2$ Mg = N = O =

4. $(NH_4)_3PO_4$ N = H = P = O =

5. $Al_2(SO_4)_3$ Al = S = O =

Solve the following problems.
6. How many grams of oxygen can be produced from the decomposition of 75.0 g of $KClO_3$?

7. How much iron can be recovered from 25.0 g of Fe_2O_3?

8. How much silver can be recovered from 125 g of Ag_2S?

EMPIRICAL FORMULAS NOTES

- opposite of percent composition
- use % to find formula for compound

EMPIRICAL FORMULA: simplest formula; subscript numbers are reduced to lowest terms

MOLECULAR FORMULA: subscripts are multiples of empirical formula subscripts

MOLECULAR FORMULA	EMPIRICAL FORMULA
C_6H_6	
$C_6H_{12}O_6$	
$C_{12}H_{16}O_4N_8$	

TO SOLVE EMPIRICAL FORMULA PROBLEMS:
A sample of a compound is found to contain 36.0 % calcium and 64.0 % chlorine. Calculate the empirical formula.

Step 1: Rewrite % as grams.
36.0 g Ca 64.0 g Cl

Step 2: Find moles of each element.
Ca: 36.0 g Ca | 1 mole Ca = 0.898 moles Ca
| 40.1 g Ca

Cl: 64.0 g Cl | 1 mole Cl = 1.80 moles Cl
| 35.5 g Cl

Step 3: Find mole ratio. (Divide by smallest number of moles.)

Ca: 0.898 moles / 0.898 = 1 Cl: 1.80 moles / 0.898 = 2

* These whole numbers are subscripts in formula.*

Step 4: Write the formula.

Ca_1Cl_2 ====> $CaCl_2$

Example 2: A sample of a compound contains 66.0 % calcium and 34.0 % phosphorus. What is the empirical formula?

Ca: 66.0 g Ca | 1 mole Ca / 40.1 g Ca = 1.65 moles Ca P: 34.0 g P | 1 mole P / 31.0 g P = 1.10 moles P

Ca: 1.65 / 1.10 = 1.5 P: 1.10 / 1.10 = 1

Q: So, what happens now? I can't write $Ca_{1.5}P_1$. And 1.5 is not close enough to round to 2.

A: The easiest way to get 1.5 to a whole # is to multiply by 2. Remember to multiply both #'s by 2 to get your answer.

Ca: 1.5 x 2 = 3 P: 1 x 2 = 2 So, formula is Ca_3P_2

PRACTICE - A compound contains 43.4 % sodium, 11.3 % carbon, and 45.3 % oxygen. What is the empirical formula for this compound?

EMPIRICAL FORMULAS WORKSHEET

Find the empirical formula for each of the following substances. The percent composition is given.

1. 88.8 % copper & 11.2 % oxygen
2. 10.04 % carbon, 0.84 % hydrogen, & 89.12 % chlorine
3. 42.50 % chromium & 57.50 % chlorine
4. 38.67 % potassium, 13.85 % nitrogen, & 47.48 % oxygen

Part 2 – Determine the empirical formula of the following compounds using the given data.

5. Find the empirical formula for sodium sulfite. Sodium sulfite contains 36.5 % sodium, 25.4 % sulfur, and 38.1 % oxygen.
6. What is the empirical formula for a compound which contains 53.73 % iron and 46.27 % sulfur?
7. What is the empirical formula of a compound if the percentage composition is: aluminum 15.77 %, sulfur 28.11 %, and oxygen 56.12 %?
8. If 8.87 grams of phosphorus react with 11.43 grams of oxygen, what is the empirical formula of the compound formed?
9. Phosgene, a poisonous gas used during World War I, contains 12.1 % C, 16.2 % O, and 71.7% Cl. What is the empirical formula for phosgene?

MOLECULAR FORMULAS NOTES

To find the molecular formula, one more piece of information must be given - the molar mass (also called molecular mass or formula mass).

EX. 1- An organic compound is found to contain 92.25% carbon and 7.75% hydrogen. If the molecular mass is 78, what is the molecular formula?

STEP 1: Find the empirical formula.

C: 92.25 g C | 1 mole C = 7.69 moles C
| 12 g C

H: 7.75 g H | 1 mole H = 7.75 moles H
| 1 g H

7.69 moles C = 1 7.75 moles H = 1 So... empirical formula is CH.
7.69 7.69

STEP 2: Find molar mass of the empirical formula.

C: 1 x 12.0 = 12.0
H: 1 x 1.0 = 1.0 +
MM = 13.0

STEP 3: Find "multiple" number.

MM of molecular formula = multiple # 78 = 6
MM of empirical formula 13

STEP 4: Write molecular formula.

Multiply "multiple" # by all subscripts in the empirical formula.
So... molecular formula is C_6H_6.

PRACTICE - An oxide of nitrogen contains 30.4 % nitrogen and 69.6 % oxygen. If the molar mass of this compound is 92 g/mole, what is the molecular formula?

MOLECULAR FORMULAS WORKSHEET

1. A compound is found to be 40.0 % carbon, 6.7 % hydrogen, and 53.5 % oxygen. Its molecular mass is 60. grams per mole. What is its molecular formula?

2. A compound is 64.9 % carbon, 13.5 % hydrogen, and 21.6 % oxygen. Its molecular mass is 74 grams per mole. What is its molecular formula?

3. A compound is 54.5 % carbon, 9.1 % hydrogen, and 36.4 % oxygen. Its molecular mass is 88 grams per mole. What is its molecular formula?

4. If the molecular mass of an oxide of nitrogen is 108. What is the molecular formula of a compound that contains 4.02 grams of nitrogen and 11.48 grams of oxygen?

5. There are two different oxides of phosphorus. Both oxides can exist in different forms depending on the temperature and pressure. Calculate the empirical and molecular formulas from the following data:
   (A) P: 56.4 %, O: 43.7 %, molecular mass = 220
   (B) P: 43.6 %, O: 56.4 %, molecular mass = 284

6. Nicotine is a compound that contains 74.0 % carbon, 8.7 % hydrogen, and 17.3 % nitrogen. If the molecular mass is 162, what is the molecular formula?

HYDRATES NOTES

Hydrates are compounds with a certain number of water molecules attached to them. Their formulas look the same except that there is a "· # H_2O" after it. Example: $MgSO_4 \cdot 7\ H_2O$

When determining the empirical formula for a hydrate, generally you will be determining the number in front of the H_2O in the formula. In order to determine this number, you will need to find the "mole ratio" between the moles of the compound and moles of water.

EXAMPLE:
A hydrated sample of sodium carbonate ($Na_2CO_3 \cdot$ # H_2O) has a mass of 29.00 grams. The sample is then heated and all water is removed. The anhydrous salt that remains has a mass of 10.75 grams. What is the empirical formula for the hydrated sodium carbonate?

STEP 1: Find moles of sodium carbonate.

$$\frac{10.75\ g\ Na_2CO_3}{|\ 106\ g\ Na_2CO_3} \times \frac{1\ mole\ Na_2CO_3}{} = 0.1014\ moles\ Na_2CO_3$$

Na: 2 x 23.0 = 46.0
C: 1 x 12.0 = 12.0
O: 3 x 16.0 = 48.0 +
106

STEP 2: Find moles of water.
First, find grams of water… hydrated sample = 29.00 grams
anhydrous sample = 10.75 grams
mass of water = **18.25 grams**

$$\frac{18.25\ g\ H_2O}{|\ 18\ g\ H_2O} \times \frac{1\ mole\ H_2O}{} = 1.014\ moles\ H_2O$$

STEP 4: Find mole ratio of water to sodium carbonate.

$$\frac{1.014\ moles}{0.1014\ moles} = 10$$

So… empirical formula for this hydrate is **$Na_2CO_3 \cdot 10\ H_2O$**

COMPOSITION OF HYDRATES WORKSHEET

1. A 2.5 gram sample of a hydrate of $Ca(NO_3)_2$ was heated, and only 1.7 grams of the anhydrous salt remained. What percentage of water was in the hydrate?

2. Strontium hydroxide is isolated as a hydrate, which means that a certain number of water molecules are included in the solid. When 6.85 grams of the hydrate are dried in an oven, 3.13 grams of anhydrous $Sr(OH)_2$ are formed. What is the empirical formula for this hydrate?

3. A 5.0 gram sample of $Cu(NO_3)_2 \cdot n\ H_2O$ is heated, and 3.9 gram sample of the anhydrous salt remains. What is the value of n?

*4. A hydrated sodium salt containing 39.7 % water is analyzed as follows: Na 16.9 %, C 17.7 %, H 6.67 %, and O 58.8 %. What is the empirical formula of this salt?

ANSWERS TO SELECT WORKSHEETS:

PERCENT COMPOSITION WORKSHEET

1. K = 24.7% Mn = 34.7% O = 40.5%
2. H = 2.74% Cl = 97.3%
3. Mg = 16.4% N = 18.9% O = 64.7%
4. N = 28.2% H = 8.05% P = 20.8% O = 43.0%
5. Al = 15.8% S = 28.1% O = 56.1%
6. 29.4 g 7. 17.5 g 8. 109 g

EMPIRICAL FORMULAS WORKSHEET

1. Cu_2O 2. $CHCl_3$ 3. $CrCl_2$ 4. KNO_3 5. Na_2SO_3 6. Fe_2S_3
7. $Al_2S_3O_{12}$ 8. P_2O_5 9. $COCl_2$

MOLECULAR FORMULAS WORKSHEET

1. $C_2H_4O_2$ 2. $C_4H_{10}O$ 3. $C_4H_8O_2$ 4. N_2O_5 5. (A) Emp= P_2O_3, Mol= P_4O_6
5. (B) Emp= P_2O_5, Mol= P_4O_{10} 6. C_5H_7N

COMPOSITION OF HYDRATES WORKSHEET

1. 32% 2. $Sr(OH)_2 \cdot 8\ H_2O$ 3. n = 3 *4. $NaC_2H_3O_2 \cdot 3\ H_2O$