AP Chemistry

The Ultimate Chemical Equations Handbook

HOMEWORK

- Do all odd exercises in this book on a separate sheet of paper.
- DO NOT WRITE IN THE BOOK.

Chapter 1

- Symbols and Nomenclature of the elements
- There is interesting info where the elements got their name, but nothing we will cover.

Chapter 2 and 3 Naming Binary Compounds

- First, determine if you have an ionic compound or a covalent compound.
- A **metal and a nonmetal** will form an **ionic** bond.
- Compounds with **Polyatomic ions** form **ionic** bonds.
- **Nonmetals** bonding together or **Nonmetals and a metalloid** form **covalent** bonds.

Covalent bonding is very similar to ionic naming

- You always name the one that is least electronegative first (furthest from fluorine)
- Most electronegative last, and gets the suffix "-ide".

Covalent bonding is very different from ionic naming

- Ionic names ignored the subscript because there was only one possible ratio of elements.
- Covalent gives several possibilities so we have to indicate how many of each atom is present in the name

Prefixes you have to know

prefix	meaning	prefix	meaning
*mono-	1	hex-	6
di-	2	hept-	7
tri-	3	oct-	8
tetr-	4	non-	9
pent-	5	dec-	10

* the first atom named does not get the prefix "mono-", it just keeps its original name!

Examples

- CO
- carbon monoxide
- CO_2
- carbon dioxide
- NI_3
- nitrogen triiodide
- P_4O_6
- tetraphosphorus hexoxide

Continuing

- I_4O_9
- tetriodine nonoxide
- S_2F_{10}
- disulfur decafluoride
- IF_7
- Iodine heptafluoride
- Si_2Cl_6
- disilicon hexachloride

Naming ionic compounds

- For monoatomic anions **only**
- drop the ending and add "-ide"
- so F^-
- fluoride
- Cl^-, O^{2-}, C^{4-}
- chloride, oxide and carbide

Continuing…

- cations keep the name of the element.
- When naming compounds always name the positive (cation) first and the negative (anion) last.
- so mixing ions of chlorine and sodium give you
- sodium chloride
- (positive) (negative)

Determining the formula of ions

- Ionic compounds are neutral
- You need to find the lowest number of each ion to make it neutral
- for example:
- Na^+ and O^{2-}
- 2 sodium for every one oxygen
- Na_2O

More examples

- Al^{3+} and O^{2-}
- Al_2O_3
- K^+ and Cl^-
- KCl
- the subscripts don't effect the name if there is only one possibility
- still (cation)(anion)
- Aluminum oxide
- Potassium chloride

Several atoms can form a couple of different ions.

- All of these are metals that are not in group 1, 2 or aluminum.
- for example iron can form Fe^{2+} or Fe^{3+}
- These are said as iron (II) and iron (III)
- Cu^+ and Cu^{2+} is Copper (I) and Copper (II)

Figuring out charge on these elements

- If the ion is named, the charge is in the name.
- If you have the formula, use the charges of the other ions present to determine the charge.
- Remember
- Alkali will **always** be +1
- Alkaline Earth +2, Halogens -1, oxygen group -2
- Aluminum will always be +3

Examples

- Copper (II) chloride
- $CuCl_2$
- Cobalt (III) sulfide
- Co_2S_3
- NiF_2
- Nickel (II) fluoride
- TiS_2
- titanium (IV) sulfide

Polyatomic ions

- Polyatomic Ions- many atoms in one ion
- You can NOT break these apart in this section.
- the "ide" suffix only applies to monoatomic anions

Common polyatomic ions

Ammonium	NH_4^+	Perchlorate	ClO_4^-	Sulfate	SO_4^{2-}
Acetate	$CH_3CO_2^-$	Chlorate	ClO_3^-	Sulfite	SO_3^{2-}
Nitrate	NO_3^-	Chlorite	ClO_2^-	Carbonate	CO_3^{2-}
Nitrite	NO_2^-	Hypochlorite	ClO^-	Dichromate	$Cr_2O_7^{2-}$
Cyanide	CN^-	Iodate	IO_3^-	Chromate	CrO_4^{2-}
Thiocyanate	SCN^-	Bromate	BrO_3^-	Oxalate	$C_2O_4^{2-}$
Hydrogen carbonate	HCO_3^-	Hydroxide	OH^-	Silicate	SiO_3^{2-}
Hydrogen sulfate	HSO_4^-	Permanganate	MnO_4^-	Phosphate	PO_4^{3-}
Hydrogen sulfite	HSO_3^-	Thiosulfate	$S_2O_3^{2-}$	Arsenate	AsO_4^{3-}

YOU WILL HAVE TO MEMORIZE THESE!

- This is one of the big differences from last year.
- We will have a quiz just like the elements quiz last year over these!
- For the summer assignment test you must have the following memorized
- Sulfate, carbonate, chlorate, chlorite, nitrate, hydroxide and ammonium.

Determining the formula of ions

- Ionic compounds are neutral
- Remember– don't break a polyatomic ion apart
- for example: Ammonium carbonate
- NH_4^+ and CO_3^{2-}
- $(NH_4)_2CO_3$

Chapter 4 acids and salts

- Oxyanions- negative ions containing oxygen.
- These have the suffix "-ate" or "-ite"
- "-ate" means it has more oxygen atoms bonded, "-ite" has less
- For example
- SO_4^{2-} sulfate
- SO_3^{2-} sulfite

Oxyanions

- Oxyanions may contain the prefix "hypo-", less than, or "per-", more than.
- For example
- ClO_4^- Perchlorate
- ClO_3^- Chlorate
- ClO_2^- Chlorite
- ClO^- Hypochlorite

Acids

- Certain compounds produce H^+ ions in water, these are called acids.
- You can recognize them because the neutral compound starts with "H".
- For example HCl, H_2SO_4, and HNO_3.
- Don't confuse a polyatomic ion with a neutral compound.
- HCO_3^- is hydrogen carbonate (or bicarbonate), not an acid.

Naming acids

- Does it contain oxygen?
- If it does **not**, it gets the prefix "hydro-" and the suffix "-ic acid"
- HCl
- Hydrochloric acid
- HF
- Hydroflouric acid
- HCN
- Hydrocyanic acid

Naming Acids

- If it does contain an oxyanion, then replace the ending.
- If the ending was "–ate", add "-ic acid"
- If the ending was "–ite", add "-ous acid"
- H_2SO_4 Sulfuric Acid
- H_2SO_3 Sulfurous Acid

Examples

- HNO_3
- Nitric acid
- HI
- Hydroiodic acid
- H_3AsO_3
- Arsenous acid

Chapter 5 Complex ions

- Complex ion- transition metal ion with attached ligands
- $Fe(CN)_6^{3-}$
- $Ni(SCN)_4^{2-}$
- Glance over this chapter. Skip the problems, most this material is out of the test.

Ch 6 Organic

- Alkanes- straight chain hydrocarbons with all single bonds
- Alkenes- hydrocarbons with a double bond
- Alkynes- hydrocarbons with a triple bond
- Cyclic hydrocarbons- rings

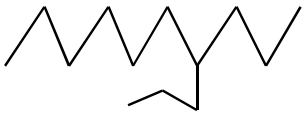
Root words

	# of C atoms		# of C atoms
Meth	1	Hex	6
Eth	2	Hept	7
Prop	3	Oct	8
But	4	Non	9
Pent	5	Dec	10

Name this molecule

And give its molecular formula

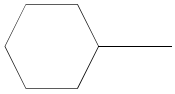
4 ethyl octane
$C_{10}H_{22}$



4 propyl decane

$C_{13}H_{28}$

Name and give the formula



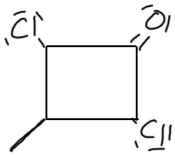
Methyl cyclohexane
C_7H_{14}

Functional groups

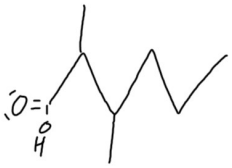
- halogenated

*R means any carbon chain

Alcohols	Carboxylic Acids
R-OH -ol	R-C=O HO -oic acid
Aldehydes	**Ketones**
at the edge R=O -al	NOT at the edge R-C-R O -one

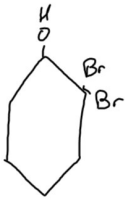


2,4 dichloro 3 methyl
1 cyclobutanone
$C_5H_6Cl_2O$



2, 3 dimethyl
hexanoic acid
$C_7H_{15}COOH$

3 bromo 2, 2 diethyl 1 hexanal
$C_{10}H_{19}BrO$



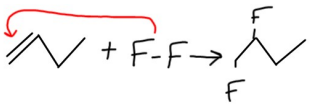
2, 2 dibromo 1 cyclohexanol
$C_6H_9Br_2OH$

Predicting organic reactions

- **Addition reactions** occur by adding halogens or hydrogen to alkene or alkynes.
- In the reaction, the new molecule takes the place of the double or triple bond.
- $Cl_2 + CH_3\text{-}CH{=}CH_2 \rightarrow CH_3\text{-}CClH\text{-}CClH_2$

example

- 1- butene is reacted with fluorine



- $C_4H_8 + F_2 \rightarrow C_4H_8F_2$

Predicting organic reactions

- **Substitution reactions** occur by adding halogens to an alkane.
- In the reaction, the new molecule takes the place of a hydrogen.

- $Cl_2 + CH_3\text{-}CH_3 \rightarrow CH_3\text{-}CClH_2 + HCl$
- $Cl_2 + C_2H_6 \rightarrow C_2ClH_5 + HCl$

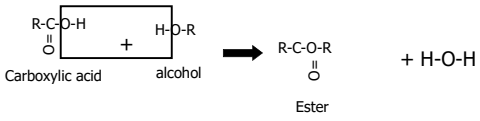
Predicting organic reactions

- **Combustion reactions** occur when an organic compound is burned in oxygen.
- The products of a complete combustion are water vapor and carbon dioxide.

- $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ H_2O + 6\ CO_2$

Predicting organic reactions

- Esterification reactions
- Made by reacting carboxylic acids with alcohols.



Examples

- Fluorine is added to 2 propene
- Ethanol is burned in oxygen
- Chlorine is added to propane
- Ethanoic acid is reacted with 1-butanol