

AP and IB Summer Assignments

AP and IB Chemistry are difficult courses. They are college level classes. It is not all about memorization; however, having the summer assignment items memorized is essential for success in learning the concepts covered in the course. Make flash cards, have your friends and family quiz you, take the lists with you on vacation, or do whatever it takes to get this information firmly planted in your head. **Do not** wait until the night before school begins. The first day test will cover eleven areas of memorization.

1. Determining Oxidation Numbers
2. The Solubility Rules
3. Rules for Naming Binary Ionic Compounds
4. Rules for Naming Binary Covalent Compounds
5. Rules for Naming Acids
6. Strong Acids and Strong Bases
7. Colors of Common Ions in Aqueous Solution
8. Symbols and Names of the Elements
9. Variable Valences for Transition Metals
10. Polyatomic Ions (including name, symbol, and charge)
11. Basics Types of Chemical Reactions

IB will, also, need to read (ie understand) Chapters 1 - 3 of the Student Guide to Internal Assessment - Chemistry. Make sure to get a copy before you leave school. E-mail me if you did not get one - kimeverett@comcast.net.

Rules for Determining Oxidation Numbers

Oxidation Number: a number assigned to an atom in a molecular compound or molecular ion that indicates the general distribution of electrons among the bonded atoms.

1. The oxidation number of any uncombined element is zero.
2. The oxidation number of a monatomic ion equals the charge on the ion. example: Mg^{2+} has the oxidation number of +2.
3. The more electronegative element in a binary compound is assigned the number equal to the charge it would have if it were an ion.
4. The oxidation number of fluorine in a compound is always -1.
5. Oxygen has an oxidation number of -2 except peroxides where the oxidation number is -1, and in compound with fluorine where it can be +2.
6. The oxidation state of hydrogen in most of its compounds is +1 unless it combines with a metal, in which cases it is -1.
7. In compounds, the elements of groups 1 and 2 as well as aluminum have oxidation numbers of +1, +2, and +3, respectively.
8. The sum of the oxidation numbers of all atoms in a neutral compound is zero.
9. The sum of the oxidation numbers of all atoms in a polyatomic ion equals the charge of the ion.

example: The oxidation number of sulfur in sulfuric acid (H_2SO_4) can be calculated from the rules above. Because this is a polyatomic species, the individual oxidation numbers must sum to equal the overall charge, which in this case is zero. Hydrogen has an oxidation number of +1, so the sum of the oxidation numbers of $\text{H}_2 = +2$. Oxygen has an oxidation number of -2, so the sum of oxidation numbers of $\text{O}_4 = -8$. Since the overall sum must equal zero, the oxidation state of sulfur can be calculated as +6 ($8-2$).

Solubility Rules

1. All compounds containing alkali metals cations and the ammonium ion are soluble.
2. All compounds containing NO_3^- , ClO_4^- , ClO_3^- , and $\text{C}_2\text{H}_3\text{O}_2^-$ anions are soluble.
3. All chlorides, bromides, and iodides are soluble except those containing Ag^+ , Pb^{2+} , or Hg_2^{2+} .
4. All sulfates are soluble except those containing Hg_2^{2+} , Pb^{2+} , Sr^{2+} , Ca^{2+} , or Ba^{2+} .
5. All hydroxides are insoluble except compounds of the alkali metals, Ca^{2+} , Sr^{2+} , and Ba^{2+} .
6. All compounds containing PO_4^{3-} , S^{2-} , CO_3^{2-} , and SO_3^{2-} ions are insoluble except those that also contain alkali metals or NH_4^+ .

Rules for Naming Binary Ionic Compounds

1. Ionic compounds are composed of a metal and a nonmetal.
2. Balance charges (charges should equal zero). Use 'crisscross' method to balance charges.
3. Cation is always written first (in name and formula).
4. Change the ending of the anion to '-ide.'

Rules for Naming Binary Covalent Compounds

1. Covalent compounds are composed of nonmetals.
2. The first element in the formula is named first, using the full element name.
3. The second element is named using the suffix '-ide.'
4. Prefixes are used to denote the numbers of atoms present. See table below for prefixes.
5. The prefix 'mono-' is only used to name the second element. example: CO is carbon monoxide; not monocarbon monoxide.

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

Rules for Naming an Acid

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

example: -ide becomes hydro _____ic acid

Cl^- is the Chloride ion so HCl = hydrochloric acid

2. When the anion name ends in '-ite,' the acid name is the stem of the anion with the suffix '-ous,' followed by the word acid.

-ite become _____ous acid

ClO_2^- is the chlorite ion so HClO_2 = Chlorous acid

3. When the anion name ends in '-ate,' the acid name is the stem of the anion with the suffix '-ic,' followed by the word acid.

-ate becomes _____ic acid

ClO_3^- is the chlorate ion so HClO_3 = chloric acid

Strong/Weak Acids and Bases

Strong Acids	
Hydrogen halides	HCl , HBr , HI (stronger down the group)
Oxyacids of Hydrogen	HClO_3 , HClO_4 , HBrO_3 , HBrO_4 , HIO_3 , HIO_4
Sulfuric Acid	H_2SO_4
Nitric Acid	HNO_3

Strong Bases	
Sodium hydroxide (Group 1 & 2 hydroxides; NOT Be or Mg)	NaOH
Potassium hydroxide	KOH
Cesium hydroxide	CsOH
Calcium hydroxide	$\text{Ca}(\text{OH})_2$

Weak Acids	
Formic Acid	HCOOH
Acetic Acid	CH_3COOH
Trichloroacetic Acid	CCl_3COOH
Hydrofluoric Acid	HF
Hydrocyanic Acid	HCN
Hydrogen sulfide or hydrosulfuric	H_2S
Water	H_2O

Weak Bases	
Ammonia	NH_3
trimethyl ammonia	$\text{N}(\text{CH}_3)_3$
Ammonia hydroxide	NH_4OH
Water	H_2O

Colors of Common Ions in Aqueous Solution

Ion	Color		Ion	Color
Fe^{2+} & Fe^{3+}	various colors		Cu^{2+}	blue to green
Cr^{2+}	blue		Cr^{3+}	green to violet
Mn^{2+}	faint pink		Ni^{2+}	green
Co^{2+}	pink		MnO_4^-	dark purple
CrO_4^{2-}	yellow		$\text{Cr}_2\text{O}_7^{2-}$	orange

Variable Valences of Transition Metals

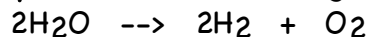
Name	Symbol	Charge	Stock Name
Chromium	Cr	+2	Chromium(II)
		+3	Chromium(III)
Manganese	Mn	+2	Manganese(II)
		+3	Manganese(III)
Iron	Fe	+2	Iron(II)
		+3	Iron(III)
Cobalt	Co	+2	Cobalt(II)
		+3	Cobalt(III)
Copper	Cu	+1	Copper(I)
		+2	Copper(II)
Lead	Pb	+2	Lead(II)
		+4	Lead(IV)
Mercury	Hg	+1	Mercury(I)
		+2	Mercury(II)
Tin	Sn	+2	Tin(II)
		+4	Tin(IV)
Gold	Au	+1	Gold(I)
		+3	Gold(III)
Silver	Ag	+1	Silver
		+2 (rarely)	Silver(II)
Bismuth	Bi	+3	Bismuth(III)
		+5	Bismuth(V)
Antimony	Sb	+3	Antimony(III)
		+5	Antimony(V)
Cadmium	Cd	+2	Cadmium
Zinc	Zn	+2	Zinc

Polyatomic Ions

Name	Symbol	Charge
ammonium	NH ₄	+1
acetate	C ₂ H ₃ O ₂	-1
bromate	BrO ₃	-1
chlorate	ClO ₃	-1
chlorite	ClO ₂	-1
cyanide	CN	-1
dihydrogen phosphate	H ₂ PO ₄	-1
hypochlorite	ClO	-1
hydrogen carbonate (bicarbonate)	HCO ₃	-1
hydrogen sulfate (bisulfate)	HSO ₄	-1
hydrogen sulfite (bisulfite)	HSO ₃	-1
hydroxide	OH	-1
iodate	IO ₃	-1
nitrate	NO ₃	-1
nitrite	NO ₂	-1
perchlorate	ClO ₄	-1
permanganate	MnO ₄	-1
thiocyanate	SCN	-1
carbonate	CO ₃	-2
chromate	CrO ₄	-2
dichromate	Cr ₂ O ₇	-2
oxalate	C ₂ O ₄	-2
peroxide	O ₂	-2
selenate	SeO ₄	-2
silicate	SiO ₃	-2
sulfate	SO ₄	-2
sulfite	SO ₃	-2
phosphate	PO ₄	-3
phosphite	PO ₃	-3

Five Basic Types of Chemical Reactions

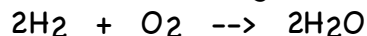
Decomposition: something breaks down.



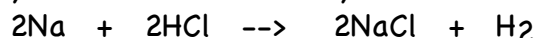
Three types of decompositions:

1. metal carbonate (CO_3) \rightarrow metal oxide + CO_2
2. metal chlorate (ClO_3) \rightarrow metal chloride + O_2
3. metal hydroxide (OH) \rightarrow metal oxide + H_2O

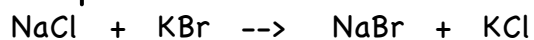
Synthesis: something is made.



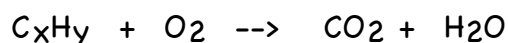
Single replacement: one reactant replaces half of the other reactant - must use the activity series and solubility rules.



Double replacement: the two reactants switch partners - must use solubility rules



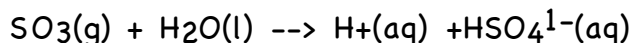
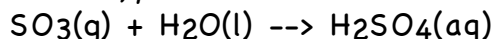
Combustion: a hydrocarbon reacts with oxygen to form CO_2 and H_2O .



Other Types of Reactions and Equations

1. nonmetal oxide + water \rightarrow acid

(NOTE: this type of reaction will REVERSE if heat is applied)

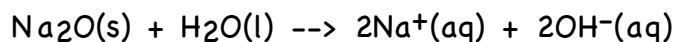
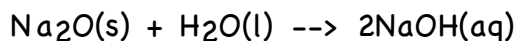


(sulfuric acid = strong; show dissociated; only 1st ionization is strong)

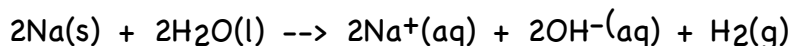
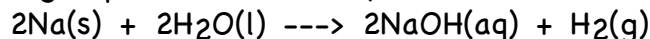


(carbonic acid = weak; show undissociated)

2. metal oxide + water \rightarrow base



3. Group 1 or 2 metal (or group 1 or 2 metal hydride) + water \rightarrow hydrogen gas + base



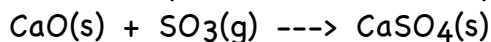
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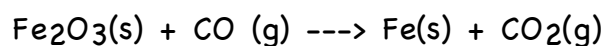
4. salt containing oxygen \rightarrow metal oxide + nonmetal oxide



5. metal oxide + nonmetal oxide \rightarrow salt (the REVERSE of #4)



6. metal oxide + reducing gas (H₂, CO) ----> metal + nonmetal oxide (CO₂, H₂O)



7. acid + metal hydrogen carbonate or metal carbonate --> salt + water + carbon dioxide



or

