

PREDICTING REACTIONS AP STYLE

You will write a net ionic equation given a description of the reactants. One point is awarded for writing the correct reactants and two points for writing the correct products. Remember to write reactants and products in net ionic form. You do not need to balance the equation. In all cases a reaction does occur.

KNOW:

1. Nomenclature
2. Solubility rules
3. Which elements are diatomic

A. Double displacement.



Precipitation → forming an insoluble product



Neutralization → acid + base → salt + water



Gas forming → carbonic acid in solution forms water and carbon dioxide and sulfurous acid will decompose into water and sulfur dioxide



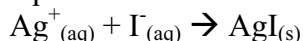
If a nonelectrolyte is formed from a double displacement reaction a reaction occurs. Phosphorus halides react with water to produce an acid of phosphorus (phosphorous acid or phosphoric acid) and a binary acid containing a halogen. Group I&II nitrides react with water to produce the metallic hydroxide and ammonia



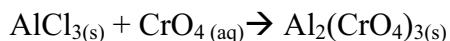
Metallic carbides will react with water to form metallic hydroxide and C_2H_2

Examples:

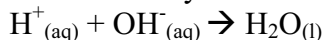
aqueous solutions of silver nitrate and sodium iodide are mixed



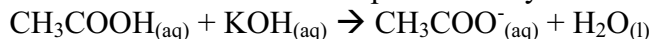
solid aluminum chloride is added to an aqueous solution of potassium chromate



solutions of hydrochloric acid and sodium hydroxide are mixed



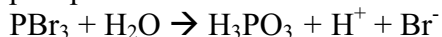
acetic acid reacts with solid potassium hydroxide



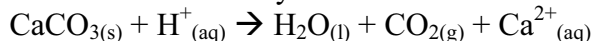
hydrofluoric acid reacts with solid silicon dioxide.



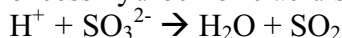
phosphorus tribromide is added to water



calcium carbonate crystals are added to a solution of hydrochloric acid



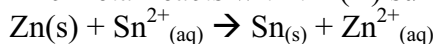
excess hydrochloric acid solution is added to a solution of potassium sulfite.



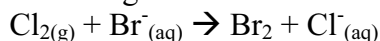
B. Single displacement may also be redox replacement: \rightarrow a more reactive element can displace a less reactive element with similar properties in a compound. (metals displace metals and nonmetals displace nonmetals)

Examples:

zinc metal reacts with tin (II) sulfate solution



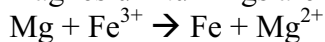
chlorine gas reacts with sodium bromide solution



potassium metal reacts with water



magnesium turnings are added to a solution of iron(III) chloride



C. Combination or synthesis \rightarrow two reactants result in a single product



Metal oxide + water \rightarrow metallic hydroxide (base)



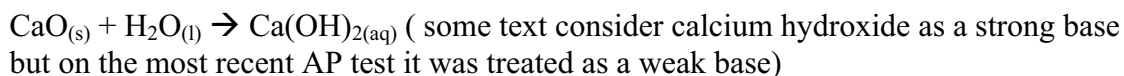
Nonmetal oxide + water \rightarrow nonbinary acid



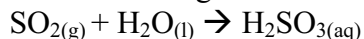
Metal oxide + nonmetal oxide \rightarrow nonbinary salt

Examples :

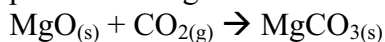
solid calcium oxide is added to water



sulfur dioxide gas is bubbled through water



powdered magnesium oxide is added to a container of carbon dioxide

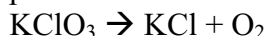


D. Decomposition → one reactant becomes several products**Metallic hydroxide → metal oxide + water****Nonbinary acid → nonmetal oxide + water****Nonbinary salt → metal oxide + nonmetal oxide****Metallic chlorates → metallic chlorides + oxygen****Electrolysis decompose compound into elements (water in dilute acids or solutions of dilute acids)****Hydrogen peroxide → water + oxygen****Metallic carbonates → metal oxides + carbon dioxide****Ammonium carbonate → ammonia, water and carbon dioxide.****Examples:**

a current of electricity is passed through water



potassium chlorate is heated



hydrogen peroxide is catalytically decomposed



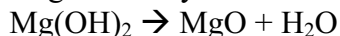
calcium carbonate is heated



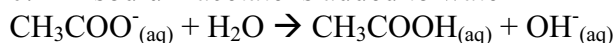
sulfurous acid decomposes



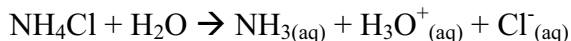
magnesium hydroxide decomposes

**E. Hydrolysis → compound reacting with water.****Watch for soluble salts that contain anions of weak acid (the anion is a conjugate base) and cations of weak bases (the cation is a conjugate acids).****Examples:**

0.1 M sodium acetate is added to water



solid ammonium chloride is added to water



F. Reactions of coordinate compounds and complex ions Remember ligands are bonded (coordinate covalent) to a central atom that is usually a transitional metal ion. The most frequently occurring ligands are hydroxide and ammonia. Review coordinate compounds nomenclature. The number of ligands attached to the central ion is often twice the oxidation number of the central metal ion.



Complex formation by adding excess source of ligand to transitional metal of highly charged metal ion such as Al^{3+}

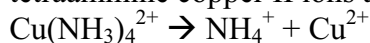
Keywords such as "excess" and "concentrated" of compounds containing common ligands indicates formation of a complex ions. $\text{AgNO}_3 + \text{HCl}$ forms the white precipitate, AgCl , but with excess, concentrated HCl , the complex ion, AgCl_2^- , will form.



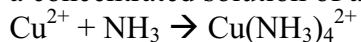
Breakup of complex by adding an acid \rightarrow metal ion and the species formed when hydrogen from the acid reacts with the ligand

Examples:

tetraammine copper II ions are reacted with nitric acid



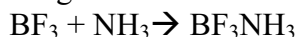
a concentrated solution of ammonia is added to a solution of copper(II) chloride.



G. Lewis acid base reactions \rightarrow formation of coordinate covalent bond

Example:

the gases boron trifluoride and ammonia are mixed



H. redox \rightarrow change in oxidation state \rightarrow a reaction between an oxidizer and a reducer.

Recognized:



Familiarization with important oxidizers and reducers



"added acid" or "acidified"



an oxidizer reacts with a reducer of the same element to produce the element at intermediate oxidation state

 **When the hydrides of an alkali metal (Family 1), Ca, Ba, or Sr dissolve in water, hydroxides will form and H₂ gas is released.**

 **OXIDIZERS:**

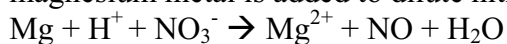
MnO ₄ ⁻ in acid	Mn ²⁺
MnO ₂ in acid	Mn ²⁺
MnO ₄ ⁻ in neutral or basic solution	MnO ₂
Cr ₂ O ₇ ²⁻ in acid	Cr ³⁺
HNO ₃ concentrated	NO ₂
HNO ₃ dilute	NO
H ₂ SO ₄ , hot, concentrated	SO ₂
Metal ous ions	Metal ous ions
Halogens diatomic	Halide ions
Na ₂ O ₂	NaOH
HClO ₄	Cl ⁻
H ₂ O ₂	H ₂ O

 **REDUCERS:**

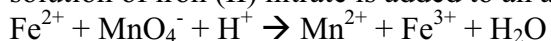
Halide ions	Halogens
Metal element	Metal ion
Sulfite	Sulfate
Nitrite	Nitrate
Halogen element in dilute basic solution	Hypohalite ion an halide ion
Halogen element in concentrated basic solution	Halite ion
Metal ous ion	Metallic ion
H ₂ O ₂	O ₂
C ₂ O ₄ ²⁻	CO ₂

Examples:

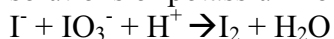
magnesium metal is added to dilute nitric acid



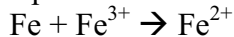
solution of iron (II) nitrate is added to an acidified solution of potassium permanganate



solutions of potassium iodide, potassium iodate and dilute sulfuric acid are mixed



a piece of iron is added to a solution of iron (III) sulfate



solid lithium hydride is placed in water



I. Combustion → results in forming the oxide of the elements of the compound



Hydrocarbons or alcohols combine with oxygen to form carbon dioxide and water.



Ammonia combines with limited oxygen to produce NO and water and with excess oxygen to produce NO₂ and water.



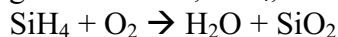
Nonmetallic hydrides combine with oxygen to form oxides and water.



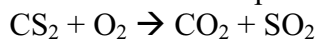
Nonmetallic sulfides combine with oxygen to form oxides and sulfur dioxide.

Examples:

gaseous silane, SiH₄, is burned in oxygen.



carbon disulfide vapor is burned in excess oxygen.



ethanol is burned completely in air.

