Decomposition Reactions

Metal Carbonates

when metal carbonates decompose they form a metal oxide and carbon dioxide gas.

eg. when solid green copper carbonate is heated, a black solid and a colourless gas is formed. The gas turns limewater cloudy when bubbled through it.

copper carbonate --> copper oxide + carbon dioxide

an exception of this rule is silver carbonate, which decomposes to form silver metal, carbon dioxide, and oxygen.

Metal Hydroxides

when metal hydroxides decompose they form a metal oxide and water.

eg. when solid white calcium hydroxide is heated, a white solid and a colourless liquid is formed. The liquid turns blue cobolt chloride paper pink.

calcium hydroxide --> calcium oxide + water

Metal Hydrogen Carbonates (bicarbonates)

when metal hydrogen carbonates decompose they form a metal carbonate, carbon dioxide, and water.

eg. sodium bicarbonate --> sodium carbonate + carbon dioxide + water

Catalytic Decomposition

a catalyst reduces the amount of energy needed for a reaction to proceed. They allow reactions to take place at room temperature that would otherwise require higher temperatures.

Hydrogen peroxide: the decomposition can be sped up by the catalyst manganese dioxide (MnO_2).

Combination/Synthesis Reactions

Chemical reactions where the atoms of one element react with the atoms of another element to form a single compound.

element **A** + element **B** --> element **AB**

Combination Reactions with Oxygen

-sometimes called oxidation reactions

-when heat/light is produced it is also known as combustion/burning

-the product is more stable than the reactants

-can have a unique flame colour (see important observations)

Ionic Compounds

when metal elements combine with non-metal elements.

-valence electrons are transferred from the metal to the non-metal

-the metal forms a positive ion and the non-metal forms a negative ion

-the ions are held together by electrostatic forces of attraction (positive-negative)

Covalent Compounds

when non-metals combine with other non-metals.

-bonding electrons are shared so that each atom has a stable full valence electron shell

Definitions

Protons	positive charge, large mass, in the atom nucleus, top left number
Neutrons	neutral charge, large mass, in the atom nucleus, subtract the number of protons from the bottom right number
Electrons	negative charge, very tiny mass, in the outer shells, top left number
Anion	negatively charged ion
Cation	positively charged ion

The number of protons deciphers the atom. The number of neutrons can change to create **isotropes**.

When forming equations, always put the cation first eg. Na + Cl --> NaCl not ClNa

Chemical Reactions

'During a chemical reaction matter cannot be created nor destroyed.'

This is the **law of conservation of mass**.

This means that the reactants and products shown in a chemical equation must balance.

Eg. $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

In this equation, the 4 is a **coefficient**. These are whole numbers that multiply the following atom/molecule.

In this equation, the 2 is a **subscript**. These are whole numbers that represent the number of atoms/molecules immediately proceeding it.

By **liviabrookes**

cheatography.com/liviabrookes/

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Precipitation Reactions

soluble means dissolvable

-some ionic salts will readily dissolve in water- these are soluble

-when they dissolve the ions dissociate (break apart into their + and - ions)

-other ionic salts will only sparingly dissolve in water- these are considered insoluble

AB + CD --> AD + BC

-a precipitate will only form if one of the products formed is insoluble

-you will observe the solution becoming cloudy and typically white solids will form

eg. lead nitrate + sodium carbonate --> lead carbonate + sodium nitrate

colourless solution of lead nitrate mixed with colourless solution of sodium carbonate forms white precipitate of lead carbonate in a colourless solution of sodium nitrate.

two soluble solutions were mixed together which allowed ions to exchange, forming the insoluble lead carbonation as a precipitate.

lead carbonate is insoluble because lead ions and carbonate ions are more attracted to each other than they are to water.

Important Observations

Metals	silvery grey except copper which is pinky orange. Copper metal formed in a displacement reaction is reddy-brown.
Gas	oxygen, hydrogen, and carbon dioxide are all colour-less.
Carbonates	white solids except copper carbonate which is a green solid and silver carbonate which is a yellow solid.
Hydroxides	white solids except iron (II) hydroxide which is a green solid, iron (III) hydroxide which is an orange/red solid, and copper hydroxide which is a blue solid.

Hydrogen peroxide is a colourless liquid.

Manganese dioxide is a black solid which catalyses the decomposition of hydrogen peroxide into water and oxygen gas.

Combination Reaction Observations

Magnesium burns with a bright light to form a grey-white ash of MgO.

Sulfur; yellow non-metal- burns with a blue flame to form a colourless gas with a suffocating, choking odour, SO_2.

Carbon; black non-metal- burns with a yellowy flame to make a colourless gas CO_2.

Important Observations (cont)

Iron + Sulfur react when heated- glows and forms a black non-magnetic solid of FeS.

Hydrogen; colourless gas + O_2 will explode with a small flame. After heating the solid glows a red-hot and a black solid is formed.

Tests for Products Observations

Hydrogen	gas burns with a squeaky pop
Carbon Dioxide	gas turns colourless limewater cloudy/milky
Oxygen	gas relights a glowing splint
Water	turns blue cobolt chloride paper pink

Displacement Reactions

when a single atom 'displaces' another metal ion from within a compound.

More reactive metals on the activity series replace a less reactive metal ion from the compound. Ag is the least reactive metal.

metal **A** +compound **BC** --> compound **AC** +element **B**

eg. $Mg+FeSO_4 \rightarrow Fe+MgSO_4$ because magnesium is more reactive than iron

To form an **ionic equation**, we get rid of the negative ion (spectator ion) because it is not involved in the reaction.

eg. to form Mg + Fe2+ --> Fe + Mg2+*

*the 2+ is written as a little number top right of the element.

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