CHEMICAL → REACTIONS

DRUSKY (UNIT 4)

Rxn = When a chemical change occurs = a chemical rxn (permanent change) has taken place. We symbolically express it as a chemical equation.

- Indicators of Chemical Δ: Change in state, color, temperature & evolution of a gas.
- Physical state of Matter: (S) solid (l) liquid (g) gas (aq) aqueous

Coefficients → $2H_2 + O_2 \longrightarrow 2H_2O$ ← Subscript; $2H_2O$ = Products; H_2 & O_2 = Reactants; (aq) = Dissolved in H_2O solution

TYPES OF RXNS

① COMBUSTION:

Involve oxygen reacting with another element or compound to produce energy in the form of heat & light. Always exothermic. Complete combustion requires plentiful supply of oxygen. When O_2 is limited, incomplete combustion occurs & different products are formed. When complete combustion occurs, products always include carbon dioxide & water.

EX:
- Fireplace
- Gas Engines
- Electricity
- Cellular Respiration

Ex: $CH_4 + 2O_2 \longrightarrow 2H_2O + CO_2$ $(AB + O_2 \rightarrow H_2O + (O_2))$

② SYNTHESIS:

AKA Addition reactions or Direct Combination Reactions. Involve 2 or more reactants combining to form a single, more complex product.

EX:
- $H_2 + O_2 \rightarrow$ WATER
- $Fe + O_2 \rightarrow$ RUST
- Photosynthesis
- $Na + Cl \rightarrow$ SALT

Ex: $C_2H_4 + Br_2 \longrightarrow C_2H_4Br_2$ $(AB + C \rightarrow ABC)$
Ethene, Bromine, Dibromoethene

$Fe + S \longrightarrow FeS$ $(A + B \longrightarrow AB)$
Iron, Sulfur, Iron Sulfide

③ DECOMPOSITION:

Involves breaking down of a compound into elements or simpler compounds. Can be thought of as the opposite of synthesis. Can occur spontaneously or be initiated by heat, a catalyst, or electrolysis.

EX:
- Soda goes flat
- Digestion of Food
- $NH_4NO_3 \rightarrow H_2O + N_2O$ (Laughing Gas)

Ex: $2H_2O_2 \longrightarrow 2H_2O + O_2$ $(AB \longrightarrow A + B)$
Hydrogen Peroxide, Water, Oxygen

④ Double Replacement:

AKA Metathesis

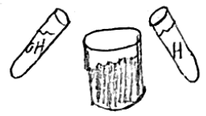
$\overset{+}{A}\overset{-}{B} + \overset{+}{C}\overset{-}{D} \longrightarrow CB + AD$

(Metal ions switch partners)

Precipitation: Aqueous compounds react to form an insoluble solid called a precipitate. It can be suspended, or fall to the bottom of the reaction vessel. Solubility rules for ionic compounds can predict whether or not a precipitate will form.

Ex: $2NaOH_{(aq)} + MgCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + Mg(OH)_{2(s)}$

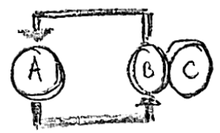
Acid-Base Neutralization: Acid (Starts w/ H) & Base (ends in -OH) react to form a salt (ionic compound). Water is commonly produced as well. Often exothermic (endothermic is possible). Resultant pH is dependent on strength of A & B



Ex: $\overset{\text{(Base)}}{NaOH} + \overset{\text{(Acid)}}{HCl} \longrightarrow \overset{\text{(Salt)}}{NaCl} + H_2O$

⑤ Single Replacement:

$A + BC \longrightarrow B + AC$



Also called "Displacement"; An element or ion moves out of a compound. Usually occurs if the element moving into the compound is more reactive than the element it displaces. Use Activity series of metals to predict.

Ex: $Mg + 2H_2O \longrightarrow Mg(OH)_2 + H_2$

* Reactions must be balanced (# of atoms in reactants = products) to obey Law of Conservation of Matter.

Rules for Balancing
1. Coefficients can be changed
2. NEVER change subscripts
   - This changes the compound

Steps
1) Seperate Rxt & Prod.
2) List the elements
3) Write # of Atoms
4) Change Coefficients

Tips
- 1st → Metals
- 2nd → Polyatomics
- 3rd → Nonmetals
- 4th → H
- 5th → O

OTHERS (Details in later units)

Oxidation Reactions - Other elements "gain" or form bonds w/ oxygen. Atoms of an element lose electrons. Oxidation does not occur without reduction. These are known as redox reactions.

EX: $4Fe + 3O_2 + 2H_2O \longrightarrow 2Fe_2O_3 \cdot H_2O$

Reduction Reactions - Other elements "lose" oxygen atoms. Atoms of an element gain electrons. Does not occur without Oxidation rxns

EX: $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

Hydrolysis - Involves breaking of chemical bonds by adding H_2O to a substance. This can cause both the substance & the water molecule to split into 2 parts

Ex. $H_2SO_4 + H_2O \longrightarrow H_3O^+ + HSO_4^-$

Condensation - Opposite of Hydrolysis

Miscellaneous

Diatomic molecules: N_2 O_2 F_2 Cl_2 Br_2 I_2 H_2

Know naming Rules for Ionic/Covalent/Acids