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ATOMIC ENERGY CENTRAL SCHOOL-KUDANKULAM

Handout –Module-2/4

Subject-Chemistry **Class-X**

Lesson No.- Chapter 1 Chemical Reactions and Equations

Name of the topic – COMBINATION REACTION AND DECOMPOSITION REACTION

TYPES OF REACTIONS

- Chemical reactions involve the breaking and making of bonds between atoms to produce new substances.
- **Different types of chemical reactions are-**
- Combination Reaction
- Decomposition reaction
- Displacement Reaction
- Double displacement Reaction
- Redox Reaction
- Neutralisation Reaction

COMBINATION REACTION

- A **combination reaction** is a reaction where two or more elements or compounds (reactants) combine to form a single compound (product).
- Examples-
- $C + O_2 \rightarrow CO_2$
- $S + O_2 \rightarrow SO_2$

- $H_2 + Cl_2 \rightarrow 2HCl$

Characteristics of combination reaction

- There is no specific number of reactants in combination reaction.
- Combination reactions are usually exothermic (Heat is released).
- Two or more reactants combine to form single product.

  $MgO + CO_2 \rightarrow MgCO_3$

  $Fe + S \rightarrow FeS$

  $Ba + F_2 \rightarrow BaF_2$

  Activity 1.4 NCERT Text
- **Experiment**-Take a small amount of calcium oxide or quick lime (CaO) in a beaker. Slowly add water to this and observe.
- **Observation**-Reaction is vigorous and large amount of heat is released, temperature rises.
- **Inference**-Calcium oxide reacts vigorously with water to produce slaked lime (calcium hydroxide) releasing a large amount of heat. This process is known as slaking of lime. It is a combination reaction
- $CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$

(Quick lime) (Slaked lime)

Chemistry of White Washing

- A solution of slaked lime produced by the reaction in activity 1.4 is used for white washing walls. Calcium hydroxide reacts slowly with the carbon dioxide in air to form a thin layer of calcium carbonate on the walls. Calcium carbonate is formed after two to three days of white washing and gives a shiny finish to the walls. It is interesting to note that the chemical formula for marble is also $CaCO_3$.
- $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

(Calcium hydroxide) (Calcium carbonate)

Exothermic Reaction

- An **exothermic reaction** is a chemical **reaction** that releases energy through light or heat.
- Reactants → Products +Energy
- Calorimeter is the device used to measure the heat released by a chemical reaction.
- It is extremely difficult to measure or even calculate the absolute total of energy in a given chemical system. Therefore, the energy change is measured instead.
- Examples-
- Burning of coal

$C\ (s) + O_2\ (g) \rightarrow CO_2\ (g)$

- Burning of natural gas

$CH_4\ (g) + 2O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O\ (g)$

- We all know that we need energy to stay alive. We get this energy from the food we eat. During digestion, food is broken down into simpler substances. For example, rice, potatoes and bread contain carbohydrates. These carbohydrates are broken down to form glucose. This glucose combines with oxygen in the cells of our body and provides energy. The special name of this reaction is respiration
- $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy

(Glucose)

Decomposition Reaction

- A decomposition reaction can be defined as a type of chemical reaction in which under suitable conditions, one single compound splits into multiple simpler substances.
- Decomposition reactions are **endothermic** reactions.
- Decomposition reactions require energy either in the form of heat, light or electricity for breaking down the reactants.

- Ex-$Ba(OH)_2 + NH_4Cl \rightarrow BaCl_2 + NH_4OH$ (**endothermic)**
- Types of Decomposition Reactions-
- Thermal Decomposition
- Electrolytic Decomposition
- Photolysis
- **Thermal Decomposition-**Single reactant breaks down to give simpler products by heating.

$2MgO \rightarrow 2Mg + O_2$

$CaCO_3 \rightarrow CaO + CO_2$

$2KClO_3 \rightarrow 2KCl + 3O_2$

Activity 1.5 NCERT Text

- **Experiment**-Take about 2 g ferrous sulphate crystals in a dry boiling tube. Note the colour of the ferrous sulphate crystals.Heat the boiling tube over the flame of a burner or spirit lamp.
- **Observation**-Green colour of ferrous sulphate changes to brown

Colourless gas with burning sulphur is released.

- **Inference-** Ferrous sulphate crystals ($FeSO_4. 7H_2O$) lose water when heated and the colour

of the crystals changes. It then decomposes to ferric oxide (Fe_2O_3), sulphur dioxide (SO_2) and sulphur trioxide (SO_3). Ferric oxide is a solid while SO_2 and SO_3 are gases.

$FeSO_4.7H_2O \rightarrow FeSO_4 + 7H_2O$

$2FeSO_4(s) \rightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$

(Ferrous sulphate) (Ferric oxide)

- Decomposition of calcium carbonate to calcium oxide and carbon dioxide on heating is an important decomposition reaction used in various industries. Calcium oxide is called lime or quick lime. It is used in the manufacture of cement.

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

(Limestone) (Quick lime)

Activity 1.6 NCERT TEXT

- **Experiment**-Take about 2 g lead nitrate powder in a boiling tube.Hold the boiling tube with a pair of tongs and heat it over a flame.
- **Observation-** Flickering sound is heard , Brown coloured gas is evolved, yellow residue is obtained
- **Inference-** When lead nitrate is heated brown coloured gas NO2 is evolved. And Lead (II) oxide is formed which is yellow in colour.
- $2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$

(Lead nitrate) (Lead oxide) (Nitrogendioxide) (Oxygen)

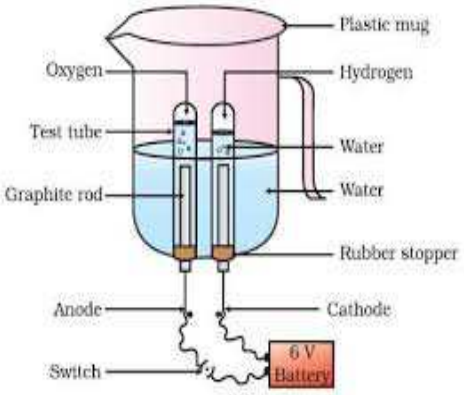
Electrolysis (Decomposition by using Electricity)

- **Electrolysis**, process by which electric current is passed through a substance to effect a chemical change.
- The process is carried out in an **electrolytic** cell,
- Electrolytic cell consist positive (anode) and negative electrode(cathode).
- Positive and negative electrodes held apart and dipped into a solution containing positively and negatively charged ions called electrolyte
- $H_2O \xrightarrow{\text{Electricity}} H_2 + O_2$
- NaCl (molten) $\xrightarrow{\text{Electricity}}$ $Na + \frac{1}{2} Cl_2$

Activity 1.7 NCERT TEXT

- **Experiment-**Take a plastic mug. Drill two holes at its base and fit rubber stoppers in these holes. Insert carbon electrodes in these rubber stoppers as shown in Fig. Connect these electrodes to a 6 volt battery. Fill the mug with water such that the electrodes are immersed. Add a few drops of dilute sulphuric acid to the water .Take two test tubes filled with water and invert them over the two carbon electrodes. Switch on the current and leave the apparatus undisturbed for some time. Once the test tubes are filled with the respective gases, remove them carefully.Test these gases

one by one by bringing a burning candle close to the mouth of the test tubes.



- **Observation**- We observe the formation of bubbles at both the electrodes. These bubbles displace water in the test tubes.
- **Inference**- Hydrogen gas is released at cathode by reduction process

Oxygen gas is released at Anode by the process of oxidation.

$2\ H_2O \xrightarrow{\text{Electrolysis}} 2\ H_2 + O_2$

- Hydrogen released will be two times of oxygen released in the process as water has two moles of hydroen atoms and one mol of oxygen atom in its chemical formula'
- **Note**- Few drops of sulphuric is added in water to enhance the ionisation of water as water is a weak electrolyte. Hence we electrolyse acidulated water to get Hydrogen and oxygen gas at respective electrode.

Photolysis (Decomposition in presence of light)

- **Photolysis**, chemical process by which molecules are broken down into smaller units through the absorption of light.
- Decomposition of ozone to oxygen in presence of UV radiation is an example of photolytic reaction.

$O_3 + \text{Light}(240–310\ \text{nm}) \rightarrow O_2 + O$

Activity 1.8 NCERT TEXT

- **Experiment- Take** 2 grams of silver chloride (White in colour) in a china dish. Place this china dish in sunlight for some time.
- **Observation-** silver chloride turns grey in sunlight
- **Inference-** This is due to the decomposition of silver chloride into silver and chlorine by light.

$2AgCl(s) \xrightarrow{sunlight} 2Ag(s) + Cl_2(g)$

- Silver bromide also behaves in the same way.

$2AgBr(s) \xrightarrow{sunlight} 2Ag(s) + Br_2(g)$

- The above reactions are used in black and white photography.

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