

SUBJECT: - ENERGY & ENVIRONMENT

SEMESTER -1 QUESTION BANK – UNIT 3

UNIT III ALTERNATE SOURCE OF ENERGY & WASTE TO ENERGY CONVERSION

QUE.1). Numerical on Binding Energy. (3M)

Question: Calculate the binding energy per nucleon of a nucleus with mass number 56 and binding energy of 491 MeV.

Solution: Total binding energy = binding energy per nucleon x number of nucleons

mass number = number of protons + number of neutrons

56 = number of protons + number of neutrons

56 = Z + number of neutrons

Let's assume that the nucleus is iron-56, which means it has 26 protons (the atomic number of iron) and therefore 30 neutrons.

number of nucleons = number of protons + number of neutrons = 26 + 30 = 56

Total binding energy = 491 MeV/nucleon x 56 nucleons = 27596 MeV

Binding energy per nucleon = Total binding energy / number of nucleons

Binding energy per nucleon = 27596 MeV / 56 nucleons = 492 MeV/nucleon (rounded to the nearest whole number)

Therefore, the binding energy per nucleon of the nucleus is 492 MeV.

QUE.2). What is Bio energy? How photolysis of water is carried out. (3M)

Ans: Bioenergy refers to the energy that is derived from organic matter, including plants and animals. It is a type of renewable energy that can be used to produce heat, electricity, and other forms of energy. Bioenergy can be obtained from various sources such as biomass, biogas, biofuels, and biochar.

Photolysis of water is a process that occurs during photosynthesis, which is the process by which plants convert sunlight into energy. During photosynthesis, light energy is absorbed by pigments called chlorophyll in the leaves of plants. This light energy is then used to power the photolysis of water, which is the splitting of water molecules into hydrogen ions (H⁺) and oxygen gas (O₂).

The photolysis of water occurs in two stages, which are called Photosystem II (PSII) and Photosystem I (PSI). In PSII, light energy is absorbed by chlorophyll molecules, which causes an electron to be excited and transferred to a molecule called a primary electron acceptor. This electron is replaced by another electron that is obtained from the photolysis of water, which releases oxygen gas.

In PSI, the electrons that were transferred from PSII are used to generate ATP (adenosine triphosphate), which is a molecule that provides energy for cellular processes. This process also generates NADPH (nicotinamide adenine dinucleotide phosphate), which is a molecule that is used in the synthesis of organic molecules such as sugars.

QUE.3). Define Photo catalyst. State the applications and limitations of Photo catalysts. (3M)

Ans: A photocatalyst is a material that can catalyse a chemical reaction when exposed to light. Photocatalysts are typically semiconductors, which means they have a structure that allows them to absorb light and generate free electrons and holes. These free electrons and holes can then participate in chemical reactions on the surface of the photocatalyst.

Applications of photocatalysts include:

1. Water purification: Photocatalysts can be used to remove pollutants from water by oxidizing organic molecules and killing bacteria.
2. Air purification: Photocatalysts can be used to remove pollutants from the air by oxidizing volatile organic compounds (VOCs) and nitrogen oxides (NO_x).
3. Self-cleaning surfaces: Photocatalytic coatings can be applied to surfaces such as glass, concrete, and metal to make them self-cleaning. These coatings can break down organic molecules and prevent the accumulation of dirt and grime.
4. Energy conversion: Photocatalysts can be used to convert solar energy into electricity or to produce hydrogen fuel from water.

Some limitations of photocatalysts include:

1. Limited range of wavelengths: Most photocatalysts are only active in a limited range of wavelengths of light, typically in the UV or visible range. This means that they may not be effective under certain lighting conditions.
2. Low efficiency: The efficiency of photocatalysts is often limited by factors such as recombination of electrons and holes, surface area, and reaction kinetics. These limitations can reduce the overall efficiency of the process.
3. Selectivity: Photocatalysts may be selective in their reactions, meaning that they may only catalyse certain types of reactions or target specific molecules. This can limit their applicability in certain situations.

QUE.4). Write descriptive note on nuclear fuel, along with advantages & disadvantages.

Ans: Nuclear fuel is a substance that is used in nuclear reactors to sustain a chain reaction of nuclear fission, which releases energy in the form of heat. The most used nuclear fuel is uranium-235 (U-235), which is a naturally occurring radioactive isotope that can be enriched to increase its concentration.

Advantages of nuclear fuel:

1. High energy density: nuclear fuel has a very high energy density, which means that it can produce a large amount of energy from a relatively small amount of material.
2. Low greenhouse gas emissions: nuclear power plants do not produce greenhouse gases such as carbon dioxide, which contributes to climate change.
3. Reliability: Nuclear power plants can operate continuously for long periods of time, with minimal interruptions for maintenance or refuelling.
4. Energy security: nuclear fuel can be sourced domestically, reducing dependence on foreign oil and gas.
5. Cost-effective: Nuclear power can be cost-competitive with other forms of energy, especially in areas with high energy demand.

Disadvantages of nuclear fuel:

1. Nuclear waste: The spent nuclear fuel produced by nuclear reactors is highly radioactive and must be stored safely for thousands of years.
2. Accidents: Nuclear accidents can have catastrophic consequences, as demonstrated by the Chernobyl and Fukushima disasters.
3. Proliferation risks: The production of nuclear fuel can also be used to produce nuclear weapons, creating security risks.

4. Uranium supply: Uranium is a finite resource, and the supply may be limited in the future.
5. Public perception: nuclear power is often viewed as unsafe and controversial, which can make it difficult to gain public acceptance for new nuclear projects.

QUE.5). Define fuel cell. State the working, advantage and disadvantages Alkaline fuel cell. (4M)

Ans: A fuel cell is an electrochemical device that converts the chemical energy of a fuel, such as hydrogen or methane, directly into electrical energy without combustion. Fuel cells typically consist of an electrolyte, an anode, and a cathode, and work by passing the fuel and an oxidant (such as air) over the electrodes.

An alkaline fuel cell (AFC) is a type of fuel cell that uses an alkaline electrolyte, typically potassium hydroxide (KOH), to carry out the electrochemical reaction. The working of an alkaline fuel cell involves the following steps:

1. Hydrogen gas is supplied to the anode, where it is split into protons and electrons.
2. The electrons travel through an external circuit, producing electrical energy.
3. The protons pass through the electrolyte to the cathode.
4. At the cathode, oxygen from the air reacts with the protons and electrons to form water.

Advantages of alkaline fuel cells:

1. High efficiency: Alkaline fuel cells have a high energy conversion efficiency, typically around 60-70%.
2. Low emissions: Alkaline fuel cells do not produce greenhouse gases, making them a clean energy source.
3. High power density: Alkaline fuel cells have a high-power density, which means they can produce a lot of power in a small space.
4. Long life: Alkaline fuel cells have a long operating life, typically around 5,000-10,000 hours.

Disadvantages of alkaline fuel cells:

1. Sensitivity to contaminants: Alkaline fuel cells are sensitive to contaminants in the fuel and oxidant, which can reduce their efficiency or damage the electrodes.
2. Corrosion: The alkaline electrolyte used in AFCs can cause corrosion of the cell components, leading to reduced performance and lifespan.
3. Cost: Alkaline fuel cells are currently more expensive than other types of fuel cells, such as proton exchange membrane (PEM) fuel cells.
4. Limited operating temperature: Alkaline fuel cells operate at a high temperature, typically around 70-90°C, which can limit their use in certain applications.

QUE.6). Define fuel cell. State the working, advantage and disadvantages methanol fuel cell. (4M)

Ans: A fuel cell is an electrochemical device that converts the chemical energy of a fuel, such as hydrogen or methanol, directly into electrical energy without combustion. Fuel cells typically consist of an electrolyte, an anode, and a cathode, and work by passing the fuel and an oxidant (such as air) over the electrodes.

A methanol fuel cell (MFC) is a type of fuel cell that uses methanol as the fuel and water as the oxidant. The working of a methanol fuel cell involves the following steps:

1. Methanol is supplied to the anode, where it is oxidized to produce protons, electrons, and carbon dioxide.
2. The electrons travel through an external circuit, producing electrical energy.

3. The protons pass through the electrolyte to the cathode.
4. At the cathode, oxygen from the air reacts with the protons and electrons to form water.

Advantages of methanol fuel cells:

1. High energy density: Methanol has a high energy density, which means it can store a large amount of energy in a small volume.
2. Ease of transportation: Methanol is a liquid at room temperature, making it easier to transport and store than hydrogen gas.
3. Low emissions: Methanol fuel cells produce low emissions, including carbon dioxide and water.
4. Flexibility: Methanol fuel cells can be used in a range of applications, from portable electronics to stationary power generation.

Disadvantages of methanol fuel cells:

1. Cost: Methanol fuel cells are currently more expensive than other types of fuel cells, such as proton exchange membrane (PEM) fuel cells.
2. Toxicity: Methanol is toxic, which can be a safety concern in some applications.
3. Fuel crossover: Methanol can cross over the electrolyte membrane, reducing the efficiency of the fuel cell.
4. Carbon monoxide poisoning: If the fuel is not pure, methanol fuel cells can be susceptible to carbon monoxide poisoning, which can damage the electrodes.

QUE.7). Define waste. Classify the waste based on segregation. (3M)

Ans: Waste can be defined as any material that is unwanted or no longer useful and needs to be disposed of. Waste can be generated from various sources, such as households, businesses, industries, hospitals, and construction sites.

Waste can be classified based on the segregation process, which involves separating waste materials into different categories based on their characteristics. This helps in managing waste more efficiently and reducing the impact of waste on the environment. The following are the common types of waste based on segregation:

1. Biodegradable waste: This includes organic waste materials, such as food waste, garden waste, and animal waste, that can decompose naturally and be used as compost.
2. Non-biodegradable waste: This includes inorganic waste materials, such as plastics, metals, glass, and rubber, that do not decompose naturally and can persist in the environment for a long time.
3. Hazardous waste: This includes waste materials that can pose a threat to human health or the environment, such as chemicals, batteries, electronic waste, and medical waste.
4. E-waste: This includes electronic waste materials, such as computers, mobile phones, and televisions, that contain hazardous components and require specialized disposal methods.
5. Construction and demolition waste: This includes waste materials generated from construction and demolition activities, such as concrete, bricks, and timber.
6. Biomedical waste: This includes waste materials generated from healthcare facilities, such as syringes, needles, and infectious waste, that require specialized disposal methods to prevent the spread of diseases.

QUE.8). How hazardous waste is managed? (6M)

Ans: Hazardous waste is any waste material that poses a potential threat to human health or the environment due to its chemical or physical properties. Examples of hazardous waste include chemicals, batteries, electronic waste, medical waste, and radioactive waste. The management of hazardous waste is critical to protecting public health and the environment. The following are the common methods of hazardous waste management:

1. **Minimization:** The first step in hazardous waste management is to minimize the generation of hazardous waste by reducing the number of hazardous materials used or by finding alternative materials that are less hazardous.
2. **Segregation:** Hazardous waste is segregated from other waste streams to prevent contamination and ensure safe handling and disposal.
3. **Storage:** Hazardous waste is stored in specially designed containers or facilities to prevent leaks or spills and to protect human health and the environment.
4. **Treatment:** Hazardous waste is treated to reduce or eliminate its hazardous properties. Treatment methods include physical, chemical, and biological processes, such as incineration, chemical neutralization, and bioremediation.
5. **Transportation:** Hazardous waste is transported from the site of generation to a treatment, storage, or disposal facility using specially designed vehicles and trained personnel.
6. **Disposal:** Hazardous waste is disposed of in a manner that minimizes the risk of harm to human health or the environment. Disposal methods include landfilling, deep well injection, and underground storage.

In addition to these methods, hazardous waste management also involves regulatory compliance, monitoring, and reporting to ensure that hazardous waste is managed safely and in accordance with applicable laws and regulations. Effective hazardous waste management requires the collaboration of government agencies, industry, and the public to ensure that hazardous waste is managed in a way that protects human health and the environment.

QUE.9). Define incineration. Explain its type. State the various advantages and disadvantages of incineration. (5M)

Ans: Incineration is a thermal process that involves the combustion of waste materials at high temperatures to convert them into ash, gases, and heat. Incineration is a common method of waste management for non-recyclable or hazardous waste materials that cannot be disposed of in landfills. The following are the types of incineration:

1. **Mass burn incineration:** This is the most common type of incineration in which waste materials are burned in a single chamber without any pre-processing or sorting.
2. **Modular incineration:** This involves the processing of waste materials in multiple chambers, where different types of waste are burned separately to optimize combustion and reduce emissions.
3. **Rotary kiln incineration:** This is a specialized type of incineration that is used to treat hazardous waste materials, such as medical waste, by rotating the waste materials in a furnace at high temperatures.

The advantages of incineration include:

1. **Volume reduction:** Incineration reduces the volume of waste materials, which helps to conserve landfill space and reduce transportation costs.
2. **Energy recovery:** Incineration produces heat that can be recovered and used to generate electricity, reducing the need for fossil fuels.
3. **Hazardous waste treatment:** Incineration is an effective method of treating hazardous waste materials, such as medical waste, by destroying pathogens and reducing the volume of waste.
4. **Reduced greenhouse gas emissions:** Incineration can help reduce greenhouse gas emissions by reducing the amount of waste sent to landfills.

However, incineration also has several disadvantages, including:

1. Air pollution: Incineration can produce harmful emissions, such as dioxins, furans, and heavy metals, which can harm human health and the environment.
2. Cost: Incineration can be expensive to build and operate, which may make it less viable compared to other waste management methods.
3. Public perception: Incineration is often seen as a controversial method of waste management due to concerns about air pollution and public health.
4. Limitations: Incineration is not suitable for all types of waste materials, such as those containing high levels of water or volatile organic compounds.

QUE.10). Write informative note on Landfill. (4M)

Ans: A landfill is a method of waste disposal in which waste materials are buried in the ground. Landfills are designed to protect human health and the environment by containing and isolating waste materials from the surrounding environment. The following are some key features of landfills:

1. Liner system: Landfills are lined with a protective barrier, usually made of clay or synthetic materials, to prevent waste materials from contaminating the surrounding soil and groundwater.
2. Leachate collection system: Landfills are equipped with a system for collecting and treating leachate, which is the liquid that is produced when rainwater mixes with waste materials.
3. Methane capture system: Landfills produce methane gas as a by-product of the decomposition of organic waste materials. Methane is a potent greenhouse gas, and so landfills are equipped with systems for capturing and utilizing methane for energy production.
4. Monitoring and maintenance: Landfills are closely monitored to ensure that waste materials are contained and that the landfill is functioning as designed. Landfills also require ongoing maintenance, such as regular cover soil placement and leachate removal.

Landfills are a common method of waste disposal in many countries around the world. However, they have several disadvantages, including:

1. Land use: Landfills require a significant amount of land, which can be a valuable resource in densely populated areas.
2. Environmental impact: Landfills can have negative environmental impacts, such as soil and groundwater contamination and emissions of greenhouse gases and other air pollutants.
3. Public perception: Landfills are often seen as unsightly and unpleasant, and so may face opposition from local communities.
4. Lifespan: Landfills have a finite lifespan, and so require ongoing planning and investment to ensure that they continue to function safely and effectively.

QUE.11). State the utilization of Syngas (4M)

Ans: Syngas, also known as synthesis gas, is a fuel gas mixture that is primarily composed of carbon monoxide, hydrogen, and carbon dioxide. Syngas can be produced from a variety of feedstocks, including coal, natural gas, and biomass. The following are some key applications of syngas:

1. Power generation: Syngas can be used as a fuel to generate electricity in gas turbines or other power generation systems.

2. Chemical production: Syngas can be used as a feedstock to produce chemicals, such as methanol, ammonia, and hydrogen.
3. Fuel production: Syngas can be processed into a variety of liquid fuels, including gasoline, diesel, and jet fuel, using a process called Fischer-Tropsch synthesis.
4. Industrial heating: Syngas can be used as a fuel for high-temperature industrial heating applications, such as steel production or glass manufacturing.

Syngas is a versatile fuel that can be used in a variety of applications. Its use can help to reduce greenhouse gas emissions, particularly if it is produced from renewable sources such as biomass or waste materials. However, syngas production can also have environmental impacts, particularly if it is produced from fossil fuels or if proper environmental controls are not in place.

QUE.12). Write informative note on thermochemical conversion of syngas. (4M)

Ans: Thermochemical conversion of syngas is a process in which syngas, a mixture of hydrogen, carbon monoxide, and carbon dioxide, is converted into other chemicals or fuels through a series of chemical reactions. There are several different thermochemical conversion processes that can be used to convert syngas, including gasification and Fischer-Tropsch synthesis.

Gasification is a process in which solid or liquid feedstocks, such as coal, biomass, or municipal solid waste, are converted into syngas through a high-temperature, oxygen-limited reaction. The resulting syngas can then be used as a fuel or further processed into other chemicals or fuels.

Fischer-Tropsch synthesis is a process in which syngas is converted into liquid hydrocarbons, such as gasoline, diesel, and jet fuel, through a catalytic reaction. The process involves several chemical reactions, including the formation of carbon-carbon bonds, and can produce a wide range of hydrocarbon products.

Thermochemical conversion of syngas has several advantages as a method for producing fuels and chemicals. It can be used to convert a variety of feedstocks into syngas, including waste materials and biomass, which can help to reduce waste and emissions. Additionally, syngas can be produced from renewable sources, such as biomass, which can help to reduce greenhouse gas emissions. Thermochemical conversion processes can also be used to produce a wide range of chemicals and fuels, which can help to reduce dependence on fossil fuels.

QUE.13). State the utilization of biogas for high value chemicals.

Ans: Biogas, which is produced through the anaerobic digestion of organic materials, primarily contains methane and carbon dioxide. Biogas can be upgraded to produce high-value chemicals, such as hydrogen, methanol, and biomethane.

Hydrogen production: Biogas can be upgraded through a process called steam methane reforming, which involves the reaction of methane with steam to produce hydrogen and carbon dioxide. The resulting hydrogen can be used as a feedstock to produce a wide range of chemicals, including ammonia and methanol.

Methanol production: Biogas can also be converted into methanol through a process called syngas production, which involves the reaction of methane and carbon dioxide with steam to produce syngas, a mixture of hydrogen and carbon monoxide. The syngas is then converted into methanol through a catalytic reaction.

Biomethane production: Biogas can be upgraded to produce biomethane, which is a renewable natural gas that can be used as a transportation fuel or injected into the natural gas grid. Biomethane can be produced through a process called biogas upgrading, which removes impurities, such as carbon dioxide and hydrogen sulphide, from the biogas to produce a high-purity methane stream.

QUE.14). Write note on: - (3M) each

i) Solid waste management.

ii) Bio energy

iii) Thermochemical conversion of syngas

iv) Incineration

Ans: i) Solid waste management: Solid waste management refers to the collection, transport, processing, recycling, and disposal of solid waste. Proper solid waste management is essential to reduce environmental pollution, health hazards, and the depletion of natural resources. Solid waste management includes several practices such as waste reduction, segregation, composting, recycling, and disposal in landfills. The aim of solid waste management is to minimize the negative environmental impact of waste and maximize the benefits of waste resources.

ii) Bioenergy: Bioenergy refers to the energy that is derived from biomass, which includes organic matter such as plants, animal waste, and municipal solid waste. Bioenergy can be produced through several processes, including combustion, gasification, pyrolysis, and anaerobic digestion. The primary advantage of bioenergy is that it is a renewable energy source that can help to reduce dependence on fossil fuels. Bioenergy production also has the potential to reduce greenhouse gas emissions and promote sustainable development.

iii) Thermochemical conversion of syngas: Thermochemical conversion of syngas refers to the conversion of syngas, a mixture of hydrogen, carbon monoxide, and carbon dioxide, into other chemicals or fuels through a series of chemical reactions. This process can be carried out through gasification and Fischer-Tropsch synthesis. Thermochemical conversion of syngas has several advantages, including the ability to convert a variety of feedstocks into syngas and the production of a wide range of chemicals and fuels. However, the process can be energy-intensive and can require significant investments in equipment and infrastructure.

iv) Incineration: Incineration is a waste treatment process that involves the combustion of waste materials. Incineration can be carried out in a variety of settings, including industrial plants and waste-to-energy facilities. Incineration can have several advantages, including the reduction of waste volume and the generation of energy. However, incineration can also produce air pollution and greenhouse gas emissions, and the process can be expensive to implement. Proper environmental controls are necessary to ensure that incineration does not have negative environmental impacts.

QUE.15). State the utilization of syngas for high value chemicals.

Ans: Syngas, which is a mixture of hydrogen, carbon monoxide, and carbon dioxide, can be utilized to produce a range of high-value chemicals. Some examples of these chemicals include:

1. **Methanol:** Syngas can be converted into methanol through a process called methanol synthesis. Methanol is a widely used industrial chemical that is used in the production of formaldehyde, acetic acid, and other chemicals.
2. **Dimethyl Ether (DME):** DME is a clean-burning fuel that can be produced from syngas through methanol synthesis followed by dehydration. DME has applications as a substitute for diesel fuel and as a propellant in aerosol sprays.
3. **Ammonia:** Syngas can be used as a feedstock to produce ammonia, which is a critical industrial chemical used in the production of fertilizers, explosives, and other chemicals.
4. **Synthetic natural gas (SNG):** Syngas can be converted into SNG through a process called methanation. SNG can be used as a substitute for natural gas in a variety of applications.
5. **Synthetic lubricants:** Syngas can be used as a feedstock to produce synthetic lubricants, which have superior performance characteristics compared to conventional lubricants.

6. Hydrogen: Syngas can be used as a source of hydrogen, which has a wide range of applications including fuel cells, chemical production, and metal refining.

QUE.16). Write informative note on gasification and utilization of syngas. (4M)

Ans: Gasification is a process in which a solid or liquid feedstock is converted into a gaseous fuel known as syngas. Syngas is a mixture of hydrogen, carbon monoxide, carbon dioxide, and other gases. It can be used as a fuel for power generation or as a feedstock to produce chemicals, such as methanol and ammonia.

The gasification process starts by feeding the feedstock into a gasifier, which is a high-temperature vessel. The feedstock is heated to a high temperature in the presence of a limited amount of oxygen or steam. This process breaks down the feedstock into its component parts, resulting in the production of syngas.

The composition of syngas depends on the feedstock and the gasification process used. However, it typically contains around 20-30% hydrogen, 20-30% carbon monoxide, and 40-60% carbon dioxide.

Syngas can be used as a fuel in gas turbines, internal combustion engines, or fuel cells to generate electricity. It can also be used as a feedstock to produce chemicals such as methanol, ammonia, and synthetic natural gas (SNG).

The utilization of syngas has several advantages over conventional fossil fuels. For instance, syngas is a cleaner-burning fuel than coal or oil, and it emits fewer pollutants when burned. It is also a renewable energy source because it can be produced from biomass, such as wood chips, agricultural waste, or municipal solid waste. Additionally, syngas can be produced using carbon capture and storage (CCS) technology, which can help to reduce greenhouse gas emissions.

QUE.17). State the various methods of solid waste management. (4M)

Ans: There are several methods of solid waste management, each with its advantages and disadvantages. Some of the common methods are:

1. Landfilling: It is the most common method of waste disposal. Waste is transported to a landfill site and then dumped into a designated area. The site is designed to prevent the contamination of soil and groundwater. However, it requires a large amount of space, and it can create air pollution due to the decomposition of organic matter.
2. Incineration: It is a thermal process that burns the waste to convert it into ash and gases. This method is useful for reducing the volume of waste and generating energy. However, it can release toxic gases into the air and produces ash that requires proper disposal.
3. Recycling: It is the process of reusing materials from waste for a new purpose. This method reduces the amount of waste sent to landfills and conserves natural resources. However, it requires a proper system for sorting and collecting recyclable materials.
4. Composting: It is the process of decomposing organic waste to produce a nutrient-rich soil amendment. This method is useful for reducing the volume of waste and improving soil health. However, it requires proper management to prevent odours and pests.
5. Waste-to-energy: It is the process of converting waste into energy through biological or thermal processes. This method can reduce the volume of waste and generate energy. However, it requires specialized equipment and technology.

QUE.18). Incineration can be eco-friendly. Explain. (4M)

Ans: Incineration is a waste treatment process that involves burning waste materials to convert them into ash, gases, and heat. Incineration can be eco-friendly if it is performed using the latest technologies and modern facilities, which

are designed to minimize the environmental impact of the process. Here are some ways that incineration can be eco-friendly:

1. **Energy Recovery:** Incineration can generate electricity or heat by using waste as a fuel. Energy recovery from incineration can reduce the need for fossil fuels and thus contribute to the reduction of greenhouse gas emissions.
2. **Emissions Control:** Incineration facilities can use advanced technologies, such as scrubbers, filters, and catalytic converters, to reduce the emissions of pollutants such as particulate matter, dioxins, and furans. The modern incineration plants can meet the strict emission standards set by regulatory authorities.
3. **Waste Reduction:** Incineration can reduce the volume of waste and the need for landfills. The ash that remains after the incineration process can be used as a construction material or as a component of cement.
4. **Public Health:** Properly operated incineration facilities can reduce the risk of diseases associated with landfills, such as water and air pollution, and the breeding of pests.

QUE.19). Write descriptive note on Photolysis of water. (4M)

Ans: Photolysis of water is a process that involves the splitting of water molecules using light energy. This process occurs in plants during photosynthesis and is essential to produce oxygen and glucose. The process can also be artificially replicated in the laboratory using specialized equipment.

In the process of photolysis, light energy is absorbed by a pigment called chlorophyll, which is present in the leaves of plants. This energy is then transferred to a molecule of water, which causes it to break down into two parts - hydrogen ions (H⁺) and hydroxide ions (OH⁻).

The reaction can be represented by the following equation:



The hydrogen ions and hydroxide ions produced in this reaction can be used in other chemical reactions that occur during photosynthesis, such as the production of glucose.

The process of photolysis of water has significant importance in the environment as it produces oxygen, which is essential for the survival of living organisms. It also helps to maintain the balance of gases in the atmosphere, by removing carbon dioxide and releasing oxygen.

In conclusion, photolysis of water is a vital process that occurs in plants during photosynthesis and plays a crucial role in the production of oxygen and glucose. It also has significant environmental importance, and the study of this process has led to the development of various technologies that harness light energy to produce clean and sustainable energy sources.