(2022)

(i)

Effects of CFCs on ozone layer:

Gaseous CFCs can deplete the ozone layer when they slowly rise into the stratosphere, are broken down by strong UV radiation, release chlorine atoms, and then react with ozone molecules.

$$CF_2Cl_2 + h\nu \longrightarrow Cl^{\cdot} + CClF_2^{\cdot}$$

$$Cl^{\cdot} + O_3 \longrightarrow ClO + O_2$$

$$ClO + O \longrightarrow Cl^{\cdot} + O_2$$

This net effect of these reactions is catalysis of the destruction of several thousand molecules of O_3 for each Cl atom produced.

(ii)

Acid rain:

Acid rain is a rain or any other form of precipitation that is unusually acidic, meaning that it possesses elevated levels of hydrogen ions (low pH). It is a broad term

that includes any form of precipitation with acidic components such as sulfuric acid or nitric acid that fall to the ground from the atmosphere in wet or dry forms. This can include rain, snow, fog, hail or even dust that is acidic.

Formation of acid rain:

Rain must pass through an atmosphere polluted with oxides of sulphur (SO_x) and oxides of nitrogen (NO_x). The falling rain and snow react with these oxides of pollutants to produce often a mixture of sulphuric acid, nitric acid and water. When these acids are carried down to earth by precipitation, acid rain occurs.

$$S + O_2 \longrightarrow SO_2$$

$$SO_2 + \frac{1}{2} O_2 \longrightarrow SO_3$$

$$SO_3 + H_2O \longrightarrow H_2SO_4 \text{ (sulphuric acid)}$$

$$NO_2 + H_2O \longrightarrow HNO_3 \text{ (nitric acid)}$$

(iii)

Point sources	Non-point sources
• A point source is a single, identifiable source of pollution such as pipe or drain.	• Non-point source pollution come from many diffuse sources.
• It is pollution caused by discharge of effluents at one point.	• It is pollution caused by discharge of pollutants over a wide area.
• Treatment plant can be installed in the area of flow of effluents.	• Treatment plant is useless for this type of pollution.
• e.g: Municipal and industrial discharge pipes.	• e.g: Agricultural runoff acid rain.

(iv)

Significance of dissolved oxygen:

Dissolved oxygen is one of the most important indicators of water quality. It is essential for the survival of fish and other aquatic organisms. The biological importance of the presence

of dissolve oxygen in river water is that the aquatic life can use the oxygen from the water for their respiration. It is a parameter to determine the quality of water. The DO value less than 4ppm indicated that water is polluted.

(v)

Sources of oxides of NOx:

Natural bacterial activity discharges 5×10^3 tonnes whereas man-made sources release 5×10^7 tonnes of NOx annually. The major man-made source is combustion of coal, oil, natural gas and gasoline. Thus, NOx is introduced into the atmosphere from automobile exhaust, furance stacks, coal based power plants and other similar sources.

Sinks of oxides of NOx:

The major sink for atmospheric N_2O is destruction in the stratosphere where the majority undergoes photolysis to $N_2 + O$. The remaining N_2O reacts with O to produce NO, which can enter into a stratospheric ozone

depleting reaction cycle.

(vi)

Removal of permanent hardness of H_2O:

Permanent hardness of water is due to dissolved salts of chlorides and sulphates of calcium and magnesium which can be removed by adding sodium carbonate (Na_2CO_3) (washing soda or soda ash) which reacts with these dissolved salts to form insoluble carbonates that can be removed by filtration and then water becomes soft.

$$Na_2CO_3 + CaSO_4 \longrightarrow CaCO_3 + Na_2SO_4$$

$$Na_2CO_3 + MgSO_4 \longrightarrow MgCO_3 + Na_2SO_4$$

(vii)

Indoor air pollution:

Pollution in homes, offices, school, departmental stores and other public places is termed as indoor pollution.

Indoor air pollutants:

The major indoor air pollutants are:

1- **Radon** is caused by the rocks and earth beneath the home, well water and building materials. These are no immediate symptoms from radon pollution. Smokers are at the higher risk of developing radion induced lungs cancer.

2- **Biological Pollutants** include molds mid bateria, small in parts fungi and dust that are found in the home. They cause

- Eyes, nose and throat irritation
- Shortness of breath and dizziness
- Digestive problems
- Asthma

(viii)

Environmental degradation:

It is defined as

"any change or disturbance to the environmental perceived to be deleterious or undesirable."

Effect on human health & productivity:

- Smoky indoor air effects 400 to 700 million people, mostly in poor rural areas.

- Air pollution from factories & vehicles affects forests and water through acid rain.
- Solid and hazardous wastes and polluted ground-water increase diseases.
- Atmospheric changes increase risks from climatic natural diseases and increase diseases from ozone depletion.

(ix)

Mesosphere:

Mesosphere is the region above the stratosphere where temperature decreases with height; it exhibits a negative lapse rate. This decrease in temperature is due to low levels of ozone and other UV adsorbing species in this region.

Temperature range:

The average temperature decreases to -92°C at an altitude around 85-90km.

Pressure profile:

The average air pressure of the mesosphere is only 0.01mb, which is just 1/100,000 that of the surface air pressure.

(x)

Chlorination:

Chlorination is the process of adding chlorine to drinking water to kill parasites, bacteria and viruses.

Advantages:

- It inactivates microorganisms.
- It keeps the water safe.
- It is easy to use.
- It helps to remove tastes and odors.
- It helps to remove unwanted nitrogen compounds from water.

Disadvantages:

- It has distinctive smell.
- It can cause skin irritation.
- Chlorination of water can fade fabrics.
- Formation of disinfection by-products and
- being ineffective against some types of microbes.

(xi)

Trickling filters:

One of the simplest biological waste treatment processes is the trickling filter in which wastewater is sprayed over rocks or other solid support material covered with microorganisms. The structure of the trickling filter is such that contact of the wastewater with air is allowed and degradation of organic matter occurs by the action of microorganisms.

(xii)

Ozone hole:

The Antarctic ozone hole is a thinning or depletion of ozone in the strato-sphere over the Antarctic each spring. This damage occurs due to the presence of chlorine and bromine from ozone depleting substances in the stratosphere and the specific meteoro-logical conditions over the Antarctic.

(xiii)

Species present in atmosphere:

Following species are present in atmosphere

- Nitrogen 78.08%
- Oxygen 20.95%
- Water 0.1 - 5%
- Argon 9.34×10^{-1} or 0.934
- CO_2 0.00314
- Ne, He, CH_4, N_2O, H_2, SO_2, NO are present in trace amount in atmosphere.

(xiv)

Effects of fertilizers on marine life:

Too much fertilizer can actually kill the plant and excess fertilizer can runoff into streams and lakes causing toxic algal blooms that are harmful to aquatic life and even people and their pets. Excess fertilizer runoff from lawns and agricultural applications also contribute to aquatic "dead zones" in coastal areas.

(xv)

Environmental Management System:

An Environmental Management System (EMS) is a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency.

The three current established EMS's are ISO 14001, the Eco-Management and Audit Scheme (EMAS), ISO 14005.

(2021)

(i)

Species responsible for removal of hydroxyl radicals:

Hydroxyl radical is most frequently removed from the troposphere by reaction with methane or carbon monoxide:

$$CH_4 + HO^{\cdot} \longrightarrow H_3C^{\cdot} + H_2O$$

$$CO + HO^{\cdot} \longrightarrow CO_2 + H$$

The highly reactive methyl radical, $H_3C^{\cdot}$, reacts with O_2, to form methyl peroxyl radical and hydrogen produced reacts with O_2 to form hydroperoxyl radical

$$H_3C^{\cdot} + O_2 \longrightarrow H_3COO^{\cdot}$$

$$H + O_2 \longrightarrow HOO^{\cdot}$$

(ii)

Eutrophication:

The term eutrophication, derived from the Greek word meaning "well nourished" describes a condition of lakes or reservoirs involving excess algal growth. Although

some algal productivity is necessary to support the food chain in an equatic system. Excess growth under eutrophic conditions may eventually lead to severe deterioration of the body of water.

Effects on marine life:

- Species diversity decreases and dominant biota changes
- Rate of sedimentation increases, shortening the lifespan of lake
- Excessive plant production
- Blooms of harmful algae
- Increased frequency of anoxic events and
- fish kills.

(iii)

Use of trickling filters:

- Trickling filters (TFs) are used to remove organic matter from wastewater.
- TFs is an aerobic treatment system that utilizes microorganisms attached to a medium to remove organic matter for wastewater.

Use of biological contactors:

A rotating biological contactor is a type of secondary treatment process. It is designed to remove nutrients and dissolved organic material from the wastewater before it is discharge to a disposal field for final treatment and dispersal in the soil.

(iv)

Objectives of environmental chemistry:

Knowledge of chemistry and chemical processes occurring in the environment is necessary for humans to determine the extent and nature of impacts, assess the consequences of these impacts, and define, develop and implement sustainable solutions.

An important objective of environmental chemistry is to understand and characterize chemical and physical measurements of complex system.

(v)

Ozone as disinfectant:

Ozone is generated using specialized equipment that produces ozone gas by passing an electrical current through oxygen molecule in air. The ozone gas is then pumped into the area to be disinfected, where it reacts with microorganisms by breaking down their cell walls and destroying their DNA. However, ozone can be hazardous to humans and animals at high concentrations, so it must be used carefully and under controlled conditions.

(vi)

Polar Vortex:

The polar vortex is a large area of low pressure and cold air surrounding both of the Earth's poles. It always exists near the poles, but weakens in summer and strengthens in winter. The term "vortex" refers to the counter-clockwise flow of air that helps keep the colder air near the poles.

(vii)

Tropopause:

The very cold layer at the top of the troposphere is known as tropopause. It is a transition layer between troposphere and stratosphere. In this layer temperature decreases upto -56°C.

Lapse rate:

The lapse rate is the rate at which temperature changes with height in the atmosphere. Lapse rate is inversely related to the change itself: if lapse rate is +ve, the temperature decreases with height; conversely if -ve, the temperature increases with height.

(viii)

Particulate matter:

Particulate matter describes a wide variety of air borne material. PM pollution consists of materials (including dust, smoke, soot) that are directly emitted into the air and results from the transformation of gaseous pollutants.

Removal of PM:

PM can be removed by

- Electrostatic precipitator
- Wet scrubbers
- Fabric filter baghouse
- Inertial collectors (cyclonic separators)

(ix)

Minimization of industrial pollutants:

- Adopting new technology, efficient training of employees for safe use, and development of better technology for disposal of waste and being more conscientious about the use of raw materials can help to control industrial pollution
- The industri should ensure the new machines that should be noise proof.
- Industries should be setup outside. Residential area and not near school.

(x)

Impacts of modren life style on environment:

Modern life style has following impacts on environment.

1- Global warming is an aftermath of modern life style. The modern you want to become the more waste you produce.

2- Climate change is a direct threat to living being's ability to survive, grow and thrive.

3- Acid rain occurs when dioxides of nitrogen and sulfur from coal plant emissions combine with moisture present in the air.

4- Agriculture runoff: Farming creates agriculture runoff.

(xi)

Smog:

Smog is composed of a mixture of air pollutants that can endanger human health.

Effects on human:

Various human health problems such as

- emphysema
- chronic bronchitis
- asthma
- Lung diseases

• and cancer are caused by the effects of smog.

(xii)

Aerosols:

An aerosol is a particle of solid or liquid matter of such minate size that it can remain suspended in the atmosphere for long period of time.

Sources:

There are two major sources of aerosol.

1- Natural sources

They include

- Sea spray
- Dust
- Combustion
- Jungle fire

2- Anthropogenic sources

They include

- Industrial combustion
- Condensed organic vapours

Sinks:

Two main types of removing process of aerosol

1- Wet deposition processes

- Rain-out & wash out
- cloud deposition

2- Dry deposition processes

- Turbulent diffusion
- Impaction
- Interception
- Brownian diffusion

(xiii)

Sources & Sinks of oxides of NOx:

Repeated 2022 (v)

(xiv)

Phosphates pollute water quality:

Phosphorus is an essential element for plant life, but when there is too much of it in water, it can speed up eutrophication of lakes and rivers. Phosphates are chemicals containing the element phosphorous and they affect water quality by causing excessive growth of algae. Excessive amount of algae cloud the water which reduces the sunlight available to other plants and kill them.

(xv)

Acid rain:

Repeated 2022 (ii)

Effect of acid rain on human:

Acid rain effects human health adversely. Adverse health effect of acid

rain on humans is respiratory problems like throat, nose and eye irritation; headache, dry coughs, asthma. Lungs of healthy people can be damaged by the pollutants in acid air.

Effects of acid rain on animals:

Acid rain can cause serious problems for many different animals and plants. When acid rain reaches the Earth, the acid sink into the soil and enter water system such as rivers, lakes and streams. In aquatic ecosystems, acid rain harms animals by increasing the acidity of water which makes the water toxic for aquatic animals. Increased acidity affects the growth rate and reproduction capabilities of fish. Acid rain has an affect on animals living in the forest. When damaged trees and plants die off, there is not as much food available to animals living in forest ecosystem.

(2020) 30

(i)

Bio-amplification:

Bio-amplification also known as bio-magnification is the increasing concentration of a substance, such as a toxic chemical, in the tissues of organisms at successively higher levels in a food chain. This often occurs because the pollutant is persistent, meaning that it cannot be or is very slowly, broken down by natural processes.

(ii)

Methane in air:

Methane is emitted to the atmosphere during the production, processing, storage, transmission, distribution and use of natural gas and the production, transportation and storage of crude oil. Coal mining is also a source of CH_4 emissions.

(iii)

Importance of BOD measurement:

BOD measures the amount of oxygen consumed by microorganisms for the process of decomposition of the organic matters in the water bodies. BOD measurement is very important water quality parameter. The higher the BOD of water, the more contaminated it is. The water with a lower BOD is less contaminated. Drinking water has a BOD of less than 5ppm, whereas severely contaminated water has a BOD of 17ppm or more.

(iv)

Physical effects of aerosols

Aerosols can cause serious health effects. These range from

- Carbon monoxide poisoning
- Lead poisoning
- Bone marrow suppression
- Burns of the skin
- cellular death

Chemical effects of aerosols:

They affect the Earth's radiation balance and climate through diverse physical and chemical processes including direct absorption and scattering of light by particles. They interfere with light transmission.

(v)

Effects of fertilizers on marine life:

Repeated 2022 (xiv)

(vi)

Green Chemistry:

Green chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances.

Significance:

Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use and ultimate disposal. It is also important because of designing safer

chemical production, food and flavour production.

(vii)

Ozone hole creation:

Repeated 2022 (xii)

(viii)

Indoor air pollutants:

Repeated 2022 (vii)

(ix)

Environmental Management System:

Repeated 2022 (xv)

(x)

Effect of acid rain on building materials:

Repeated 2017 (vi)

(2019)

(i)

Bioaccumulation:

Bio-accumulation is defined as the increase of contaminant concentratations in aquatic organisms following uptake from the ambient environmental medium. Different sources of exposure contribute to contaminant bioaccumulation.

(ii)

Temp & pressure variation in Troposphere:

Repeated

(iii)

Measurement of COD of wastewater:

COD measurement is based on the use of an oxidizing solution (potassium dichromate in concentrated sulfuric acid) in contact with a water sample during 2 hours of mineralization in hot conditions.

(iv)

Sources of Oxides of Carbon:

Carbon dioxide is released naturally through the combustion and decomposition of plant and animals. CO_2 is also released by burning of fossile fuels. Natural sources of CO_2 include most animals which exhale CO_2 as waste product. Human activities that lead to CO_2 emissions come primarily from energy production, including burning coal, oil or natural gas.

Sinks of Oxides of Carbon:

The ocean, soil and forests are the world's largest carbon sinks. The shortest carbon sink is found in the tropical rain-forests.

(v)

Radon as Indoor pollutant:

Repeated 2022 (vii)

(vi)

Diff b/w primary & secondary pollutants:

Repeated 2017 (iii)

(vii)

Polar Vortex: Repeated 2021 (vi)

(viii)

Fertilizers affects water quality:

When manure or commercial fertilizers enter surface water, the nutrients they release stimulate microorganism growth. The growth and reproduction of microorganisms reduce the dissolve oxygen content of the water body. Without sufficient dissolved oxygen in surface water, fish and other aquatic species suffocate.

(ix)

Effects of lead in water ways:

Lead is a powerful neurotoxin, which means exposure to lead, can cause serious health problems if too much enters your body from drinking water or other sources. It can cause damage to the brain and kidneys and exposure to enough lead can even kill.

Lead is one of the most widespread heavy metal contaminated in soils. It can cause morphological, physiological and biochemical dysfunctions in plants.

(x)

Masonary Buildings affected by acid rain:

One drastic effect of acid rain can be seen on one of the seven Wonders of the World, Taj Mahal in India. Damage to historic monuments like Taj Mahal often described as stone cancer or stone leprosy. The chemistry of attack by acid rain on historical monuments involves the leaching of $CaCO_3$ and Fe_2O_3 by H_2SO_4. Buildings can be damaged by acid rain because it dissolves the stone or corrodes the metal that is exposed to the weather. The marble walls and pillars of this great man-made monument are found to be getting eroded by acid rains. In such way acid rain affects Masonary Buildings. Even St. Paul's Cathedral in London and the Statue of Liberty in New York are few such examples.

(2018)

(i)

Coagulation:

Coagulation is a process of aggregation or accumulation of colloidal particles to settle down as a precipitate. Substances like metals, their sulfides etc cannot be simply mixed with the dispersion medium to form a colloidal solution. Some special methods are used to make their colloidal solutions.

(ii)

Natural source of CH_4:

CH_4 is produced by number of ways such as

- action of anaerobic bacteria on vegetation
- decomposition of organic matter
- incomplete combustion of vegetation
- Natural gas pipeline leaks & petroleum oil
- production & transport of coal, natural gas & oil.

(iii)

Significance of COD value:

- It measure the effect of pollutants on dissolved oxygen.
- It helps in designing & calculation of efficiency of water treatment plants
- It helps in designing the disposal of domestic and industrial effluents in various types of water streams.

(iv)

Physical & chemical effects of aerosols:

Repeated 2020 (iv)

(v)

Effects of fertilizers in waterways:

Repeated 2019 (viii)

(vi)

Green chemistry:

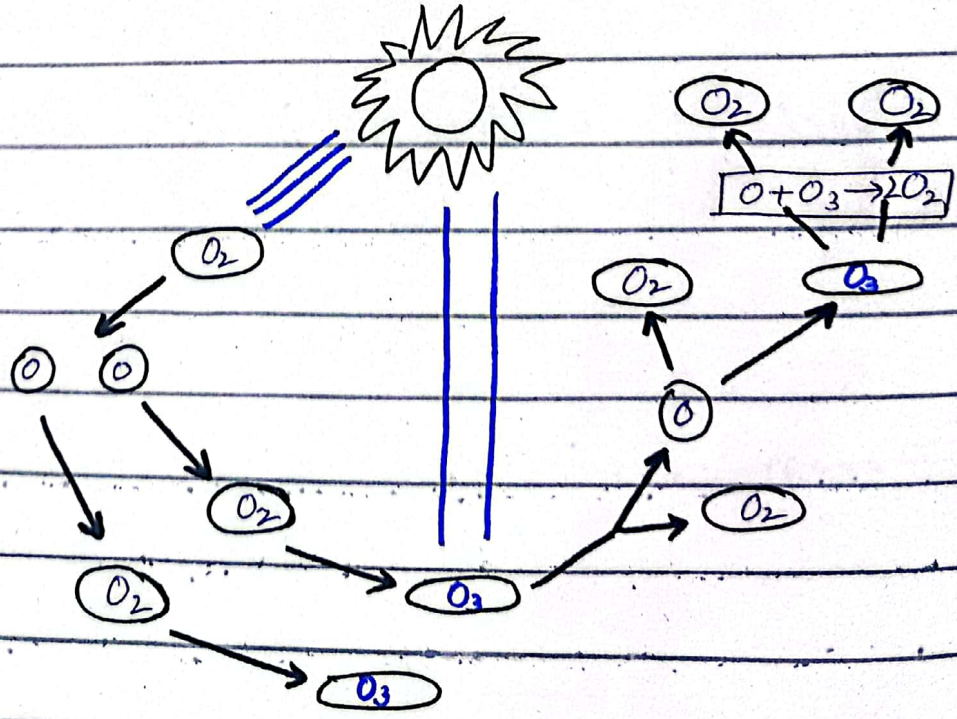
Repeated 2020 (vi)

(vii)

Ozone cycle in stratosphere:

Oxygen atoms cycle between oxygen molecules and ozone. The sun's rays split oxygen molecules (O_2) apart into individual O atoms. These O atoms then join with an oxygen molecules (O_2) to make ozone (O_3). As the ozone absorbs UV rays, it splits into O and O_2. Then atomic oxygen will either join back up with an oxygen molecule, O_2 to make an ozone molecule again, or recombine with an ozone molecule to make two oxygen molecules (O_2).

($O + O_3 \rightarrow 2O_2$)



(viii)

RADON as indoor pollutant:

Repeated 2022 (vii), 2019(v)

(ix)

Bio-amplification:

Repeated 2020 (i)

(x)

Agricultural land affected by acid rain:

The biggest damadge caused by acid rain to the soil is the solvent effect. Namely with this effect it dissolves and liberates the toxic substances in the soil and removes useful nutrients and minerals from the vegetation. In this context, soil ecosystems and forests suffer greatly. Acid rain leaches aluminum from the soil. That aluminum may be harmful to fields, plants as well as animals. By leaching out nutrients from the soils, the fertility of such soils decreases.

—(2017)—

(i)

Effects of CO on humans:

Carbon monoxide cause fatigue in healthy people and chest pain in people with heart problems even at low levels of explosure when people at higher concentration of CO, there vision and coordination become impaired confussion dizziness and nausea along with other flue like symptoms are also common.

(ii)

Primary water treatment:

Primary treatment of wastewater consists of the removal of insoluble matter such as grit, grease and scum from water. When the waste water. When the waste water is to be dumped off into a river or flowing steam, the treatment is carried out by sedimentation, coagulation and filtration. This is known as primary treadment.

(iii)

Primary pollutant	Secondary pollutant
• Primary pollutants are emitted directly from the source.	• Secondary pollutants are not emitted directly from the source but are formed due to chemical reaction.
• They are found in the atmosphere in the form they are emitted.	• They are found as products of chemical reaction between the atmospheric constituents and primary pollutants.
• e.g: Ash, smoke, dust, oxides of carbon, sulphur & nitrogen are primary pollutants.	• e.g: SO_3, O_3, ketones and hydrogen cyanide are secondary pollutants.

(iv)

Ozone hole:

The Antarctic ozone hole is a thinning or depletion of ozone in the stratosphere over the Antarctic each spring. This damage occurs due to the presence of chlorine and bromine from ozone depleting

substances in the stratosphere and the specific meteorological conditions over the Antarctic.

(v)

Lead poisoning:

Lead poisoning also known as **plumbism** and **saturnism** is a type of metal poisoning caused by lead in the body. The brain is most sensitive. Symptoms may include abdominal pain, constipation, headaches, irritability, memory problems, infertility and tingling in hand and feet. Exposure to lead can occur by contaminated air, water, dust, food or consumer products.

(vi)

Effects of acid rain on buildings:

Acid rain can ruin buildings and statues by stripping away the stone that was used to make those structures. Architects choose limestone, marble, steel and brass as durable materials intended to resist

the elements. One drastic effect of acid rain can be seen on one of the Seventh Wonders of the World, Taj Mahal in India. The chemistry of attack by acid rain on historical monuments involves the leaching of $CaCO_3$ and Fe_2O_3 by H_2SO_4. Buildings can be damaged by acid rain because it dissolves the stone or corrodes the metal that is exposed to the weather. The marble walls and pillars of this great man-made monuments are found to be getting eroded by acid rain.

(vii)

Point sources	Non-point sources
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• It is pollution caused by discharge of effluents at one point.	• It is pollution caused by discharge of pollutants over a wide area.
• Treatment plant can be installed in the area	• Treatment plant is useless for this type of

of flow of effluents. • e.g: Municipal and industrial discharge pipes.	pollution. • e.g: Agricultural runoff, acid rain.

(viii)

Methane as green house gas:

Methane is also a green house gas (GHG), so its presence in the atmosphere affects the earth's temperature and climate (change) system. Methan is produced by number of ways such as action of anaerobic bacteria on vegetation, decomposition of organic matter, incomplete combustion of vegetation, natural gas pipeline leaks and petroleum etc. It is rising 2% approximately every year. It absorbs 20-25% times more heat than CO_2. In addition to acting as a greenhouse gas, methane has significant effects upon atmospheric chemistry.

(ix)

Reducing smog:

Reducing smog refers to air pollution episodes characterized by high concentration of sulfur-dioxide and smoke. Reducing smog is also sometimes called London-type smog, because of famous incidents that occurred in that city during the 1950s. There have been a number of incidents of substantial increases in human illness and mortality caused by reducing smog, especially among higher risk people with chronic respiratory or heart diseases.

(x)

Significance of Environmental Education:

Environmental education is a process that allows individuals to explore environmental issues, engage in problem solving and take actions to improve the environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible dicisions.