

# 14 ■ ■ ■ Environmental Chemistry

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## Facts that Matter

### ● Environmental Chemistry

It is the branch of science which deals with the chemical changes in the environment. It includes our surroundings as air, water, soil, forest etc.

### ● Environmental Pollution

It is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings.

### ● Pollutants

A substance, which causes pollution, is known as pollutant. Pollutants can be solid, liquid or gaseous substances. Present in higher concentration, it can be produced due to human activities or natural happenings.

### ● Troposphere

The lowest region of atmosphere, in which the human beings along with other organisms live, is called troposphere.

It extends to the height of about 10 km from the sea level. It contains air, water vapours, clouds etc. The pollution in this region is caused by some poisonous gases, smoke fumes, smog etc.

### ● Stratosphere

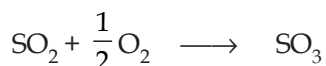
It extends from height of 10 to 50 km above the sea level. Ozone and some other gaseous substances present in this region are responsible for the pollution.

### ● Tropospheric Pollution

Pollution in this region is caused by the presence of undesirable gaseous particles like oxides of sulphur, nitrogen and carbon, hydrocarbons along with solid particles like dust, mist, fumes, smoke etc.

### ● Oxides of Sulphur

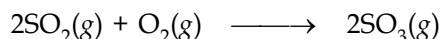
These are produced when coal containing sulphur is burnt.



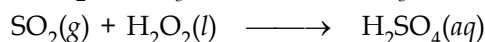
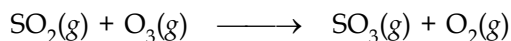
It is also produced during volcanic eruptions.

**Harmful effects:**

- (i) It is poisonous to both animals and plants.
- (ii) A very high concentration of  $\text{SO}_2$  may cause respiratory diseases *e.g.*, asthma, bronchitis, emphysema in human beings.
- (iii) It causes irritation to the eyes, resulting in tears and redness.
- (iv) Its high concentration leads to the stiffness of flower buds.
- (v) Particulate matter present in the air can catalyse the formation of sulphur trioxide from sulphur dioxide.



$\text{O}_3$  and  $\text{H}_2\text{O}_2$  also promote this reaction.

**• Oxides of Nitrogen**

Main oxides of nitrogen are nitric oxide (NO) and nitrogen dioxide ( $\text{NO}_2$ ).

**Major Sources:**

- (i) Lightning discharge results in the combination of  $\text{N}_2$  and  $\text{O}_2$  to form NO.
- (ii) Combustion of gasoline in automobiles, burning of hydrocarbons and coal etc.

**Harmful effects:**

Nitric oxide itself is not harmful to human beings, but it is very unstable and changes to nitrogen dioxide which is toxic in nature. These effects are as follows:

- (i) It reacts with Ozone ( $\text{O}_3$ ) present in the atmosphere and thus decrease the density of Ozone.
- (ii) It affects the respiratory system and damages the lungs.
- (iii) Higher concentrations of  $\text{NO}_2$  damage the leaves of plants and retard the rate of photosynthesis.
- (iv) It causes cracks in rubber.
- (v) Nitrogen dioxide is also harmful to various textile fibres and metals.

**• Hydrocarbons**

Incomplete combustion of fossil fuel in industry and thermal power plants and the exhaust of automobiles release hydrocarbons into the atmosphere constantly causing pollution.

**Harmful Effects:**

- (i) They cause cancer.
- (ii) Methane is one of the greenhouse gases.
- (iii) They harm plants in various ways like breakdown of tissues, shedding of leaves etc.

**• Oxides of Carbon****Carbon dioxide:**

0.03%  $\text{CO}_2$  is present in air by Volume.

**Major Sources:**

- (i) By burning of fossil fuels.
- (ii) By the decomposition of limestone during the manufacture of cement.
- (iii) Emitted during volcanic eruptions.
- (iv)  $\text{CO}_2$  is released into the atmosphere by respiration.

**Harmful effects:**

Deforestation and burning of fossil fuel increases the CO<sub>2</sub> level which is mainly responsible for global warming.

**Carbon Monoxide:** Carbon Monoxide is a colourless and odourless gas.

**Major Sources:**

- (i) Released by the automobile exhaust.
- (ii) Incomplete combustion of coal, fire wood, petrol etc.
- (iii) By the dissociation of CO<sub>2</sub> at high temperature.

**Harmful effects:**

- (i) It binds to haemoglobin to form carboxyhaemoglobin which is more stable than oxygen-haemoglobin complex. Its concentration in blood when reaches to 3–4%, the oxygen carrying capacity of blood is greatly reduced.  
The oxygen deficiency, results into headache, weak eyesight, nervousness etc.
- (ii) It has harmful effects on plants when its concentration is (100 ppm or more).

**● Global Warming and Greenhouse Effect****Greenhouse Effect:**

Some gases like carbondioxide, methane, ozone, water vapours, CFCs have the capacity to trap some of the heat radiations that are released from the earth or from sun. These gases are known as greenhouse gases and the effect is called greenhouse effect. This leads to global warming.

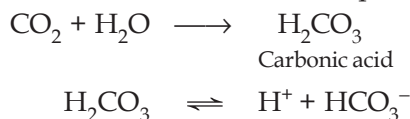
**Consequences of global warming:**

- (i) It leads to melting of polar ice caps and flooding of low lying areas all over the earth.
- (ii) Global rise in temperature increases the incidence of infectious diseases like dengue, malaria, yellow fever, sleeping sickness etc.

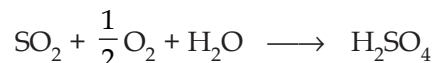
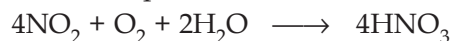
**● Acid Rain**

When the pH of the rain water drops below 5.6, it is known as acid rain.

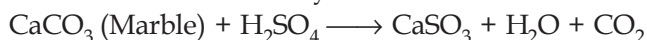
Normal rain is slightly acidic due to dissolution of atmospheric carbon dioxide in water.



Oxides of nitrogen and sulphur released as a result of combustion of fossil fuels dissolve in water to form nitric acid and sulphuric acid.

**Harmful Effects of Acid Rain:**

- (i) It has harmful effects on trees and plants as it dissolves and washes away nutrients needed for their growth.
- (ii) It has very bad effect on aquatic ecosystem.
- (iii) Acid rain damages buildings and other structures made of stone or metal. Taj Mahal in India has been affected by acid rain.



## ● Particulate Pollutants

**Viable Particulates:** They are minute living organisms that are dispersed in the atmosphere. *e.g.*, bacteria, fungi, moulds, algae etc.

**Non Viable Particulates:**

- (i) **Smoke:** It is the mixture of solid and liquid particles formed during combustion of organic matter.  
**Example:** Cigarette smoke, smoke from burning of fossil fuel.
- (ii) **Dust:** Composed of fine solid particles (over 2µm in diameter).  
It is produced during crushing, grinding and attrition of solid particles.
- (iii) **Mist:** These are produced due to the spray of liquids like herbicides and pesticides over the plants. They travel through air and form mist.
- (iv) **Fumes:** They are generally released to the atmosphere by the metallurgical operations and also by several chemical reactions.

**Harmful Effects of Particulate Pollutants:**

- (i) Fine particles less than 5 microns penetrate into the lungs. Inhalation of such particles can lead to serious lung diseases including lung cancer.
- (ii) Suspended particles of bigger size can hinder the sun rays from reaching the earth surface. This can lower the temperature of earth and make the weather foggy.

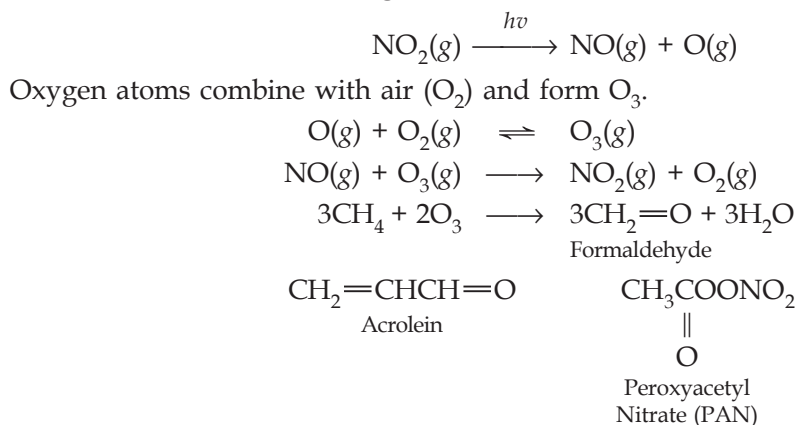
## ● Smog

This is the common form of air pollution which is combination of smoke and fog.

**Smog exists in two types:**

- (i) **Classical Smog:** Occurs in cool humid climate. It contains smoke, fog and sulphur dioxide. It is also called as reducing smog.
- (ii) **Photochemical Smog:** This type of smog result from the action of sunlight on unsaturated hydrocarbons and nitrogen oxides released by the vehicles and industries. It has high concentration of oxidising agents and is therefore, called as oxidising smog.

**Formation of Photochemical Smog**



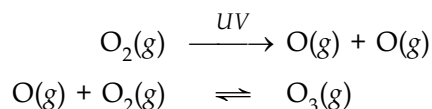
**Harmful effects of photochemical smog:**

- (i) It can cause cough, bronchitis, irritation of respiratory system etc.
  - To control this type of pollution the engines of the automobiles are fitted with catalytic converters to check the release of both oxides of nitrogen and hydrocarbons in the atmosphere.

- Some plants like Vitis, Pinus, Juniparus, Quercus, Pyrus can metabolise nitrogen oxide and therefore, their plantation can be done.

### ● Stratospheric Pollution

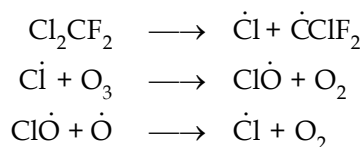
**Formation of Ozone:** Ozone in the stratosphere is produced by UV radiations. When UV radiations act on dioxygen (O<sub>2</sub>) molecules, Ozone is produced.



Ozone is thermodynamically unstable and decomposes to molecular oxygen. Thus there exists an equilibrium between production and decomposition of Ozone molecules.

**Depletion of Ozone layer:** Ozone blanket in the upper atmosphere prevent the harmful UV radiations from reaching earth.

But in recent years, there have been reports of depletion of this layer due to presence of certain chemicals in the stratosphere. Chlorofluorocarbons (CFCs), nitrogen oxides, chloride, CCl<sub>4</sub> etc. are the chemicals responsible for depletion.



Chlorofluorocarbons dissociate in the presence of light gives chlorine free radicals which catalyse the conversion of ozone into oxygen.

#### Effects of the depletion of Ozone layer:

- This leads to many diseases like skin cancer, sunburn, ageing of skin, cataract etc.
- UV radiations can kill many phytoplanktons, damage the fish productivity.
- It can decrease moisture content of the soil by increasing the evaporation of surface water.
- UV radiations can damage paints and fibres, causing them to fade faster.

### ● Water Pollution

Presence of undesirable materials in water which is harmful for the human beings and plants is known as water pollution. Normal properties of the water can be changed by the presence of these foreign materials.

#### Maximum Prescribed Concentration of Some Metals in Drinking Water

<i>Metal</i>	<i>Maximum concentration (ppm or mg dm<sup>-3</sup>)</i>
Fe	01.2
Mn	0.05
Al	0.2
Cu	3.0
Zn	5.0
Cd	0.005

### Major Water Pollutants

<i>Pollutant</i>	<i>Source</i>
Micro-organisms	Domestic sewage
Organic Wastes	Domestic sewage, animal excreta and waste, decaying animals and plants, discharge from food processing factories.
Plant nutrients	Chemical fertilizers
Toxic heavy metals	Industries and chemical factories
Sediments	Erosion of soil by agriculture and strip mining
Pesticides	Chemicals used for killing insects, fungi and weeds
Radioactive substances	Mining of uranium containing minerals
Heat	Water used for cooling in industries

#### Causes of Water Pollution:

- (i) **Pathogens:** Pathogens are the bacteria and the other organisms that enter water from domestic sewage and animal excreta.  
Human excreta contain bacteria such as *Escherichia coli* and *Streptococcus faecalis*. It causes gastrointestinal diseases.
- (ii) **Organic Wastes:** Organic matter such as leaves, grass, trash etc. can pollute water.
  - Excessive growth of phytoplankton within water also pollute water.
  - Large numbers of bacteria in water can consume oxygen dissolved in water by decomposing organic matter present in water.
  - If the concentration of dissolved oxygen in water is below 6 ppm, the growth of fish gets inhibited.
  - If too much of organic matter is added to water, all the available oxygen is used up. This can cause the death of the aquatic life.

#### ● BOD (Biochemical Oxygen Demand)

It is defined as the amount of oxygen required by bacteria for the breakdown of the organic matter present in a certain volume of a sample of water.

The amount of BOD in water is a measure of the amount of organic material in the water.

Clean water has BOD value of less than 5 ppm.

Highly polluted water could have a BOD value of 17 ppm or more.

#### ● Chemical Pollutants

- (i) **Industrial Wastes:** Chemical reactions carried in the industrial units also pollute water to a great extent. For example, lead, mercury, nickel, cobalt etc. These chemicals give very bad effect to the groundwater and waterbodies are polluted due to the chemical reactions known as leaching.  
Organic chemicals like petroleum products also pollute many sources of water *e.g.*, major oil spills in oceans.
- (ii) **Pesticides:** These are mostly chlorinated hydrocarbons, organophosphates and metallic salts etc. They dissolve in water to small extent and pollute it. Since all the pesticides are toxic in nature, they are injurious to both plants and animals.
- (iii) **Polychlorinated biphenyls (PCBS):** These are the chemical compounds used as fluids in transformers and capacitors. These are released in atmosphere as vapours. They mix with rain water and thus contaminate the water.
- (iv) **Eutrophication:** The process in which algae like organisms reduce dissolved oxygen in water is called as eutrophication. It is harmful for aquatic life.

### ● International Standards for Drinking Water

**Fluoride:** Concentration of fluoride upto 1 ppm or 1 mg dm<sup>-3</sup>, is not harmful for human beings if it is used as drinking water. The F<sup>-</sup> ions make the enamel on teeth much harder by converting hydroxyapatite [3Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>·Ca(OH)<sub>2</sub>] the enamel on the surface of the teeth, into much harder fluorapatite, [3Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>·CaF<sub>2</sub>]. Concentration of F<sup>-</sup> above 2 ppm causes brown mottling of teeth. Excess of fluoride is harmful to bones also.

**Lead:** Upper limit concentration of lead in drinking water is about 50 ppm. Lead can damage kidney, liver, reproductive system etc.

**Sulphate:** At moderate level it is harmless but excess is harmful.

**Nitrate:** The maximum limit of nitrate should be 50 ppm. Excess nitrate in drinking water can cause diseases such as methemoglobinemia (blue baby syndrome).

**Chemical Oxygen Demand (COD):** Water is treated with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> in acidic medium to oxidise polluting substance which cannot be oxidised by microbial oxidation. The remaining K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> is determined by back titration with suitable reducing agent.

From the concentration of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> consumed, the amount of O<sub>2</sub> used in the oxidation is calculated.



### ● Soil Pollution—Sources of Soil Pollution

**Pesticides:** It can be classified as:

(i) **Insecticide:** The most common insecticides are chlorinated hydrocarbons like DDT, BHC etc.

As they are not much soluble in water, they stay in the soil for long time. They are absorbed by the soil and contaminate root crops like radish, carrot etc.

(ii) **Herbicides:** These are the compounds used to control weeds, namely, sodium chlorate (NaClO<sub>3</sub>) and sodium arsenite (Na<sub>3</sub>AsO<sub>3</sub>) are commonly used herbicides but arsenic compounds, being toxic are no longer preferred.

**Fungicides:** Organo-mercury compounds are the most common fungicides. Its dissociation in soil produces mercury which is highly toxic and harmful for the crops.

**Industrial Waste:** It has seen that most of the industrial wastes are thrown into water or dumped into the soil. These industrial wastes contain huge amounts of toxic chemicals which are mostly non-biodegradable. For example, metal processing industries, mining cement, glass industries, petroleum industry etc., fertilizer industry produce gypsum.

The disposal of non-biodegradable industrial solid waste is not done by suitable methods and cause many serious problems.

**Strategies to control environmental pollution:**

(i) The improper disposal of wastes is one of the major causes of environmental degradation. The management of wastes is very important.

(ii) All domestic wastes should be properly collected and disposed.

### ● Green Chemistry

Green Chemistry is a way of thinking and is about utilising the knowledge and principles of chemistry that would control the increasing environmental pollution.

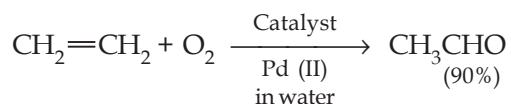
**Green chemistry in day-to-day life:**

(i) **Dry-Cleaning of clothes and laundry:** Replacement of halogenated solvent like (CCl<sub>4</sub>) by liquid CO<sub>2</sub> which is less harmful to groundwater.

Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) is used for the purpose of bleaching clothes.



- (ii) **Bleaching of Paper:** In place of chlorine  $\text{H}_2\text{O}_2$  is used for the bleaching of paper.
- (iii) **Synthesis of Chemicals:** Ethanal ( $\text{CH}_3\text{CHO}$ ) is prepared by step oxidation of ethene. Such as,



## Words that Matter

- **Environmental pollution:** It is the effect of undesirable changes in the surroundings that have harmful effects on plants, animals, and human beings.
- **Troposphere:** The lowest region of atmosphere which extends up to the height of ~ 10 km from sea level in which man and other living organism exists.
- **Stratosphere:** It is above troposphere between 10 to 50 km above the sea level.
- **Acid rain:** It is caused by the presence of oxides of sulphur and nitrogen and  $\text{CO}_2$  in the atmosphere. The pH of the rain drops below 5.6, and it becomes acidic.
- **Greenhouse gases:** Some gases like carbon dioxide, methane, ozone, water vapours, CFCs have the capacity to trap some of the heat radiations from the earth or from the sun. This leads to global warming.
- **Eutrophication:** When phosphate ion increases in water it increases the growth of algae which consume the dissolved oxygen in water consequently aquatic life is adversely affected. This results in loss of biodiversity and the phenomenon is known as Eutrophication.
- **COD (Chemical Oxygen Demand):** It is calculated as the amount of oxygen required to oxidise the polluting substances. It is measured by treating the given sample of water with an oxidising agent, generally  $\text{K}_2\text{Cr}_2\text{O}_7$  in the presence of dil.  $\text{H}_2\text{SO}_4$ .

## NCERT TEXTBOOK QUESTIONS SOLVED

**Q1.** Define environmental chemistry?

**Ans.** Environmental Chemistry is the branch of science which deals with the chemical changes in the environment. It includes our surroundings such as air, water, soil, forest etc.

**Q2.** Explain the tropospheric pollution in 100 words?

**Ans.** Tropospheric pollution occurs due to the presence of undesirable substance in air. These may be the solid or gaseous pollutants.

(i) **Gaseous Air Pollutants:** These are oxides of sulphur, nitrogen and carbon, hydrogen sulphide, hydrocarbons, ozone and other oxidants.

(ii) **Particulate Pollutants:** These are dust, mist, fumes, and smog etc.

**Q3.** Carbon monoxide gas is more dangerous than carbon dioxide gas. Why?

**Ans.** Carbon monoxide combines with haemoglobin to form a very stable compound known as carboxyhaemoglobin when its concentration in blood reaches 3–4%, the oxygen carrying capacity of the blood is greatly reduced. This results into headache, nervousness and sometimes death of the person. On the other hand  $\text{CO}_2$  does not combine with haemoglobin and hence is less harmful than CO.

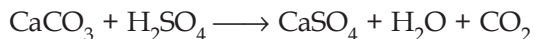
**Q4.** Which gases are responsible for greenhouse effect? List some of them.

**Ans.**  $\text{CO}_2$  is mainly responsible for greenhouse effect. Other greenhouse gases are methane, nitrous oxide, water vapours, CFCs and Ozone.



**Q5.** Statues and monuments in India are affected by acid rain. How?

**Ans.** This is mainly due to the large number of industries and power plants in the nearby areas. Acid rain has vapours of sulphuric acid dissolved in it. When it comes in contact with various statues or monuments, the acid reacts chemically with calcium carbonate.



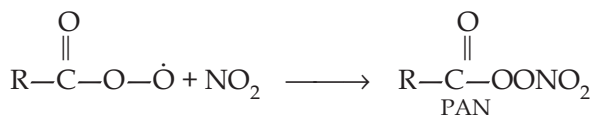
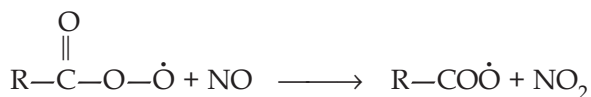
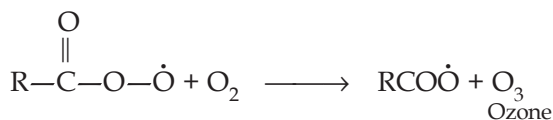
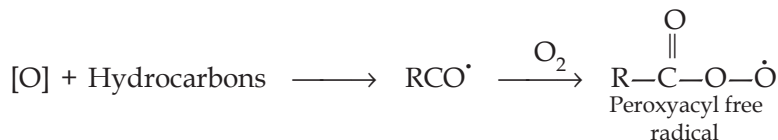
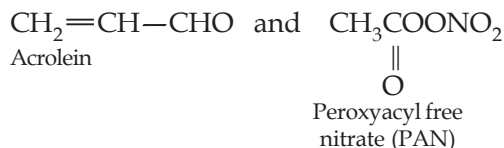
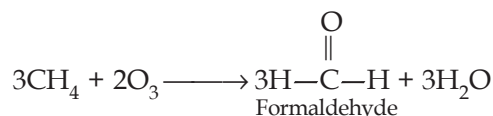
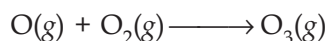
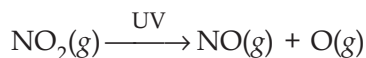
**Q6.** What is smog? How is classical smog different from photochemical smog?

**Ans.** The word smog is a combination of smoke and fog. It is a type of air pollution that occurs in many cities throughout the world. Classical smog occurs in cool humid climate. It is also called as reducing smog.

Whereas photochemical smog occurs in warm and dry sunny climate. It has high concentration of oxidising agents and therefore, it is also called as oxidising smog.

**Q7.** Write down the reactions involved during the formation of photochemical smog.

**Ans. Mechanism of formation of photochemical smog:**



Q8. What are the harmful effects of photochemical smog and how can they be controlled?

Ans. Harmful effects of photochemical smog:

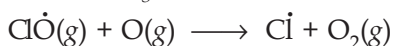
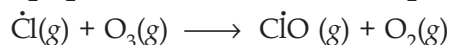
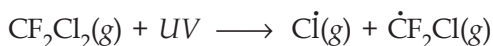
- (i) Their high concentration causes headache, chest pain and dryness of the throat.
- (ii) Ozone and PAN act as powerful eye irritants.
- (iii) Photochemical smog leads to cracking of rubber and extensive damage to plant life.
- (iv) It causes corrosion of metals, stones, building materials, and painted surface etc.

**Control:**

- (i) Use of catalytic converter in automobiles prevents the release of nitrogen dioxide and hydrocarbons to the atmosphere.
- (ii) Pinus, juniparus, quercus, pyrus etc. can metabolise nitrogen dioxide thus their plantation could help to some extent.

Q9. What are the reactions involved for ozone layer depletion in the stratosphere?

Ans. The reaction can be shown as follows:



Q10. What do you mean by ozone hole? What are its consequences?

Ans. Depletion of ozone layer creates some sort of holes in the blanket of ozone which surround us, this is known as ozone hole.

- (i) With the depletion of the ozone layer, UV radiation filters into the troposphere which leads to aging of skin, cataract, sunburn, skin cancer etc.
- (ii) By killing many of the phytoplanktons, it can damage the fish productivity.
- (iii) Evaporation rate increases through the surface and stomata of leaves which can decrease the moisture content of the soil.

Q11. What are the major causes of water pollution? Explain.

Ans. **Causes of water pollution:**

- (i) **Pathogens:** Pathogens include bacteria and other microorganisms that enter water from domestic sewage and animal excreta.  
Human excreta contain bacteria such as *Escherichia coli* and *Streptococcus faecalis* which cause gastrointestinal diseases.
- (ii) **Organic wastes:** Organic wastes when added to water, as these are biodegradable, bacteria decomposes organic matter and consume dissolved oxygen in water. When the concentration of dissolved oxygen of water is below 6 ppm, the growth of fish gets inhibited. Breakdown of the organic wastes by anaerobic bacteria produces chemicals that have a foul smell and are harmful to human health.
- (iii) **Chemical pollutants:** Some inorganic chemicals as an industrial wastes dissolve in water like cadmium, mercury nickel etc. These metals are dangerous to humans and other animals. These metals can damage kidneys and central nervous system, liver etc. Petroleum products pollute many sources of water.

Q12. Have you ever observed any water pollution in your area? What measures would you suggest to control it?

Ans. Answer yourself.

**Q13.** What do you mean by Biochemical Oxygen Demand (BOD)?

**Ans.** The amount of oxygen required by bacteria to breakdown the organic matter present in a certain volume of a sample of water is called Biochemical Oxygen Demand (BOD).

**Q14.** Do you observe any soil pollution in your neighbourhood? What efforts will you make for controlling the soil pollution?

**Ans.** Answer yourself.

**Q15.** What are pesticides and herbicides? Explain giving examples.

**Ans.** Pesticides are the chemical compounds used in agriculture to control the damages caused by insects, rodents, weeds and various crop diseases.

*Example:* Aldrin, Dilldrin, B.H.C etc.

**Herbicides:** These are the chemicals used to control weeds.

*Example:* Triazines.

**Q16.** What do you mean by green chemistry? How will it help in decreasing environmental pollution?

**Ans.** Green chemistry is a way of thinking and is about utilising the existing knowledge and principles of chemistry and other sciences to reduce the adverse effect of pollution.

For example:

(i) Automobile engines have been fitted with catalytic converters which prevent the release of the vapours of hydrocarbons and oxides of nitrogen into acrolein and peroxyacetyl nitrate.

(ii) CO<sub>2</sub> has replaced CFCs as blowing agents in the manufacture of polystyrene foam sheets.

**Q17.** What would have happened if the greenhouse gases were totally missing in the earth's atmosphere? Discuss.

**Ans.** The solar energy radiated back from the earth surface is absorbed by the green house gases. (CO<sub>2</sub>, CH<sub>4</sub>, O<sub>3</sub>, CFCs) are present near the earth's surface.

They heat up the atmosphere near the earth's surface and keep it warm. As a result of these, there is growth of vegetation which supports the life. In the absence of this effect, there will be no life of both plant and animal on the surface of the earth.

**Q18.** A large number of fish are suddenly found floating dead on a lake. There is no evidence of toxic dumping but you find an abundance of phytoplankton. Suggest a reason for the fish kill.

**Ans.** Excessive phytoplankton (organic pollutants such as leaves, grass trash etc.) present in water are biodegradable. Bacteria decomposes these organic matters in water. During this process when large number of bacteria decomposes these organic matters, they consume the dissolved oxygen in water. When the level of dissolved oxygen falls below 6 ppm the fish cannot survive.

**Q19.** How can domestic waste be used as manure?

**Ans.** Domestic waste consists of biodegradable waste which can be converted into manure by suitable method.

**Q20.** For your agricultural field or garden you have developed a compost producing pit. Discuss the process in the light of bad odour, flies and recycling of wastes for a good produce.

**Ans.** The compost producing pit should be kept covered so that flies cannot make entry into it and bad odour is minimized.

The waste materials which are non-biodegradable like glasses, plastic bags, polybags, must be handed over to the vendors who can send them to the recycling plants.

## MORE QUESTIONS SOLVED

### I. VERY SHORT ANSWER TYPE QUESTIONS

- Q1.** *What do you mean by primary and secondary pollutants of the air?*  
**Ans.** Primary pollutants are those which after their formation remains as it was before e.g., NO. Secondary pollutants are formed as a reaction with primary pollutants e.g., PAN (peroxyacyl nitrates).
- Q2.** *What is the name of the compound formed when CO combines with blood?*  
**Ans.** Carboxyhaemoglobin.
- Q3.** *How are NO and NO<sub>2</sub> formed in the atmosphere?*  
**Ans.** NO is formed due to the reaction between N<sub>2</sub> and O<sub>2</sub> during lightning or by the combustion of fossil fuels.  
NO is oxidised to form NO<sub>2</sub>.
- Q4.** *What is chlorosis?*  
**Ans.** Slowdown of process of formation of chlorophyll in plants with the presence of SO<sub>2</sub> is called chlorosis.
- Q5.** *Which zone is known as ozonosphere?*  
**Ans.** Stratosphere.
- Q6.** *Which main gases is responsible for damage in ozone layer?*  
**Ans.** NO and CFCs
- Q7.** *What is the nature of classical smog?*  
**Ans.** Reducing.
- Q8.** *Name the acids which are responsible for acid rain?*  
**Ans.** H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub> and HCl.
- Q9.** *What is BOD?*  
**Ans.** The amount of oxygen consumed by micro organism in decomposing organic wastes of sewage water is called BOD (Biochemical Oxygen Demand).
- Q. 10.** *What do you mean by viable and non-viable particulates?*  
**Ans.** Viable particulates are microorganisms like bacteria, fungi, moulds, algae etc. Non-viable particulates are formed by the disintegration of bigger size particles or by the condensation of water vapour. e.g., mist, smoke, fume and dust.
- Q11.** *What is siltation?*  
**Ans.** Mixing of soil or rock particles in water is called siltation.
- Q12.** *What is the composition of London Smog?*  
**Ans.** London Smog consists H<sub>2</sub>SO<sub>4</sub> deposited on the particulates suspended in the atmosphere.
- Q13.** *List out the gases which are considered as major source of air pollution.*  
**Ans.** Carbon monoxide (CO), sulphur dioxide (SO<sub>2</sub>) and oxides of nitrogen (NO<sub>2</sub>).
- Q14.** *Why is acid rain considered as threat to Taj Mahal?*  
**Ans.** Acids present in acid rain can react with marble (CaCO<sub>3</sub>) and damage the monument.
- Q15.** *Give one example of organic herbicide.*  
**Ans.** Triazines.
- Q16.** *What are pesticides?*  
**Ans.** Pesticides are the substances used to kill unwanted pests.  
For example, DDT.

Q17. What is PAN stands for?

Ans. It is peroxyacetyl nitrate.

Q18. Give the examples of insecticides.

Ans. DDT, BHC.

Q19. Which gas was mainly responsible for Bhopal gas tragedy?

Ans. Methyl isocyanate.

Q20. What is meant by polar vortex?

Ans. A tight whirlpool of wind formed in the stratosphere which surrounds Antarctica is called polar vortex.

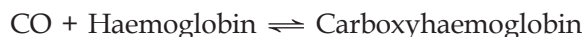
Q21. What should be the tolerable limit of  $F^-$  ions in drinking water?

Ans. 1 ppm or  $1 \text{ mg dm}^{-3}$ .

## II. SHORT ANSWER TYPE QUESTIONS

Q1. How carbon monoxide acts as a poison for human beings?

Ans. Carbon monoxide is poisonous because it combines with haemoglobin of R.B.C. to form carboxyhaemoglobin as.



It inhibits the transport of oxygen to different parts of the body. Thus the body becomes oxygen-starved.

Q2. What is 'Acid Rain'? How is it harmful to the environment?

Ans. Acid rain is the rain water mixed with small amount of sulphuric acid, nitric acid along with hydrochloric acid which are formed from the oxides of sulphur and nitrogen present in air as pollutants. It has a pH of 4–5.

### Harmful effects of Acid Rain

- (i) It is toxic to vegetation and aquatic life.
- (ii) It damages buildings and statues. Taj Mahal has been damaged by acid rain.
- (iii) Acid rain corrodes water conducting pipes resulting in the leaching of heavy metals such as iron, lead, etc., to the drinking water.

Q3. What is photochemical smog? What are its effects? How can it be controlled?

Ans. This is a type of smog formed in warm, dry and sunny climate. They are formed when sunlight is absorbed by  $\text{SO}_2$ , oxides of nitrogen and hydrocarbons. They act as oxidising agents.

### Effects of photochemical smog

- (i) They produce irritation in the eyes and also in respiratory system.
- (ii) They can damage many materials such as metals, stones, building materials etc.
- (iii)  $\text{NO}_2$  present gives a brown colour to the photochemical smog which reduces visibility.
- (iv) It is harmful to fabrics, crops and ornamental plants.

### Control of photochemical smog

- (i) By using catalytic converters in automobiles.
- (ii) By spraying certain compounds into atmosphere which generate free radicals that can easily combine with the free radicals that initiate the reaction forming toxic compounds of photochemical smog.
- (iii) Certain plants such as pinus, juniparus, pyrus could be helpful in this matter.

**Q4.** What do you mean by greenhouse effect? What is the role of  $\text{CO}_2$  in the greenhouse effect?

**Ans.** It is the phenomenon in which earth's atmosphere traps the heat from the sun and prevents it from escaping in outer space. Gases such as  $\text{CO}_2$ , methane, ozone, CFCs are believed to be responsible for this effect.

Heat from the sun after being absorbed by the earth is absorbed by  $\text{CO}_2$  and then radiated back to the earth. Thus making the environment of the earth warm.

**Q5.** (a) Define eutrophication and pneumoconiosis.  
(b) Write difference between photochemical and classical smog.

**Ans.** (a) **Eutrophication:** When the growth of algae increases in the surface of water, dissolved oxygen in water is reduced. This phenomenon is known as eutrophication. (Due to this growth of fish gets inhibited).

**Pneumoconiosis:** It is a disease which irritates lungs. It causes scarring or fibrosis of the lung.

(b)	Photochemical smog	Classical smog
	(i) It is formed as a result of photochemical decomposition of nitrogen dioxide and chemical reactions involving hydrocarbons. (ii) It takes place during dry warm season in presence of sunlight. (iii) It is oxidising in nature.	(i) It is formed due to condensation of $\text{SO}_2$ vapours on particles of carbon in cold climate. (ii) It is generally formed during winter when there is severe cold. (iii) It is reducing in nature.

### III. MULTIPLE CHOICE QUESTIONS

- Which of the following acid is most abundant in acid rain?  
(a)  $\text{HCl}$                       (b)  $\text{HNO}_3$                       (c)  $\text{H}_2\text{SO}_4$                       (d) Organic acid
  - Which of the following causes less pollution?  
(a)  $\text{NO}_x$                       (b)  $\text{SO}_x$                       (c)  $\text{CO}_2$                       (d)  $\text{C}_x\text{H}_y$
  - Besides  $\text{CO}_2$ , the other greenhouse gas is  
(a) Ar                      (b)  $\text{N}_2$                       (c)  $\text{O}_2$                       (d)  $\text{CH}_4$
  - BOD is a measure of  
(a) Organic pollutant in water                      (b) Inorganic pollutant in water  
(c) Particulate matter in water                      (d) All of the above
  - The gas which reacts with haemoglobin in blood is  
(a) CO                      (b)  $\text{SO}_2$                       (c)  $\text{CO}_2$                       (d)  $\text{NO}_2$
  - Ozone depletion is mainly due to  
(a) HCFs                      (b) CFCs                      (c)  $\text{CH}_3\text{Br}$                       (d) all of the above
  - The pollutant released in Bhopal gas tragedy was  
(a) Ammonia                      (b) Mustard gas                      (c) Nitrous oxide                      (d) Methyl isocyanate
  - Which of the following will increase the BOD of water supply?  
(a)  $\text{O}_3$                       (b)  $\text{C}_2\text{H}_5\text{OH}$                       (c)  $\text{H}_2\text{O}$                       (d)  $\text{CO}_2$
- Ans.** 1. (c)                      2. (c)                      3. (d)                      4. (a)                      5. (a)  
6. (b)                      7. (d)                      8. (c)

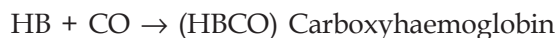
#### IV. HOTS QUESTIONS

**Q1.** *What is meant by PCBs?*

**Ans.** PCBs are polychlorinated biphenyls. They are contaminants of water. They are used as fluids in transformers and capacitors.

**Q2.** *What is the compound formed when CO combines with blood?*

**Ans.** When CO combines with blood, the following reaction occurs forming carboxyhaemoglobin:-



**Q3.** *Give three examples in which green chemistry has been applied.*

**Ans.** (i) In dry-cleaning, use of liquefied  $\text{CO}_2$  in place of tetrachloroethene ( $\text{Cl}_2\text{C} = \text{CCl}_2$ ).

(ii) In bleaching of paper using  $\text{H}_2\text{O}_2$  in place of chlorine.

(iii) In the manufacture of chemicals like ethanal using environment-friendly chemicals and conditions.

□□□