Environmental Chemistry

14 Chapter

Exercise:

1. Define environmental chemistry?

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

2. Explain the tropospheric pollution in 100 words?

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

- **Gaseous Air Pollutants:** These are oxides of sulphur, nitrogen and carbon, hydrogen sulphide, hydrocarbons, ozone and other oxidants
- **Particulate Pollutants:** These are dust, mist, fumes, and smog etc.

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

Ans: Carbon monoxide combines with hemoglobin to form a very stable compound known as carboxyhemoglobin when its concentration in blood reaches 3-4%, the oxygen carrying capacity of the blood is greatly reduced because the level of hemoglobin is reduced and not available for combination with oxygen. This results in headache, nervousness and sometimes death. On the other hand CO_2 does not combine with hemoglobin and hence is less harmful than CO.

4. List gases which are responsible for the greenhouse effect?

Ans: CO_2 is mainly responsible for the greenhouse effect. Other greenhouse gases are methane, nitrous oxide, water vapors, CFCs and Ozone.

5. 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 vapors of sulphuric acid dissolved in it. When it comes in contact with various statues or monuments, the acid reacts chemically with calcium carbonate.

$$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$$

6. 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 climates. It is also called as reducing smog form by combination of smoke, dust and fog containing sulphur oxides. Whereas photochemical smog occurs in warm and dry sunny climates. It has a high concentration of oxidizing agents and therefore, it is also called as oxidizing smog.

7. Write down the reactions involved during the formation of photochemical smog.

Ans: mechanism of formation of photochemical smog

$$NO_2(g) + \xrightarrow{UV} NO(g) + O(g)$$

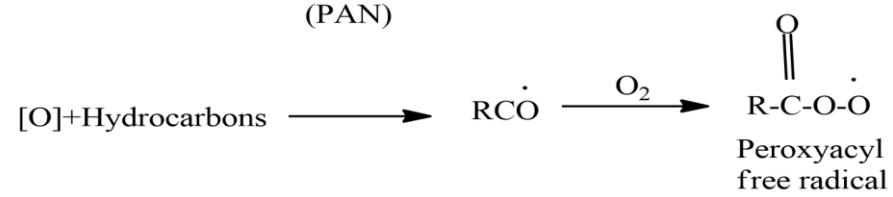
$$O(g) + O_2(g) \rightarrow O_3(g)$$

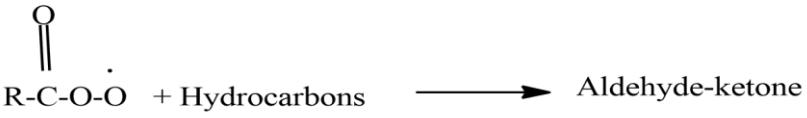
$$NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g)$$

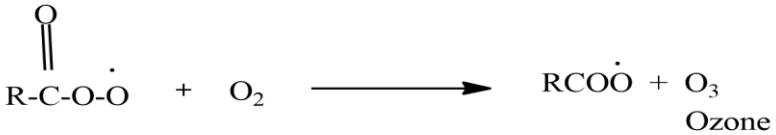
$$3CH_4 + 2O_3 \rightarrow 3\underset{\text{Formaldehyde}}{HCHO} + 3H_2O$$

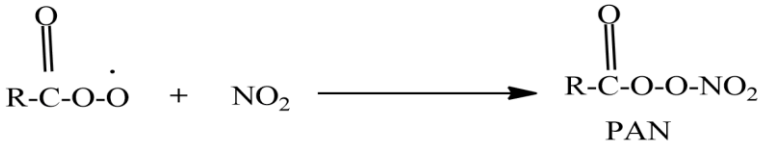
$CH_2{=}CH\text{-}CHO$ and CH_3COONO_2

Acrolein — Peroxyacyl free nitrate (PAN)









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

Ans: Harmful effects of photochemical smog:

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

Control:

- Use of catalytic converter in automobiles prevents the release of nitrogen dioxide and hydrocarbons to the atmosphere.
- Pinus, Juniparus, Quercus, Pyrus like plants can metabolize nitrogen dioxide thus their plantation could help to some extent.

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

Ans: The reaction can be shown as follows:

$$CF_2Cl_2(g) + UV \rightarrow Cl(g) + CF_2Cl(g)$$

$$Cl(g) + O_3(g) \rightarrow ClO(g) + O_2(g)$$

$$ClO(g) + O(g) \rightarrow Cl + O_2(g)$$

10. 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 surrounds earth; this is known as ozone hole.

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

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

Ans: Causes of water pollution:

- **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 faecal which cause gastrointestinal diseases.
- **Organic wastes:** Organic wastes when added to water, as these are biodegradable, bacteria decompose 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.
- **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 levers etc. Petroleum products pollute many sources of water.

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

Ans: Water pollution arises as a result of various human activities. This includes discharges from wastewater treatment plants, run-off from agricultural fields, storm-water drainage, etc.
Pollutants from these sources enter the water bodies, thereby contaminating the water and rendering it impure.
Industries and chemical factories discharge toxic, heavy metals such as Fe, Mn, Al, etc., along with organic wastes into water. Domestic sewage and animal excreta are also responsible for pathogenic contamination of water. These pollutants make water unfit for drinking.
Therefore, all industrial and chemical discharges should be made free from toxic metals before allowing them to enter a water body. The concentration of these pollutants should be checked regularly. Compost should be preferred over chemical fertilizers in gardens and agricultural fields to avoid harmful chemicals from entering groundwater.

13. 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).

14. Do you observe any soil pollution in your neighborhood? What efforts will you make to control soil pollution?

Ans: Major sources of soil pollution are industrial wastes and agricultural

pollutants such as pesticides, fertilizers, etc.
It is very important to maintain the quality and fertility of soil to ensure and sustain the growth of plants and food crops.
Insecticides like DDT are not soluble in water. For this reason, they remain in soil for a long time, contaminating the root crops. Pesticides like Aldrin and Dieldrin are non- biodegradable and highly toxic in nature. They can enter the higher trophic levels through food chains, causing metabolic and physiological disorders. The same is true for industrial wastes that comprises several toxic metals like Pb, As, Hg, Cd, etc. Hence, the best way to check soil pollution is to avoid direct addition of pollutants to the soil. Also, wastes should undergo proper treatment. They should be recycled and only then, allowed to be dumped.

15. 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, Dieldrin, B.H.C. etc.
Herbicides: These are the chemicals used to control weeds.
Example: Triazines.

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

Ans: Green chemistry is a strategy to design chemical processes and products that reduce or eliminate the use and regeneration of hazardous substances. This would bring about minimum pollution or deterioration to the environment.
For example:

- Automobile engines have been fitted with catalytic converters which prevent the release of the vapors of hydrocarbons and oxides of nitrogen into acrolein and peroxyacetyl nitrate.
- CO2 has replaced CFCs as blowing agents in the manufacture of polystyrene foam sheets.
- Liquid carbon dioxides used for dry cleaning instead of other chemicals.

17. 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 greenhouse gases. (CO_2,CH_4,O_3 , 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 life. In the absence of this effect, there will be no life of both plant and animal on the surface of the earth

because temperature will be much lower while CO_2 is a very important part of green plants.

18. A large number of fish are suddenly found floating dead on a lake. T here 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 decompose these organic matters in water. During this process when a large number of bacteria decompose these organic matter, they consume the dissolved oxygen in water. When the level of dissolved oxygen falls below 6 ppm and the proper amount of oxygen is not available, fish present in the lake cannot survive.

19. How can domestic waste be used as manure?

Ans: Domestic waste consists of biodegradable waste which can be converted into manure by suitable methods.

20. 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 product.

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.

I. Very Short Answer Type Questions

1. What do you mean by primary and secondary pollutants of the air?

Ans: Primary pollutants are those which after their formation remain as it were before e.g., No. Secondary pollutants are formed as reactions with primary pollutants e.g., PAN (peroxyacyl nitrates).

2. What is the name of the compound formed when CO combines with blood?

Ans: Carboxyhaemoglobin

3. How are NO and NO_2 formed in the atmosphere?

Ans: NO is formed due to the reaction between N_2 and O_2 during lightning or by the combustion of fossil fuels. NO Is oxidized to form NO_2.

4. What is chlorosis?

Ans: Slowdown of the process of formation of chlorophyll in plants with the presence of SO2 is called chlorosis. It occurs generally due to deficiency of iron and zinc.

5. Which zone is called the ozonosphere?

Ans: stratosphere

6. Which main gases are responsible for damage is the ozone layer?

Ans: NO and CFCs

7. What is the nature of classic smog?

Ans: Reducing.

8. Name the acids which are responsible for acid rain?

Ans: H_2SO_4, HNO_3 and HCl

9. What is BOD?

Ans: The amount of oxygen consumed by micro organism in decomposing wastes of sewage water is called BOD (Biological Oxygen Demand)

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.

11. What is siltation?

Ans: Mixing of soil or rock particles in water is called siltationwhich becomes suspended after some time period in the form of silt.

12. What is the composition of London Smog?

Ans: London Smog consists H_2SO_4 deposited on the particles suspended in the atmosphere.

13. List out the gases which are considered as a major source of air pollution?

Ans: Carbon monoxide (CO), Sulphur dioxide (SO_2) and oxides of nitrogen (NO_2).

14. Why is acid rain considered a threat to the Taj Mahal?

Ans: Acids present in acid rain can react with marble ($CaCO_3$) and damage the monument.

15. Give one example of organic herbicide?

Ans: Traizines

16. What are pesticides?

Ans: Pesticides are the substances used to kill unwanted pests. For example: DDT

17. What does PAN stand for?

Ans: It is Peroxyacetyl nitrate

18. Give examples of insecticides?

Ans: DDT, BHC

19. Which gas was mainly responsible for the Bhopal gas tragedy?

Ans: Methyl Isocyanate

20. What is meant by polar vortex?

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

21. What should be the tolerable limit of F ions in drinking water?

Ans: 1-1.5 ppm

II. Short Answer Questions

1. How does carbon monoxide act as a poison for human beings?

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

CO + haemoglobin → Carboxyhaemoglobin

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

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

Ans: Acid rain is the rain water mixed with small **amounts** of sulphuric acid, nitric and 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

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

3. 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 **climates**. They are formed when sunlight is absorbed by SO2, oxides of nitrogen and hydrocarbons. They act as oxidizing agents.

Effects of photochemical smog

- They produce irritation in the eyes and also in the respiratory system.
- They can damage many materials such as metals, stones, building material etc.
- NO_2 Present gives a brown colour to the photochemical smog which reduces visibility.
- It is harmful to fabrics, crops and ornamental plants.

Control of photochemical smog

- By using catalytic converters in automobiles
- By spraying certain compounds into the atmosphere which generate free radicals that can easily combine with free radicals that initiate the reaction forming toxic compounds of photochemical smog.
- Certain plants such as Pinus, Juniparus, Pyrus could be helpful in this matter.

4. What do you mean by greenhouse effect? What is the role CO_2 in the greenhouse effect?3

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 CO_2, methane, ozone, and CFCs are believed to be responsible for this effect. Heat from the sun after being absorbed by the earth is absorbed by CO_2 and then radiated back to the earth. Thus making the environment of the earth warm results in melting of glaciers and increases sea levels.

5. a) Define eutrophication and pneumoconiosis.

Ans: Eutrophication: When the growth of algaes 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 because algae growth releases toxins in water).

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

b) Write difference between photochemical and classical smog.

Ans:

Photochemical smog	Classical smog
(i)It is formed as a result of photochemical decomposition of nitrogen dioxide and chemical reactions involving hydrocarbons.	(i) It is formed due to condensation of SO,vapours on particles of carbon in cold climates .
(ii) It takes place during the dry warm season in the presence of sunlight by reaction with nitrogen oxides an hydrocarbons released by automobiles.	(ii) It is generally formed during winter when there is severe cold due to reaction of sulphuroxidedand polluted air.
(iii) It is oxidizing in nature.	(iii) It is reducing in nature.

III. Multiple choice questions

1. Which of the following is the most abundant in acid rain?

a) **HCl**

b) **HNO_3**

c) **H_2SO_4**

d) Organic acid

Ans: c) H_2SO_4

2. Which of the following causes less pollution?

a) **NO_x**

b) **SO_x**

c) **CO_2**

d) **C_xH_y**

Ans: c) CO_2

3. **Besides CO_2, the other greenhouse gas is**
   a) Ar
   b) N_2
   c) O_2
   d) CH_4

Ans: d) CH_4

4. **BOD is a measure of**
   a) Organic pollutant in water
   b) Inorganic pollutant in water
   c) Particulate pollutant in water
   d) All of the above

Ans: a) Organic pollutant in water

5. **The gas which reacts with a Hemoglobin in blood is**
   a) CO
   b) SO_2
   c) CO_2
   d) NO_2

Ans: a) CO

6. **Ozone depletion mainly due to**
   a) HCFs
   b) CFCs
   c) CH_3Br
   d) All of the above

Ans: b) CFCs

7. **The pollutant released in Bhopal gas tragedy was**
   a) Ammonia
   b) Mustard gas
   c) Nitrous oxide
   d) Methyl isocyanate

Ans: d) Methyl isocyanate

8. **Which of the following will increase the BOD of water supply?**
   a) $\mathbf{O_3}$
   b) $\mathbf{C_2H_5OH}$
   c) $\mathbf{H_2O}$
   d) $\mathbf{CO_2}$

Ans: c) H_2O

IV. Hots Questions

1. **What is meant by PCB's?**

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

2. **Which compound is formed when CO combines with blood?**

Ans: When CO combines with blood, the following reaction occurs forming carboxyhemoglobin which is a permanent compound and does not dissociate further:-

$HB + CO \rightarrow HBCO(\text{Carboxyhaemoglobin})$

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

Ans:

- In dry-cleaning, use of liquefied CO_2 in place of **tetrachloroethene** ($Cl_2C = CCl_2$).
- In bleaching of paper using H_2O_2 in place of chlorine.
- In the manufacture of chemicals like ethanol using environment-friendly chemicals and conditions.