

DAY SEVENTEEN

Environmental Chemistry

Learning & Revision for the Day

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|--------------------------------|--------------------------|---|
| ♦ Pollutants | ♦ Air Pollution | ♦ Green Chemistry as an Alternative Tool for Reducing |
| ♦ Major Atmospheric Pollutants | ♦ Water Pollution | ♦ Strategies to Control Environmental Pollution |
| | ♦ Soil or Land Pollution | |

Contamination of the environment (i.e. our surroundings such as air, water, soil etc.) with harmful wastes arising mainly from certain human activities is called **environmental pollution**.

Pollutants

Any substance which is harmful for the environment is known as **pollutants**.

- (i) **Primary Pollutants** These are the pollutants persisting in the environment in the form, they are produced, e.g. carbon monoxide.
- (ii) **Secondary Pollutants** These are formed by the combination of primary pollutants present in the environment, e.g. two primary pollutants, nitrogen oxides and hydrocarbons, react together in the presence of sunlight to form secondary pollutant, peroxyacetyl nitrate (PAN).
- (iii) **Biodegradable Pollutants** These pollutants are those which are decomposed by microorganisms either by itself or by suitable treatment, e.g. sewage, various oxides of nitrogen and sulphur, etc.
- (iv) **Non-biodegradable Pollutants** These pollutants are not decomposed naturally and are not recycled. They are harmful to environment even in low concentrations, e.g. heavy metals, detergents, plastics, pesticides etc.

Major Atmospheric Pollutants

The following are the major atmospheric pollutants are of two types :

Gaseous Air Pollutants

- (i) **Oxides of Sulphur** Sulphur dioxide (SO_2) and sulphur trioxide (SO_3) are the two oxides of sulphur that cause air pollution.
- (ii) **Oxides of Nitrogen** Among the various oxides of nitrogen, nitric oxide (NO), a colourless, odourless gas and nitrogen dioxide (NO_2), a brown gas with pungent odour, are the two oxides that act as tropospheric pollutants.

- (iii) **Hydrocarbons** These are the compounds of only carbon (C) and hydrogen (H). Among various hydrocarbons methane (CH₄) or **marsh gas** is the most abundance hydrocarbon pollutant.
- (iv) **Oxides of Carbon** Carbon forms two oxides, i.e., carbon monoxide (CO) and carbon dioxide (CO₂). Both are colourless and odourless gases. However, the former one is the most serious air pollutant.

NOTE Particulate pollutants like dust, mist, fumes, smoke etc.

Types of Pollution

- On the basis of pollutant, the pollution can be classified as:
 - (i) Thermal pollution
 - (ii) Noise pollution
 - (iii) Chemical pollution
 - (iv) Metal pollution
 - (v) Smog pollution
 - (vi) Oil pollution
- On the basis of part of environment polluted, the pollution can be classified as:
 - (i) Air pollution
 - (ii) Water pollution
 - (iii) Soil pollution
- Sink** is a medium present in atmosphere which takes up certain pollutants, e.g. ocean is a sink for water soluble oxides like CO₂, SO₂, etc.

Air Pollution

It occurs when the concentration of a normal component of the air or a new chemical substance added or formed in air, build up to undesirable proportions causing harm to humans, animals, vegetation and materials. The chemical substances and particles causing pollution are called **air pollutants**.

Sources of air pollution are:

- Burning of fossil fuels such as coal, wood and oil.
- Exhaust gases emitted by internal combustion engines of vehicles.
- Chemical industries and their released products.

Consequences of Air Pollution

1. Greenhouse Effect

The phenomenon in which atmosphere of earth traps the heat coming from the sun and prevents it from escaping into the outer space, is called **green house effect**.

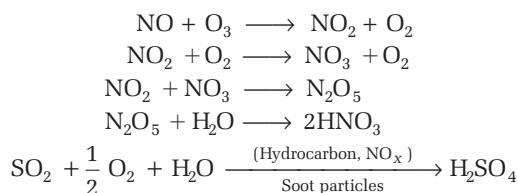
Certain gases, called green house gases [carbon dioxide, methane, ozone, chlorofluorocarbon compounds (CFCs) and water vapour] in the atmosphere absorb the heat reflected or emitted by earth and radiate back it to the surface of the earth. The greenhouse gases are useful in keeping the earth warm with in an average global temperature of about 15°.

2. Global Warming

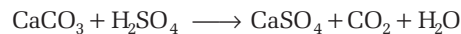
The warming of the earth as a consequence of the warming of air due to greenhouse gases, is called **global warming**. Increase in the concentration of CO₂ in the atmosphere leads to increase in the temperature of the earth's surface resulting in melting of glaciers and polar ice caps and hence, level of sea water may rise.

3. Acid Rain

The rain having pH value below 5 (whereas normal rain has pH around 5.6), is called **acid rain**. Oxides of N and S are responsible for making rain water acidic. which are converted into HNO₃ and H₂SO₄ respectively.



Acid rain causes extensive damage to building and sculptural materials of marble, limestone, slate, mortar etc.



In acid rain, the order of concentration of various acids is



Smog

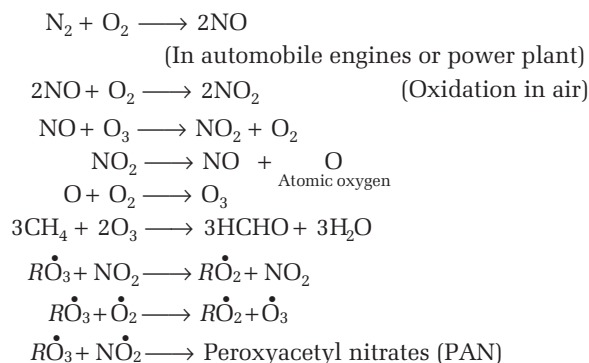
The term smog was derived to describe a condition, common in London, where combination of smoke and fog occurs.



Smog is an important example of air pollution which can be seen in many cities throughout the world.

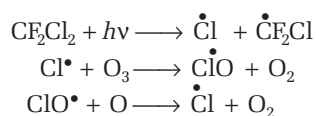
Smog are mainly of two types :

- Classical Smog** SO₂ and particulate matter are main components of classical smog (London smog) which is mostly observed in cool humid climate and is chemically reducing in nature.
- Photochemical Smog** (Los Angeles Smog) It contains a mixture of primary pollutants such as nitrogen oxides, carbon monoxide and secondary pollutants such as O₃ and HCHO. It occurs in warm, dry and sunny climate and are caused by the action of sunlight on nitrogen oxides and hydrocarbons and is oxidising in nature. Formation of photochemical smog can be shown as follows:



Ozone Depletion

- Ozone (O₃) present in the stratosphere prevents about 99.5% of UV radiations reaching to the earth's surface and there by protecting humans and other animals from its harmful effect.
- Ozone Depletion is caused by the chlorofluorocarbons present in aerosols, air conditioning and refrigeration devices.
- One molecule of CFC can destroy more than thousand molecules of O₃, which leads to the formation of ozone hole. The reaction is shown below;



- CFCs are stable in lower atmosphere but when they reach the stratosphere, they split and become unstable by sunlight.
- The ozone depletion over **Antarctica** occurs during spring but gets replenished after spring is over.
- Stable wind patterns in stratosphere are called polar vortex, which does not allow the O₃ rich air to fill up the gap.
- **As remedial measures** of air pollution industries should purify the smoke to a certain extent before releasing into air. They should use chimneys. Planting more and more trees is also a method to maintain the oxygen-carbon dioxide balance.

Effects of Depletion of Ozone Layer

Due to the depletion of ozone layer, harmful UV radiations reach the earth surface. These radiations can cause skin cancer, sunburn, ageing of skin, cataract or even blindness. These also lead to the harmful mutation of cells in plants, depletion of plants and crops. These decrease the moisture content of soil, thereby increasing the evaporation of surface water.

Water Pollution

It is the degradation of quality of water due to addition of inorganic, organic, biological or radiological substances. The substances make water unfit for human use and growth of aquatic biota.

Sources of water pollution are as follows:

- Leaching of minerals, slit from soil erosion and falling of organic matter from banks are the important **natural sources** of water pollution.
- Sewage, domestic waste, soaps and detergents, fertilizers and pesticides, industrial wastes, heat, are the **man made sources** of water pollution.

- (i) **Biochemical Oxygen Demand (BOD)** is the amount of oxygen consumed by microorganism in decomposing the waste present in a certain volume of sample of water.

$$\text{BOD} = \frac{\text{Number of milligrams of O}_2 \text{ needed}}{\text{Number of litres of the sample}}$$

- (ii) **Chemical Oxygen Demand (COD)** determination involves a known quantity of water sample is oxidised by acidified K₂C₂O₇. The unused amount of dichromate is determined by back titration. The amount of oxygen used in oxidation is calculated from consumed concentration of K₂C₂O₇.

Effects of Water Pollution

Effects of water pollution are as follows :

- High concentration of fluoride are poisonous and are harmful to bones and teeth at levels over 10 ppm.
- Excessive sulphate (> 500 ppm) have a laxative effect.
- Excess nitrate (NO₃⁻) in drinking water can lead to blue baby syndrome (methemoglobinemia).

Remedial Measures

Remedial measures for water pollution are as follows :

- Removal of large solids from waste water by filtration.
- Settlement of the filtered waste water to remove suspended solids, oily and greasy material, which floats on the surface can be skimmed off.
- Degradation of organic content of waste water by microbial oxidation.
- Removal of phosphates, coagulation, filtration, and disinfection using chlorine for improving the quality of waste water.

Soil or Land Pollution

Soil pollution is the addition of such chemical substances (in an indefinite proportion) which decreases its productivity, quality of plants and ground water, to the soil system.

Causes of soil pollution are as follows :

- (i) Erosion of upper fertile layer and over use of the land.
- (ii) Pesticides like insecticides (e.g. DDT, BHC), herbicides (e.g. NaClO₃, Na₂AsO₃), fungicides (e.g. organomercury compounds) and fertilizers. Soil conditioners (e.g. compounds of As, Hg, Pb, etc.)
- (iii) Dumping of waste such as garbage, rubbish, industrial wastes, ash, sludge, broken cans and bottles, etc.

Remedial measures for soil pollution are as follows :

- (i) Forestation to check the spread of desert.
- (ii) Chemicals like fertilizers, insecticides, polymers, pesticides and herbicides should be used, only when necessary.

Green Chemistry as an Alternative Tool for Reducing Pollution

Green chemistry is a branch of chemistry in which chemicals of daily needs are produced by using such reactions or processes that neither use toxic chemicals nor emit such chemicals into the atmosphere. In this, various reactions are carried out in the presence of mild and environment friendly reagents such as ultraviolet light (photochemistry), sound waves (sonic chemistry), enzymes and microwaves so that harmful chemicals are neither used up nor released.

Applications of Green Chemistry

Some uses of the green chemistry in day to day life are:

1. Use of liquefied carbon dioxide with suitable detergents for drycleaning clothes which replaces tetrachloroethene, a pollutant and suspected carcinogen (used earlier for drycleaning).
2. Use of hydrogen peroxide for bleaching clothes, in laundry and paper.
3. Catalytic dehydrogenation of diethanolamine without using formaldehyde and cyanide.

Strategies to Control Environmental Pollution

- (i) **Waste management and green chemistry** are used to control environmental pollution. Waste management is done by recycling, digestion, incineration, dumping and sewage treatment.
- (ii) **Recycling**, i.e. conversion of waste into useful products. It saves raw materials and reduces the cost of waste disposal, e.g. recycling glass bottles, scrap metal in the manufacture of steel, generation of energy by burning combustible waste.
- (iii) **Incineration**, i.e. reduction of many combustible wastes from households, hospitals etc., to ash by burning it at very high temperature ($> 1000^{\circ}\text{C}$) in excess of oxygen.
- (iv) **Green fuel**, the plastic waste is being converted into fuel which has high octane number and doesn't contain any lead.
- (v) **Digestion**, i.e. conversion of the organic material (C,H,O) into carbon dioxide and methane by microorganisms (anaerobic digestion).

DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

- 1 Which of the following is a secondary pollutant?
(a) Carbon monoxide (b) Carbon dioxide
(c) PAN (d) Sulphur dioxide
- 2 Atmospheric pollutant is
(a) CO_2 (b) CO (c) O_2 (d) N_2
- 3 Which of the following is a sink for CO? → NEET 2017
(a) Haemoglobin
(b) Microorganisms present in the soil
(c) Oceans
(d) Plants
- 4 Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity? → NEET 2018
(a) N_2O (b) NO_2
(c) N_2O_5 (d) NO
- 5 Highly toxic gas which causes headache, visual difficulty, paralysis and even death is
(a) O_3 (b) N_2
(c) CO (d) All of these
- 6 Gas released during Bhopal tragedy was
(a) methyl isocyanate
(b) ethyl isocyanate
(c) sodium isothiocyanate
(d) potassium isothiocyanate
- 7 Which of the following gases is not a greenhouse gas?
(a) CO (b) O_3
(c) CH_4 (d) H_2O vapour
- 8 Freon used as refrigerant is
(a) $\text{CF}_2=\text{CF}_2$ (b) CH_2F_2 (c) CCl_2F_2 (d) CF_4
- 9 Consider the following Assertion and Reason and choose the correct option
Assertion For greenhouse effect presence of CO_2 is essential.
Reason With increase in concentration of CO_2 , greenhouse effect increases.
(a) Assertion is true, Reason is true; Reason is the correct explanation for Assertion
(b) Assertion is true, Reason is true; Reason is not the correct explanation for Assertion
(c) Assertion is true, Reason is false
(d) Assertion is false, Reason is true
- 10 Acid rain is produced by
(a) excess NO_2 and SO_2 from burning fossil fuels
(b) excess release of CO by incomplete combustion
(c) excess formation of CO_2 by combustion and animal respiration
(d) None of the above

- 11** Sulphur dioxide present in the industrial chimney exhaust causes
 (a) respiratory and lung disease
 (b) reduction in plants productivity due to acid rain
 (c) corrosion of building materials
 (d) All of the above
- 12** Photochemical smog is caused by
 (a) O₃ (b) CO
 (c) CO₂ (d) NO₂
- 13** The smog is essentially caused by the presence of
 (a) O₂ and N₂ (b) oxides of S and N
 (c) O₃ and N₂ (d) O₂ and O₃
- 14** Classical smog occurs in places of
 (a) excess SO₂ (b) low temperature
 (c) high temperature (d) excess NH₃
- 15** The basic component of the smog is
 (a) PAN (b) PBN
 (c) NO₂ (d) All of these
- 16** Which one of the following is not a common component of photochemical smog? → **CBSE-AIPMT 2014**
 (a) Ozone (b) Acrolein
 (c) Peroxyacetylnitrate (d) Chlorofluorocarbons
- 17** Which one of the following statements regarding photochemical smog is not correct? → **CBSE-AIPMT 2012**
 (a) Carbon monoxide does not play any role in photochemical smog formation
 (b) Photochemical smog is an oxidising agent in character
 (c) Photochemical smog is formed through photochemical reaction involving solar energy
 (d) Photochemical smog does not cause irritation in eyes and throat
- 18** Which of the following is used as catalyst in a device smog?
 (a) Platinum (b) Palladium
 (c) Nickel (d) Both (a) and (b)
- 19** Ozone hole refers to
 (a) reduction of thickness of ozone in troposphere
 (b) reduction of thickness of ozone in stratosphere
 (c) increase concentration of ozone
 (d) All of the above
- 20** Ozone concentration is minimum over
 (a) India (b) Africa
 (c) Antarctica (d) Europe
- 21** Which of the following cause (s) both global warming and ozone layer depletion?
 (a) CO₂ (b) H₂O -vapour (c) CFCs (d) SO₂
- 22** Growing more trees help to
 (a) reduce O₂ in air
 (b) increase CO₂ in the air
 (c) reduce CO₂ only in the air
 (d) reduce CO₂ and increase O₂ in the air
- 23** Sewage water is purified by
 (a) microorganisms (b) fishes
 (c) aquatic plants (d) All of these
- 24** Which one of the following statements is not true? → **CBSE-AIPMT 2012**
 (a) Concentration of BOD below 6 ppm is good for the growth of fish
 (b) Clean water would have a BOD value of less than 5 ppm
 (c) Oxides of sulphur, nitrogen and carbon are the most widespread air pollutant
 (d) pH of drinking water should be between 5.5-9.5
- 25** Addition of phosphate and nitrate fertilizers into water leads to
 (a) reduced algal growth
 (b) increased algal growth
 (c) increased growth of decomposers
 (d) eutrophication
- 26** Lead in water can cause
 (a) eye disease (b) arthritis
 (c) kidney damage (d) hair falling
- 27** The principal gas evolved from sludge digestion tank is
 (a) methane (b) carbon dioxide
 (c) carbon monoxide (d) nitrogen
- 28** Mottling of teeth is due to the presence of following element in drinking water.
 (a) mercury (b) lead (c) chlorine (d) fluorine
- 29** DDT is a substance that causes
 (a) greenhouse effect (b) soil pollution
 (c) water pollution (d) Both (b) and (c)
- 30** Which of the following is not a suggested strategy for waste management ?
 (a) Burning waste from hospitals above 1000°C
 (b) Burning leaves and twigs in open air
 (c) Conversion of plastic into high octan fuel
 (d) Conversion of organic substances into CH₄ and CO₂

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

1 Which of the following are constituents of Los Angeles smog?

- I. PAN
 III. NO_x
 II. SO_x
 IV. Humidity

Codes

- (a) I, II and III are correct (b) I and II are correct
 (c) II and IV are correct (d) I and III are correct

2 Which of the following statement is correct?

- (a) Ozone hole is a hole formed in stratosphere from which ozone comes out
 (b) Ozone hole is a hole formed in the troposphere from which ozone comes out
 (c) Ozone hole is thinning of ozone layer of stratosphere at some places
 (d) Ozone hole means vanishing of ozone layer around the earth

3 Phosphate containing fertilizers cause water pollution. Addition of such compounds in water bodies causes

→ NCERT Exemplar

- I. enhanced growth of algae.
 II. decrease in amount of dissolved oxygen in water.
 III. deposition of calcium phosphate.
 IV. increase in fish population.
 (a) Both I and II (b) Both II and IV
 (c) Both I and III (d) II, III and IV

4 Dinitrogen and dioxygen are main constituents of air but these do not react with each other to form oxides of nitrogen because

- (a) the reaction is endothermic and required very high temperature
 (b) the reaction can be initiated only in the presence of a catalyst
 (c) oxides of nitrogen are unstable
 (d) N₂ and O₂ are unreactive

5 A body which allows the short wavelength incoming solar radiation to enter in but does not allow long wave outgoing infrared radiation to escape out is called

- (a) global warming (b) greenhouse
 (c) ionosphere (d) None of these

6 Identify the wrong statements in the following.

- (a) Chlorofluorocarbons are responsible for ozone layer depletion

- (b) Greenhouse effect is responsible for global warming
 (c) Ozone layer does not permit infrared radiation from the sun to reach the earth
 (d) Acid rain is mostly because of oxides of nitrogen and sulphur

7 Match the Column I and Column II and pick the correct matching from the codes given below.

Column I	Column II
A. Peroxy acetyl nitrate	1. Waste incineration
B. Polycyclic aromatic	2. Global warming
C. Dioxins	3. Photochemical smog
D. IR active molecules	4. Carcinogens

Codes

- | | |
|-------------------|-------------------|
| A B C D | A B C D |
| (a) 3 4 1 2 | (b) 2 4 3 1 |
| (c) 3 1 2 4 | (d) 4 3 1 2 |

8 Which of the following statements is wrong?

- (a) Polar stratospheric clouds (PSCs) are clouds formed over Antarctica
 (b) Acid rain dissolves heavy metals such as Cu, Pb, Hg and Al from soil, rocks and sediments
 (c) H₂SO₄ is major contributor to acid rain, HNO₃ ranks second and HCl third in this respect
 (d) Fishes do not grow in warm as well as in cold water

9 Match Column I with Column II and choose correct option using the codes that follows:

Column I	Column II
A. Itai-itai	1. Nitrate
B. Minamata	2. Sulphate
C. Blue baby syndrome	3. Lead
D. Laxative	4. Cadmium
	5. Mercury

Codes

- | | |
|-------------------|-------------------|
| A B C D | A B C D |
| (a) 3 4 2 1 | (b) 4 5 1 2 |
| (c) 1 5 3 2 | (d) 3 5 2 1 |

ANSWERS

SESSION 1	1 (c)	2 (b)	3 (b)	4 (c)	5 (c)	6 (a)	7 (a)	8 (c)	9 (d)	10 (a)
	11 (d)	12 (d)	13 (b)	14 (b)	15 (d)	16 (d)	17 (d)	18 (d)	19 (b)	20 (c)
	21 (c)	22 (d)	23 (a)	24 (a)	25 (d)	26 (c)	27 (a)	28 (d)	29 (d)	30 (b)

SESSION 2	1 (d)	2 (c)	3 (a)	4 (a)	5 (b)	6 (c)	7 (a)	8 (d)	9 (b)
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Hints and Explanations

SESSION 1

- A secondary pollutant is the one that is formed by reaction between two or more primary pollutants, e.g. PAN (Peroxyacetyl Nitrate)
- CO is the main atmospheric pollutant released by incomplete combustion of fuel.
- Microorganisms present in the soil act as biggest source and sink. A sink is a natural or artificial reservoir that accumulates and stores some chemical compound for an indefinite period. Thus, (b) is correct option.
- Nitrous oxide (N_2O), nitrogen dioxide (NO_2) and nitric oxide (NO) are the common pollutant introduced into the atmosphere.
 N_2O occurs naturally in environment. NO and NO_2 causes considerable amount of air pollution. They are given off in car exhaust fumes and when fossil fuels are burnt as well as produced during thunderstorms. In each case NO is formed first and then NO_2 .
- Carbon monoxide(CO) is highly toxic. It combines with haemoglobin forming carboxy haemoglobin complex.
- Methyl isocyanate (MIC) gas was released during Bhopal gas tragedy.
- The gases which absorb sunlight near the earth's surface and then its radiated back to the earth are called greenhouse gases.
Carbon dioxide, water vapour, methane, ozone, oxides of nitrogen, chlorofluorocarbons etc., are

greenhouse gases. CO is not a greenhouse gas..

- Freon is CCl_2F_2 . It is used as refrigerant. It destroys ozone layer.
- CO_2 molecules trap the longer wavelength, infrared radiations emitted by earth and causes greenhouse effect.
- NO_2 and SO_2 released during burning of fossil fuels are responsible for acid rain
- SO_2 produces smog, corrodes metals, damages buildings, causes eye irritation, damages respiratory tract, produces asthma and bronchitis. It also causes acid rain and destruction of chlorophyll.
- Photochemical smog occurs at high temperature and in the presence of sunlight over cities and towns due to still air, emission of nitrogen dioxides and hydrocarbons.
- Oxides of sulphur and nitrogen produce smog. Smog is opaque or dark fog having condensed water vapours, dust, smoke and gases.
- Classical smog occurs in places of low temperature, while photochemical smog occurs in places of high temperatures.
- Peroxyacetyl nitrate (PAN), peroxybenzoyl nitrate (PBN), nitrogen dioxide (NO_2) and hydrogen peroxide (H_2O_2) are the components of smog.
- Among the given, chlorofluorocarbons are the compounds that are responsible for ozone depletion which degrades ozone into molecular oxygen. It is not a component of photochemical smog. While other given compounds are the

main components of photochemical smog..

- Photochemical smog is formed in warm and sunny climate during day time by the action of sunlight on primary pollutants. It contains nitrogen oxides, ozone, PAN etc., which are oxidising in nature. So, photochemical smog is an oxidising agent in character. It causes irritation in eyes and throat.
- Both platinum and palladium are used in **catalytic converter**, which converts CO and hydrocarbons into CO_2 and H_2O .
- Ozone hole or reduction in thickness of ozone in stratosphere is caused by a number of pollutants such as CFCs, N and S oxides, CCl_4 , chlorine, etc.
- A large hole has appeared in ozone shield over Antarctica and a smaller one over north pole.
- Chlorofluorocarbons cause both green house effect, hence global warming and also causes depletion of ozone layer.
- Growing more trees increases O_2 and reduces CO_2 in the environment.
- Organic matter present in the sewage water is decomposed by microorganisms.
- Growth of fishes is inhibited if concentration of BOD is below 6 ppm.
- Addition of phosphate and nitrate fertilizers in water causes eutrophication. It leads to organic loading, depletion of oxygen, death of animals and fouling of water.
- Lead in water can cause liver, brain and kidney damage.

- 27** Gas evolved from sludge digestion tank is methane.
- 28** Mottling of teeth occurs due to the presence of fluorine in drinking water.
- 29** DDT is a white powdery pesticide which causes both water and soil pollution.
- 30** Burning leaves and twigs from carbon monoxide and carbon dioxide gases which is harmful for the environment.

SESSION 2

- 1** Photochemical smog (Los Angeles smog) occurs in warm, dry and sunny climate.
It is caused by the action of sunlight on nitrogen oxides and hydrocarbons. Its main constituents are oxides of nitrogen, carbon monoxide, PAN, ozone etc.
- 2** The decreased concentration of ozone in stratosphere at some places is termed as ozone hole. Ozone hole is mostly found over Antarctica.

- 3** Adding of phosphate containing fertilizers in water bodies causes eutrophication. As in water bodies phosphate and nitrogen are limiting agent in growth of organisms. By adding fertilizers in water bodies. There is bloom in growth of organisms causing increased growth of algae, plants and other organisms which leads to consumption of dissolved oxygen leading to decrease in (DO) of water.
- 4** Bond dissociation energy of nitrogen molecule is very high, hence, to form its oxide it need extra energy which is not available normal atmospheric conditions. To complete this reaction it requires very high temperature, i.e. it is an endothermic reaction. These two (N_2 and O_2) reacts during thunderstorms and lightning and forms oxides of nitrogen.
- 5** Green house gases allows sunlight to reach earth's surface but when light of longer wavelength (i.e. in infrared

region) are reflected back from earth's surface, these gases trap them and doesn't allow them to pass through them, which causes green house gas effect.

- 6** Ozone layer blocks the entry of short wavelength light rays, i.e. UV rays into the troposphere.
- 7** Peroxyacetyl nitrate's constituent of photochemical smog. Polycyclic aromatic compounds are carcinogenic in nature. IR active molecules absorb IR rays and are responsible for global warming. Dioxins are produced during waste incineration.
- 8** Fishes can grow in cold as well as warm water. They are adapted to their native environment and can only grow in their native environment.
- 9** *Itai-Itai* is a disease caused by the cadmium while Minamata is caused by the mercury. Blue-baby syndrome or methaemoglobinaemia disease is caused by excess concentration of nitrates in water while sulphur responsible for laxative.