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ENVIRONMENTAL CHEMISTRY

ENVIRONMENTAL POLLUTION

The addition of any undesirable material to air, water and soil by a natural source (or due to human activity) which affects the quality of environment is called an environmental pollution. The undesirable material which added to the environment is called as pollutant.

TYPES OF POLLUTANTS

1. **Primary and secondary pollutants:**
   - (a) **Primary pollutants:** Those which after their formation enter the environment and remain as such.
     Ex : NO, NO_2, SO_2
   - (b) **Secondary pollutants :** The harmful material which are formed by chemical reaction between primary pollutants in the atmosphere. Ex. PAN (Peroxy acetyl nitrate).
2. **Bio degradable and Non bio degradable pollutants :**
   - (a) **Bio degradable pollutants :** The materials (such as cow dungs) which are easily decomposed by the micro-organism. Thus are not harmful, but in the excess in environment, they do not undergo degradation completing and thus become pollutant.
   - (b) **Non bio-degradable pollutants :** The material (such as Hg, Al, DDT) which do not undergo degradation (or degrade very slowly) but their presence even in very small amount in the environment is very harmful. They may react with other compounds present in the environment and produce more toxic compound.

Classification of Potential Pollutants

Pollutant	Examples
Agrochemicals	Nutrients N and P in commercial fertilizers, manures, biosolids. Waste water treatment effluent
Hazardous organic chemicals	Insecticides ,herbicides, fungicides etc.
Acidification	Strong acids and bases, Acid precipitation, acid mine drainage
Salinity or Sodicity	Saline irrigation water, salt water intrusion
Trace elements	Heavy metals, elements normally present at low Concentration in soil and plant.
Sediments	Eroded soil in surface waters.
Particulates	Dust (from wind erosion), volcanic dust ash.
Greenhouse gases	CO_2, CH_4 and other relatively active gases.
Smog form of compounds	Ozone, secondary products of fuel combustion

ATMOSPHERIC POLLUTION

It is defined as the undesirable materials into the atmosphere either due to natural phenomena or due to human activities.

Depending upon the regions of the atmosphere which gets polluted, the atmospheric pollution may be classified:

(i) **Troposphere pollution :** (upto 11 km from earth surface)
The pollutants in the troposphere are of two types -
- (a) **Gaseous air pollutants :** Oxides of sulphur, Oxides of nitrogen, Carbon monoxide, Unburnt hydrocarbons, Hydrogen sulphide.
- (b) **Particulate air pollutants :** Dust, Fumes, Mist, Smoke, Metal particulates etc.

(ii) **Stratospheric pollution :** (11 to 50 km from earth surface)
Stratosphere contains nitrogen, oxygen and ozone. In stratospheric region, temperature increases (from –56°C to –2°C) with altitude due to the absorption of ultraviolet radiation by ozone.

GASEOUS AIR POLLUTANTS

1. **Carbon monoxide :**
   - **(A) Source of CO :**
     - * Due to incomplete combustion of hydro carbons.
       $CH_4 + \frac{3}{2}O_2 \longrightarrow CO + 2H_2O$
     - * Due to forest fire (or agriculture waste) burning.
     - * Reduction of CO_2 : $CO_2 + C \rightarrow 2CO$
     - * Dissociation of CO_2 at high temp. (2000K)
       $CO_2 \longrightarrow CO + C$
     - * From synthesis and decay of chlorophyll.
     - * From oceans.
   - **(B) Harmful effect of CO :** The CO is poisonous because it combine with haemoglobin of R.B.C. about 300 times easily than O_2, to form carboxy haemoglobin.
     $Hb + CO \longrightarrow HbCO$ (carboxy haemoglobin)
     $Hb + O_2 \longrightarrow HbO_2$ (oxy haemoglobin)
   - **(C) Controlling of CO pollution:** The CO pollution due to human activity is the use of internal combustion engines in the automobiles. For controlling the CO emission, some modification is used in the internal combustion engine or in the quality of fuels.
     - * The exhaust system is adjusted to give complete combustion.
     - * The catalytic chamber is fitted in the exhaust pipe so that the poisonous gases are converted in harmless gases.
     - * Instead of gasoline, the use of CNG and LNG
       CNG = Condensed Natural Gas.
       LNG = Liquified Natural Gas.

2. Carbon dioxide :

(i) It is a green house gas. It is produced due to combustion of fuels, volcanic eruptions and during the process of respiration.

(ii) Its average concentration in the atmosphere is 300 ppm.

(iii) It is normally not an atmospheric pollutants, but under very high concentration it may act as a pollutant.

(iv) It causes Global warming.

(v) Carbon dioxide causes mild narcotic effect, stimulation of the respiratory system and leads to asphyxiation.

3. Hydrocarbon:

(i) Source of hydro carbon :

* Due to decomposition of organic matter in soil.

$$2HCHO \xrightarrow{\text{Bacteria}} CH_4 + CO_2$$

* Due to burning of stationary fuel.
* Evaporation of organic solvent.

(ii) Hydrocarbons are carcinogenic, cause irritation of eyes and mucous membrane.

(iii) Benzene is a known carcinogen causing leukemia.

(iv) Ethylene (C_2H_4) causes premature senescence and abscission in many plants especially in orchids and cotton.

(v) Methane (marsh gas) has the potential to destroy ozone.

4. Sulphur compounds:

* It is produced during combustion of fossil fuels (mainly coal) and smelting of sulphur containing ores.
* It causes acid rain (gaseous SO_2 oxidises to SO_3, which on combination with water forms H_2SO_4).
* Acid rain is 60-70% due to SO_2 and SO_3, and 30-40% due to NO_2 and NO_3.
* SO_2 corrodes stones, metals, leather, paper and fabrics. There is deterioration of colour and lusture of fabrics, stones and painted surfaces.
* It causes cough, breathlessness and spasm of the larynx.
* H_2S is more poisonous than CO_2.

5. Nitrogen oxides :

* There are three oxides of nitrogen which act as air pollutants: Nitric oxide (NO), nitrogen dioxide (NO_2) and nitrogen trioxide.
* Nitrogen and oxygen combine together at high temperature in any combustion process to produce nitrogen oxides.

$$N_2(g) + O_2(g) \xrightarrow{>1210^\circ C} 2NO(g)$$

$$2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$$

* These are also released by furnaces, forest fires, industries and denitrifying bacteria.
* NO is less toxic but NO_2 is a poisonous gas.
* Nitrogen oxides are responsible for forming photochemical smog.

PARTICULATE AIR POLLUTANTS

Some common particulates are :

(a) Mists are produced by particles of spray liquids and the condensation of vapours in air. Examples are portions of herbicides and insecticides that miss their targets and travel through the air to form mists.

(b) Smoke denotes very small soot particles produced by burning and combustion of organic matter. Oil smoke, tobacco smoke and carbon smoke are typical examples of this type of particulate emission.

(c) Aerosols : These are chemicals released in the air with force in the form of mist or vapour by jet planes. Aerosols contain CFC (chlorofluorocarbons) which destroy ozone layer in the stratosphere.

(d) Dust consists of the particles produced during crushing, grinding and attribution of solid materials. Non-viable dust particulates in the atmosphere consist of ground limestone, sand tailings from floatation, pulverised coal, cement, fly ash and silica dust.

EFFECTS OF AIR POLLUTANTS

1. SMOG : Smog which describe the "smoke-fog" like condition, are the best-known examples of air pollution that occurs in many cities throughout the word.

There are two types of smogs:

(i) Classical smog (London smog/Sulphurous smog) which occur in cool humid climate and are the result of buildup of sulphur oxides and particulate matter from fuel combustion.

(ii) Photochemical smog (Los Angeles smog) which occur in warm, dry and sunny climate and result from the action of sunlight on the nitrogen oxides and hydrocarbons produced by automobiles and factories. Photochemical smog is an oxidising smog having a high concentration of oxidising agents whereas classical smog is chemically reducing smog with high concentrations of SO_2.

Formation of photochemical smog :

At the high temperatures, in the petrol and diesel engines of cars and trucks, N_2 and O_2 react to form a small quantity of NO, which is emitted into air with the exhaust gases. This NO oxidised in air to NO_2 which in turn absorbs energy from sunlight and breaks up into nitric oxide and free oxygen atom. (Photochemical decomposition)

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

Oxygen atoms are very reactive and can combine with O_2 to form ozone; $O(g) + O_2(g) \longrightarrow O_3(g)$

The O_3 formed in the above reaction reacts rapidly with the NO(g) formed in reaction to regenerate NO_2.

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

Both NO and O_3 are strong oxidising agents and can react with the unburnt hydrocarbons in the polluted air to produce chemicals such as formaldehyde, acrolein and

peroxyacetyl nitrate (PAN) that cause the eyes to water and burn and are harmful to the respiratory system. The brownish haze of photochemical smog is largely attributed to the brown colour or NO_2.

$$3CH_4 + 2O_3 \longrightarrow \underset{\text{Formaldehyde}}{3CH_2=O} + 3H_2O$$

Acrolein and peroxyacetyl nitrate (PAN) are particularly noxious.

$CH_2 = CHCH = O$ (Acrolein)

$\underset{\underset{O}{\|}}{CH_3C}OONO_2$ [Peroxyacetyl nitrate (PAN)]

Control of Photochemical Smog:

* Installation of efficient catalytic converters in the automobiles is the most straightforward way of reducing smog formation as it prevents the release of nitrogen oxides and hydrocarbons to the atmosphere.
* Photochemical smog can also be suppressed by certain compounds, which act as free radical traps. When these compounds are sprayed in the atmosphere, they generate free radicals which readily combine with free radical precursors of photochemical smog.

2. **ACID RAIN :** The rain containing H_2SO_4, HNO_3 (and small amount of HCl) which are formed from the oxide of S and N_2 present in the air is called as acid rain. The pH of acid rain is 4-5.

Formation of acid rain : The oxide of nitrogen undergo oxidation reaction. The reaction with the water vapour present in the atm to form HNO_3.

Step (I) : $NO + O_3 \xrightarrow{h\nu} NO_2 + O_2$

$$NO_2 + O_3 \xrightarrow{h\nu} NO_3 + O_2$$

$$NO_2 + NO_3 \xrightarrow{h\nu} N_2O_5$$

$$N_2O_5 + H_2O \xrightarrow{h\nu} 2HNO_3$$

HNO_3 come down with rain to earths.

Step (II): $2SO_2 + O_2 \longrightarrow 2SO_3$

The SO_3 react with water vapour and formed H_2SO_4
The HNO_3 and H_2SO_4 combine with HCl present in the air to produce acidic precipitation which is called as acid rain. In acid rain

$H_2SO_4 = 60\text{-}70\%$; $HNO_3 = 30\text{-}40\%$
HCl = Very small amount.

Harmful effect of acid-rain:

* It damage to building and status which contain marble, lime stone, state, mortar etc.

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

* It damage iron and steel structure.
* It corrodes water pipe. So heavy metal (like Fe,Pb, Cu) are mixed with water which have toxic effect.
* The acid rain increase the acidity of the lake, which is harmful to fishes.
* It damage the trees, plants and retards the growth of the plant.

3. **GREEN HOUSE EFFECT**

The warming of earth due to remission of sun's energy absorbed by the earth. The remission of earth's energy is absorbed by CO_2 molecules and H_2O vapour present near the earth's surface and then its radiation back to the earth, is called a green house effect. So the temperature of the earth is increasing is called global warming. 50% of the increase in earth's temperature in due to CO_2, 20% is due to CFCs and remaining 30% is due to other gases.

4. **OZONE DEPLETION**

Formation of ozone layer :

In the stratosphere (11-50 km), the O_2 is partially converted into O_3.

Step (I) : $O_2 \xrightarrow{h\nu} \dot{O} + \dot{O}$

Step (II) : $O_2 + \dot{O} \xrightarrow{h\nu} O_3$

In Step I : The ultraviolet radiation coming from the sun have sufficient energy to split the O_2 into 2 oxygen atoms.
In step II : The oxygen atom react with more O_2 to form O_3 the O_3 absorbed the U.V. radiations and again broken into O_2 and O atom. The heat is also given out from this reaction which warm up stratosphere. For this reason stratosphere is a ozone of increasing temp.

$$O_2 \xrightarrow{h\nu} O_2 + \dot{O} + x \text{ k cal.}$$

In this way the O_3 cycle is completed in this region.

Depletion of ozone layer :

Due to human activity 2 compounds NO and CFC are responsible for depletion of O_3 layer.

(a) NO (Nitric oxide) :

$$NO + O_3 \longrightarrow NO_2 + O_2$$

$$NO_2 + \dot{O} \longrightarrow NO + O_2$$

The NO react with O_3 so decrease the amount of O_3 and forms NO_2 which react with oxygen atoms available in the stratosphere and producing back NO. Thus no NO is consumed but O_2 gets depleted.

(b) Chlorofluoro carbons (CFC) or freons :

The freons decomposes in the presence of U.V. radiation coming from the sun.

$$CF_2Cl_2 \xrightarrow{h\nu} \dot{C}F_2Cl + \dot{C}l$$

$$CFCl_3 \xrightarrow{h\nu} \dot{C}l + \dot{C}FCl_2$$

The reactive chlorine atoms then destroy the ozone layer through the following sequence of reaction. Which are repeated because chlorine atom are regenerated in the second reaction :

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

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

The one molecule CFC can destroy more than one thousand O_3 molecules in the stratosphere.

(c) Effect of depletion of O_3 layer : Due to depletion of O_3 layer, U.V. radiation fall on the earth.

* The U.V. radiation, damage the cornea and lens of the eyes.
* The U.V. radiation affect the plant proteins so reduce the chlorophyll.
* The U.V. radiation, disturb the heat balance of the earth.

NOTE

The Bhopal gas tragedy : One of the most disastrous tragedy took place on the night of December 2, 1984, when a dense cloud of deadly methyl isocyanate (MIC) gas leaked from a storage tank of the Union Carbide Ltd., plant at Bhopal (Madhya Pradesh).

This plant was involved in the manufacture of the insecticide carbaryl marketed under the commercial name sevin, using methyl isocyanate.

WATER POLLUTION

The quality of drinking water is very important for human welfare. The pollution of water by savage has been linked to the spread of diseases such as cholera and typhoid fever. The major water pollutants and their sources :

Pollutant	Source
Microorganisms	Domestic sewage
Organic wastes	Domestic sewage, animal waste, decaying animals and plants and 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	Cooling water used by industrial plants (which is discharged as hot water)

In addition, industrial wastes also contaminate water.

(i) Heavy Metals: Metals such as Cd, Pb and Hg may be present in industrial or mining waste. These metals can prove poisonous to humans - Cadmium and mercury can harm kidneys, liver, brain and central nervous system. All of these metals are cumulative poisons the body does not excrete them and their concentration builds up.

(ii) Detergents and Fertilizers: These may contain phosphates as additives. The addition of phosphorus to water, in the form of the phosphate anion PO_4^{3-}-, encourages the formation of algae, which reduces the dissolved oxygen concentration of water. The process, known as **eutrophication**, impedes the development of higher life forms, such as fish.

(iii) Acid-polluted water (pH < 3) : This is deadly to most forms of aquatic life. Water downstream from a mine may be contaminated by acid mine drainage, the result of microbial oxidation of discarded waste material at the mine site. Acid mine water principally contain sulphuric acid produced by the oxidation of iron pyrites (FeS_2). Industrial wastes and acid rain may also contribute to the acidity of natural waters.

(iv) Polychlorinated biphenyls (PCBs) : These chemicals are relatively recent additions to the list of contaminants of water. Having high stabilities, PCBs find many applications, for example they are used as fluids in transformer capacitors. PCBs are resistant to oxidation and their release into the environment causes skin disorders in humans. They are reported to be carcinogenic.

International standards for drinking water :

The quality of water is of vital concern for mankind since it is directly linked with human welfare. There are some international standards for drinking water, which must always be obeyed if water is to be used for drinking purposes.

Fluoride: Soluble fluoride is often added to drinking water to bring it up to a concentration of 1 ppm or 1 mg dm^{-3}. This concentration is within agreed safety limits and has been shown to protect teeth against decay. High concentrations of fluoride are poisonous and are harmful to bone and teeth at levels over 10 ppm (mg dm^{-3}).

Lead: The limit for the concentration of lead ions in drinking water is 50 ppb (μg dm^{-3}). If water is relatively acidic and lead pipes are used for water transport, then the water is liable to get contaminated with lead.

pH : The pH of drinking water should be between 5.5 and 9.5. A decrease in the pH of the water increases the solubility of metal ions.

Other Metals : The maximum recommended levels of common metals drinking water are :

Metal	Max. concentration (ppm or mg dm^{-3})
Zn	5
Fe	0.2
Mn	0.05
Cu	3
Cd	0.005
Al	0.2

Sulphate : Sulphate is harmless at moderate levels, but excessive sulphate (>500ppm) is thought to have a laxative effect.

Nitrate: Excess nitrate in drinking water can lead to methemoglobinemia (blue-baby syndrome). It also may be linked to stomach cancer, although this link has not been proved. A maximum limit of 50 ppm for the nitrate ion in drinking water has been set.

BIOCHEMICAL OXYGEN DEMAND (BOD) AND CHEMICAL OXYGEN DEMAND (COD)

* Biochemical oxygen demand (BOD) is a measure of the dissolved oxygen that would be needed by the microorganisms to oxidise compounds.
* BOD is a measure of the contamination caused by the totality of those compounds which can be oxidised in the presence of microorganisms.
* The BOD is taken as a realistic measure of water quality 'clean water' would have a BOD value of less than 5 ppm whereas highly polluted river water could have a BOD value of 17 ppm or more.
* BOD measurement takes a few days (generally five days), so another parameter called the chemical oxygen demand (COD) is sometimes measured.
* In a COD determination the water sample is treated with a known quantity of an oxidising agent, usually potassium ..... $_2Cr_2O_7$ in acidic medium. This reagent oxidises most of the polluting substances, including those which are resistant to microbial oxidation. The remaining $K_2Cr_2O_7$ is determined by back titration with a suitable reducing agent like Mohr's salt. From the concentration of $K_2Cr_2O_7$ consumed, the amount of oxygen used in the oxidation may be calculated using the following chemical equation. $K_2Cr_2O_7(aq) + 4H_2SO_4(aq) \longrightarrow$

$$K_2SO_4(aq) + Cr(SO_4)_3(aq) + 4H_2O(\ell) + 3O(aq)$$

The results are expressed in terms of amount of oxygen, in ppm, that would be required to oxidise the contaminants. This is called COD.

SOIL POLLUTION

Soil pollution refers to addition of solid and liquid wastes to soil creating imbalance in its natural composition and functions. It is typically caused by industrial activity, agricultural chemicals, or improper disposal of waste.

The most common chemicals involved are petroleum hydrocarbons, polynuclear aromatic hydrocarbons, solvents, pesticides, lead, and other heavy metals.

Pesticides :

* A pesticide is a substance or mixture of substances used to kill a pest. These include insecticides (kill insects), fungicides (kill fungi), algicides (kill algal blooms), weedicides or herbicides (kill weeds), rodenticides (kill rodents).
* DDT (1,4-dichlorophenyltrichloroethane) is a most common insecticides.
* 2,4-D (2,4-dichlorophenoxyacetic acid) is a common weedicide.
* Pesticide hinders nitrogen fixation in legumes. The insecticides DDT, methyl parathion, and especially pentachlorophenol have been shown to interfere with legume-rhizobium chemical signaling. Reduction of this symbiotic chemical signaling results in reduced nitrogen fixation and thus reduced crop yields.
* Dieldrin is five times more toxic than DDT when ingested and 40 times more poisonous when absorbed.
* Endrin in the most toxic amongst chlorinated hydrocarbons.
* In 1971-72, many people in Iraq died by eating bread made from the grains that were treated with the fungicide called methylmercury.
* **Persistent organic pollutants :** Persistent organic pollutants (POPs) are compounds that resist degradation and thus remain in the environment for years. Some pesticides, including aldrin, chlordane, DDT, dieldrin,endrin, heptachlor, hexachlorobenzene, mirex, and toxaphene, are considered POPs. POPs have the ability to volatilize and travel great distances through the atmosphere to become deposited in remote regions.

Fertilizer :

* An agrochemical that is added to soil to reduce or eliminate nutrient-caused constraints to crop productivity.
* Excessive use of fertilizers can lead to the contamination of groundwater with nitrate, rendering it unfit for consumption by humans or livestock.
* Water containing large concentrations of nitrate can poison animals by immobilizing some of the hemoglobin in blood, reducing the ability to transport oxygen.

GREEN CHEMISTRY

Green Chemistry focuses on processes and products that reduce or eliminate the use and generation of hazardous substances. For success in achieving the objective of green chemistry, one has to take care of many aspects. The use of starting materials-regents and solvent that posses less hazard to man and his environment, is one aspect. Using raw materials more efficiently and generating less waste is another. In this regard, the utilisation of reactions that are simple additions which completely incorporate the starting material into the final product and, therefore, do not produce waste that needs to be treated, disposed of, or otherwise dealt with becomes a goal. Green chemistry and the design and development of green chemical products and processes follows the same tradition of scientific discovery and understanding that has characterized chemistry from its origins. Green chemistry simply utilises the information that is now available to the scientific community about the toxicity and other hazards posed by certain chemical in order to fully evaluate the negative as well as positive impact of the chemistry being designed. Databases of information on the hazardous properties of chemicals have only recently become available.

Achievements of Green Chemistry :

Since the inception of green chemistry, chemists from all over the world are using this creative and innovative skills to develop new processes, synthetic method, analytical tools reaction conditions, catalysts, etc.

(i) Development of a new method of synthesizing ibuprofen in 99% yield, avoiding the uses of large quantities of solvent and wastes associated with the traditional stoichiometric use of ausillary chemicals when effecting chemical conversions.

(ii) Development of a method for catalytic dehydrogenation of diethanolamine in which a new technique allows the production of an environmentally friendly herbicide in a less dangerous way. This technology represents a major breakthrough because it avoids the use of cyanide and formaldehyde. It is safer to operate, produces high overall yield and has fewer process steps.

(iii) Development of processes using carbon dioxide as the blowing agent, for manufacture of polystyrene foam sheet packaging material. This technology allows elimination of chlorofluorocarbon blowing agents, chemicals that contribute to ozone depletion, global warming and ground level smog.

(iv) Designing of a safer marine antifouling compound 'Sea-nine' that degrades far more rapidly that organotins has been designed.

Green Chemistry in day-to-day Life

(i) **Dry Cleaning of Clothes** Tetra chlroroethene ($Cl_2C=CCl_2$) was earlier used as solvent for dry cleaning. The compound contaminates the ground water and is also a suspected carcinogen. The process using this compound is now being replaced by a process, where liquefied carbondioxide, with a suitable detergent is used. Replacement of halogenated solvent by liquid CO_2 will result in less harm to ground water.

These days hydrogen peroxide (H_2O_2) is used for the purpose of bleaching clothes in the process of laundary, which gives better results and makes use of lesser amount of water.

(ii) **Bleaching of Paper :** Chlorine gas was used earlier for bleaching paper. These days, hydrogen peroxide (H_2O_2) with suitable catalyst, which promotes the bleaching action of hydrogen peroxide, is used.

(iii) **Synthesis of Chemicals :** Ethanal (CH_3CHO) is now commercially prepared by one step oxidation of ethene in the presence of ionic catalyst in aqueous medium with a yield of 90%.

$$CH_2=CH_2(g)+O_2(g) \xrightarrow[\text{in water}]{\text{Pd (II)/Cu (II)}} CH_3CHO\,(90\%)$$

ADDITIONAL EXAMPLES

Example 1 :

Eutrophication causes reduction in –

(A) Dissolved salts (B) Dissolved hydrogen

(C) Dissolved oxygen (D) All the above

Sol. **(C).** Eutrophication causes reduction in dissolved oxygen.

Example 2 :

Which are quantitative pollutants out of the following –

(A) CO_2 (B) P_2O_5

(C) N_2O_5 (D) NO_2

Sol. **(A).** CO_2 become pollutants only when their concentration reaches beyond a threshold value in the environment.

Example 3 :

Which are secondary pollutants in the following –

(A) O_3 (B) CO_2

(C) CO (D) Cl_2

Sol. **(A).** These are formed by reaction between primary pollutants in the presence of sunlight.

QUESTION BANK

CHAPTER 13 : ENVIRONMENTAL CHEMISTRY

EXERCISE - 1 [LEVEL-1]

Choose one correct response for each question.

PART - 1 : AIR POLLUTION

Q.1 The region which is greatly affected by air pollution is
(A) troposphere (B) stratosphere
(C) mesosphere (D) thermosphere.

Q.2 Which of the following green gas is damaging the ozone layer?
(A) CFCs (B) CO_2
(C) CH_4 (D) SO_2

Q.3 Which of the following is present in highest concentration in exhaust emission –
(A) CO_2 (B) Hydrocarbons
(C) CO (D) Oxides of nitrogen

Q.4 The word smog stands for –
(A) smoke
(B) fog
(C) combination of smoke and fog
(D) Neither (A) nor (B)

Q.5 Chlorofluorocarbon releases _____ which is harmful to ozone.
(A) Fluorine radical (B) Chlorine radical
(C) Nitrogen dioxide (D) Sulphur dioxide

Q.6 Which of the given option is not correct?
(A) Greenhouse effect is due to high concentration of CO_2 in atmosphere.
(B) Greenhouse effect is influenced by gases such as CH_4, O_3 & chloro-fluoro carbons.
(C) Greenhouse effect is responsible for the warming up of the earth.
(D) Greenhouse effect is responsible for lowering the level of oceans due to high evaporation.

Q.7 Which of the following atmospheric layer contains clouds, water vapour and air?
(A) Stratosphere (B) Troposphere
(C) Mesosphere (D) All of these

Q.8 CO produced by incomplete combustion of fuel exerts a harmful effect because –
(A) It is respiratory inhibitor. (B) It is CO_2 antagonist.
(B) It is carcinogenic. (D) It is corrosive to eye

Q.9 If CCl_3F is present in the stratosphere it will react with
(A) O_3 (B) N_2
(C) CO_2 (D) all of these

Q.10 Photochemical smog formed in congested metropolitan cities mainly consists of
(A) hydrocarbons, SO_2 and CO_2
(B) hydrocarbons, ozone and SO_2
(C) ozone, peroxy acetyl nitrate and NO_2
(D) smoke, peroxy acetyl nitrate and SO_2

Q.11 Which of the following is/are the green house gases?
(A) CO_2 (B) Chlorofluorocarbon
(C) CH_4 (D) All of these

Q.12 Sulphur oxides which are responsible for major air pollution are caused by
(A) burning of coal and refining of petroleum.
(B) burning of fuels in automobiles
(C) combustion of fuels containing C and H
(D) using indoor combustion devices like cooking gas.

Q.13 Which of the following reaction occurs in the stratosphere?
(A) $O_2 + UV \rightarrow O + O$ (B) $O_2 + O \rightarrow P_3$
(C) $\cdot Cl + O_3 \rightarrow ClO\cdot + O_2$ (D) All of the above

Q.14 Which of the following is not a direct atmospheric pollutant–
(A) CO (B) SO_2
(C) Hydrocarbons/CH_4 (D) CO_2 & Water vapour

Q.15 The gaseous envelope around the earth is known as atmosphere. The lowest layer of this is extended upto 10km from sea level, this layer is
(A) Stratosphere (B) Troposphere
(C) Mesosphere (D) Hydrosphere

Q.16 Which of the following are major gaseous pollutants present in the troposphere?
(A) H_2S
(B) Oxides of sulphur, nitrogen and carbon
(C) O_3
(D) All of these

Q.17 Which of the following is not regarded as a pollutant?
(A) NO_2 (B) CO_2
(C) SO_2 (D) CO

Q.18 Mists are produced by —
(A) smoke formed during combustion of organic matter.
(B) particles of spray liquids and by condensation of vapours in air.
(C) fine solid particles produced during crushing and grinding.
(D) condensation of vapours during chemical reactions.

Q.19 Freons are not recommended to be used in refrigerators because they —
(A) cause global warming
(B) cause acid rain
(C) cause depletion of ozone layer
(D) cause very less cooling.

Q.20 Acid rains are produced by
(A) excess NO_2 and SO_2 from burning fossil fuels.
(B) excess production of NH_3 by industry and coal gas.
(C) excess release of carbon monoxide by incomplele combustion.
(D) excess formation of CO_2 by combustion and animal respiration.

Q.21 Which of the following statements is not true about classical smog?
(A) Its main components are produced by the action of sunlight on emissions of automobiles and factories.
(B) Produced in cold and humid climate.
(C) It contains compounds of reducing nature.
(D) It contains smoke, fog and sulphur dioxide.

Q.22 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 requires very high temperature.
(B) the reaction can be initiated only in presence of a catalyst.
(C) oxides of nitrogen are unstable.
(D) N_2 and O_2 are unreactive.

Q.23 Incomplete combustion of petrol or diesel in automobile engine produces
(A) CO and H_2O vapours (B) SO_2
(C) CO and NO_2 (D) CO

Q.24 Acid rain is due to –
I. Oxides of nitrogen II. Oxides of sulphur
III. Methane present in air
Select the correct option.
(A) I and II (B) II and III
(C) I, II and III (D) I and III

Q.25 The dissolution of ozone layer causes ozone hole in the blanket surrounding the atmosphere. What are the ill effects of ozone hole?
(A) Greenhouse effect
(B) Global warming
(C) Acid rain
(D) UV rays reaching the earth.

Q.26 Carbon monoxide is mainly released into air by
(A) automobile exhaust.
(B) incomplete combustion of coal.
(C) incomplete combustion of firewood.
(D) All of the above.

Q.27 The brown, hazy fumes of photochemical smog are due to
(A) nitrogen dioxide (B) PAN formation
(C) aldehydes (D) SO_2

Q.28 Which of the following does not contribute towards the formation of photochemical smog?
(A) NO (B) SO_2
(C) O_3 (D) Hydrocarbons

Q.29 Which of the following statement is correct regarding O_3 layer?
(A) O_3 layer is found in troposphere
(B) O_3 layer absorbs infrared radiation
(C) O_3 layer absorbs UV radiation
(D) Both (A) and (C) are correct

Q.30 Photochemical smog is formed due to presence of –
(A) oxides of sulphur (B) oxides of nitrogen
(C) oxides of carbon (D) oxides of lead

Q.31 Increased level of greenhouse gases causes global warming which will result in
(A) biomagnification (B) eutrophication
(C) melting of glaciers (D) ozone depletion.

PART - 2 : WATER POLLUTION

Q.32 BOD stands for
(A) Biochemical oxygen demand
(B) Biochemical oxygen degradation
(C) Bacterial oxygen demand
(D) Biochemical oxidative diffusion

Q.33 When huge amount of sewage is dumped in rivers the BOD will
(A) increase (B) remain unchanged
(C) decrease (D) increase or decrease

Q.34 Organic matter is considered as a major source of water pollution caused by wastes of food, animal and human excreta, garbage etc. The excess of organic matter in water causes a threat to aquatic life because –
(A) the space available to aquatic life decreases.
(B) microorganisms consume dissolved oxygen decompose organic matter.
(C) organic matter is swallowed by small animals.
(D) decomposition of organic matter increases the temperature of water.

Q.35 By what method the quantity of organic pollutants in water can be determined –
(A) By measuring BOD
(B) By pH Measurement
(C) By transparency measurements
(D) By measuring the change of colour/CFC.

Q.36 Which of the following types of pollution causes the out break of jaundice –
(A) Water (B) Land
(C) Thermal (D) Air

Q.37 Fluoride deficiency in drinking water causes
I. harmful effect on bone II. tooth decay
III. blue baby syndrome
Choose the correct option.
(A) Only I (B) Only II
(C) Only III (D) I and II

PART - 3 : SOIL POLLUTION

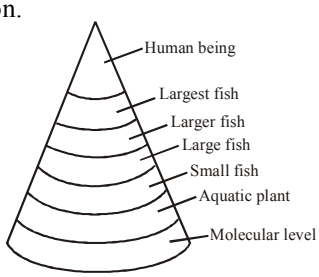
Q.38 Nicotine is used as
I. fertilizers II. pest controlling chemical
III. medicine
Choose the correct option.
(A) I and II (B) Only I
(C) Only II (D) I, II and III

Q.39 Soil is polluted by: I. pesticides II. synthetic fertilizers
III. green manure
Choose the correct option
(A) I and III (B) I and II
(C) II and III (D) I, II and III

Q.40 Which of the following pesticide is introduced during World War II to control malaria?
(A) Nicotine (B) DDT
(C) Aldrin (D) Dieldrin

Q.41 Negative soil pollution is
(A) reduction in soil productivity due to erosion and over use.
(B) reduction in soil productivity due to addition of pesticides and industrial wastes.
(C) converting fertile land into barren land by dumping ash, sludge and garbage.
(D) none of the above.

Q.42 Study the given diagram and answer the following question.



Which is the most appropriate statement about the figure?
(A) The tropic levels decrease from molecular level to human beings.
(B) At each tropic level the pollutants get approximately 10 times concentrated.
(C) The level of pollutants is maximum at molecular level and minimum in human beings.
(D) Repeated use of toxins reduces its concentration at highest level.

PART - 4 : INDUSTRIAL WASTE

Q.43 Biodegradable pollutant is –
(A) Sewage (B) Mercury
(C) Plastic (D) Asbestos

Q.44 Biodegradable industrial wastes are generated by –
(A) cotton mills (B) paper mills
(C) food processing unit (D) All of these

PART - 5 : GREEN CHEMISTRY

Q.45 Which of the following practices will not come under green chemistry?
(A) If possible, making use of soap made of vegetable oils instead of using synthetic detergents.
(B) Using H_2O_2 for bleaching purpose instead of using chlorine based bleaching agents.
(C) Using bicycle for travelling small distances instead of using petrol/diesel based vehicles.
(D) Using plastic cans for neatly storing substances.

Q.46 Which type of harm in environment will be prevented by stopping use of tetra-chloroethene?
(A) At contaminates the ground water
(B) It is also a suspected carcinogen
(C) Both (A) and (B)
(D) None of the above

Q.47 Green chemistry involves
(A) minimum pollution or deterioration to the environment.
(B) to excess exploitation of natural resources.
(C) environment unfriendly and cost-ineffective producer.
(D) to study the reactions in plants.

EXERCISE - 2 [LEVEL-2]

Choose one correct response for each question.

Q.1 A dental disease characterised by mottling of teeth is due to presence of a certain chemical element in drinking water. Which is the element –
(A) Fluorine (B) Mercury
(C) Boron (D) Chlorine

Q.2 Chlorine treatment of water –
(A) Disinfect by killing germs
(B) Remove hardness of water
(C) Remove all the air pollutants
(D) All above

Q.3 The pollutants chlorofluorocarbons are major source of air pollution contributed by –
(A) Sewage pollutants (B) Aerosols
(C) Industrial effluents (D) All above

Q.4 Which of the following processes is not responsible for adding particulates to the atmosphere?
(A) Photosynthesis (B) Combustion of fuels
(C) Industrial processes (D) Agricultural processes

Q.5 The basic component of the smog may be –
(A) O_3 and PAN (B) O_3
(C) PAN (D) PVC

Q.6 Water pollution causes –
(A) Increased deoxygenation and turbidity
(B) Decreased turbidity
(C) Increased oxygenation
(D) Increased photosynthesis

Q.7 Most harmful types of environment pollutants are
(A) Human organic wastes
(B) Non biodegradable chemicals
(C) Natural nutrients present in excess
(D) Wastes from feed lots

Q.8 One of the pollutants that is generally helping in the early degradation of the ozone layer is
(A) SO_2 (B) DDT
(C) CO_2 (D) Freons

Q.9 In coming years, skin related disorders will become more common due to –
(A) Air pollution
(B) Excessive use of detergents
(C) Depletion of ozone layer
(D) Water pollution

Q.10 The term biomagnification refers to the –
(A) Increase in population size.
(B) Growth of organisms due to food consumption.
(C) Increase in the concentration of nondegradable pollutants as they pass through food chain.
(D) Blowing up of environmental issues by man.

Q.11 Which of the following green house gas is released in paddy field?
I. CFCs II. CH_4 III. SO_2
(A) Only I (B) Only II
(C) Only III (D) I and II

Q.12 Which of the following are the examples of nondegradable pollutants?
(A) DDT (B) Nuclear wastes
(C) Plastic materials (D) All of these

Q.13 Ozone depletion is due to the formation of which of the following compound?
(A) Acrolein (B) Peroxy acetyl nitrate
(C) SO_2 and SO_3 (D) Carbon dioxide

Q.14 Lead pollution is mainly caused by
(A) sewage (B) insecticide
(C) leaded gasoline (D) None of these

Q.15 Which of the following are involved in the formation of PAN?
(I) NO_2 (II) O_3
(III) Unburnt hydrocarbon (IV) CO_2
(A) I and II only (B) I, II and IV
(C) I, III and IV (D) I, II and III

Q.16 The aromatic compounds present as particulates are –
(A) benzene
(B) toluene
(C) nitrobenzene
(D) polycyclic aromatic hydrocarbons

Q.17 Which of the following is not a common component of photochemical smog?
(A) Peroxyacetyl nitrate (B)Acrolein
(C) Formaldehyde (D) Carbon dioxide

Q.18 Which of these are biodegradable pollutants?
(i) Pesticides (ii) Mercuric salts
(iii) Sewage (iv) Radioactive wastes
(A) (i) and (ii) (B) (i) and (iii)
(C) (i), (iii) and (iv) (D) (iii) only

Q.19 Which of the following gases cause global warming?
I. CO_2 II. O_3
III. CO IV. Chlorofluorocarbons
(A) I, II and III (B) II, III and IV
(C) I, II and IV (D) I, II, III and IV

Q.20 Formula of tear gas is
(A) $COCl_2$ (B) N_2O
(C) CCl_3NO_2 (D) None of these

Q.21 Choose the INCORRECT matching –
(A) Air pollutants-Oxides of sulphur, nitrogen and carbon
(B) Particulate pollutants - Dust, mist, fumes
(C) Global warming - Methane, ozone, CFCs
(D) Water soluble chemical pollutants - Oxides of nitrogen, carbon and sodium

Q.22 Carbon monoxide is harmful to human beings as it –
(A) is carcinogenic
(B) is antagonistic to CO_2
(C) has higher affinity for haemoglobin as compared to oxygen.
(D) is destructive to CO_2.

Q.23 Acid rain mainly contains
(A) H_2SO_4 (B) HNO_3
(C) Both (A) and (B) (D) HCl

Q.24 Classical smog is a mixture of –
(A) smoke + SO_2 (B) smoke + H_2O
(C) smoke + fog+H_2O (D) smoke + fog + SO_2

Q.25 Which of the following statements about photochemical smog is not correct?
(A) It occurs in warm, dry and sunny climate.
(B) Chemically, it is a reducing mixture and is called reducing smog.
(C) It is formed as a result of action of sunlight on unsaturated hydrocarbons and nitrogen oxides.
(D) It has high concentration of oxidising agents and is also called oxidising smog.

Q.26 Mark the incorrect choice of ill effects caused by pollutant.
(A) Lead - Kidney, Liver, Reproductive system
(B) Fluoride - Bones and teeth
(C) Nitrate - Blue baby's syndrome
(D) Sulphur dioxide - Nervous system diseases

Q.27 Persons working in cement plants and lime stone quarries are more prone to disease like
(A) asthama (B) cancer
(C) silicosis (D) pneumoconiosis

Q.28 Ozone hole is maximum over
(A) Europe (B) Antarctica
(C) India (D)Africa

Q.29 Pick up the correct statement.
(A) CO which is major pollutant resulting from the combustion of fuels in automobiles plays a major role in photochemical smog.
(B) Classical smog has an oxidizing character while the photochemical smog is reducing in character.
(C) Photochemical smog occurs in day time whereas the classical smog occurs in early morning hours.
(D) During formation of smog the level of ozone in the atmosphere goes down.

Q.30 Which of the following are the harmful effects of nitrogen oxide?
(A) It retards the rate of photosynthesis.
(B) It causes respiratory disease in children.
(C) It is toxic to living tissues.
(D) All of these

Q.31 Smog is a common pollutant in places which have –
(A) high altitudes
(B) high temperature
(C) high concentration of SO_2 in air
(D) high concentration of NH_3 in air.

Q.32 Sulphur doixide causes
I. respiratory diseases in human being.
II. red haze in the traffic.
III. irritation of the eyes.
The correct option(s) is/are
(A) I and II (B) II and III
(C) I and III (D) I, II and III

Q.33 Photochemical smog occurs in warm, dry and sunny climate. One of the following is not amongst the components of photochemical smog, identify it.
(A) NO_2 (B) O_3
(C) SO_2 (D) Unsaturated hydrocarbon

Q.34 Phosphate pollution is brought about by –
(A) phosphate rocks
(B) fertilizers
(C) phosphate rocks and sewage
(D) fertilizers and sewage

Q.35 Lithosphere refers to the
(A) layer of rock material on the earth's surface the ocean floor.
(B) layer of earth in which all forms of life exist.
(C) uppermost layer of atmosphere merging space.
(D) all sources of water such as oceans, seas, rivers, lakes, etc.

EXERCISE - 3 [PREVIOUS YEARS AIEEE / JEE MAIN QUESTIONS]

Q.1 When rain is accompanied by a thunderstorm, the collected rain water will have a pH value **[AIEEE- 2003]**
(A) uninfluenced by occurrence of thunderstorm.
(B) which depends on the amount of dust in air.
(C) slightly lower than that of rain water without thunderstorm.
(D) slighty higher than that when the thunderstorm is not there.

Q.2 The smog is essentially caused by the presence of – **[AIEEE- 2004]**
(A) O_2 and O_3 (B) O_2 and N_2
(C) Oxides of sulphur and nitrogen (D) O_3 and N_2

Q.3 Identify tthe wrong statement in the following : **[AIEEE- 2008]**
(A) Greenhouse effect is responsible for global warming.
(B) Ozone layer does not permit infrared ratiation from the sun to reach the earth.
(C) Acid rain is mostly because of oxides of nitrogen and sulphur.
(D) Chlorofluorocarbons are responsible for ozone layer depliction.

Q.4 What is DDT among the following : **[AIEEE- 2012]**
(A) Greenhouse gas
(B) Afertilizer
(C) Biodegradable pollutant
(D) Non-biodegradable pollutant

Q.5 The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was – **[JEE MAIN 2013]**
(A) Methylisocyanate (B) Methylamine
(C) Ammonia (D) Phosgene

Q.6 The concentration of fluoride, lead, nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of : **[JEE MAIN 2016]**
(A) Lead (B) Nitrate
(C) Iron (D) Fluoride

Q.7 A water sample has ppm level concentration of following anions : $F^- = 10$; $SO_4^{2-} = 100$; $NO_3^- = 50$
The anion/anions that make/makes the water sample unsuitable for drinking is/are: **[JEE MAIN 2017]**
(A) Only SO_4^{2-} (B) Only NO_3^-
(C) Both SO_4^{2-} and NO_3^- (D) Only F^-

Q.8 The recommended concentration of fluoride ion in drinking water is up to 1 ppm as fluoride ion is required to make teeth enamel harder by converting $[3Ca_3(PO_4)_2.Ca(OH)_2]$ to : **[JEE MAIN 2018]**
(A) $[3Ca_3(PO_4)_2.CaF_2]$ (B) $[3\{Ca_3(OH))_2\}.CaF_2]$
(C) $[CaF_2]$ (D) $[3(CaF_2).Ca(OH)_2]$

Q.9 A water sample has ppm level concentration of the following metals: Fe= 0.2; Mn = 5.0; Cu = 3.0; Zn = 5.0. The metal that makes the water sample unsuitable drinking is : **[JEE MAIN 2019 (JAN)]**
(A) Zn (B) Fe
(C) Mn (D) Cu

Q.10 **Assertion :** Ozone is destroyed by CFCs in the upper stratosphere
Reason : Ozone holes increase the amount of UV radiation reaching the earth. **[JEE MAIN 2019 (APRIL)]**
(A) Assertion and reason are correct, but the reason is not the explanation for the assertion.
(B) Assertion is false, but the reason is correct.
(C) Assertion and reason are incorrect, Assertion and reason are both correct.
(D) And the reason is the correct explanation for the assertion.

Q.11 Which is wrong with respect to our responsibility as a human being to protect our environment ? **[JEE MAIN 2019 (APRIL)]**
(A) Avoiding the use of floodlighted facilities.
(B) Restricting the use of vehicles.
(C) Using plastic bags.
(D) Setting up compost tin in gardens.

Q.12 The maximum prescribed concentration of copper in drinking water is: **[JEE MAIN 2019 (APRIL)]**
(A) 5 ppm (B) 0.5 ppm
(C) 0.05 ppm (D) 3 ppm

Q.13 Excessive release of CO_2 into the atomosphere results in : **[JEE MAIN 2019 (APRIL)]**
(A) polar vortex (B) depletion of ozone
(C) formation of smog (D) global warming

Q.14 The regions of the atmosphere, where clouds form and where we line respectively, are **[JEE MAIN 2019 (APRIL)]**
(A) Stratosphere and Troposphere.
(B) Troposphere and Stratosphere.
(C) Troposphere and Troposphere.
(D) Stratosphere and Stratosphere.

Q.15 The correct set of species responsible for the photochemical smog is : **[JEE MAIN 2019 (APRIL)]**
(A) NO, NO_2, O_3 and hydrocarbons
(B) N_2,O_2, O_3 and hydrocarbons
(C) N_2, NO_2 and hydrocarbons
(D) CO_2, NO_2, SO_2 and hydrocarbons

Q.16 Which of the following are "green house gases" ?
(a) CO_2 (b) O_2 (c) O_3
(d) CFC (e) H_2O
[JEE MAIN 2020 (JAN)]
(A) a, b and d (B) a, b, c and d
(C) a, c and d (D) a, c, d and e

Q.17 Biochemical Oxygen Demand (BOD) is the amount of oxygen required (in ppm): **[JEE MAIN 2020 (JAN)]**
(A) by anaerobic bacteria to breakdown inorganic waste present in a water body.
(B) for the photochemical breakdown of waste present in 1 m^3 volume of a water body.
(C) by bacteria to break-down organic waste in a certain volume of a water sample.
(D) for sustaining life in a water body.

EXERCISE - 4 (PREVIOUS YEARS AIPMT / NEET EXAM QUESTIONS)

Q.1 Green Chemistry means such reactions which :
(A) Study the reactions in plants **[AIPMT 2008]**
(B) Produce colour during reactions
(C) Reduce the use and production of hazardous chemicals
(D) Are related to the depletion of ozone layer.

Q.2 Which one of the following statement is not true? **[AIPMT 2011]**
(A) Oxides of sulphur, nitrogen and carbon are the most widespread air pollutant.
(B) pH of drinking water should be between 5.5 – 9.5.
(C) Concentration of DO below 6 ppm is good for the growth of fish.
(D) Clean water would have a BOD value of less than 5ppm.

Q.3 Which one of the following statements regarding photochemical smog is not correct ? **[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.

Q.4 Which one of the following is not a common component of Photochemical Smog? **[AIPMT 2014]**
(A) Ozone (B) Acrolein
(C) Peroxyacetyl nitrate (D) Chlorofluorocarbons

Q.5 Which of the following is a sink for CO ? **[NEET 2017]**
(A) Micro organism present in the soil
(B) Oceans
(C) Plants
(D) Haemoglobin

Q.6 Among the following, the one that is not a green house gas is **[NEET 2019]**
(A) Nitrous oxide (B) Methane
(C) Ozone (D) Sulphur dioxide

ANSWER KEY

EXERCISE - 1

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	A	A	C	C	B	D	B	A	A	C	D	A	D	D	B	D	B	B	C	A	A	A	D	A	D
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47			
A	D	A	B	C	B	C	A	A	B	A	A	B	C	B	B	A	B	A	D	D	C	A			

EXERCISE - 2

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	A	A	B	A	A	A	B	D	C	C	B	D	B	C	D	D	D	D	C	C	D	C	C	D	B
Q	26	27	28	29	30	31	32	33	34	35															
A	D	C	B	C	D	C	C	C	D	A															

EXERCISE-3

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	C	C	B	D	A	B	D	A	C	A	C	D	D	C	A	D	C

EXERCISE - 4

Q	1	2	3	4	5	6
A	C	C	D	D	A	D

CHAPTER-13 : ENVIRONMENTAL CHEMISTRY

EXERCISE-1

(1) **(A).** Troposphere is the lower most region of earth atmosphere and hence greatly affected by air pollution.

(2) **(A).** Chlorofluorocarbons (CFCs) are man-made industrial chemicals used in air conditioning etc. CFCs are damaging the ozone layer

(3) **(C).** CO is present in highest concentration in exhaust emission.

(4) **(C).** The word smog is derived from smoke and fog. Somes are of two types

(i) classical smog and (ii) photochemical smog.

(5) **(B).** $CF_2Cl_2 \xrightarrow{UV} \dot{C}F_2Cl_2 + Cl^{\bullet}$

$Cl^{\bullet} + O_3 \longrightarrow Cl\dot{O} + O_2$

(6) **(D).** Greenhouse effect is responsible for increasing the level of oceans due to high melting of glaciers and ice caps.

(7) **(B).** Troposphere is a turbulent, dusty zone containing air, water vapour and clouds.

(8) **(A).** CO produced by incomplete combustion of fuel exerts a harmful effect because it is respiratory inhibitor.

(9) **(A).** If CCl_3F is present in the stratosphere it will react with O_3.

(10) **(C).** Photochemical smog mainly consists of ozone, peroxy acetyl nitrate and NO_2.

(11) **(D).** The gases which trap the sunlight (heat) near the earth's surface and keep it arm, known as green house gases. eg., CO_2, CH_4, O_3, CFCs, water vapour and nitrous oxide etc. Green house gases cause global warming.

(12) **(A).** Main sources of oxides of sulphur are burning of fossil fuels, coal, petroleum, refining of petroleum, smelting of sulphide ores, etc.

(13) **(D).** All the given reactions occur in stratosphere.

(14) **(D).** CO_2 & Water vapour.

(15) **(B).** Troposphere.

(16) **(D).** Oxides of sulphur, nitrogen and carbon, H_2S, hydrocarbons, O_3, ets. are gaseous air pollutants present in the troposphere.

(17) **(B).** CO_2 is not regarded as pollutant.

(18) **(B).** Mists are produced by particles of spray liquids and by condensation of vapours in air. The insecticides and herbicides sprayed in the field travel through air and form mists.

(19) **(C).** Freons are CFCs which cause ozone layer depletion.

(20) **(A).** Excess of SO_2 and NO_2 reacts with water to form H_2SO_3 (sulphonic acid) and HNO_3 (nitric acid) respectively which cause decrease is pH of water.

(21) **(A).** Classical smog :

* Produced in cold and humid climate.
* It contains compounds of reducing nature.
* It contains smoke, fog and sulphur dioxide.

(22) **(A).** Dinitrogen and dioxygen are main constituents of air but these do not react with each other to form oxides of nitrogen because the reaction is endothermic and requires very high temperature.

(23) **(D).** CO is produced as a result of incomplete combustion of fossil fuels.

(24) **(A).** Acid rain is the byproduct of a variety of human activities that emit the oxides of sulphur and nitrogen in the atmosphere.

(25) **(D).** Ozone hole would allow the harmful UV rays of sun to reach the earth which cause skin cancer.

(26) **(D).** CO is produced as a result of incomplete combustion of carbon. Carbon monoxide is mainly released into the air by automobile exhaust.

(27) **(A).** Brown hazy fumes of photochemical smog are due to nitrogen dioxide.

(28) **(B).** SO_2 has no contribution in photochemical smog.

(29) **(C).** O_3 layer absorbs UV radiation

(30) **(B).** Photochemical smog is formed due to photochemical reaction taking place when air contains NO_2 and hydrocarbons.

(31) **(C).** Global warming may result in increase in average temperature of the earth and melting of glaciers.

(32) **(A).** BOD : Biochemical oxygen demand.

(33) **(A).** When huge amount of sewage is dumped in rivers the BOD will increase.

(34) **(B).** If a lot of organic matter is decomposed, a lot of dissolved oxygen is consumed by microorganisms hence dissolved oxygen is no longer available for aquatic life.

(35) **(A).** By measuring BOD the quantity of organic pollutants in water can be determined.

(36) **(A).** Water causes the out break of jaundice.

(37) **(B).** Fluoride deficiency in drinking water is harmful to man and causes diseases such as tooth decay etc.

(38) **(C).** Nicotine is used as pest controlling substance for crops.

(39) **(B).** Pesticides and synthetic fertilizers pollute the soil.

(40) **(B).** During World War II, DDT was found to be of great use in the control of malaria and other insect-borne diseases.

(41) **(A).** Negative soil pollution is reduction in soil productivity due to erosion and over use.

(42) **(B).** Most of the pesticides and other non- biodegradable toxins are transferred from lower tropic level to higher tropic level through food chain. At every level the concentration of toxins increases ten times.

(43) **(A).** Sewage is Biodegradable pollutant.

(44) **(D).** Biodegradable wastes are are generated by cotton mills , food processing units, paper mills and textile factories.

(45) **(D).** Plastics are non-biodegradable, hence are not environmental friendly.

(46) **(C).** Tetrachlroroethene ($Cl_2C=CCl_2$) was earlier used as solvent for dry cleaning. The compound contaminates the ground water and is also a suspected carcinogen.

(47) **(A).** Green chemistry is a production process that would bring about minimum pollution or deterioration to the environment. i.e., "Reducing potentially hazardous waste through smarter production."

EXERCISE-2

(1) **(A).** Fluorine

(2) **(A).** Chlorine treatment of water disinfect by killing germs.

(3) **(B).** The pollutants chlorofluorocarbons are major source of air pollution contributed by Aerosols.

(4) **(A).** Photosynthesis does not produce any particulates.

(5) **(A).** The basic component of the smog may be O_3 and PAN

(6) **(A).** Water pollution causes increased deoxygenation and turbidity.

(7) **(B).** Most harmful types of environment pollutants are non biodegradable chemicals.

(8) **(D).** One of the pollutants that is generally helping in the early degradation of the ozone layer is freons.

(9) **(C).** In coming years, skin related disorders will become more common due to depletion of ozone layer

(10) **(C).** The term biomagnification refers to the increase in the concentration of nondegradable pollutants as they pass through food chain.

(11) **(B).** Large amount of CH_4 are released in paddy fields, coal mines and by fossil fuels.

(12) **(D).** The examples of nondegradable pollutants are DDT, nuclear wastes and plastic materials.

(13) **(B).** Ozone depletion is due to the formation of peroxy acetyl nitrate

(14) **(C).** Lead pollution may be caused by leaded gasoline.

(15) **(D).** NO_2, O_3 and unburnt hydrocarbon are involved in the formation of PAN.

(16) **(D).** Polycyclic aromatic hydrocarbons (PAH) are present as particulates.

(17) **(D).** Formation of photochemical smog :

$$NO_2 \xrightarrow{h\nu} NO + O,\ O + O_2 \rightarrow O_3$$

$$NO + O_3 \rightarrow NO_2 + O_2$$

$$3CH_4 + 2O_3 \rightarrow 3HCHO + 3H_2O$$

(Formaldehyde)

$$CH_2 = CHCH = O \text{ (Acrolein)}$$

$$CH_3 - \underset{\underset{O}{\|}}{C} - OONO_2 \text{ (PAN)}$$

(18) **(D).** Only sewage is biodegradable.

(19) **(C).** About 75% of the solar energy reaching the earth is absorbed by the earth's surface, which increases its temperature. The rest of the heat radiates back to the atmosphere. Some of the heat is trapped by gases such as CO_2, CH_4, O_3, CFCs and water vapour in the atmosphere. Thus, they add to the heating of the atmosphere. This causes global warming.

(20) **(C).** CCl_3NO_2 – tear gas

(21) **(D).** Water soluble chemical pollutants are sulphuric acid, inorganic metal compounds.

(22) **(C).** Carbon monoxide has higher affinity for haemoglobin as compared to oxygen.

(23) **(C).** SO_2 and NO_2 after oxidation and reaction with H_2O are major contributors to acid rain, because polluted air usually contains particulate matter that catalyse the oxidation.

$$2\,SO_2\,(g) + O_2\,(g) + 2H_2O\,(\ell) \rightarrow 2H_2SO_4\,(aq)$$

$$4\,NO_2\,(g) + O_2\,(g) + 2H_2O\,(\ell) \rightarrow 4HNO_3\,(aq)$$

(24) **(D).** Classical smog is a mixture of smoke, fog and SO_2.

(25) **(B).** Classical smog is a reducing smog.

(26) **(D).** Even a low concentration of sulphur dioxide causes respiratory diseases e.g., asthma, bronchitis, emphysema in human beings. Sulphur dioxide causes irritation to the eyes, resulting in tears and redness.

(27) **(C).** Silicosis - by inhalation of silica.

(28) **(B).** Ozone hole is maximum over Antarctica due to climate conditions.

(29) **(C).** Photochemical smog occurs in summers during day time whereas classical smog is formed in the early morning hours of winter months.

(30) **(D).** Higher concentrations of NO_2 damage the leaves of plants and retard the rate of photosynthesis. NO_2 is a lung irritant that can lead to an acute respiratory disease in children. It is toxic to living tissues also.

(31) **(C).** Smog is a common pollutant in places which have high concentration of SO_2 in air.

(32) **(C).** Sulphur doixide causes respiratory diseases in human being. and irritation of the eyes.

(33) **(C).** SO_2 is the component of classical smog (i.e.; reducing smog) while unsaturated hydrocarbons, nitrogen oxides and ozone are the components of photochemical smog (i.e.; oxidising smog).

(34) **(D).** Phosphate pollution is brought about by fertilizers and sewage.

(35) **(A).** The word lithosphere refers to the layer of rock material on the earth's surface both on the continents and the ocean floor.

EXERCISE-3

(1) **(C).** When rain is accompanied by a thunderstorm, the collected rain water will have a pH value slightly lower than that of rain water without thunderstorm.

(2) **(C).** Oxide of sulphur and nitrogen is responsible for smog.

(3) **(B).** Ozone layer prevent UV-radiation from sun to reach the earth.

(4) **(D).**

(5) **(A).** Methyl isocyanate $CH_3 - N = C = O$ (MIC gas).

(6) **(B).** In drinking water maximum permissible concentration of : Lead about 50 ppb ; Nitrate about 50 ppm ;

Iron about 0.2 ppm ; Fluoride about < 1 ppm

High concentration of nitrate in drinking water can cause disease such as methemoglobinemia.

(7) **(D).** NO_3^-: The maximum limit of nitrate in drinking water is 50 ppm. Excess nitrate in drinkingwater can cause disease. Such as methemoglobinemia.

SO_4^{2-} : Above 500 ppm of SO_4^{2-} ion in drinking water causes laxative effect otherwise at moderate levels it is harmless

F^- : Above 2ppm concentration of F^- in drinking water cause brown mottling of teeth.

$\therefore$ The concentration given in question of SO_4^{2-} & NO_3^- in water is suitable for drinking but the concentration of F^- (i.e 10 ppm) make water unsuitable for drinking purpose.

(8) **(A).** The F^- ions make the enamel on teeth much harder by converting hydroxyapatite,

$[3Ca_3 (PO_4)_2 . Ca (OH)_2]$, into much harder fluorapatite i.e. $[3Ca_3(PO_4)_2 . CaF_2]$.

(9) **(C).** Permissible values :

(i) Zn = 5 ppm (ii) Fe = 0.2 ppm

(iii) Mn = 0.05 ppm (iv) Cu = 3.0 ppm

(10) **(A).** The upper stratosphere consists of ozone (O_3), which protect us from harmful ultraviolet (UV) radiations coming from sun.

(11) **(C).**

(12) **(D).** The maximum prescribed concentration of Cu in drinking water is 3 ppm.

(13) **(D).** Excessive release of CO_2 into the atmosphere results in global warming.

(14) **(C).** Troposphere is the lowest region of atmosphere bounded by Earth beneath and the stratosphere above where most of the clouds form and where life form exists.

(15) **(A).** The common component of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde & peroxyacetyl nitrate (PAN).

(16) **(D).** CO_2, O_3, H_2O vapours and CFC's are green house gases.

(17) **(C).** Biochemical oxygen demand (BOD) is amount of oxygen required by bacteria to break down organic waste in a certain volume of water sample.

EXERCISE-4

(1) **(C).** Green chemistry deals with the minimum use of toxic chemicals.

(2) **(C).** Growth of fish is inhibited if concentration of DO is below 6 ppm.

(3) **(D).** Photochemical smog cause's irritation in nose, eyes and throat.

(4) **(D).** Chlorofluorocarbon are the compounds that are responsible for ozone depletion. It is not a component of photochemical smog.

(5) **(A).** Microorganism present in the soil.

(6) **(D).** SO_2 (g) is not a greenhouse gas.