CHAPTER > 14

Environmental Chemistry

KEY NOTES

Environmental chemistry deals with the study of the origin, transport, reactions, effects and fates of chemical species in the environment.

Environmental Pollution

Environmental pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. The substance which causes pollution is called **pollutant**. Pollutant can be degradable like discarded vegetables and slowly degradable that remain unchanged for many decades.

Atmosphere and Atmospheric Pollution

Earth is surrounded by a covering of various gases called atmosphere. It can be divided into following regions.

Troposphere

It is the lower layer of atmosphere which extends upto the height of ~ 10 km from the sea level. It contains water vapours and is greatly affected by air pollution. It is turbulent, dusty zone containing air and water vapour.

Stratosphere

It is the region of the earth's atmosphere present above the troposphere. Ozone layer is present in this region.

Tropospheric Pollution

It occurs due to the presence of undesirable solids or gaseous particles present in air. Following are major pollutant in troposphere :

- Gaseous air pollutants which consists of oxides of sulphur, nitrogen and carbon, hydrocarbons, ozone etc.
- Particulate pollutants which consists of mist, dust, fumes, smoke, smog etc.

Gaseous Air Pollutants

Various types of gaseous air pollutants are :

Oxides of Sulphur

These are produced when sulphur containing fossil fuel is burnt. Most common is sulphur dioxide (SO_2). Low concentration of SO_2 causes respiratory diseases, e.g. asthma, bronchitis, emphysema, irritation in eyes and high concentration leads to stiffness of flower buds.

Oxides of Nitrogen

When lightning strikes at high altitudes, N_2 and O_2 combine to form oxides of nitrogen. Also, in automobile engine, when fossil fuel is burnt, N_2 and O_2 combine to give NO and NO_2. The irritant red haze in traffic and congested places is due to oxides of nitrogen. Higher concentration of NO_2 damages leaves of plants and related photosynthesis further NO_2 is a lung irritant.

Hydrocarbons

These are formed by incomplete combustion of fuel and are carcinogenic. These also cause ageing of plants and breakdown of tissues.

Oxides of Carbon

The two main oxides of carbon that cause pollution are carbon monoxide (CO) and carbon dioxide (CO_2).

- **Carbon monoxide** (CO) is colourless and odourless gas, highly poisonous to living beings. It is produced as a result of incomplete combustion of carbon. It binds to haemoglobin to form carboxyhaemoglobin, which is about 300 times more stable than oxygen-haemoglobin complex.

- **Carbon dioxide** (CO_2) is released into atmosphere by respiration, by decomposition of limestone and by burning of fossil fuel. Deforestation and burning of fossil fuel increases the CO_2 level and disturb the balance in the atmosphere. It is also responsible for global warming.

Particulate Pollutants

These are minute solid particles or liquid droplets in air. These may be viable and non-viable.

Viable Particulates

Viable particulates are minute living organisms that dispersed in the atmosphere. e.g. bacteria, fungi, algae etc.

Non-viable Particulates

Non-viable particulates may be classified as follows :

- **Smoke** The vaporised matter with suspended particles of carbon that arises as a result of burning or combustion is called smoke.
- **Dust** The air borne solid particles having size 0.1 μ-25 μ are called dust. e.g. saw dust, pulverised coal etc.
- As a result of **smoke** and dust, coal miners suffer from black lung disease and textile workers suffer from white lung disease.
- **Mist** It is produced by particles of spray liquids and by condensation of vapours in air, e.g. H_2SO_4 mist.
- **Fumes** These are obtained by condensation of vapours during sublimation, distillation, boiling etc.

Consequences of Air Pollutants

The main consequences of air pollutants are as follows :

Green House Effect and Global Warming

- The phenomenon of heating of earth and its objects because of trapping of IR radiations coming from the sun and prevent them from escaping into outer space is called **green house effect.**

  The major green house gases are CO_2, CH_4, N_2O, water vapour, O_3 and CFC's.
- When concentration of green house gases increases, these trap excess IR-rays and increases the temperature of earth too much. This is termed as **global warming**.

  It has drastic effect on climatic conditions.

Acid Rain

- When the pH of rainwater drops below 5.6 due to the presence of certain acids like H_2SO_4, HNO_3, it is called acid rain.
- Oxide of nitrogen and sulphur released into the atmosphere from thermal power plants, industries and automobiles are the main sources of acid rain.

$$2SO_2(g) + O_2(g) + 2H_2O(l) \longrightarrow 2H_2SO_4(aq)$$

$$2H_2O(l) + 4NO_2(g) + O_2(g) \longrightarrow 4HNO_3(aq)$$

- Acid rain damages buildings, corrodes metal pipes, causes respiratory diseases.

Smog

It is a harmful mixture of smoke and fog.

Two types of smog are as follows :

- **Classical smog** (Reducing or London smog) is a mixture of smoke, fog and sulphur dioxide. It occurs in cool humid climate. It is reducing in nature.
- **Photochemical smog** (Oxidising smog) It results from the action of sunlight on nitrogen oxides and hydrocarbons produced by automobiles and factories. It is oxidising in nature because it has high concentration of oxidising agents.

Formation of Photochemical Smog

It is due to the burning of fossil fuels. On burning, two major pollutants such as hydrocarbons and NO are emitted.
On reaction with sunlight, NO is converted to NO_2.

Various effects of components of photochemical smog are as follows :

- Ozone and PAN act as powerful eye irritants.
- Ozone and nitric oxide irritate the nose and throat and their high concentration causes headache.

Effects of Photochemical Smog

- The common components of photochemical smog are ozone, nitric oxide, acrolein, PAN, formaldehyde.
- Photochemical smog causes serious health problems.
- Ozone and PAN act as powerful eye irritant.
- Their higher concentration causes headache, chest pain, dryness of the throat cough and difficulty in breathing.
- It also causes corrosion of metals, stones and building materials.

Control of Photochemical Smog

- Use of catalytic converter in the automobiles which prevent the release of nitrogen oxide and hydrocarbons to the atmosphere.
- Certain plants, e.g. Pinus, Juniparus, Quercus, Pyrus and Vitis can metabolise nitrogen oxide and therefore, their plantation could help in this matter.

Stratospheric Pollution

- Stratosphere consists of ozone (O_3) that protect us from skin cancer. It is a product of UV radiations acting on O_2.
- In 1980s, atmospheric scientists working in Antarctica reported about depletion of ozone layer, known as **ozone hole**. The reason of ozone layer depletion is the release of chlorofluorocarbon compounds, also known as **freons**. The effects of depletion of ozone layer are cataract, skin cancer, killing of phytoplanktons etc.

Water Pollution

- It originates from human activities. Easily identified source or place of water pollution is called point source, e.g. municipal and industrial discharge pipes.

- Non-point source of water pollution are those where source of pollution cannot be easily identified, e.g. agricultural run off, acid rain, storm water drainage etc.

Major Water Pollutants

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

Causes of Water Pollution

- **Pathogens** The disease causing agents, bacteria and other microorganisms, are called **pathogens**. These enter into the water bodies from domestic sewage and animals excreta.
- **Organic wastes** Leaves, grass, trash, sewage, oxygen demanding wastes (from industries and agriculture) etc., are other major water pollutants.
- **Chemical pollutants** Water being an excellent solvent, dissolves most of the inorganic and organic chemicals that make it contaminated (or polluted).
- The degree of water pollution is measured in terms of biochemical oxygen demand (BOD). It is defined as the amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water, is called **Biochemical Oxygen Demand** (BOD).
- Clean water has BOD value less than 5 ppm.
- **Eutrophication** is the process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving of oxygen and results in subsequent loss of biodiversity.

International Standards for Drinking Water

- The **concentration of fluorides** should be upto 1 ppm or 1 mg dm^{-3}. Above 2 ppm of F^- ion concentration, it causes brown mottling of teeth.
- The **concentration of lead** should be < 50 ppb.
- The concentration of **sulphate** should be < 500 ppm.
- The concentration of **nitrate** should be < 50 ppm. More than above limit of nitrates in drinking water, causes blue body syndrome.

Soil Pollution

- The addition of substances, in an indefinite proportion changes the productivity of the soil. This is called soil pollution.
- Chemicals like insecticides (DDT, BHC), pesticides ($NaClO_3$, Na_3AsO_3), industrial wastes, radioactive wastes from research centres etc., are the main sources of soil pollution.
- **Industrial wastes** are classified as biodegradable and non-biodegradable wastes. The disposal of non-biodegradable industrial solid waste may cause serious threat to the environment. Now-a-days, large quantities of toxic wastes are destroyed by controlled incineration. Whereas small quantities are burnt along with factory.

Note ***Green fuel*** *is the fuel obtained from plastic waste that has high octane rating and no lead.*

Strategies to Control Environmental Pollution

Environmental pollution is mainly controlled either by waste management or by **green chemistry.**

Waste Management

Various steps involved in waste management are as follows :

- At the disposable site the wastes are separated into **biodegradable** and **non-biodegradable** materials.
- The biodegradable waste materials are used for filling land pits and are converted into compost, i.e. degraded by anaerobic microorganisms into CO_2 and CH_4.

  This process of degradation of toxic organic wastes by anaerobic microorganisms is called **digestion**.

Green Chemistry

Green chemistry is a production process that would bring about minimum pollution or deterioration to the environment. It includes finding non-volatile solvent impurities, developing new catalysts and environmental friendly materials.

Mastering NCERT

MULTIPLE CHOICE QUESTIONS

TOPIC 1 ~ *Environmental Pollution*

1 Environmental chemistry deals with the study of the
(a) origin of chemical species in environment
(b) effect of chemical species in environment
(c) reactions of chemical species in environment
(d) All of the above

2 Pollutants can be found in the form of
(a) solid (b) liquid
(c) gas (d) All of these

3 How much times of air with respect to food is required by an average human being?
(a) 2-4 (b) 200-400
(c) 12-15 (d) None of these

4 Pollutants, which are broken down by natural process, are known as
(a) degradable pollutants
(b) non-degradable pollutants
(c) natural pollutants
(d) environmental pollutants

5 Pollutants, which are slowly degradable and remain in the environment in an unchanged form for many decades, are termed as
(a) slow-degradable pollutants
(b) non-degradable pollutants
(c) soil pollutants
(d) None of the above

TOPIC 2 ~ *Atmospheric Pollution : By Gaseous Pollutants*

6 The concentric layers or regions of air around earth have
(a) same density for all the layers
(b) different densities for each layer
(c) usually same density but vary with day temperature
(d) same density except the first layer from sea level

7 The regions of the atmosphere, where clouds form and where we live respectively, are ***JEE Main 2019***
(a) stratosphere and stratosphere
(b) troposphere and troposphere
(c) troposphere and stratosphere
(d) stratosphere and troposphere

8 Which of the following is the correct height for troposphere from sea level?
(a) ~10 km (b) ~ 50 km
(c) ~ 100 km (d) ~ 1 km

9 Which of the following atmospheric layer contains clouds, water vapour and air?
(a) Stratosphere (b) Troposphere
(c) Mesosphere (d) All of these

10 The region of atmosphere that contains dinitrogen, dioxygen, ozone and little water vapour is
(a) troposphere (b) stratosphere
(c) mesosphere (d) enosphere

11 Production of oxides of sulphur is done by
(a) burning coal with hydrogen
(b) combustion of fuels in automobile
(c) burning fossil fuels and sulphur
(d) using indoor combustion devices

12 High concentration of SO_2 leads to
(a) acute respiratory disease
(b) stiffness of flower buds
(c) harm of various textile fibres and metals
(d) None of the above

13 Which of the following pollutant(s) catalyse(s) the oxidation of sulphur dioxide to sulphur trioxide?
(a) Particulate matter
(b) CO_2
(c) NO_2
(d) All of the above

14 In an automobile engine, (at high temperature) when fossil fuel is burnt, N_2 and O_2 combine to yield
(a) NO (b) NO_2
(c) HNO_3 (d) Both (a) and (b)

15 In which of the following, rate of production of NO_2 is faster?
(a) $N_2(g) + O_2(g) \xrightarrow{1483K} 2NO(g)$
(b) $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$
(c) $NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$
(d) None of the above

16 Consider the following effects :

(i) Ageing

(ii) Breakdown of tissues.

(iii) Shedding of leaves, flowers and twigs.

Which of the following causes the above mention effects?

(a) Sulphur dioxide (b) Nitrogen dioxide

(c) Hydrocarbons (d) Sulphur trioxide

17 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

18 Carbon monoxide is a highly poisonous gas for human beings because

(a) it binds to haemoglobin to form stable compound

(b) it is carcinogenic in nature

(c) it induces the chance of heart attack

(d) it affects nervous system fatally

19 Which of the following is produced on incomplete combustion of petrol or diesel?

(a) $CO + H_2O$ (b) $CO + NO_2$ (c) CO (d) SO_2

20 Which of the following is a sink for CO? ***NEET 2017***

(a) Haemoglobin

(b) Microorganisms present in the soil

(c) Oceans

(d) Plants

21 What will happen to oxygen carrying capacity of blood when concentration of carboxyhaemoglobin reaches about 3-4%?

(a) Increase (b) Reduce

(c) Remains same

(d) First increases and then remains constant

22 In pregnant women has the habit of smoking, the increased CO level in blood may induce harmful effects like

(a) premature birth (b) spontaneous abortions

(c) deformed babies (d) All of these

23 Which of the following gases does not cause global warming?

(a) CO_2 (b) O_3

(c) CO (d) Chlorofluorocarbons

24 Among the gases (A)-(E), the gases that cause greenhouse effect are : ***JEE Main 2020***

(A) CO_2 (B) H_2O (C) CFCs (D) O_2 (E) O_3

(a) (A), (B), (C) andn (D) (b) (A) and (D)

(c) (A), (B), (C) and (E) (d) (A), (C), (D) and (E)

25 Among the following, the one that is not a green house gas is ***NEET (National) 2019***

(a) methane (b) ozone

(c) sulphur dioxide (d) nitrous oxide

26 What is the minimum per cent of CO_2 that can disturb the natural greenhouse balance?

(a) 0.3 (b) 0.5 (c) 0.03 (d) 1.0

27 Which of the following greenhouse gas is released in paddy field?

(a) CFCs (b) CH_4 (c) SO_2 (d) All of these

28 Among the following, which one is damaging the ozone layer?

(a) CFCs (b) CO_2 (c) CH_4 (d) SO_2

29 Which of the following chemicals increases when chemical fertilisers are used in excess?

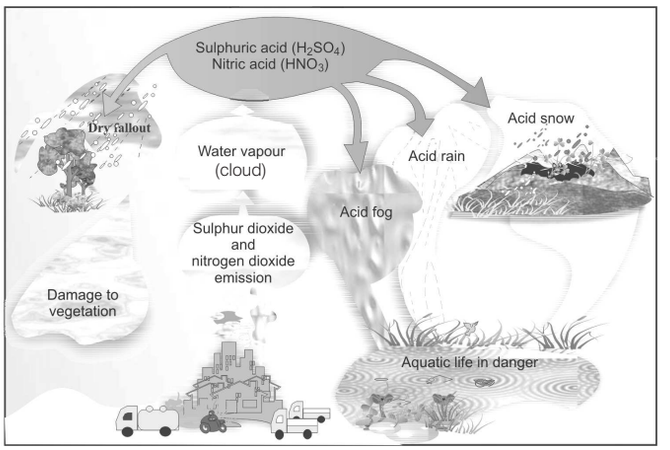
(a) Nitrogen oxide (b) Carbon dioxide

(c) Carbon monoxide (d) Methane

30 The pH of rain water, is approximately ***JEE Main 2019***

(a) 7.5 (b) 6.5 (c) 5.6 (d) 1.0

31 The following figure represents the phenomenon of



(a) global warming (b) acid deposition

(c) photochemical smog (d) Both (b) and (c)

32 Which among the following oxides deposit(s) as acid in atmosphere?

(a) Oxides of sulphur (b) Oxide of phosphorus

(c) Oxides of nitrogen (d) Both (a) and (c)

33 Which type of activity is not a cause of acid rain?

(a) Emission from motor vehicles

(b) Generation of electricity in thermal power stations

(c) Production of carbon monoxide during combustion of wood

(d) Use of fossil fuel in furnaces

34 The main constituent(s) of acid rain is/are

(a) H_2SO_4 (b) HNO_3

(c) HCl (d) Both (a) and (b)

35 Which type of deposition occurs due to aerosol particles of oxides or ammonium salts in raindrops?

(a) Dry deposition (b) Wet deposition

(c) Normal deposition (d) Both (a) and (b)

36 Which of the following air pollutant is deposited as dry deposition?
(a) SO_2 (b) Cl_2 (c) CO (d) All of these

37 Which of the following is responsible for damaging Taj Mahal and other monuments near Agra?
(a) SO_2 (b) NO_2
(c) Industrial pollutants (d) All of these

38 What do you mean by Taj Trapezium?
(a) A Trapezium shaped park inside the Taj Mahal
(b) A Trapezium shaped residential colony developed near Taj Mahal to promote greenery
(c) A plan that aims at cleaning the air in an area that includes the Agra and other surrounding towns
(d) Both (a) and (b)

TOPIC 3 ~ *Atmospheric Pollution : By Particulate Pollutants*

39 Which of the following is not a viable particulate?
(a) Bacteria (b) Fungi (c) Moulds (d) Mist

40 Non-viable particulates are classified on the basis of
(a) nature of particles (b) size of particles
(c) composition of particles (d) Both (a) and (b)

41 When herbicides and insecticides travel through air, they readily form
(a) smoke (b) dust
(c) mist (d) All of these

42 The size of the particulate pollutant that can lodge in the nasal passage is
(a) 5 microns (b) 10 microns
(c) 8 microns (d) 12 microns

43 Which of the following is the major particulate matter emitted by vehicles?
(a) Hg (b) Pb (c) Cd (d) Co

44 The health hazard caused by the use of leaded petrol is
(a) abnormal development of red blood cell
(b) breathing problems and other lungs diseases
(c) rashes on skin
(d) All of the above

45 When smoke simultaneously exists with fog, it is called
(a) mist (b) fume
(c) smog (d) black fume

46 Classical smog is a mixture of
(a) smoke + SO_2 (b) smoke + H_2O
(c) smoke + fog + H_2O (d) smoke + fog + SO_2

47 Which of the following is the other name for the classical smog?
(a) Oxidising smog (b) Reducing smog
(c) Photochemical smog (d) Foam

48 Which type of smog occur in warm, dry and sunny climate?
(a) Classical smog (b) Normal smog
(c) Photochemical smog (d) None of these

49 Oxidising smog is also known as
(a) normal smog (b) photochemical smog
(c) classical smog (d) Both (a) and (b)

50 Which one of the following is not a common component of photochemical smog?
CBSE AIPMT 2014
(a) Ozone (b) Acrolein
(c) Peroxyacetyl nitrate (d) Chlorofluorocarbons

51 Which of the following options represent(s) the structure of PAN?
(a) CH_2O (b) $CH_2{=}CH{-}CHO$
(c) $CH_3CH_2{-}O{-}N{=}O$ (d) $CH_3{-}\overset{\overset{O}{\|}}{C}{-}OONO_2$

52 Which of the following components of photochemical smog act as powerful eye irritants?
(a) O_3 (b) PAN
(c) Hydrocarbon (d) Both (a) and (b)

53 Which of the following is/are the primary precursor(s) of the photochemical smog?
(a) PAN (b) NO_2
(c) Hydrocarbon (d) Both (b) and (c)

54 Which of the following belongs to secondary air pollutants?
(a) PAN (b) Hydrocarbon (c) SO_2 (d) CFCs

55 Which of the following is present in the upper stratosphere?
(a) SO_3 (b) SO_2 (c) NO_2 (d) O_3

56 Which of the following reaction(s) is/are carried out during the formation of O_3 layer in stratosphere?
(a) $O_2(g) \xrightarrow{UV} O(g) + O(g)$
(b) $O(g) + O_2 \xrightarrow{UV} O_3(g)$
(c) $O_3(g) \xrightarrow{UV} O_2(g) + O(g)$
(d) All of the above

57 Point out the plants, which are most effective for controlling the photochemical smog?
(a) *Pinus* (b) *Juniparus* (c) *Vitis* (d) All of these

58 Freon gas causing stratospheric ozone depletion is released mainly from
(a) refrigerator (b) automobile
(c) thermal power plant (d) steel industry

59 CFCs are used in refrigerators, air conditioners because of its
(a) non-reactive nature (b) non-toxic nature
(c) non-flammable nature (d) All of these

60 CFCs deplete the ozone layer because
(a) they release Cl_2 gas
(b) they release chlorine free radical
(c) they release F_2 gas
(d) Both (a) and (b)

61 The depletion of ozone leads to the formation of
(a) ozone hole (b) ozone centre
(c) ozone point (d) All of these

62 Excessive release of CO_2 into the atmosphere results in ***JEE Main 2019***
(a) formation of smog
(b) depletion of ozone
(c) polar vortex
(d) global warming

63 Which of the two chemical species combine with NO_2 and CH_4 in summer season to produce chlorine sinks?
(a) Chlorine, carbon dioxide
(b) Chlorine monoxide, chlorine
(c) Chlorine, chlorine monoxide
(d) Ozone, chlorine

TOPIC 4 ~ *Water Pollution*

64 Which of the following source of water pollution is a point source?
(a) Run off from farm
(b) Industrial discharge
(c) Acid rain
(d) Storm water drainage

65 Which of the following is/are most serious disease causing agent found in polluted water?
(a) Chemical pollutants
(b) Organic wastes
(c) Pathogens
(d) Both (a) and (b)

66 Human excreta contain bacteria such as *Escherichia coli* and *Streptococcus faecalis*, which cause
(a) respiratory diseases
(b) gastrointestinal diseases
(c) hypertension
(d) urinary problems

67 Which of the following constitutes organic wastes?
(a) Drainage from mineral fields
(b) Sewage
(c) Industrial organic chemical
(d) Fertilisers

68 Biochemical oxygen demand (BOD) is the amount of oxygen required (in ppm) ***JEE Main 2020***
(a) for the photochemical breakdown of waste present in 1 m^3 volume of a water body
(b) for sustaining life in a water body
(c) by anaerobic bacteria to breakdown inorganic waste present in a water body
(d) by bacteria to breakdown organic waste in a certain volume of a water sample

69 The value of BOD of highly polluted water is
(a) more than 17 ppm
(b) more than 5 ppm
(c) 1 ppm
(d) 5 ppm

70 BOD of four samples of water A, B, C and D are given below :
A. 30 $mg\,L^{-1}$ B. 300 $mg\,L^{-1}$
C. 2000 $mg\,L^{-1}$ D. 3400 $mg\,L^{-1}$
The decreasing order of extent of pollution in water is
(a) C > D > B > A (b) C > D > A > B
(c) D > C > B > A (d) A > B > C > D

71 Name the process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen.
(a) Biological oxygen demand
(b) Biomagnification
(c) Eutrophication
(d) Chemical oxygen demand

72 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 for drinking is ***JEE Main 2019***
(a) Cu (b) Fe
(c) Mn (d) Zn

73 The condition for methemoglobinemia by drinking water is ***JEE Main 2019***
(a) > 50 ppm nitrate
(b) > 50 ppm chloride
(c) > 50 ppm lead
(d) > 100 ppm sulphate

TOPIC 5 ~ *Soil Pollution*

74 Naturally occurring chemical nicotine is obtained from
(a) power plants (b) cotton
(c) paddy (d) tobacco plants

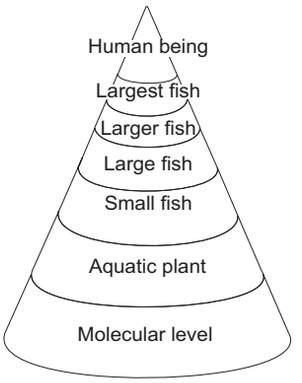
75 Which of the following pesticide is introduced during World War II to control malaria?
(a) Nicotine (b) DDT
(c) Aldrin (d) Dieldrin

76 Which of the following pesticide cause severe nerve toxicity?
(a) DDT (b) Carbamate
(c) Aldrin (d) None of these

77 Which of the following is/are example(s) of herbicides?
(a) Sodium chlorate (b) Sodium arsenite
(c) $KMnO_4$ (d) Both (a) and (b)

78 Which types of pollutant toxins are deposited in the different trophic levels?
(a) Biodegradable pollutants
(b) Non-biodegradable pollutants
(c) Water pollutants
(d) None of the above

79 Consider the following representation of trophic levels.



Which trophic level has least concentration of toxins deposition?
(a) Aquatic plant (b) Small fish
(c) Human being (d) Largest fish

80 Which trophic level has highest concentration of DDT deposition?
(a) Aquatic plant (b) Human being
(c) Largest fish (d) Small fish

TOPIC 6 ~ *Industrial Wastes*

81 Which one of the following plant/factory is considered for generating non-biodegradable wastes?
(a) Thermal power plant (b) Textile factory
(c) Iron and steel plant (d) Both (a) and (c)

82 Large quantities of toxic wastes are destroyed by which of the following method?
(a) Burnt in air (b) Open dump
(c) Controlled incineration (d) None of these

83 Fuel obtained from plastic waste has high octane rating. It contains no lead and is known as
(a) green fuel (b) bio fuel
(c) octane fuel (d) toxic fuel

84 Technology has been developed to produce electricity from the garbage. Name the gas obtained during this?
(a) Water gas (b) Producer gas
(c) Bio gas (d) Hydrogen gas

TOPIC 7 ~ *Strategies to Control Environmental Pollution and Green Chemistry*

85 Which of the following mission is launched by Government of India in order to control waste pollution?
(a) Swachh Bharat Abhiyan
(b) Digital India
(c) MNREGA
(d) All of the above

86 The two programmes which are being implemented under the broad umbrella of Swachh Bharat Abhiyan are
(a) SBM - U and Digital India
(b) SBM - U and SBM - G
(c) MNREGA and NREGA
(d) rural health mission and SBM-G

87 Which of the following is/are the main targets of SBM - G programme?
(a) Improvement in the general quality of life in rural areas
(b) Eliminating open defecation
(c) Both (a) and (b)
(d) None of the above

88 Green chemistry involves
(a) minimum pollution or deterioration to the environment
(b) reduction of exploitation of natural resources
(c) to store solar energy as plants do
(d) to study the reactions in plants

89 Why water is the better solvent medium for most of the synthetic chemical reaction?
(a) Use of water is low in cost
(b) It devoids of any carcinogenic effects
(c) Water has high specific heat capacity
(d) All of the above

90 "Reducing potentially hazardous waste through smarter production".
This represents a great step forward for
(a) green revolution (b) green chemistry
(c) industrial revolution (d) green biotechnology

91 Which of the following chemical has more toxic effect when used for the purpose of dry cleaning of clothes?
(a) Tetrachloroethene
(b) H_2O_2
(c) Liquefied CO_2 with suitable detergents
(d) None of the above

92 Which of the following is now used for bleaching of paper, in place of chlorine?
(a) H_2O_2 (b) $CH_2=CH_2$ (c) CH_3CHO (d)$Cl_2C=CCl_2$

93 Which branch of chemistry is a cost effective approach which involves reduction in material, energy consumption and waste generation?
(a) Environmental chemistry (b) Green chemistry
(c) Organic chemistry (d) Biochemistry

SPECIAL TYPES QUESTIONS

I. Statement Based Questions

94 Which of the following statements are the harmful effects of nitrogen oxide?
I. It retards the rate of photosynthesis.
II. It causes respiratory disease in children.
III. It is toxic to living tissues.
Choose the correct statements.
(a) Both I and II (b) Both II and III
(c) I, II and III (d) Both I and III

95 Which of the following diseases are caused due to low concentration of SO_2?
I. Digestive diseases II. Asthma
III. Bronchitis IV. Emphysema
Choose the correct statements.
(a) Both I and II (b) II, III and IV
(c) Both III and IV (d) I, II and III

96 Sulphur dioxide causes
I. respiratory diseases in human beings.
II. red haze in the traffic.
III. irritation of the eyes.
Choose the correct statements.
(a) Both I and II
(b) Both II and III
(c) Both I and III
(d) I, II and III

97 Acid rain is due to
I. oxides of nitrogen. II. oxides of sulphur.
Choose the correct statements.
(a) Both I and II (b) Only II
(c) Only I (d) None of these

98 The viable particulates stand for
I. minute living organisms present in atmosphere.
II. minute non-living particles present in atmosphere.
Choose the correct statements.
(a) Only I (b) Only II
(c) Both I and II (d) Neither I nor II

99 Which of the following are the major particulate pollutants?
I. Dust II. Mist
III. Smoke IV. Smog
Choose the correct statements.
(a) I and IV
(b) Both III and IV
(c) II, III and IV
(d) I, II, III and IV

100 Mist is produced by
I. particles of spray liquids.
II. condensation of vapours in air.
Choose the correct statements.
(a) Only I (b) Only II
(c) Both I and II (d) Neither I nor II

101 Which of the following statements are major gaseous pollutants present in the troposphere?

I. H_2S
II. Oxides of sulphur, nitrogen and carbon.
III. O_3

Choose the correct statements.

(a) Both I and II (b) Both I and III
(c) I, II and III (d) None of these

102 Which of the following statements are involved in the formation of PAN?

I. NO_2 II. O_3
III. Unburnt hydrocarbon IV. CO_2

Choose the correct statements.

(a) Both I and II (b) I, II and IV
(c) I, III and IV (d) I, II and III

103 Which of the following statements are the examples of non-degradable pollutants?

I. DDT II. Nuclear wastes
III. Plastic materials

Choose the correct statement.

(a) Both I and II (b) Both II and III
(c) I, II and III (d) Both I and III

104 Which one of the following statements is/are incorrect regarding photochemical smog?

(a) CO 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

105 Heavy metal water pollutants are dangerous to human because

I. human body cannot excrete them.
II. human body can excrete them.
III. these metals can damage kidney and liver.

Which of the following is the correct option?

(a) I, II and III (b) Both I and II
(c) Both II and III (d) Both I and III

106 Which of the following conditions show the polluted environment?

(a) pH of rain water is 5.6
(b) Amount of carbon dioxide in the atmosphere is 0.03%
(c) Biochemical oxygen demand 5 ppm
(d) Eutrophication

107 The consequences of global warming may be

(a) decrease in average temperature of the earth
(b) melting of Himalayan Glaciers
(c) increased biochemical oxygen demand
(d) eutrophication

108 Which one of the following statements is incorrect?

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(a) Oxides of sulphur, nitrogen and carbon are the most wide spread 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 5 ppm

109 Which of the following statement is correct?

(a) Domestic wastes are collected in community bins
(b) At the disposable site, garbage is sorted out and separated out on the basis of material
(c) Non-biodegradable wastes like polythene bag, metal scraps etc. choke the sewers and cause inconvenience
(d) Domestic waste should be disposed off openly or into compost

110 Polychlorinated biphenyls (PCBs) are

I. non-carcinogenic in nature.
II. carcinogenic in nature.
III. used as cleansing solvent.

Choose the correct statement.

(a) Both I and III (b) Both II and III
(c) Only II (d) Only III

111 Fluoride deficiency in drinking water causes

I. harmful effect on bone. II. tooth decay.
III. blue baby syndrome.

Choose the correct statement.

(a) Only I (b) Only II
(c) Only III (d) Both I and II

112 When fluoride ion concentration in water is more than 2 ppm then it causes

I. tooth decay. II.brown mottling of teeth.
III. harmful effect to bone.

Choose the correct statement.

(a) Both I and II (b) Both II and III
(c) I, II and III (d) Only I

113 Which one of the following statements is/are correct?

(a) Aldrin and dialdrin were introduced in the market by pesticide industry.
(b) Sodium chlorate ($NaClO_3$) is used as herbicides.
(c) DDT and BH.C are not good insecticides because they are absorbed by the soil and containrate root crops.
(d) All give statements are correct.

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

(a) enhanced growth of algae
(b) increase in amount of dissolved oxygen in water
(c) deposition of calcium phosphate
(d) increase in fish population

115 Consider the following statements.

I. Green fuel has low octane rating and contains lead .

II. Recycled plastic wastes are used for making clothes.

III. Production of electricity by garbage is done by setling. up pilot gas plant.

Which of the above statement(s) is/are incorrect?

(a) Only II (b) Both I and II

(c) Both II and III (d) Only I

III. Assertion and Reason

■ **Directions** (Q.Nos. 116-122) *In the following questions a statement of Assertion* (A) *followed by a statement of Reason* (R) *is given. Choose the corrcet option out of the choices given below in each question.*

(a) Both A and R are correct and R is the correct explanation of A.

(b) Both A and R are correct and R is not the correct explanation of A.

(c) A is correct; R is incorrect.

(d) A is incorrect; R is correct.

116 **Assertion** (A) In a green house effect solar radiations pass through the transparent glass and heat up the soil and plants.

Reason (R) Green house name has been given because glass houses are made of green glass.

117 **Assertion** (A) Carbon dioxide is one of the important green house gas.

Reason (R) It is largely produced by respiratory function of animals and plants.

118 **Assertion** (A) The pH of acid rain is less than 5.6.

Reason (R) Carbon dioxide present in the atmosphere dissolves in rain water and forms carbonic acid.

119 **Assertion** (A) Photochemical smog is oxidising in nature.

Reason (R) Photochemical smog contains NO_2 and O_3, which are formed during the sequence of reactions.

120 **Assertion** (A) Ozone is destroyed by solar radiation in upper stratosphere.

Reason (R) Thinning of the ozone layer allows excessive UV radiations to reach the surface of earth.

121 **Assertion** (A) Heavy metals such as cadmium, mercury, nickel etc. are water pollutants.

Reason (R) Heavy metals are not harmful to humans.

122 **Assertion** (A) Excessive use of chlorinated synthetic pesticides causes soil and water pollution.

Reason (R) Synthetic pesticides are non-biodegradable.

III. Matching Type Questions

123 Match the Column I with Column II and choose the correct option from the codes given below.

	Column I		Column II
A.	SO_2	1.	Binds to haemoglobin
B.	NO_2	2.	Leads to stiffness of flower buds
C.	CO	3.	Irritant red haze in the traffic

Codes

	A	B	C		A	B	C
(a)	1	2	3	(b)	3	2	1
(c)	2	3	1	(d)	1	3	2

124 Match the Column I with the Column II and choose the correct option from the codes given below.

	Column I (Metals)		Column II (Maximum prescribed concentration ppm or mg dm^{-3})
A.	Fe	1.	0.005
B.	Cd	2.	0.2
C.	Mn	3.	5.0
D.	Zn	4.	0.05

Codes

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

125 Match the Column I and Column II and choose the correct option from the codes given below.

	Column I		Column II
A.	Dry cleaner which is not environment friendly	1.	Production of CH_3CHO by environmental friendly process
B.	Dry cleaner which is environment friendly	2.	Tetrachloroethene
C.	Ionic catalyst in aqueous medium	3.	H_2O_2

Codes

	A	B	C		A	B	C
(a)	1	2	3	(b)	3	2	1
(c)	2	3	1	(d)	1	3	2

126 Match the Column I with Column II and chose the correct options from the codes given below.

	Column I		Column II
A.	Industries manufacturing zinc and copper	1.	Hazardous wastes
B.	Pharmaceutical industries	2.	Mud and tailings
C.	Fertiliser industries	3.	Gypsum

Codes

	A	B	C		A	B	C
(a)	2	1	3	(b)	1	2	3
(c)	3	2	1	(d)	3	1	2

127 Match the items in Column I and Column II and choose the correct option from the codes given below.

Column I		Column II	
A.	UV-radiation	1.	Biomagnification
B.	DDT	2.	Skin cancer
C.	Phosphate	3.	Eutrophication

Codes

	A	B	C		A	B	C
(a)	1	2	3	(b)	3	2	1
(c)	2	3	1	(d)	2	1	3

128 Match the Column I with Column II and choose the correct option from the codes given below.

Column I		Column II	
A.	Degradable pollutant(s)	1.	Nuclear wastes
B.	Biomagnification	2.	Discarded vegetables
C.	Nuclear power plant	3.	DDT

Codes

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

129 Match the Column I with Column II and choose the correct option from the codes given below.

Column I		Column II	
A.	Troposphere	1.	~10-50 km above sea level
B.	Stratosphere	2.	~0-10 km above sea level
C.	Mesosphere	3.	50-85 km above sea level

Codes

	A	B	C		A	B	C
(a)	3	2	1	(b)	1	2	3
(c)	2	1	3	(d)	1	3	2

130 Match the Column I with the Column II and choose the correct option from the codes given below.

Column I		Column II	
A.	Normal rain	1.	H_2CO_3
B.	Acid rain	2.	HNO_3 and H_2SO_4
C.	Greenhouse effect	3.	CH_4, CFCs and O_3
D.	Global warming	4.	CO_2

Codes

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

131 Match the pollutants given in Column I with their effects given in Column II and choose the correct option from the codes given below.

Column I		Column II	
A.	Sulphur dioxide in air	1.	Global warming
B.	Carbon dioxide in air	2.	Eutrophication
C.	Phosphate fertilisers	3.	Acid rain

Codes

	A	B	C		A	B	C
(a)	3	1	2	(b)	3	1	2
(c)	1	3	2	(d)	2	3	1

132 Match the terms given in Column I with the compounds given in Column II and choose the correct option from the codes given below.

Column I		Column II	
A.	Acid rain	1.	$CHCl_2$ — CHF_2
B.	Photochemical smog	2.	CO
C.	Combination with haemoglobin	3.	H_2CO_3
D.	Depletion of ozone layer	4.	Unsaturated hydrocarbons

Codes

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

133 Match the Column I with the Column II and choose the correct option from the codes given below.

Column I		Column II	
A.	Domestic sewage	1.	Microorganisms
B.	Nuclear power plant	2.	Radioactive waste
C.	Chemical used for killing insects and fungi	3.	Pesticides

Codes

	A	B	C		A	B	C
(a)	1	2	3	(b)	2	1	3
(c)	3	2	1	(d)	2	3	1

134 Match the pollutant(s) in Column I with the effect(s) in Column II and choose the correct option from the codes given below.

Column I		Column II	
A.	Nitrogen dioxide	1.	Global warming
B.	Carbon dioxide	2.	Damage to kidney
C.	Nitrate in drinking water	3.	'Blue baby' syndrome
D.	Lead	4.	Red haze in traffic and congested areas

Codes

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

NCERT & NCERT Exemplar

MULTIPLE CHOICE QUESTIONS

NCERT

135 Which gases are responsible for greenhouse effect?
(a) CO_2 (b) CH_4 (c) NO_2 (d) All of these

136 When the pH of the rain water drops below 5.6, it is called
(a) acid rain (b) base rain (c) neutral rain (d) normal rain

137 What would have happened if the greenhouse gases were totally missing in the earth's atmosphere?
(a) More vegetation on earth
(b) No vegetation and no life on earth
(c) No impact on earth
(d) None of the above

NCERT Exemplar

138 Which of the following gases is not a greenhouse gas?
(a) CO (b) O_3 (c) CH_4 (d) H_2O vapour

139 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

140 Which of the following statements is incorrect about classical smog?
(a) Its main components are produced by the action of sunlight on emission 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

141 Biochemical Oxygen Demand, BOD is a measure of organic material present in water. BOD value less than 5 ppm indicates a water sample to be
(a) rich in dissolved oxygen (b) poor in dissolved oxygen
(c) highly polluted (d) not suitable for aquatic life

142 Which of the following statements is incorrect?
(a) Ozone is not responsible for greenhouse effect
(b) Ozone can oxidise sulphur dioxide present in the atmosphere in to sulphur trioxide
(c) Ozone hole is thinning of ozone layer present in stratosphere
(d) Ozone is produced in upper stratosphere by the action of UV rays on oxygen

143 Sewage containing organic waste should not be disposed in water bodies because it causes major water pollution. Fishes in such a polluted water die because of
(a) large number of mosquitoes
(b) increase in the amount of dissolved oxygen
(c) decrease in the amount of dissolved oxygen in water
(d) clogging of gills by mud

144 Which of the following statements about photochemical smog is incorrect?
(a) It has high concentration of oxidising agents
(b) It has low concentration of oxidising agents
(c) It can be controlled by controlling the release of NO_2, hydrocarbons, ozone etc
(d) Plantation of some plants like pinus helps in controlling photochemical smog

145 The gaseous envelope around the earth is known as atmosphere. The lowest layer of this is extended upto 10 km from sea level, this layer is
(a) stratosphere (b) troposphere
(c) mesosphere (d) hydrosphere

146 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 the presence of a catalyst
(c) oxides of nitrogen are unstable
(d) N_2 and O_2 are unreactive

147 The pollutants which come directly in the air from sources are called primary pollutants. Primary pollutants are sometimes converted into secondary pollutants. Which of the following belongs to secondary air pollutants?
(a) CO (b) Hydrocarbon
(c) Peroxyacetyl nitrate (d) NO

148 Which of the following statements is correct?
(a) Ozone hole is a hole formed in stratosphere from which ozone oozes out
(b) Ozone hole is a hole formed in troposphere from which ozone oozes 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 completely

149 Which of the following particles 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

Answers

› Mastering NCERT with MCQs

1 (d)	2 (d)	3 (c)	4 (a)	5 (b)	6 (b)	7 (b)	8 (a)	9 (b)	10 (b)
11 (c)	12 (b)	13 (a)	14 (d)	15 (c)	16 (c)	17 (a)	18 (a)	19 (c)	20 (b)
21 (b)	22 (d)	23 (c)	24 (a)	25 (c)	26 (c)	27 (b)	28 (a)	29 (a)	30 (c)
31 (b)	32 (d)	33 (c)	34 (d)	35 (b)	36 (a)	37 (d)	38 (c)	39 (d)	40 (d)
41 (c)	42 (a)	43 (b)	44 (a)	45 (c)	46 (d)	47 (b)	48 (c)	49 (b)	50 (d)
51 (d)	52 (d)	53 (d)	54 (a)	55 (d)	56 (d)	57 (d)	58 (a)	59 (d)	60 (b)
61 (a)	62 (d)	63 (b)	64 (b)	65 (c)	66 (b)	67 (b)	68 (a)	69 (a)	70 (c)
71 (c)	72 (c)	73 (a)	74 (d)	75 (b)	76 (b)	77 (d)	78 (a)	79 (a)	80 (b)
81 (d)	82 (c)	83 (a)	84 (c)	85 (a)	86 (b)	87 (c)	88 (a)	89 (d)	90 (b)
91 (a)	92 (a)	93 (b)							

› Special Types Quesitons

94 (c)	95 (b)	96 (c)	97 (a)	98 (a)	99 (d)	100 (c)	101 (c)	102 (d)	103 (c)
104 (d)	105 (d)	106 (d)	107 (b)	108 (c)	109 (c)	110 (b)	111 (b)	112 (c)	113 (d)
114 (a)	115 (d)	116 (c)	117 (b)	118 (b)	119 (a)	120 (d)	121 (a)	122 (a)	123 (c)
124 (b)	125 (c)	126 (a)	127 (d)	128 (c)	129 (c)	130 (c)	131 (a)	132 (a)	133 (a)
134 (b)									

› NCERT & NCERT Exemplar Questions

135 (d)	136 (a)	137 (b)	138 (a)	139 (c)	140 (a)	141 (a)	142 (a)	143 (c)	144 (b)
145 (b)	146 (a)	147 (c)	148 (c)	149 (d)					

Hints & Explanations

5 (*b*) Pollutants which are degraded slowly and remain in the environment in an unchanged form for many decades are called non-degradable pollutants. e.g. DDT (dichloro diphenyl trichloroethane), plastic materials, heavy metals, nuclear wastes etc.

6 (*b*) The atmosphere that surrounds the earth is not of same thickness at all heights. There are concentric layers of air and each layer has different density.

7 (*b*) The lowest region of atmosphere is troposphere which extends upto the height of 10 km (approx) from sea level. We live in the tropospheric region. It contains air, water vapour and dust which can form clouds with the help of strong air movement.

Above the troposphere, stratospheric region extends upto 50 km from sea level. It contains mainly N_2, O_2, O_3 and little water vapour. O_3 in the stratosphere absorbs 99.5% of the sun's harmful UV raditions and thus protects the lives on the earth.

9 (*b*) Troposphere is a turbulent, dusty zone that contains air, water vapours and clouds.

10 (*b*) The region of atmosphere that contains dinitrogen, dioxygen, ozone and little water vapour is stratosphere. This region lies above the troposphere, i.e. between 10 and 50 km above sea level.

12 (*b*) High concentration of SO_2 leads to stiffness of flower buds which eventually fall off from plants.

13 (*a*) The presence of particulate matter in polluted air catalysed the oxidation of SO_2 to SO_3.

Reaction is as follows :

$$2SO_2(g) + O_2(g) \xrightarrow{\text{Particulate matter}} 2SO_3(g)$$

14 (*d*) In an automobile engine (at high temperature) when fossil fuel is burnt, N_2 and O_2 combine to yield nitric oxide (NO) and nitrogen dioxide (NO_2).

Reactions involved are as follows :

$$N_2(g) + O_2(g) \xrightarrow{1483\,K} 2NO(g)$$

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

16 (*c*) Hydrocarbons are formed by incomplete combustion of fuel in automobiles. These are carcinogenic and these also harm plants by causing ageing, breakdown of tissues and shedding of leaves etc.

17 (*a*) Carbon monoxide (CO) is produced as a result of incomplete combustion of carbon. It is mainly released into the air by automobile exhaust. Other sources which produce CO, involve incomplete combustion of coal, firewood, petrol etc.

18 (*a*) Carbon monoxide (CO) is highly poisonous gas for human being because it binds to haemoglobin to form carboxyhaemoglobin complex, which is about 300 times more stable than the oxygen-haemoglobin complex.

20 (*b*) Microorganisms present in the soil act as biggest source and sink for CO. A sink is a natural or artificial reservoir that accumulates and stores some carbon containing chemical compounds for an indefinite period.

21 (*b*) In blood, when the concentration of carboxyhaemoglobin reaches about 3-4%, the oxygen carrying capacity of blood is greatly reduced.

23 (*c*) CO gas does not cause global warming. Some gases like CO_2, O_3, CFCs etc. trap heat and, thus are responsible for increasing the temperature of earth surface. This causes global warming.

24 (*c*) CO_2, H_2O, CFCs and O_3 are green house gases. These gases trap the UV-radiations coming from the sun and heat up the earth. Thus, heating up of earth is called green house effect.

25 (*c*) Sulphur dioxide (SO_2) is not a green house gas. Carbon dioxide (CO_2), methane (CH_4), water vapour, nitrous oxide (N_2O), CFCs and ozone (O_3) are the green house gases. These gases are responsible for the global warming.

26 (*c*) Carbon dioxide (CO_2) gas is a green house gas. The molecules of this gas trap heat as they are transparent to sunlight but not to the heat radiation. If the amount of CO_2 crosses the delicate proportion of 0.03%, the natural greenhouse balance may get disturbed.

28 (*a*) CFCs (chlorofluorocarbons) are man made industrial chemicals used in air conditioners etc.
These are damaging the ozone layer.

29 (*a*) Excess use of chemical fertilisers increase the quantity of nitrogen oxides (air pollutant) in the atmosphere.

30 (*c*) Normally, rain water has a pH of 5.6 due to the presence of H^+ ions formed by the reaction of rain water with carbon dioxide present in the atmosphere.

31 (*b*) The given figure represents acid deposition due to gases released from automobile exhaust and industry. The gases released are NO_2, SO_2 etc.

32 (*d*) Oxides of nitrogen and oxides of sulphur rises up in the atmosphere and form acids like HNO_3 and H_2SO_4 respectively. Oxides of phosphorus do not cause acid rain.

33 (*c*) Production of carbon monoxide during combustion of wood is not a cause of acid rain, whereas burning of fossil fuel in vehicles, power plants or furnaces produces oxides of sulphur and nitrogen, thus causes acid rain.

34 (*d*) The main constituents of acid rain are H_2SO_4 and HNO_3. SO_2 and NO_2 after oxidation and reaction with H_2O are major contributors of acid rain, because polluted air usually contains particulate matter that catalyse their oxidation.

$$2SO_2(g) + O_2(g) + 2H_2O(l) \longrightarrow \underset{\text{Sulphuric acid}}{2H_2SO_4(aq)}$$

$$4NO_2(g) + O_2(g) + 2H_2O(l) \longrightarrow \underset{\text{Nitric acid}}{4HNO_3(aq)}$$

36 (*a*) SO_2 gets absorbed directly on both solid and liquid ground surfaces and is, thus deposited as dry deposition.

37 (*d*) The area around Taj Mahal contains a high level of SO_2 and NO_2. Various pollutants such as SO_2 and NO_2 and industrial pollutants react with rain. The resulting acid rain reacts with marble,$CaCO_3$ of Taj Mahal causing damage to this wonderful monument.
Reaction involved is as follows :

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

38 (*c*) A plan that aims at cleaning the air in an area that includes the towns of Agra, Firozabad, Mathura and Bharatpur is known as Taj Trapezium. Under this plan more than 2000 polluting industries inside the Taj Trapezium area would start using natural gas or LPG instead of coal or oil.

39 (*d*) The viable particulates are minute living organisms like bacteria, fungi and moulds. Thus, mist is not a viable particulate.

40 (*d*) Non-viable particulates may be classified according to nature and size of particles, e.g. smoke, dust, mist and fumes.
Hence, both (a) and (b) are correct options.

41 (*c*) Herbicides and insecticides that miss their targets and travel through air forms mist.

42 (*a*) The size of the particulate pollutant that can lodge in the nasal passage is 5 microns, whereas particles of about 10 microns enter into lungs easily.

43 (*b*) Lead (Pb) is a major particulate matter emitted by vehicles. Leaded petrol used to be the primary source of air-borne lead emission in Indian cities.

44 (*a*) Lead primarily interferes with the development and maturation of red blood cells. The health hazard by leaded petrol causes the abnormal development of red blood cells.

45 (*c*) When smoke simultaneous exists with fog, it is called smog. It is the most common example of air pollution that occur in many cities.

47 (*b*) Classical smog occurs in cold humid climate. Chemically, it is a reducing mixture and, hence it is also called reducing smog.

49 (*b*) Photochemical smog is also known as oxidising smog due to high concentration of oxidising agents.

50 (*d*) Among the given options, chlorofluorocarbons are the compounds that are responsible for ozone depletion i.e., 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.

51 (*d*) PAN is peroxyacetylnitrate which is produced when unburnt hydrocarbons react with polluted air.

The structure of PAN is

$$CH_3—\underset{\underset{O}{\|}}{C}—OONO_2$$

52 (*d*) Both O_3 and PAN act as strong eye irritants.

53 (*d*) The primary precursors of photochemical smog are NO_2 and hydrocarbons.

54 (*a*) PAN belongs to the category of secondary air pollutants, i.e. these are obtained by the reaction of primary pollutants.

55 (*d*) Ozone (O_3) is present in the upper stratosphere which protect us from the harmful ultraviolet (UV) radiations ($\lambda = 225$ mm) coming from the sun.

60 (*b*) CFCs deplete the ozone layer because they release chlorine free radical.

In stratosphere, CFCs get broken down by powerful UV radiations, releasing Cl free radicals.

Reactions are as follows :

$$CF_2Cl_2(g) \xrightarrow{UV} \dot{Cl}(g) + \dot{C}F_2Cl(g)$$

$$\dot{Cl}(g) + O_3(g) \longrightarrow Cl\dot{O}(g) + O_2(g)$$

$$Cl\dot{O}(g) + O(g) \longrightarrow \dot{Cl}(g) + O_2(g)$$

The chlorine radicals are continuously generated and cause the breakdown of ozone.

61 (*a*) The depletion of ozone leads to the formation of ozone hole.

In 1980s, atmospheric scientists working in Antarctica reported about depletion of ozone layer over the south pole, which was termed as ozone hole. It was due to the reaction of Cl (free radical) with O_3. The Cl produced from chlorofluorocarbon emitted from earth surface.

62 (*d*) The effect of release of CO_2 gas into atmosphere is global warming.

63 (*b*) Nitrogen dioxide and methane in summer season combine chlorine monoxide and chlorine atoms to produce chlorine sinks.

Reactions involved are as follows :

$$Cl\dot{O}(g) + NO_2(g) \longrightarrow ClONO_2(g)$$

$$\dot{Cl}(g) + CH_4(g) \longrightarrow \dot{C}H_3(g) + HCl(g)$$

64 (*b*) Industrial discharge is a source of water pollution and act as a point source because it can be easily identified.

65 (*c*) The most serious disease causing agents are called pathogens. Pathogens include bacteria and other organisms that enter into water from domestic sewage and animal excreta.

67 (*b*) Sewage constitutes organic wastes because it is biodegradable. Other options such as drainage from mineral fields, industrial organic chemicals and fertilizers constitute inorganic wastes.

68 (*a*) 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).

70 (*c*) The decreasing order of extent of pollution in water is

$$D > C > B > A$$

Larger the value of BOD, higher is the extent of pollution.

71 (*c*) A process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving oxygen and results in subsequent loss of biodiversity is known as **eutrophication**.

72 (*c*) For drinking water, the maximum recommended levels of some metals, set by European Environment Commission (EEC) is

Metal	Max. concentration in ppm
Zn	5
Mn	0.05
Fe	0.2
Cu	3

As the concentration of Mn in the given water sample is more than the recommended concentration. Thus, it makes water unsuitable for drinking.

73 (*a*) According to EEC (European Environment Commission), excess of NO_3^- (> 50 ppm) in drinking water may lead to methemoglobinemia ('Blue baby syndrome'). It also may cause stomach-cancer.

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

76 (*b*) Carbamate pesticide causes severe nerve toxins.
It is less persistent and more biodegradable product.
It is harmful for the humans.

77 (*d*) Sodium chlorate ($NaClO_3$) and sodium arsenite (Na_3AsO_3) are the examples of herbicides. These are not environmental friendly.

Hence, both (a) and (b) are examples of herbicides.

79 (*a*) Lower trophic level has lower toxin deposition than higher trophic level. So, aquatic plant has least concentration of toxin deposition.

80 (*b*) Higher trophic level has highest concentration of DDT deposition. So, human beings have highest concentration of DDT deposition.

81 (*d*) Non-biodegradable wastes are generated by thermal and power plants which produce fly ash and integrated iron steel plants which produce blast furnace slag and steel melting slag, whereas, biodegradable wastes are generated by textile factories.

82 (*c*) Large quantities of toxic wastes are usually destroyed by controlled incineration, whereas small quantities are burnt alongwith factory garbage in open bins.

83 (*a*) Fuel obtained from plastic waste has high octane rating. It contains no lead and is known as green fuel.

84 (*c*) Technology has been developed to produce electricity from the garbage. In this method, garbage is mixed with water. It is then cultured with bacterial species for producing methane, commonly known as biogas.

86 (*b*) Two programmes are being implemented under the broad umbrella of the Swachh Bharat Abhiyan. These are Swachh Bharat Mission-Urban (SBM-U) and Swachh Bharat Mission-Gramin (SBM-G).

87 (*c*) The main targets of SBM-G programme involves the improvement in the general quality of life in rural areas by promoting cleanliness and hygiene and also by eliminating open defection.

88 (*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.

89 (*d*) Water is a better solvent medium for most of the synthetic chemical reactions because of following reasons :

(i) Use of water is low in cost.

(ii) It devoids of any carcinogenic effect.

(iii) It has high specific heat capacity.

95 (*b*) Statement I is incorrect.

It's correct form is as follows :

A low concentration of SO_2 causes respiratory diseases, e.g. asthma, bronchitis, emphysema in human beings.

Rest other statements are correct.

96 (*c*) Statement II is incorrect.

It's correct form is as follows :

Sulphur dioxide causes respiratory diseases in human beings and irritation of the eyes.

Rest other statements are correct.

98 (*a*) Statement I is correct, while II is incorrect.

It's correct form is as follows :

The viable particulates, e.g. bacteria, fungi, moulds, algae etc., are minute living organisms that are dispersed in atmosphere.

102 (*d*) Statement (d) is correct, while the statement IV is incorrect. It's correct form is as follows :

NO_2, O_3, and unburnt hydrocarbons are involved in the formation of PAN but CO_2 is not involved.

Reactions involved are as follows :

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

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

$$3CH_4 + 2O_3 \longrightarrow 3CH_2{=}O + 3H_2O + CH_2{=}CHCHO + CH_3\overset{\overset{O}{\|}}{C}OONO_2$$

PAN

104 (*d*) Statement (d) is incorrect regarding photochemical smog.

It's correct form is as follows :

Photochemical smog causes irritation in eyes and throat.

Rest other statements are correct.

105 (*d*) Statements I and III are correct, while the statement II is incorrect.

It's correct form is as follows :

Heavy metals like cadmium, mercury, nickel etc., are dangerous to human because our body cannot excrete them. These metals can damage kidneys, CNS (central nervous system), liver etc.

106 (*d*) Eutrophication shows the condition of polluted environment. In this process, polluted water may contain nutrients for the growth of algae, which covers the surface water and reduces the oxygen concentration in water. This leads to anaerobic condition, accumulation of decayed matter and animal death. Other given conditions show the clean environment.

107 (*b*) If the rate at which solar radiation are arriving the earth remain constant but the amount of CO_2 in the air increases, the heat radiated back to the earth will increase consequently, the temperature of the earth surface will increase.

This increase in temperature will disturb the thermal balance on the earth and could cause glaciers and ice caps to melt.

108 (*c*) Statement (c) is incorrect.

It's correct form is as follows :

The concentration of dissolved oxygen (DO) below 6 ppm is bad for the growth of fish. The fish growth is inhibited, if the dissolved concentration of oxygen in water is below 6 ppm.

Rest other statements are correct.

109 (*c*) Statement (c) is correct while other statements are incorrect. Corrected form are as follows :

(a) Domestic wastes are collected in small bins which are then transferred to community bins by private or municipal workers.

(b) At the site, garbage is sorted out and separated into biodegradable and non-biodegradable materials.

(d) Domestic waste should not be elisposed off openly or into compost.

110 (*b*) Statement II and III are correct, while the statement I is incorrect.

It's correct form is as follows :

Various industrial chemicals like polychlorinated biphenyls (PCBs) which are used as cleansing solvent, detergents and fertilizers add to list of water pollutants. PCBs are suspected to be carcinogenic.

111 (*b*) Statement II is correct while the statements I and III are incorrect. Corrected form are as follows :

Fluoride deficiency in drinking water is harmful to man and cause diseases such as tooth decay etc.

It does not causes harmful effect on bone and also does not causes blue baby syndrome.

114 (*a*) Fertilizers contain phosphates as additives. These causes water pollution. The addition of phosphates in water enhances, algae growth. Such profuse growth of algae covers the water surface and reduces the oxygen concentration in water.

115 (*d*) Statement I is incorrect.

It's correct form is as follows :

The green fuel obtained from plastic waste has low octane rating and contains no lead and hence also known as lead free fuel.

Rest other statements are correct.

116 (*c*) In cold countries, sunlight required to grow plants is less. Hence, plants are kept in a house made of glass, placed in such a manner, so that sunlight enters the greenhouse, heat up the soil and plants.

The warm soil and plants emit infrared radiations. Since, glass is opaque to infrared radiations, it partly reflects and partly absorbs these radiations and keep the house warm.

Thus, A is correct but R is incorrect.

117 (*b*) Carbon dioxide (CO_2) is one of the important greenhouse gas because this gas trap the heat and causes the heating of atmosphere.

It is largely produced by the combustion of fossil fuels like coal, natural gas, petroleum etc. It is also produced by respiratory function of animals and plants (at night).

Thus, both A and R are correct but R is not the correct explanation of A.

118 (*b*) Normally, rain water has a pH of 5.6 due to the presence of H^+ ions formed by the reaction of rain water with carbon dioxide present in the atmosphere.

$$H_2O\,(l) + CO_2(g) \longrightarrow H_2CO_3(aq)$$

$$H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$

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

Thus, both A and R are correct and R is not the correct explanation of A.

120 (*d*) Ozone layer is found in the stratosphere. The depletion of ozone layer (creation of ozone hole) takes place due to its reaction with NO or by reaction with chlorofluorocarbons (CFCs) called freons.

The ozone hole allows the UV radiations to pass through and reach us, increasing chances of skin cancer.
Thus, A is incorrect and R is correct.

121 (*a*) Photochemical smog is oxidising in nature because it has high concentration of oxidising agents.

It contains NO_2 and O_3 that are strong oxidising agents.

Thus, both A and R are correct and R is the correct explanation of A.

122 (*a*) Insecticides, pesticides and herbicides are causes soil and water pollution as they are non-biodegradable.

Thus, both A and R are correct and R is the correct explanation of A.

123 (*c*) The correct match is :

$$A \rightarrow 2,\ B \rightarrow 3,\ C \rightarrow 1$$

- CO is a primary air pollutant. It binds with haemoglobin to form stable complex carboxy haemoglobin. So, that CO is highly poisonous to living beings. The irritant red haze in the traffic and congested place are due to oxides of nitrogen (brown air effect).
- SO_2 causes irritation to the eyes, resulting in tears and redness. High conc. of SO_2 leads to stiffness of flower buds.

127 (*d*) The correct match is :

$A \rightarrow 2,\ B \rightarrow 1,\ C \rightarrow 3.$

A. UV radiation causes **skin cancer** in human.

B. DDT pass into food chain and increase in amount per unit weight of organisms with the rise in trophic level due to their accumulation in fat.
This phenomenon is called **biomagnification**.

C. **Fertilizers** containing phosphates are used as additives in the phenomenon of eutrophication.

134 (*b*) The correct match is :

$A \rightarrow 4,\ B \rightarrow 1,\ C \rightarrow 3,\ D \rightarrow 2$

CO_2 is a greenhouse gas causes global warming. The red haze in the traffic and congested place is due to oxides of nitrogen. Excess nitrate in drinking water can cause disease such as methanoglobinemia (blue baby syndrome). Lead causes damage to kidney.

136 (*a*) Normal rain is slightly acidic and its pH value ranges from 5.6 to 7.0. But when pH value fall below 5.6, it is called acid rain.

137 (*b*) Natural greenhouse effect is caused by greenhouse gases such as CO_2, CH_4 etc. These gases maintain the temperature and make the earth perfect for life. If there were no greenhouse gases, there would have no vegetation and life on our earth (because the earth would convert into a cold planet).

138 (*a*) The gases which absorb sunlight near the earth's surface and then radiated it 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.

139 (*c*) The smog which is formed in the presence of sunlight is called photochemical smog. This occurs in the month of summer, when NO_2 and hydrocarbons are present in large amounts in atmosphere. Concentration of O_3, PAN, aldehydes and ketones are build up in the atmosphere.

Thus, SO_2 is not responsible for photochemical smog.

140 (*a*) Statement (a) is incorrect for classical smog.

It's correct form is as follows :

Classical smog produced in cold and humid climate. It is a mixture of smoke, fog and sulphur dioxide. Chemically, it is a reducing mixture that's why, it is also called reducing smog.

Note *Gases released by automobiles and factories are not responsible for classical smog.*

Rest other statements are correct.

141 (*a*) The total amount of oxygen consumed by microorganisms (bacteria) in decomposing organic matter present in certain volume of a sample of water is called Biochemical Oxygen Demand (BOD) of the water.

Water is considered to be pure if it has BOD less than 5 ppm, whereas highly polluted water has BOD more than 17 ppm.

Thus, water having BOD less than 5 ppm is rich in dissolved oxygen.

142 (*a*) Statement (a) is incorrect.

It's correct form is as follows :

O_3 is responsible for 8% of total greenhouse effect.

Rest other statements are correct.

143 (*c*) Dissolved oxygen is essential for aquatic life. Organic waste is oxidised by microorganisms using dissolved oxygen.

Hence, oxygen from water decreases. It is harmful for aquatic life.

144 (*b*) Statement (b) is incorrect.

It's correct form is as follows :

Photochemical smog or Los Angeles smog was first observed in Los Angeles in 1950. It is formed due to photochemical reactions taking place when air contains NO_2 and hydrocarbons. The concentrations of O_3, PAN, RCHO and R_2CO build up in the atmosphere. These compounds produce irritation in the eyes.

It has high concentration of oxidants such as O_3, organic oxidant etc.

Rest other statements are correct.

145 (*b*) Troposphere is the lowest region of the atmosphere. It extends upto the height of ~ 10 km from sea level.

It is a turbulent, dusty zone containing air, much water vapour and clouds.

146 (*a*) Major components of atmosphere are dinitrogen, dioxygen and water vapour.

[N_2 = 78.08% and O_2 = 20.95%.]

These do not react with each other as nitrogen is an inactive gas. The triple bond in N_2 is very stable and its dissociation energy is very high. Both requires very high temperature to react with each other.

Reaction involved is as follows :

$$N_2(g) + O_2(g) \xrightarrow{3000^\circ C} 2NO(g)$$

147 (*c*) Hydrocarbons present in atmosphere combine with oxygen atom produced by the photolysis of NO_2 to form highly reactive intermediate called free radicals.
Free radical initiates a series of reactions and peroxyacetyl nitrates are formed, which can be said as secondary pollutants. Among the given options, peroxy acetyl nitrate belongs to secondary air pollutant.

$$\text{Hydrocarbon} + O \longrightarrow R\dot{C}O \text{ (free radicals)}$$

$$R\dot{C}O + O_2 \longrightarrow R\dot{C}O_3$$

$$R\dot{C}O_3 + NO_2 \longrightarrow \underset{\text{Peroxyacetyl nitrate}}{R\dot{C}O_3NO_2}$$

148 (*c*) Ozone hole is thinning of ozone layer of stratosphere at some places.

Thus, statement (c) is correct.

149 (*d*) Using plastic cans for storing substances neatly does not come under green chemistry.

Rest all other statements are correct.