I. Multiple Choice Questions (Type-I)

1. Which of the following gases is not a greenhouse gas?
(i) CO
(ii) O3
(iii) CH4
(iv) H2O vapour
Solution:
Option (i) is the answer.

2. Photochemical smog occurs in a warm, dry and sunny climate. One of the following is not amongst the components of photochemical smog, identify it.
(i) NO2
(ii) O3
(iii) SO2
(iv) Unsaturated hydrocarbon
Solution:
Option (iii) is the answer.

3. Which of the following statements is not true about classical smog?
(i) Its main components are produced by the action of sunlight on emissions of automobiles and factories.
(ii) Produced in a cold and humid climate.
(iii) It contains compounds of reducing nature.
(iv) It contains smoke, fog and sulphur dioxide.
Solution:
Option (i) is the answer.

4. 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 _____.
(i) rich in dissolved oxygen.
(ii) poor in dissolved oxygen.
(iii) highly polluted.
(iv) not suitable for aquatic life.
Solution:
Option (i) is the answer.

5. Which of the following statements is wrong?
(i) Ozone is not responsible for the greenhouse effect.
(ii) Ozone can oxidise sulphur dioxide present in the atmosphere to sulphur trioxide.
(iii) The ozone hole is thinning of ozone layer present in the stratosphere.
(iv) Ozone is produced in the upper stratosphere by the action of UV rays on oxygen.
Solution:
Option (i) is the answer.

6. Sewage containing organic waste should not be disposed of in water bodies because it causes major water pollution. Fishes in such polluted water die because of
(i) Large number of mosquitoes.
(ii) Increase in the amount of dissolved oxygen.
(iii) The decrease in the amount of dissolved oxygen in the water.
(iv) Clogging of gills by mud.
Solution:
Option (iii) is the answer.

7. Which of the following statements about photochemical smog is wrong?
(i) It has a high concentration of oxidising agents.
(ii) It has a low concentration of the oxidising agent.
(iii) It can be controlled by controlling the release of NO2 , hydrocarbons, ozone etc.
(iv) Plantation of some plants like pinus helps in controlling photochemical smog.
Solution:
Option (ii) is the answer.

8. The gaseous envelope around the earth is known as the atmosphere. The lowest the layer of this is extended up to 10 km from sea level, this layer is _____.
(i) Stratosphere
(ii) Troposphere
(iii) Mesosphere
(iv) Hydrosphere
Solution:
Option (ii) is the answer.

9. Dinitrogen and dioxygen are main constituents of air but these do not react with each other to form oxides of nitrogen because of _____.
(i) the reaction is endothermic and requires very high temperature.
(ii) the reaction can be initiated only in the presence of a catalyst.
(iii) oxides of nitrogen are unstable.
(iv) N2and O2 are unreactive.
Solution:
Option (i) is the answer.

10. 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?
(i) CO
(ii) Hydrocarbon
(iii) Peroxyacetyl nitrate

(iv) NO
Solution:
Option (iii) is the answer.

11. Which of the following statements is correct?
(i) The ozone hole is a hole formed in the stratosphere from which ozone oozes out.
(ii) The ozone hole is a hole formed in the troposphere from which ozone oozes out.
(iii) The ozone hole is thinning of the ozone layer of the stratosphere at some places.
(iv) Ozone hole means vanishing of ozone layer around the earth completely.
Solution:
Option (iii) is the answer.

12. Which of the following practices will not come under green chemistry?
(i) If possible, making use of soap made of vegetable oils instead of using synthetic detergents.
(ii) Using H_2O_2 for bleaching purpose instead of using chlorine-based bleaching agents.
(iii) Using a bicycle for travelling small distances instead of using petrol/diesel-based vehicles.
(iv) Using plastic cans for neatly storing substances.
Solution:
Option (iv) is the answer.

II. Multiple Choice Questions (Type-II)
In the following questions, two or more options may be correct.

13. Which of the following conditions shows the polluted environment.
(i) a pH of rainwater is 5.6.
(ii) amount of carbon dioxide in the atmosphere is 0.03%.
(iii) biochemical oxygen demand 10 ppm.
(iv) eutrophication.
Solution:
Option (iii) and (iv) are the answers.

14. Phosphate containing fertilisers cause water pollution. Addition of such compounds in water bodies causes _____.
(i) enhanced growth of algae.
(ii) the decrease in the amount of dissolved oxygen in the water.
(iii) deposition of calcium phosphate.
(iv) increase in the fish population.
Solution:
Option (i) and (ii) are the answers.

15. The acids present in acid rain are _____.
(i) Peroxyacetylnitrate
(ii) H_2CO_3
(iii) HNO_3
(iv) H_2SO_4

Solution:
Option (ii), (iii) and (iv) are the answers.

16. The consequences of global warming may be _____.
(i) increase in average temperature of the earth
(ii) melting of Himalayan Glaciers.
(iii) increased biochemical oxygen demand.
(iv) eutrophication.
Solution:
Option (i) and (ii) are the answers.

III. Short Answer Type

17. Greenhouse effect leads to global warming. Which substances are responsible for the greenhouse effect?
Solution:
Gases such as carbon dioxide, methane, ozone, chlorofluorocarbon compounds (CFCs) and water vapour which are all greenhouse gases that are responsible for the greenhouse effect leading to global warming.

18. Acid rain is known to contain some acids. Name these acids and where from they come in the rain?
Solution:
Acid rain is the result of human activities that emit the oxides of sulphur and nitrogen in the atmosphere.
$2SO_2 (g) + O_2 (g) + 2H_2O (l) \rightarrow 2H_2SO_4 (aq)$
$4NO_2 (g) + O_2 (g) + 2H_2O (l) \rightarrow 4HNO_3 (aq)$.
Nitric acid and sulphuric acid are acids present in acid rain which causes harmful effects to both living and non-living things.

19. Ozone is a toxic gas and is a strong oxidizing agent even then its presence in the stratosphere is very important. Explain what would happen if ozone from this region is completely removed?
Solution:
If ozone is removed the ultraviolet radiation comes directly in contact with living things and cause damages such as skin cancers and many other serious diseases. Ozone in the stratosphere absorbs this UV radiation from the sun and does not allow to pass it to the inner atmosphere.

20. Dissolved oxygen in water is very important for aquatic life. What processes are responsible for the reduction of dissolved oxygen in water?
Solution:
Eutrophication is the process responsible for the reduction of dissolved oxygen in the water. It is a process in which nutrient-enriched water bodies support a dense plant population, which kill animal life by depriving of oxygen and result in subsequent loss of biodiversity.

21. Based on chemical reactions involved, explain how chlorofluorocarbons cause thinning of the ozone layer in the stratosphere.
Solution:

The action of U.V rays causes the dissociation of chlorofluorocarbons to release the free chlorine radicle
$CF2Cl2 + U\ V\ radiations \rightarrow Cl + CFC$
Now this Chlorine radicle so formed is free and in the stratospheric layer reacts with the Ozone to form Chlorine monoxide and oxygen
$Cl\ (g) + O3\ (g) \rightarrow ClO\ (g) + O2(g)$
chlorine monoxide reacts with the nascent oxygen and free radical of chlorine is formed.
$ClO\ (g) + O\ (g) \rightarrow Cl + O2$
Chlorine radicles are being regenerated in this way and are reacting with the ozone layer. So, CFCs are considered as the source of chlorine radicles which are destroying the ozone layer of the stratosphere.

22. What could be the harmful effects of improper management of industrial and domestic solid waste in a city?
Solution:
The improper management of industrial and domestic waste in a city can cause serious damages to both living and non-living things.
1. Domestic waste if not disposed of properly it will lead to the blockage of sewage lines and thus mosquitoes will grow in the water and cause dengue-like diseases.
2. Improper management of such domestic wastes contributes to soil pollution to a large extent and also water pollution.
3. Soil pollution is caused by the dumping of harmful chemicals generated by industries which penetrate in soil and get mixed with groundwater.

23. During an educational trip, a student of botany saw a beautiful lake in a village. She collected many plants from that area. She noticed that villagers were washing clothes around the lake and at some places waste material from houses was destroying its beauty.
After a few years, she visited the same lake again. She was surprised to find that the lake was covered with algae, the stinking smell was coming out and its water had become unusable. Can you explain the reason for this condition of the lake?
Solution:
Due to the disposal of domestic waste in the lake can provide nutrients for algae to grow rapidly and also aquatic plants. The decomposition of these with the help of bacteria can cause foul smell also. This development of plants in the nutrient-rich lake is due to the process called eutrophication.

24. What are biodegradable and non-biodegradable pollutants?
Solution:
Biodegradable pollutants are those which can be decomposed by bacteria or any other environmental factors like fruits, sewages etc.
Non-biodegradable pollutants are not easily decomposed by bacteria. It remains as such in the environment.
Examples like DDT, mercury etc.

25. What are the sources of dissolved oxygen in water?
Solution:
Oxygen reaches the water through the atmosphere where there is direct contact of water with atmospheric air.
Photosynthesis by green aquatic plants at day time. In the night the photosynthesis does not take place

but the plants respire but the amount of oxygen is reduced.

26. What is the importance of measuring BOD of a water body?
Solution:
Biochemical oxygen demand (BOD) is defined as the amount of oxygen required by the bacteria to decompose the organic matter. Higher the BOD of water highly polluted is the water. Lesser the BOD of waterless polluted is the water. Drinking water has BOD of the range of less than 5ppm and highly polluted water have BOD of the value of 17ppm or more.

27. Why does water cover with excessive algal growth become polluted?
Solution:
The decomposition of algae by the bacteria continuously produces foul smell and the algae make water polluted and undesirable. The amount of dissolved oxygen also decreases and can lead to the death of aquatic animals.

28. A factory was started near a village. Suddenly villagers started feeling the presence of irritating vapours in the village and cases of headache, chest pain, cough, dryness of throat and breathing problems increased. Villagers blamed the emissions from the chimney of the factory for such problems. Explain what could have happened. Give chemical reactions for the support of your explanation.
Solution:
The harmful oxides of nitrogen and sulphur in the atmosphere can cause this type of breathing problems. The source of these oxides is from industries through oxidation of fossil fuels like coal.
$N_2 (g) + O_2 (g) \rightarrow 2 NO (g)$
$2NO (g) + O_2 (g) \rightarrow 2 NO_2$

29. Oxidation of Sulphur dioxide into Sulphur trioxide in the absence of a catalyst is a slow process but this oxidation occurs easily in the atmosphere. Explain how does this happen. Give chemical reactions for the conversion of SO_2 into SO_3.
Solution:
Oxidation of sulphur dioxide to sulphur trioxide is slow in uncatalysed reaction but easily can be oxidized in the presence of a catalyst in the atmosphere. The atmosphere contains matters which can act as a catalyst.
$2SO_2 (g) + O_2 (g) \rightarrow 2SO_3 (g)$

30. From where does ozone come in the photochemical smog?
Solution:
The composition of photochemical smog is nitrogen oxides, Volatile organic compounds (VOC), ozone, PAN i.e. peroxyacetyl nitrate.
nitrogen oxide present in the smog undergoes dissociation in the presence of sunlight to NO and nascent oxygen (O)
$NO_2 (g) \rightarrow NO (g) + O (g)$
The nascent oxygen reacts with oxygen gas to form ozone gas along with inert gas.
$O (g) + O_2 (g) + M \rightarrow O_3 (g) + M(\text{inert gas})$

31. How is ozone produced in stratosphere?

Solution:
The ozone layer is formed in the stratosphere by the action of U. V radiations on the atmospheric oxygen. UV radiations cause the splitting or dissociation of molecular oxygen to two oxygen atoms
$O_2 (g) \rightarrow O (g) + O (g)$
Now the oxygen atom combines with other molecular oxygen to form Ozone
$O (g) + O_2 (g) \rightarrow O_3 (g)$

32. Ozone is a gas heavier than air. Why does the ozone layer not settle down near the earth?
Solution:
The ozone layer is heavier than oxygen and is thermodynamically unstable and there is a dynamic equilibrium in the reaction between formation and dissociation of the ozone. So they do not settle down near the earth.

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

33. Some time ago the formation of polar stratospheric clouds was reported over Antarctica. Why were these formed? What happens when such clouds break up by the warmth of sunlight?
Solution:
This is depletion of the ozone layer. In the summer season, the nitrogen dioxide and methane reacted with the chlorine monoxide and chlorine radicle respectively forming chlorine sinks thereby preventing the depletion of ozone.
$ClO + NO_2 (g) \rightarrow ClONO_2$
$Cl (g) + CH_4 \rightarrow CH_3(g) + HCl (g)$
$ClONO_2 (g) + H_2O \rightarrow HOCl (g) + HNO_3$
$ClONO_2 (g) + HCl \rightarrow Cl_2 (g) + HNO_3 (g)$
When the sunlight returned back in the spring it breaks up clouds and HOCl and molecular chlorine gets photolysed by sunlight to form chlorine radicles:
$Cl_2 (g) \rightarrow 2\ Cl$
These chlorine radicles further caused the ozone depletion.

34. A person was using water supplied by the Municipality. Due to the shortage of water, he started using underground water. He felt a laxative effect. What could be the cause?
Solution:
The laxative effect is the effect caused by laxative substances that loosen stools and increases bowel movement. High doses of laxatives may even cause diarrhoea. This can be due to the excessive presence of sulphate in drinking water.

IV. Matching Type
In the following questions more than one option of Column I and Column II may match.

35. Match the terms given in Column I with the compounds given in Column II.

Column I	Column II
(i) Acid rain	(a) $CHCl_2 – CHF_2$
(ii) Photochemical smog	(b) CO
(iii) Combination with haemoglobin	(c) CO_2
(iv) Depletion of ozone layer hydrocarbons	(d) SO_2
	(e) Unsaturated

Solution:

(i) are c and d
(ii) are e and d
(iii) is b
(iv) is a

36. Match the pollutant(s) in Column I with the effect(s) in Column II.

Column I	Column II
(i) Oxides of sulphur	(a) Global warming
(ii) Nitrogen dioxide	(b) Damage to kidney
(iii) Carbon dioxide	(c) 'Blue baby' syndrome
(iv) Nitrate in drinking water	(d) Respiratory diseases
(v) Lead	(e) Red haze in traffic and congested areas

Solution:

(i) is d
(ii) is e
(iii) is a
(iv) is c
(v) is b

37. Match the activity given in Column I with the type of pollution created by it given in Column II.

Column I (Activity)	Column II (Effect)
(i) Releasing gases to the atmosphere after burning waste material containing sulphur.	(a) Water pollution
(ii) Using carbamates as pesticides	(b) Photochemical smog, damage to plant life,Corrosion to building material induce breathing problems, Water pollution
(iii) Using synthetic detergents for washing clothes	(c) Damaging ozone layer
(iv) Releasing gases produced by automobiles and factories in the atmosphere.	(d) May cause nerve diseases inhuman.
(v) Using chlorofluorocarbon compounds for computer parts	(e) Classical smog, acid rain, water pollution, induce breathing problems, damage to buildings, corrosion of metals.

Solution:
(i) is e
(ii) is d
(iii) is a
(iv) is b
(v) is c

38. Match the pollutants given in Column I with their effects given in Column II.

Column I	Column II
(i) Phosphate fertilisers in water	(a) BOD level of water increases
(ii) Methane in the air	(b) Acid rain
(iii) Synthetic detergents in water	(c) Global warming
(iv) Nitrogen oxides in air	(d) Eutrophication

Solution:
(i) are a and d
(ii) is c
(iii) is a
(iv) is b

V. Assertion and Reason Type
In the following questions, a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

39. Assertion (A): Greenhouse effect was observed in houses used to grow plants and these are made of green glass.
Reason (R): Greenhouse name has been given because glasshouses are made of green glass.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.
Solution:
Option (iii) is correct.

40. 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.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.
Solution
Option (ii) is correct.

41. **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.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.
Solution:
Option (i) is correct.

42. Assertion (A): Carbon dioxide is one of the important greenhouse gases.
Reason (R): It is largely produced by respiratory function of animals and plants.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.
Solution:
Option (ii) is the answer.

43. Assertion (A): Ozone is destroyed by solar radiation in the upper stratosphere.
Reason (R): Thinning of the ozone layer allows excessive UV radiations to reach the surface of the earth.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.
Solution:
Option (iv) is the answer.

44. Assertion (A): Excessive use of chlorinated synthetic pesticides causes soil and water pollution.
Reason (R): Such pesticides are non-biodegradable.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.
(iii) Both A and R are not correct.
(iv) A is not correct but R is correct
Solution:
Option (i) is the answer.

45. Assertion (A): If BOD level of water in a reservoir is less than 5 ppm it is highly polluted.
Reason (R): High biological oxygen demand means a low activity of bacteria in water.
(i) Both A and R are correct and R is the correct explanation of A.
(ii) Both A and R are correct but R is not the correct explanation of A.

(iii) Both A and R are not correct.
(iv) A is not correct but R is correct.
Solution:
Option (iii) is the answer.