Class 9th Chemistry Chapter 10
Environmental Chemistry

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Q.1 (Ex. Q.4 (i)) Describe the harmful effects of the major pollutants present in the air.

Ans. Pollutants and their Harmful Effects

No.	**Pollutants**	**Harmful Effects**
1.	Carbon dioxide (CO_2)	Higher levels of carbon dioxide lead to increased global warming, which can cause ice caps to melt and oceans to warm, causing sea levels to rise. Extreme weather changes such as heat waves, heavy rains, and wildfires also occur.
2.	**Carbon monoxide (CO)**	It is an extremely poisonous gas that can cause suffocation and death. Carbon monoxide is a very toxic gas that stops the red blood cells in animals' blood from carrying the oxygen that the body needs.
3.	**Oxides of nitrogen (NO_x), NO, NO_2**	NO_x can damage lungs, irritate the eyes, and damage vegetation. It can also cause acid rain, which affects buildings and statues made of limestone.
4.	**Oxides of sulphur (SO_x), SO_2, SO_3**	SO_x irritates the eyes and causes breathing difficulties and acid rain.
5.	**Hydrocarbons**	They can cause pneumonia, coughing, and many other breathing and lung diseases. They also cause global warming.
6.	**Particulate matter**	Irritates the eyes and can also cause severe breathing problems for people with asthma. It also makes clothes dirty. Also, visibility is reduced because it produces haze in the air.
7.	**Ozone (O_3)**	Breathing ozone can cause a variety of health problems, including chest pain, coughing, throat irritation, and congestion.
8.	**Smog**	It can lead to health complications like allergies, asthma, and lung infections. Inhibits the proper growth of plants.

Q.2 (Ex. Q.4 (ii)) Explain the greenhouse effect. How is global warming dangerous for us?

Ans. Greenhouse Effect: The process of warming up of the Earth's surface due to the covering effect of man-made carbon dioxide, methane, water vapours, and other gases in the atmosphere is called the Greenhouse Effect.

Phenomenon: The sun emits short-wavelength radiation (UV) that passes through greenhouse gases to heat the surface of the Earth. At night, the hot Earth's surface emits infrared radiation (IR) that is mostly absorbed by greenhouse gases. This process of absorption prevents the radiation from reaching space, reducing the speed at which the Earth can cool off. This increases the temperature of the Earth and causes global warming.

Effects of Greenhouse Effect:

i. Rise in Sea Level: Higher temperature will make the water of the seas and oceans expand. Ice melting in the Antarctic and Greenland will flow into the sea, resulting in higher sea levels. This phenomenon will threaten the low-lying coastal areas of the world such as the Netherlands and Bangladesh.
ii. Increase in Rainfall: There may be an enormous increase in rainfall in a few regions, which may increase the sea level. This ultimately will cause worldwide floods, endangering the survival of living species.
iii. Effects on Agriculture: The changes in the weather will affect the types of crops grown in different parts of the world. Some crops such as wheat and rice grow better at higher temperatures, but other plants such as maize and sugarcane do not.
iv. Hot Summer and Winter: In moderate regions, the winter will be shorter and warmer, and the summer will be longer and hotter.

Q.3 (Ex. Q.4 (iii)) What is the air quality index? What information does it convey?
Ans. Air Quality Index (AQI)
Definition: The Air Quality Index (AQI) is a rating system that shows how bad the atmosphere around you is.
Beneficial AQI: An AQI value under 50 is considered good in quality. This means that it is safe for you to spend time outdoors without posing a risk to your health.
Hazardous AQI: As the AQI number increases, so does the risk to health. An AQI over 300 is considered hazardous. Children under 18, adults over 65, people with chronic heart or lung disease, and diabetic people are high-risk groups. Outdoor workers can also be considered at higher risk because of prolonged exposure.

Q.4 (Ex. Q.4 (iv)) Who are high-risk groups and why is pollution more dangerous for them?
Ans. The AQI is a rating system that shows how bad the atmosphere around you is. An AQI value under 50 is considered good, while an AQI over 300 is considered hazardous. High-risk groups include:

- Children under 18
- Adults over 65
- People with chronic heart or lung disease
- Diabetic individuals
- Outdoor workers (due to prolonged exposure)

Control Measurements:
The following steps should be taken when air quality is bad:

1. Reduce the time you spend outdoors. Also reduce the intensity of outdoor activity. According to experts, the chances of being affected by an unhealthy atmosphere increase the longer a person is active outdoors and the more laborious the activity.
2. If you are forced to go out, consider wearing a mask. Unfortunately, not all masks provide adequate safety against particulate matter. Cloth or dust masks may not effectively filter out the finer particles. However, well-fitted N95 masks have better filtration capabilities and may be safer to use.
3. Keep your indoor air healthy by keeping windows and doors closed. If it is difficult to maintain clean air in the entire room, then create a clean room by switching on an air conditioner or air cleaner.
4. If you experience symptoms that worry you, talk to your doctor.
5. Install a carbon monoxide detector to detect increased levels of carbon monoxide. These higher levels of CO may occur due to faulty fuel-burning appliances.

Effects: Breathing polluted air by these high-risk groups may affect their lungs, heart, and brain. Air pollutants can enter their bloodstream and can cause coughing or itching of eyes, which may lead to poor quality of life, hospitalization, cancer, or even premature death.

Q.5 (Ex. Q.4 (v)) Describe three strategies to address environmental issues.

Ans. Huge amounts of pollutant gases are thrown into the atmosphere by burning fossil fuels. Automobiles, airplanes, industrial machines, and coal-fired electricity-generating plants are mainly responsible for the extremely polluted air, especially in big cities. Scientists have developed a number of different ways to control this menace of pollution.

i. Tree Plantation

Planting trees is thought to be very helpful in removing air pollution. A well-known process carried out by plants is photosynthesis, in which plants clean the air through absorption of carbon dioxide and release oxygen. This reaction takes place in the presence of sunlight and is catalyzed by chlorophyll, the green pigment present in leaves.

$6CO_2 + 6H_2O$ --(Sunlight/Chlorophyll)--> $C_6H_{12}O_6 + 6O_2$

The particulate matter present in the atmosphere is also removed by plants when it deposits on leaves, branches, and trunk surfaces.

ii. Catalytic Converters

Catalytic converters are used in the exhaust systems of modern-day automobiles to reduce the emissions from an internal combustion engine. Due to the non-availability of enough oxygen, the carbon fuel in the engine does not burn completely into carbon dioxide and water. Thus, toxic by-products like CO and hydrocarbons are produced. A three-way catalytic converter performs the following three functions simultaneously:

1. It reduces nitrogen oxides into elemental nitrogen and oxygen.
   $2NO_x \rightarrow N_2 + xO_2$
2. It oxidizes CO to CO_2.
   $2CO + O_2 \rightarrow 2CO_2$
3. It oxidizes hydrocarbons into CO_2 and H_2O.
   $C_xH\_y + (x + y/4)O_2 \rightarrow xCO_2 + (y/2)H_2O$

iii. Flue Gas Desulphurization Process

The emission of sulphur dioxide can be decreased either by using fuels which have significantly less sulphur content or by using the flue gas desulphurization process. This process can remove sulphur dioxide gas from the exhaust gases of fossil fuels. Flue gas is the mixture of waste gases produced when fossil fuels are burnt in power plants. The desulphurization process involves the addition of adsorbents like calcium oxide, which can remove up to 95% of the sulphur dioxide from the flue gas.

iv. Use of Harmless Renewable Resources

To discourage the excessive use of fossil fuels in our daily lives, it is urgently required to use renewable resources to meet our energy needs. Renewable resources are those resources that can continue to exist despite being consumed over a period of time, even as they are used.

Investigative Questions

Q.1. (Ex. Q.5 (i)) Major Pakistani cities experience a very high AQI in winter, which renders them among the most polluted cities in the world. Point out some of the major causes of high AQI in these cities.

Ans. Air Quality Index (AQI):

The Air Quality Index (AQI) is a rating system that shows how bad the atmosphere around you is. An

AQI below 50 is considered good in quality, meaning it is safe for you to spend time outdoors without posing a risk to your health. As the AQI number increases, so does the risk to health.

Quality Rating	Consideration
0 – 50	Good
51-100	Moderate
101-150	Unhealthy for sensitive groups
151-200	Unhealthy
201-300	Very Unhealthy
301+	Hazardous

High-Risk Groups: An AQI over 300 is considered hazardous. Children under 18, adults over 65, people with chronic heart or lung disease, and diabetic individuals are high-risk groups. Outdoor workers can also be considered at higher risk because of prolonged exposure.
Effects of Hazardous AQI: Breathing polluted air can affect the lungs, heart, and brain. Air pollutants can enter the bloodstream and can cause coughing or itching of eyes, which may lead to poor quality of life, hospitalization, cancer, or even premature death.
Major Causes of High AQI:

1. **Crop Burning:** Farmers burn their crops in fields after harvesting. They burn the crop residues to prepare the land for the next crop.
2. **Fossil Fuel Burning:** Fossil fuels like petroleum products, coal, and natural gas are burnt to get energy for transportation, heating, and electricity generation.
3. **Destruction of Green Areas:** Concrete structures have been installed in place of green areas. A decrease in the number of plants increases the AQI.
4. **Industrial Emissions:** Smoke coming from chimneys of industries is playing a major role in the bad AQI.

Q.2. (Ex. Q.5 (ii)) Why does AQI not rise in Pakistan on hot days of summer?
Ans. The Air Quality Index (AQI) in Pakistan often remains moderate during hot summer days due to the following reasons:
i. High Temperature: High temperature creates surface heating, resulting in the mixing up of layers of air. This mixing dilutes air pollutants in the atmosphere.
ii. Reduced Photochemical Reactions: Hot summer reduces the precursors of photochemical reactions like volatile organic compounds and nitrogen oxides (NO_x). They cannot combine, helping in less ozone formation.
iii. Low Humidity: Low humidity in many regions decreases the formation of secondary aerosols (a major component of particulate matter).
iv. Wind Patterns: Hot weather often brings strong winds in plain areas. These winds disperse and transport pollutants away from urban centers.
v. Chemical Kinetics of Pollutants: Dry and windy conditions due to reduced moisture render the formation of secondary pollutants less likely.

Q.3. (Ex. Q.5 (iii)) How has climate change affected Pakistan during the last five years?

Ans. Climate change has significantly impacted Pakistan over the last five years, causing environmental, economic, and agricultural losses. The following are effects of climate change:
i. Heatwaves: Pakistan experienced record-breaking heatwaves in the last five years. Temperatures exceeded 50°C in some areas of Pakistan.
ii. Rise in Sea Level: High temperature will make the water of seas and oceans expand. Ice melting in Antarctica and Greenland will flow into the sea, resulting in higher sea levels. This phenomenon will threaten low-lying coastal areas of Pakistan.
iii. Increase in Rainfall: There may be a sufficient increase in rainfall in a few regions that may increase the sea level. This ultimately will cause worldwide floods, endangering the survival of living species.
iv. Effects on Agriculture: It will affect the type of crops grown in different parts of Pakistan. Some crops such as wheat and rice grow better at higher temperatures, but others like maize and sugarcane do not.

SLO Based Additional Long Questions
Q.1. Write the sources of Air Pollutants.
Ans.
i. Human Activities: Millions of tonnes of pollutants are emitted into the atmosphere each year as a result of human activities. The major activity among them is the combustion of fossil fuels, which alone is responsible for most of our pollution problems.
ii. Combustion: Burning of fossil fuels (oil, natural gas, coal) produces carbon dioxide, carbon monoxide, NO_x, SO_x, CH_4, ash, smoke, and suspended particles. Many of these pollutants are also released into the air by natural processes, e.g., volcanic eruptions release large quantities of CO_2, SO_2, and particulates. Methane is released into the air by the decomposition of vegetation. It is also present in waste gases produced during digestion in animals.

iii. Overpopulation: Rapid growth of population, urbanization, industrialization, and transportation are the main factors responsible for environmental pollution. All these factors are increasing in every city of the world, especially in the last half-century. These pollutants are affecting the environment very badly.
iv. Ozone: Another pollutant, ozone (O_3), is formed when heat and sunlight cause chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (hydrocarbons).

Q.2. Define acid rain and how is it formed?
Ans. Definition: When rainwater has a pH less than 5.6, it is known as acid rain.
Historical Background: In 1852, Robert Angus Smith was the first to show the relationship between acid rain and atmospheric pollution in Manchester, England. He is sometimes referred to as the "Father of Acid Rain."
Causes: Burning of fossil fuels releases harmful gases into the atmosphere. These gases (SO_2, SO_3) are produced due to the presence of sulphur in the fossil fuels. SO_2 is converted to SO_3 in the presence of oxides of nitrogen in the atmosphere. Oxides of nitrogen are produced mostly by the direct combination of atmospheric oxygen and nitrogen in industrial and domestic combustion processes. They are also produced by the combustion of atmospheric nitrogen and oxygen in the presence of lightning. A significant amount of nitrogen oxides is produced by reactions taking place in automobile engines.
Formation: These gases mix with the moisture that is always present in the air to form acid droplets. Wind can carry these acidic droplets for huge distances. Finally, these droplets return to the ground as acid rain, acid hail, snow, and even fog. Acid rain looks, feels, and tastes like clean rain. Its

corrosive nature causes widespread damage to the environment.

$S + O_2 \rightarrow SO_2$

$2SO_2 + O_2 \rightarrow 2SO_3$

$SO_3 + H_2O \rightarrow H_2SO_4$

$N_2 + O_2 \rightarrow 2NO$

$2NO + O_2 \rightarrow 2NO_2$

$2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$

Q.3. What are the effects of Acid Rain?

Ans. Effects of Acid Rain:

Acid rain causes a number of adverse effects. It tends to increase the acidity of the soil, threatens human and aquatic life, destroys forests, and reduces agricultural productivity. Besides, it can corrode buildings, monuments, statues, bridges, and railings. The most important adverse effects of acid rain are as follows:

i. Soil: Acid rain makes soil more acidic. It dissolves and washes away nutrients present in the soil that are needed by plants. It can also dissolve toxic substances such as aluminium and mercury, which are naturally present in the soil.

ii. Plants: Many plants cannot live or grow in acidic soil. It can damage vegetation and plants. Tree roots hold the soil together on hills and mountain areas. If the trees are destroyed, then the soil is washed away and new plants cannot grow there.

iii. Aquatic Life: Acid rain falls into drains, streams, lakes, marshes, and rivers and damages aquatic life. Acid rain can make water too acidic for animals to live in. Due to this, many lakes and rivers no longer have fish.

iv. Human Health: The acidification of surface water does not affect life directly. However, toxic substances leached from the soil can pollute land water supplies and damage human health.

v. Agriculture: Crops are less affected by acid rain than forests. Farmers can prevent acid rain damage by monitoring the conditions of the soil and, when necessary, adding crushed lime to neutralize the acid.

vi. Human-made Structures: Acid rain and the dry deposition of acidic particles damage buildings, statues, automobiles, and other structures made of stone, metal, etc. Historical buildings like the Parthenon in Athens (Greece) and the Taj Mahal in Agra (India) are deteriorating due to acid rain.

Q.1 What is the main objective of environmental education?

Ans. Environmental chemistry is a part of environmental education. The objective of which is to enlighten the people, particularly the students, about the importance of protection and conservation of our environment. The increasing use of fossil fuels (natural gas, coal, and petroleum) has polluted the atmosphere to such an extent that it is difficult to breathe air in some areas of metropolitan cities.

Q.2 How is particulate matter released into the atmosphere?

Ans. Burning of fossil fuels (oil, natural gas, coal), volcanic eruptions, decomposition of vegetation, rapid growth of population, urbanization, industrialization, and transportation are the main factors that release particulate matter into the atmosphere.

Q.3 Which gas is more poisonous, CO_2 or CO?

Ans. CO is a poisonous gas because it binds to haemoglobin in the blood. It hinders the supply of O_2 to all parts of the body and ultimately causes suffocation and death of the organism.

Q.4 How does acid rain affect forests?
Ans. Acid rain can damage vegetation and plants. Many plants cannot live or grow in acidic soil. Tree roots hold the soil together on hills and mountain areas. If the trees are destroyed, then the soil is washed away and new plants cannot grow there.

Q.5 In what way does sulphur present in fossil fuels become dangerous?
Ans. When sulphur-containing fossil fuels are burned, oxides of sulphur (SO_x, SO_2, SO_3) are produced. SO_x irritates the eyes and causes breathing difficulties and acid rain.
$S + O_2 \rightarrow SO_2$
$2SO_2 + O_2 \rightarrow 2SO_3$
$SO_3 + H_2O \rightarrow H_2SO_4$

Q.6 Name any three major sources responsible for the greenhouse effect.
Ans. Methane (CH_4), carbon dioxide (CO_2), nitrous oxide (N_2O), and water vapours produced due to the burning of fossil fuels.

Q.7 How is geothermal energy useful for us?
Ans. Geothermal energy is useful for us because it provides a renewable and sustainable source of energy. It can be used for electricity generation, heating buildings, and supplying hot water. It is environmentally friendly.

Q.8 Which method is used to separate gases present in the air?
Ans. The process used to separate gases present in the air is fractional distillation. In this process, the air is first cooled to liquefy it, and then it is slowly warmed to boil gases at their boiling temperatures. Vapours of each gas are collected separately.

Q.9 Which gas is released when fizzy drinks are opened?
Ans. CO_2 gas is released when carbonated drinks are opened.

Q.10 How does air pollution affect plants?
Ans. Air pollutants like ozone, SO_2, NO_2, etc., inhibit the growth of plants by reducing the amount of carbon dioxide absorbed during photosynthesis and reduce crop yields.

Q.11 Which acids are made when SO_2 and NO_2 dissolve in rain?
Ans. Sulphuric acid (H_2SO_4) and nitric acid (HNO_3) are made when SO_2 and NO_2 dissolve in rain, respectively.
$SO_3 + H_2O \rightarrow H_2SO_4$
$2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$

Q.12 What happens to the soil if trees are destroyed by acid rain?
Ans. Tree roots hold the soil together on hills and mountain areas. If the trees are destroyed, then the soil is washed away and new plants cannot grow there.

Q.13 How do living things add and plants remove carbon dioxide from the air?
Ans. Living things like humans and animals inhale O_2 from the air and exhale CO_2 into the air during respiration. While plants consume CO_2 from the air during photosynthesis. In this way, living things add and plants remove CO_2 from the air.

Q.14 Which gas do rice plants produce?
Ans. Rice plants produce oxygen as a byproduct of photosynthesis and methane (CH_4) through methanogenesis.

Q.15 Which gas is given out by rotting garbage?
Ans. Methane gas (CH_4) is produced during the rotting of garbage.

Composition of Atmosphere
Q.16 What do you mean by atmosphere?
Ans. The atmosphere is the envelope of different gases around the Earth.

Q.17 What is environmental chemistry?
Ans. The branch of chemistry which deals with the study of chemicals and other pollutants in the environment is called environmental chemistry.

Q.18 Why is environmental science important for us?
Ans. Environmental science helps us to understand the complex interactions that occur in our ecosystem and the impacts on human life.

Q.19 What is the difference between the atmosphere and the environment?
Ans. Atmosphere: The atmosphere is the envelope of different gases around the Earth.
Environment: The environment is the sum of all social, biological, physical, and chemical factors which constitute the surroundings of living things.

Q.20 Write the composition of dry air.
Ans. Composition of Dry Air

Major Constituent	Percentage	Minor Constituent	Percentage
Nitrogen	78.0	Carbon dioxide	0.03
Oxygen	21.0	Noble gases	About 1.0
		Water Vapours	Variable

Q.21 What is the difference between a pollutant and a contaminant?
Ans. Pollutants are those substances which cause pollution, while contaminants are those substances that make something impure.

Q.22 What are air pollutants?
Ans. Any substance (solid, liquid, or gas) in the air which has an adverse effect on human health, quality of life, and the natural functioning of the ecosystem is called an air pollutant. It has two types: primary pollutants and secondary pollutants.

Q.23 How are sulphur-containing compounds emitted naturally?
Ans. Naturally, sulphur compounds are emitted through bacterial decay of organic matter, in volcanic gases, and forest fires.

Q.24 Comment: Burning in open air is preferred.
Ans. In open-air burning, CO_2 gas is produced which becomes part of the atmosphere. CO_2 is not a poisonous gas. Whereas in closed places, CO is produced due to limited supply of oxygen. CO is a poisonous gas and can be fatal. That's why burning in open air is preferred.

Q.25 CO is a hidden enemy. Explain its action. OR (How is CO considered a health hazard?)
Ans. CO is a poisonous gas. Being colourless and odourless, its presence cannot be noticed easily and readily. It binds with haemoglobin. So, the supply of oxygen is cut off. If inhaled for a longer time, it causes breathing difficulty which leads to death.

Q.26 State the major sources of CO and CO_2 emission. (Write down the sources of oxides of carbon).
Ans. Sources of CO and CO_2 Emission:

1. Both of these gases are emitted due to volcanic eruptions and the decomposition of organic matter naturally.
2. The major source for the emission of these gases is the combustion of fossil fuels (coal, petroleum, and natural gas). Fossil fuels burnt in the combustion engine of any type of automobile, the kiln of any industry, or open-air fires emit CO_2 and CO.

Q.27 Write down the physical properties, sources, and effects of oxides of nitrogen.
Ans. Physical Properties: NO is a colourless, odourless gas soluble in water. NO_2 is a reddish-brown gas with a pungent odour soluble in water. Both are highly acidic gases.
Sources: Exhaust fumes of motor vehicles, power stations, and industries using fossil fuels.
Harmful Effects: Cough, headaches, lung diseases, acid rain, and greenhouse effect (global warming).

Acid Rain
Q.28 How many tons of garbage are spread over in the Pacific Ocean?
Ans. There is a giant floating patch of garbage spread over the Pacific Ocean. It contains about 100 million tons of garbage.

Q.29 How is acid rain produced?
Ans. Acid rain means the presence of excessive acids in rainwater. This rain is produced when normal rainwater dissolves oxides of sulphur and nitrogen in the air. Rainwater converts SO_2 into H_2SO_4 and NO_x to HNO_2 and HNO_3. These acids reduce the pH of rainwater up to 4. Thus, acid rain is formed on dissolving acidic air pollutants such as SO_2 and NO_2 in rainwater.

Q.30 How is aquatic life affected by acid rain? / How does aluminium harm fish?
Ans. Acid rain on soil and rocks leaches heavy metals (Al, Hg, Pb, Cr, etc.) with it and discharges these metals into rivers and lakes. Aquatic life present in lakes suffers because of the high concentration of these metals. Especially high concentrations of aluminium metal clog the fish gills. It causes suffocation and ultimately death of fish.

Q.31 Why are plants dying day by day? Comment.

Ans. Acid rain directly damages the leaves of trees and plants, thus limiting their growth. Depending upon the severity of the damage, plant growth can be hampered. Plants' ability to bear cold or diseases reduces, and they ultimately die.

Q.32 What are the strategies to reduce or control acid rain?

Ans. Acid Rain Mitigation:

1. **Emission Control:** Measures to reduce emissions of sulphur dioxide and nitrogen oxides from industrial units, power plants, and vehicles are important for reducing acid rain. This can be achieved through the introduction of anti-pollution technologies and the use of cleaner fuels.
2. **Low Sulphur Fuels:** Promoting low-sulphur fuels can also minimize the amount of sulphuric acid in the atmosphere that causes acid rain.

Global Warming (Greenhouse Effect)

Q.33 How is the temperature of the atmosphere maintained?

Ans. CO_2 and water vapours maintain the temperature of the atmosphere. These gases absorb much of the infrared radiations coming from the Earth's surface and warm the atmosphere.

Q.34 CO_2 is responsible for heating up the atmosphere. How? What do you mean by the Greenhouse Effect?

Ans. CO_2 is a greenhouse gas. In the atmosphere, it acts like a glass wall of a greenhouse. It absorbs infrared radiations and allows visible light to pass through. So, it absorbs most of the outgoing radiations which result in the heating of the atmosphere. This is called the Greenhouse Effect.

Q.35 What do you mean by the Greenhouse Effect?

Ans. The CO_2 layer acts like an envelope around the earth. It absorbs infrared radiations emitted by the Earth's surface and helps to keep it warm at night. Increased concentration of CO_2 increases the average temperature of the Earth's surface gradually. This is called the Greenhouse Effect.

Q.36 Define global warming.

Ans. Global warming is the rising of temperature because of the trapping of heat energy by carbon dioxide gas in the atmosphere.

Q.37 Why are flood risks increasing?

Ans. An increase in the temperature of the Earth due to global warming melts glaciers and snow caps, which increases flood risk.

Q.38 What are the global effects of pollution?

Ans. Greenhouse effect, depletion of ozone, and acid rain are the global effects of pollution.

Q.39 What are the sources of Greenhouse gases?

Ans. Due to the burning of large amounts of coal, oil, and natural gas, the amount of greenhouse gases, carbon dioxide together with other gases in the atmosphere, has increased for the last 300 years. About half of this carbon dioxide is utilized by plant life during photosynthesis. As human beings cut down forests, the capacity of the trees to remove CO_2 from the air is diminished. Methane is another greenhouse gas which causes adverse effects. The increase in its concentration in the air

is due to the increased decay of vegetation matter, digestion in animals, and increased farming of rice fields.

Q.40 Why are water vapours dangerous for us?
Ans. Water vapours also act as a greenhouse gas. When released into the atmosphere, water soon comes back to earth as acid rain.

Strategies to Reduce Environmental Issues
Q.41 What are catalytic converters? Write their advantages.
Ans. Catalytic converters are used in the exhaust systems of modern-day automobiles to reduce the emissions from an internal combustion engine. Due to the non-availability of enough oxygen, the carbon fuel in the engine does not burn completely into carbon dioxide and water. Thus, toxic by-products like CO and hydrocarbons are produced.
Advantages:
A three-way catalytic converter performs the following three functions simultaneously:

1. It reduces nitrogen oxides into elemental nitrogen and oxygen.
   $2NO_x \rightarrow N_2 + xO_2$
2. It oxidizes CO to CO_2.
   $2CO + O_2 \rightarrow 2CO_2$
3. It oxidizes hydrocarbons into CO_2 and H_2O.
   $C_xH\_y + (x + y/4)O_2 \rightarrow xCO_2 + (y/2)H_2O$

Q.42 How can high emissions of SO_2 be controlled?

Ans. The emission of sulphur dioxide can be decreased either by using fuels which have significantly less sulphur content or by using the flue gas desulphurization process. This process can remove sulphur dioxide gas from the exhaust gases of fossil fuels. Flue gas is the emitted material produced when fossil fuels are burnt in power plants. The desulphurization process involves the addition of absorbents like calcium oxide, which can remove up to 95% of the sulphur dioxide from the flue gas.

Q.43 What are renewable resources?
Ans. Renewable resources are those resources that can continue to exist despite being consumed over a period of time, even as they are used. These resources include the Sun, wind, water, geothermal, biomass, and hydrogen gas, generating electricity without damaging the environment.

Constructed Response Questions
Q.1 (Ex. Q.3 (i)) How is the excessive use of insecticides and pesticides harmful for birds?
Ans. Excessive pesticide and insecticide use harms birds through direct poisoning, food chain contamination, habitat disruption, and reproductive issues.

Q.2 (Ex. Q.3 (ii)) The percentage of CO_2 in air is only 0.03%. Then how does it become harmful for the ecosystem?
Ans. The carbon dioxide which is not utilized in photosynthesis goes on accumulating in the lower areas of the atmosphere and forms a thick dense layer. This layer behaves like a glass sheet of a greenhouse that allows the incoming solar radiation but does not allow it to escape outside; as a result of this, the average temperature of the Earth rises.

Q.3 (Ex. Q.3 (iii)) Why do only some pollutant gases present in the atmosphere cause the greenhouse effect while others do not?
Ans. Greenhouse gases absorb and emit infrared radiation due to their structure and vibrational properties. Other pollutants do not have such characteristics, which is why they are not termed as greenhouse gases.

Q.4 (Ex. Q.3 (iv)) How can you reduce the emission of CO present in the gases emitted by the burning of fuel in automobile engines?
Ans. Catalytic converters are used in the exhaust systems of modern-day automobiles to reduce the emissions from an internal combustion engine. Due to the non-availability of enough oxygen, the carbon fuel in the engine does not burn completely into carbon dioxide and water. Thus, toxic by-products like CO and hydrocarbons are produced. The converter oxidizes CO to CO_2.
$2CO + O_2 \rightarrow 2CO_2$

Q.5 (Ex. Q.3 (v)) Mention three different ways in which solar energy can be useful for us.
Ans. Solar energy can be helpful for us in electricity generation, solar water heating, and solar drying and agricultural applications.

Multiple Choice Questions (Exercise)

1. Which gases are responsible for the greenhouse effect?
   (c) CO, CH_4 ✔
2. Indicate the source of sulphur which is responsible for the presence of oxides of sulphur in the atmosphere.
   (d) Combustion of fossil fuels ✔
3. The concentration of which gas in the atmosphere is decreased by photosynthesis in plants?
   (c) Carbon dioxide ✔
4. Which substance remains unaffected in the catalytic converter fixed in the exhaust of automobiles?
   (a) CO_2 ✔
5. People of which age groups are most affected by air pollution?
   (d) Both children and aged people ✔
6. In which area is there a greater possibility of acid rain?
   (c) Around industrial area ✔
7. Why is smog not felt in summer?
   (a) Because fog is not present in summer ✔
8. Which catalyst is used in the catalytic converter fixed in the exhaust systems of automobiles?
   (c) Pt, Pd, and Rh ✔
9. Which components are essential for the formation of photochemical smog?
   (b) NO_2, volatile organic compounds, sunlight ✔
10. Which gases contribute towards the formation of acid rain?
    (d) Oxides of both nitrogen and sulphur ✔

Composition of Atmosphere

11. The % age of oxygen gas by volume in dry air is:
    (b) 21% ✔
12. 99% of the atmosphere consists of:
    (b) N_2 and O_2 ✔

13. The envelope of different gases around the Earth is called:
    (a) atmosphere ✔
14. The percentage by volume of nitrogen in dry air is:
    (a) 78% ✔

Air Pollutants

15. Which one of these pollutants is not found in car exhaust fumes?
    (d) SO_2 *(Note: SO_2 is found but in smaller amounts compared to CO, NO_2, and hydrocarbons)*
16. Carbon monoxide is harmful to us because:
    (c) it reduces the oxygen-carrying ability of haemoglobin ✔
17. The percentage of SO_2 released by the combustion of coal and petroleum products is:
    (b) 60% ✔
18. Which is not a characteristic of SO_2?
    (d) it does not form sulphuric acid ✔
19. How many % of marine mammals are at the risk of choking on plastic?
    (a) 21% ✔
20. How many % of all available water is used by humans?
    (a) 1% ✔
21. Which gas is produced by electrical lightning in the air?
    (a) NO ✔
22. Which is not an air pollutant?
    (d) NH_3 *(Note: NH_3 is a pollutant, but CO_2 is a natural component of air)*
23. Which is not a poisonous gas?
    (c) Carbon dioxide ✔
24. Higher concentration of CO causes:
    (d) All of these ✔

25. A pollutant is a waste material that pollutes:
    (d) all of these ✔
26. Which factor determines the severity of a pollutant?
    (d) all of the above ✔
27. Which of the following is a poisonous gas?
    (b) ozone *(Note: Ozone is a pollutant and poisonous at ground level)*
28. Which gas is emitted due to volcanic eruption?
    (d) Both a & b ✔

Acid Rains

29. Normally rainwater is weakly acidic because of:
    (b) CO_2 gas ✔
30. Buildings are being damaged by acid rain because it attacks:
    (c) calcium carbonate ✔
31. The pH of normal rainwater is:
    (b) 5-6 ✔

Global Warming (Greenhouse Effect)

32. A group of gases that maintains the temperature of the atmosphere is:
    (a) carbon dioxide and water vapours ✔
33. The Earth's atmosphere is getting hotter because of:
    (b) increasing concentration of CO_2 ✔
34. Which one of the following is not a greenhouse effect?
    (b) increasing food chains ✔

35. Global warming causes the rising of the sea level. The cause of global warming is:
    (a) CO_2 gas ✔
36. Global warming is because of:
    (a) Absorption of infrared radiations emitted by Earth's surface ✔
37. Which gas is responsible for warming the atmosphere?
    (d) carbon dioxide ✔
38. Which gas in the atmosphere acts as a wall of a greenhouse?
    (b) carbon dioxide ✔
39. Increased concentration of CO_2 in the air results in:
    (b) increasing temperature ✔
40. Which type of pollutants are responsible for changing weather?
    (a) air pollutants ✔
41. Fossil fuel means:
    (d) all of these ✔
42. Forest fires and burning of wood emit:
    (a) CO_2 ✔
43. How many trees are there in the world?
    (b) 3.04 trillion *(Approximately 3.04 trillion trees)*
44. How many trees are cut down to make toilet paper every day?
    (d) 27000 *(Approximately 27,000 trees are cut down daily for toilet paper)*
45. How many tons of ice have been lost since 1990?
    (a) 28 trillion *(Approximately 28 trillion tons of ice have been lost)*
46. How many tons of ice melt every year?
    (a) 1.2 trillion *(Approximately 1.2 trillion tons of ice melt annually)*

Strategies to Reduce Environmental Issues

47. Catalytic converters convert:
    (a) CO to CO_2 ✔
48. Which gas is also known as life gas for plants?
    (c) CO_2 ✔
49. In bacterial decay, the compounds of which element are emitted?
    (a) Sulphur ✔