10 CHAPTER

ENVIRONMENTAL CHEMISTRY

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Student Learning Outcomes

After studying this chapter, students will be able to:

- State that composition of clean, dry air is approximately 78% nitrogen, N_2, 21% oxygen, O_2, and the remainder as a mixture of noble gasses and carbon dioxide CO_2 State the major Sðúrces of air pollutants (Some examples include:

a) Carbon dioxide from the complete combustion of carbon-containing fuels
b) carbon- monoxide: arid particulates from the incomplete combustion of carbon containing fuels.
c) methane from the decomposition of vegetation and waste gasses from digestion in animals
d) oxides of nitrogen from car engines
e) sulfur dioxide from the combustion of fossil_ fuels which contain sulfur compounds
f) ground level ozone from reactions of oxides of nitrogen; from car engines, and volatile organic compounds; in presence of light)
g) State the adverse• effects of air pollutants (Some examples include:
carbon dioxide: higher levels of carbon dioxide to increased' global warming, which leads to climate change b' carbon monoxide•-toxic gas

- particulates: increased risk-of-respiratory problems and cancel
- The ethane: higher levels of methane leading to increased global warming, which leads to climate change
  a. oxides of nitrogen: acid rain, photochemical smog and respiratory problems
  b. f. sulfur dioxide: acid and and haze)
  c. Explain- how greenhouse gasses_ carbon. dioxide* and methane cause global warming, examples include:_
  a. the absorption, reflection and emission ofthermä1[9]enêrgy
  b. reducing thermal [energy loss to space]
- Describe the role of sulfur in the formation of acid rain and impact on the environment.
  Describe the strategies to reduce the effects of major environmental issues (some examples include:

  a. climate change: planting trees, reduction in livestock farming, decreasing use of fossil fuels, increasing use of hydrogen and renewable energy, e.g. wind, solar.

  b. Acid rain: Use of catalytic converters in vehicles, reducing emissions of sulfur dioxide by using low sulfur fuéls and flue-gas desulfurization with calcium oxide).
- Describe the role of NO and NO_2(subscript) in the formation of acid rain, both directly and through their catalytic role in the oxidation of atmospheric sulfur dioxide.
- Explain how oxide of nitrogen form in car engines and describe their removal by catalytic converters, e.g. $CO + 2NO \longrightarrow 2CO_2 + N_2$
- Define photosynthesis as the reaction between carbon dioxide and water to produce glucose and oxygen in the presence of chlorophyll and using energy from flight.
- Analyze how to use tools to reduce personal exposure to harmful pollutants (some examples include the usage masks air quality indices and CO.

- Identify high risk situation in life including those where long-tern exposure to these pollutants can lead to respiratory issues and reduction in quality and longevity of life.

INTRODUCTIONS

SHORT QUESTION

Q.1 What is meant by environmental chemistry? Give its scope. ***(Knowledge Base)*** **(BWP 2017)**

Ans: **ENVIRONMENTAL CHEMISTRY**

Definition

The branch of Chemistry which deals with the study of chemicals and other pollutants in the environment is called environmental chemistry.

Scope

It also covers the adverse effects of these chemicals on living and non-living things.
Environmental chemistry is a part of environmental education.

Q.2 What is objective and need of environmental chemistry?

Ans: **OBJECTIVE OF AND NEED OF ENVIRONMENTAL CHEMISTRY**

Objectives

The objective of which is to enlighten the people. Particularly the students, about the importance of protection and conservation of our environment.

Need

The need for this environmental education, both formal and non-formal, is keenly felt at the national level to keep the environment clean and safe for the mankind.

Q.2 What are adverse effects of human activities on environment? (Knowledge Base)(BWP 2017)

Ans: **ADVERSE EFFECTS OF HUMAN ACTIVITIES**

Since the start of industrial revolution, human activities have played havoc with the atmosphere of the earth.

Examples

(i) Gases from the fossil fuel burning

The gases which are released due to the increasing use of fossil fuels (natural gas, coal and petroleum) have polluted the atmosphere upto such an extent that it is difficult to breathe air in some areas of metropolitan cities.

(ii) Excessive use of fertilizers, insecticides and pesticides

The excessive use of fertilizers, insecticides and pesticides, etc. for agriculture purposes has proved to be harmful for animals, birds and human beings. The situation is turning serious for every passing day and there is an urgent need to control the emission of pollutants to the atmosphere.

(iii) Industrial Discharge

(iv) Domestic Wastes

10.1 COMPOSITION OF ATMOSPHERE

LONG QUESTIONS

Q.1 What is atmosphere? Explain the composition of dry atmosphere. (Knowledge+Understanding Base)

Ans: **ATMOSPHERE**

Definition:

"Atmosphere is the ***envelope of different gases*** *around the Earth".*

OR

Earth is covered with a blanket of air called the "atmosphere" which is made up of several layers of gases.

Location:

It extends continuously from the Earth's surface outwards without any boundary.

Importance of Air

Air is essential for life on earth, for animals to breathe and for plants to make their food. You cannot see, smell or taste earth's atmosphere. It contains more nitrogen than any other gas.

Components of the atmosphere

The components of the atmosphere may be divided into major and minor constituents. The amount of these different gases in the air varies slightly from place to place season to season and day to night. The percentages of these constituents by volume are given in Table (10.1).

Table (10.1): Major and Minor Constituents of the Atmosphere

Major Constituents	Percentage by Volume	Major Constituents	Percentage by Volume
Nitrogen	78.0	Carbon dioxide	0.03
Oxygen	21	Noble gases	About 1.0
		Water Vapours	Variable

EXERCISE
(a) Which method is used to separate gases present in the air? Ans: Fractional distillation is used to separate gases present in the air. (b) **Which gas is released when fizzy drinks open?** Ans: Carbon dioxide gas is released when fizzy drinks open.

INTERESTING INFORMATION
SIGNIFICANCE OF ENVIRONMENTAL CHEMISTRY Environmental science helps us to understand the complex interactions that occur in our ecosystems and the impacts on human life.

SHORT QUESTION

Q.1 What do you mean by atmosphere? *(Knowledge Base)* (GRW 2013, LHR 2013, SWL 2017)

Ans:

ATMOSPHERE

"Atmosphere is the envelope of different gases around the Earth".

Layers of atmosphere:

Atmosphere consists of four layers extending from the surface of the Earth upwards which are as follows:

- Troposphere
- Stratosphere
- Mesosphere
- Thermosphere

Q.2 What is difference between atmosphere and environment? *(Knowledge+Understanding Base)* (LHR 2014)

Ans:

DIFFERENTIATION

The differences between atmosphere and environment are as follows:

Atmosphere	Environment

Definition	
• Atmosphere is the envelope of different gases around the Earth. It extends continuously from the Earth's surface outwards without any boundary.	• Environment is the sum of all social, biological, physical and chemical factors which constitutes the surroundings of man.
Composition	
• It consists of four layers i.e., troposphere, stratosphere, mesosphere, thermosphere.	• It consists of air, water, food and sunlight.

Q.3 Name the major constituents of troposphere? ***(Knowledge Base)*** **(LHR 2015, MTN 2016 G-I)**

Ans: **MAJOR CONSTITUENTS**

The major constituents of troposphere are:

- Nitrogen (78 %)
- Oxygen (21 %)

Both Nitrogen and oxygen constitute 99 % of atmosphere by volume.

10.1 COMPOSITION OF ATMOSPHERE

MULTIPLE CHOICE QUESTION

1. Percentage of argon in atmosphere by volume is: ***(K.B)***

(A) 0.934 (B) 0.03
(C) 0.21 (D) 78.09

2. Percentage of carbon dioxide in atmosphere by volume is: ***(K.B)***

(A) 0.93 (B) 0.21
(C) 0.04 (D) 78.09

3. Solar energy absorbed by Earth is converted into: ***(K.B)***

(A) Heat energy (B) Light energy
(C) Both A and B (D) None of these

4. Percentage of nitrogen in the composition of atmosphere by volume is : ***(K.B)***

(A) 78.0% (B) 20.94%
(C) 0.03% (D) 0.93%

10.2 AIR POLLUTANTS

LONG QUESTIONS

Q.1 (A) What is meant by pollutant? Write a note on air pollutants. (SGD 2016 G-II)
(B) Write a note on Air Pollutants.

Ans: **(A) POLLUTANT**

Definition:

"*A pollutant is a* ***waste material*** *that pollutes air, water or soil (environment) and this phenomenon is called pollution".*

Characteristics:

The characteristics of pollutants are as follows:

- They make the environment (air, water or soil) harmful to life.
- They cause pollution.
- The contaminants are those substances that make something impure.
- A beneficial substance beyond a specific concentration may be harmful.

(B) AIR POLLUTANT (DGK 2016 G-II)

Any substance (solid, liquid or gas) in the air which has adverse effect on human health, quality of life and natural functioning of ecosystem is called an air pollutant.

OR

"*The harmful substances present in air are called air pollutants".*

Harmful Effects of Air pollutants

Air pollutants have following harmful effects:

- Change the weather
- Badly affect the human health
- Damage the plants
- Destroy buildings

Unit used to Express Concentration of Pollutant

The concentration of a pollutant is expressed in parts per million (ppm).

Parts per million (ppm)

A concentration of one ppm means one part of pollutant per million part of solid, liquid or gas mixture in which the pollutant is formed.

Precautions to Prevent Water Pollution

Every Individual should try to…….

- Pour liquid waste into sewers not in open drains, river and sea.
- Stop using chlorofluorocarbon (CFCs) products.

Q.2 Write down major air pollutants. Describe the sources of Air Pollutants.
(Knowledge Base) **(GRW 2015)**

Ans:

MAJOR AIR POLLUTANTS

Definition:

Air is not always as pure as it should be. There are five types of harmful substances which account for more than 90% of air pollution. These are fast growing sources of air pollution created by our day-to-day activities. The detail of these substances is mentioned below.

No.	Name of Air Pollutant	Chemical formula of Air Pollutant
(i)	Carbon dioxide	CO_2
(ii)	Carbon monoxide	CO
(iii)	Oxides of nitrogen	(NO, NO_2) collectively referred to as NOx
(iv)	Oxides of sulphur	(SO_2, SO_3) collectively referred to as SO_x
(v)	Hydrocarbons	Methane, ethane etc.)
(vi)	Particulates	Dust, pollens, metallic compounds
(vii)	Ozone	O_3
(viii)	Smog	Mixture of smoke and fog

Q.3 Describe the sources of air pollutants.

Ans:

SOURCES OF AIR POLLUTANT

Millions of tonnes of pollutants are emitted into the atmosphere each year as a result of human activities. Following are the important sources of air pollutants:

1. **Complete and incomplete combustion of fossil fuels**

The major activity among them is the complete and incomplete combustion of fossil fuels which alone is responsible for most of our pollution problem.

Burning of fossil fuels (oil natural gas, coal) produces:

- Carbon dioxide
- carbon monoxide
- NO_x
- SO_x
- CH_4
- Ash
- Smoke
- suspended particles.

2. **Natural Processes**

Many of these pollutants are also released into the air by natural processes.

Example

Volcanic eruption releases large quantities of CO_2, SO_2 and particulates.

3. **Decomposition of Vegetation**
Methane is released in the air by the decomposition of vegetation.

4. **Digestion in Animals**
It is also present in waste gases produced during digestion in animals.

5. **Main Factors for Environmental Pollution**
Following are the main factors which are responsible for environmental pollution.
- Rapid growth of population
- Urbanization
- Industrialization
- transportation

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.

6. **Reaction between NOx and hydrocarbons**
Another pollutant ozone (03) is formed when heat and sunlight cause chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (hydrocarbons).

7. **Smog Formation**
An extremely ugly pollutant, smog, is suspended in many cities of Pakistan especially in winter.

Cause of Suspension of Smog
Its suspension is caused by a combination of factors which include industrial pollution, vehicle emission and crop burning. These factors are responsible for the accumulation of nitrogen oxides, sulphur dioxide, particulate matter and volatile organic compounds (VOCs) in air.

Q.4 Describe the harmful effects of air pollutants. (GRW 2015)

Ans: **HARMFUL EFFECTS OF AIR POLLUTANTS**

The following Table (10.2) shows the major air pollutants and their harmful effects on human beings and on the environment.

Table (10.2) Pollutants and Their Harmful Effects

No	Pollutants	Harmful Effects
	Carbon dioxide (CO_2)	**(i) Increased global warming** Higher levels of carbon dioxide lead to increased global warming. **Effects of Global Warming** It can cause: • ice caps to melt • oceans to warm • causing sea levels to rise. **(ii) Extreme Weather Changes** Extreme weather changes can occur **Effects of Extreme Weather Changes** • heat waves • heavy rains • wild fires also occur
2	**Carbon monoxide (CO)**	**Effects** • It is **extremely poisonous gas** that can cause suffocation and death. • Carbon monoxide is **very toxic gas** that **stops the red blood cells** in animal's blood from **carrying oxygen** that body needs.

3	**Oxides of nitrogen (NO_x) NO, NO_2**	**Effects** **(i) Damage to the life** NOx can damage lungs, irritate the eyes and damage vegetation. **(ii) Acid Rain** It can also cause acid rain which affects buildings and statues made of limestone.
4	**Oxides of sulphur (SO_x) SO_2, SO_3**	Following are the effects of oxides of sulphur: • SOx irritates the eyes • causes breathing difficulties • acid rain
5	**Hydrocarbons**	**Poisonous** and cause **global warming.**
6	**Particulate matter**	Following are the effects of 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. • It may render lakes and streams acidic.
7	**Ozone**	Breathing ozone can cause a variety of health problems including: • Chest pain • Coughing • Throat irritation • congestion
8	**Smog**	It can lead to health complications like: • Allergies • Asthma • Lung infections • Inhibits the proper growth of plants

AMAZING FACTORS ABOUT THE ENVIRONMENT

1. 78% of marine mammals are at risk of choking on plastic.
2. Human use only 0.2 % of all available water.
3. The world has over 3.04 trillion trees. 27000 out of them are cut down daily to make toilet paper.

EXERCISE

How does air pollution affect plants?

Ans: HARMFUL EFFECTS OF AIR POLLUTANTS

Air pollutants have following harmful effects:

- Change the weather
- Badly affect the human health
- Damage the plants
- Destroy buildings

SHORT QUESTION

Q.1 CO_2 is the life gas for plants and animals. Comment it. ***(Knowledge Base)***

Ans:

CO_2 AS LIFE GAS

CO_2 is the life gas for plants as well as for the human beings and animals.

Comments:

CO_2 absorbs infrared radiations emitted by the Earth. Although CO_2 is negligible as compared to N_2 and O_2, yet its heat retaining capacity is tremendous. Without CO_2, life on earth would have been impossible.

Q.2 What are catalytic converters? ***(Knowledge Base+Application Base)***

Ans:

CATALYTIC CONVERTERS

Definition:

"An instrument which is used to ***convert harmful gases (CO, NO_x hydrocarbons etc) present in automobile exhaust into harmless substances (CO_2, N_2 and H_2O),*** *in the presence of some catalyst like Pd, Cd etc is called catalytic converter".*

Importance:

Converters should be used in automobile exhaust so that they convert **CO to CO_2** and oxides of nitrogen **NO_x to N_2** before it enters in air. Catalytic converters are attached to automobile exhausts.

Q.3 Describe working of catalytic converters. ***(Application Base)***

Ans:

WORKING OF CATALYTIC CONVERTERS

When hot gases pass through the converters, harmful pollutants are converted to harmless substances.

Examples:

- Carbon monoxide is oxidized to carbon dioxide.
- Unburnt hydrocarbons are oxidized to carbon dioxide and water, while oxides of nitrogen are reduced to nitrogen.

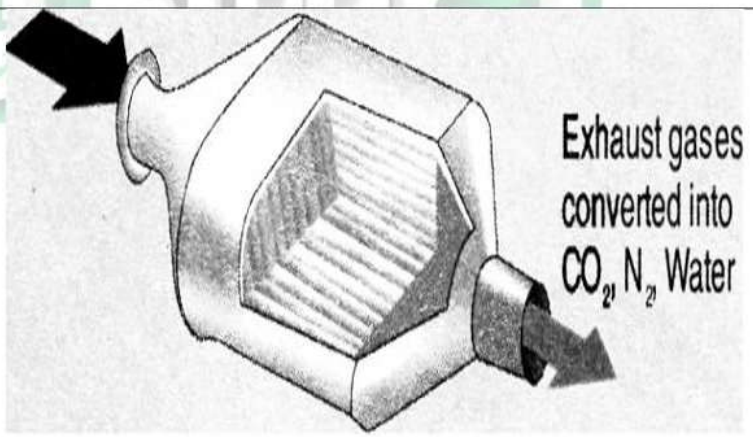


Figure: Catalytic Converter Used in Automobile Vehicle

Q.4 What are effects of SO_2? ***(Knowledge Base)*** **(RWP 2017)**

Ans: *Answer Given on Page #*

Q.5 Define global warming? ***(Knowledge Base)*** **(RWP 2016**

Ans:

GLOBAL WARMING

Definition:

"The increase in average temperature of earth's atmosphere and oceanic temperature due to greenhouse effect (resulting especially due to pollution) is called global warming".

Effects of Global Warming

- Rising of temperature
- Weather changes
- Melting of glaciers and snow caps
- Rise of sea level

Q.6 What are life gases for plants and animals? ***(Knowledge Base)***

Ans:

LIFE GASES

- CO_2 is the life gas for plants used for photosynthesis.
- O_2 is for the respiration of human beings and animals.

Q.7 How CO_2 is responsible for existence of life on earth? ***(Knowledge Base***

Ans:

ROLE OF CO_2

CO_2 is responsible for existence of life on earth. It absorbs infrared radiations emitted by the Earth. Although CO_2 is negligible as compared to N_2 and O_2 yet its heat retaining capacity is tremendous. Without CO_2, life on Earth would have been impossible.

Q.8 What do you mean by an air pollutant? ***(Knowledge Base)*** **(BWP 2016 G-II, SGD 2017)**

Ans:

AIR POLLUTANT

"*The harmful substances present in air are called air pollutants".*

Examples:

- H_2SO_4
- HNO_2
- SO_2
- CO etc.

Q.9 Name three air pollutants. ***(Knowledge Base)***

Ans:

THREE AIR POLLUTANTS

Following are the names of three air pollutants:

- Sulphurdioxide : SO_2
- Sulphur trioxide : SO_3
- Carbon monoxide : CO etc.

Q.10 Identify as primary or secondary air pollutants. SO_2, CH_4, HNO_3, NH_3, H_2SO_4, O_3. ***(Knowledge Base)***

Ans:

IDENTIFICATION OF AIR POLLUTANTS

The primary and secondary air pollutants are as follows:

Primary Pollutants	Secondary Pollutants
NH_3	HNO_3
CH_4	H_2SO_4
SO_2	O_3

Q.11 Why CO_2 is called a greenhouse gas? ***(Knowledge Base)***

(LHR 2013, DGK 2016 G-I, GRW 2017)

Ans:

CO_2 AS A GREENHOUSE GAS

Carbon dioxide is called as a greenhouse gas because it acts like a glass wall of green house.

Mechanism:

It allows UV radiations to pass through it but does not allow the IR radiations to pass through it. As concentration of CO_2 increases, less heat is lost from the surface. So, average temperature of earth's surface gradually increases. This is called green house effect.

Q.12 Why the flood risks are increasing? ***(Knowledge Base)*** **(SWL 2016 G-II)**

Ans:

INCREASING FLOOD RISKS

Flood risks are increasing because Global Warming is melting the glaciers and snow caps.

Q.13 Comment: burning in open air is preferred. ***(Knowledge Base)***

And:

BURNING IN OPEN AIR IS PREFERRED

Burning in open air is preferred because in open air, burning produces CO_2 gas which is not

poisonous and becomes part of atmosphere where as in closed places, CO is produced due to limited supply of oxygen, CO is poisonous gas and can be fatal.

Q.14 How sulphur containing compounds are emitted naturally? ***(Knowledge Base)***

Ans: **EMISSION OF SULPHUR COMPOUNDS**

Sulphur containing compounds are emitted naturally in the following ways:

- Bacterial decay of organic matter
- Volcanic gases
- Forest fires

Q.15 How combustion of fossil fuels in internal combustion engine produces oxides of nitrogen? ***(Knowledge Base)***

Ans: **COMBUSTION OF FOSSIL FUELS**

Combustion of fossil fuels in internal combustion engines, in thermal power stations and factories where huge amount of coal is burnt, NO is formed by the direct combination of nitrogen and oxygen. NO combines with O_2 to form NO_2.

$$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$$

$$2NO + O_2 \longrightarrow 2NO_2$$

MULTIPLE CHOICE QUESTION

1. A group of gases that maintains the temperature of atmosphere is: ***(K.B)***
(A) Carbon dioxide and water vapours (B) Nitrogen and carbon dioxide
(C) Oxygen and water vapours (D) Nitrogen and oxygen

2. Which one of the following is a greenhouse effect? ***(K.B)***
(A) Increasing atmosphere temperature (B) Both A and C
(C) Increasing flood risks (D) None of these

3. Formula of nitrogen dioxide is: ***(K.B)***
(A) H_2SO_4 (B) NO_2
(C) HNO_3 (D) NO

4. Infrared radiations emitted by the Earth are absorbed by: ***(K.B)***
(A) CO_2 and H_2O (B) N_2 and O_2
(C) CO_2 and N_2 (D) O_2 and CO_2

5. Cause of global warming is: ***(K.B)*** **(LHR 2014, GRW 2014, MTN 2017)**
(A) CO_2 (B) SO_2
(C) NO_2 (D) SO_3

6. The harmful substances present in air are called: ***(K.B)***
(A) Air pollutants (B) Ozone
(C) Carbondioxide (D) Water

7. When wood burns in limited supply of oxygen which gas is produced? ***(K.B)***
(A) CO_2 (B) CO
(C) SO_2 (D) SO_3

8. Which pollutant is not found in car exhaust gases? ***(K.B)*** **(LHR 2014)**
(A) CO (B) O_3
(C) NO_2 (D) SO_2

9. Which gas is inert? ***(K.B)*** **(GRW 2014, LHR 2016)**
(A) O_2 (B) CO
(C) N_2 (D) O_3

10. Photosynthesis process produces: ***(K.B)*** **(GRW 2015)**
(A) Starch (B) Cellulose
(C) Sucrose (D) Glucose

11. Carbon monoxide gas is harmful to us because: ***(K.B)*** **(DGK 2016 G-I)**
(A) It paralysis the lungs
(B) It damages lung tissues

(C) It reduces oxygen carrying ability of hemoglobin
(D) It makes the blood coagulate

10.3 ACID RAIN

LONG QUESTION

Q.1 Explain how rain water is acidic and what are the effects of acidic rain?
(Knowledge+Understanding Base)
How rain water is acidic?

OR

Define acid rain. How it forms and what are its effects? (LHR 2014, 15)

Ans:

ACID RAIN

Definition:

"A rain having a pH lower than that of ***normal rain water*** *due to the presence of H_2SO_4 and HNO_3 is called acid rain".*

OR

When rain water has pH less than 5.6, it is known as acid rain.

Discovery of relation between acid rain and atmospheric pollution

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".

Normal Rain Water:

Normal rain water is weakly acidic because it consists of dissolved CO_2 of the air. Its pH is about **5.6 to 6.**

Acid Rain Water:

Rain water on dissolving air pollutants (acids) becomes more acidic and its **pH reduces to 3 and in extreme conditions pH may reduce to 2.5.**

FORMATION OF ACID RAIN

Burning of fossil fuels releases harmful gases into the atmosphere.

(i) Production of SO_2 and SO_3

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 of the atmosphere.

(ii) Production of oxides of Nitrogen

Oxides of nitrogen are produced mostly by

- The direct combination of atmospheric oxygen and nitrogen in the industrial and domestic combustion processes.
- They are also produced by the combination of atmospheric nitrogen and oxygen in the presence of lightning.
- Significant amount of nitrogen oxides is produced by the reactions taking place in automobile engines

(iii) Mixing of SO_2, SO_3 and NO_2 wih moisture

These gases mix with the moisture that is always present in the air to form acid droplets. Wind can carry these acidic droplets to huge distance.

(iv) Returning of Acid Rain to the ground

Finally, these droplets return to the ground as acid rain, acid hail, snow and even fog.

Characteristics of Acid Rain

Acid rain looks, feels and tastes like clean rain. its corrosive nature causes widespread damage to the environment.

$$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$$

$$2SO_{2(g)} + O_{2(g)} \xrightarrow{\text{Oxides of nitrogen}} 2SO_{3(g)}$$

$$SO_{3(g)} + H_2O_{(l)} \longrightarrow H_2SO_{4(aq)}$$

$$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$$

$$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_2$$

$$2NO_{2(g)} + H_2O_{(l)} \longrightarrow HNO_{3(g)} + HNO_{2(g)}$$

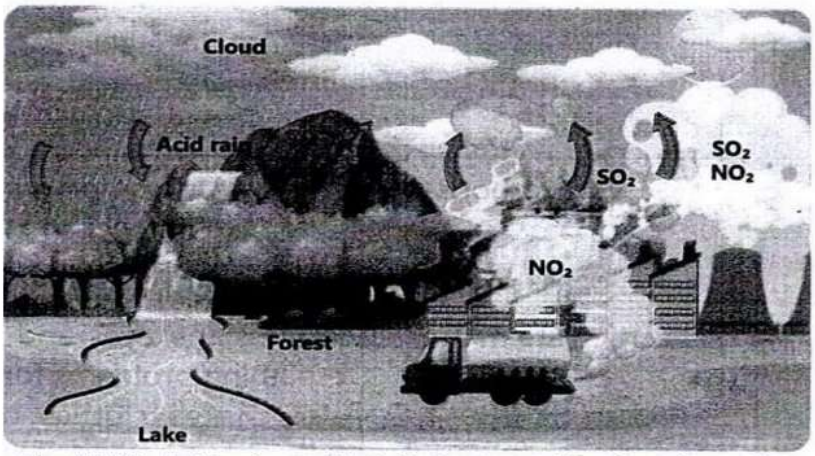


Fig (10.1): Acid rain usally falls far from the site where the acidic oxides are generated.

INTERESTING INFORMATION!

GIANT FLOATING PATCH OF GARBAGE

There is a giant floating patch of garbage spread over in the Pacific Ocean. It contains about 100 million tons of garbage.

EFFECTS OF ACID RAIN (SWL 2016 G-I, MTN 2016 G-II, DGK 2016 G-I)

Acid rain causes a number of adverse effects. It tends:

- to increase acidity of the soil
- threatens human and aquatic life
- destroys forests
- reduces agricultural productivity
- Besides, it can corrode buildings, monuments, statues, bridges and railings.

Most important adverse effects of acid rain

Most important adverse effects of acid rain are as follows:

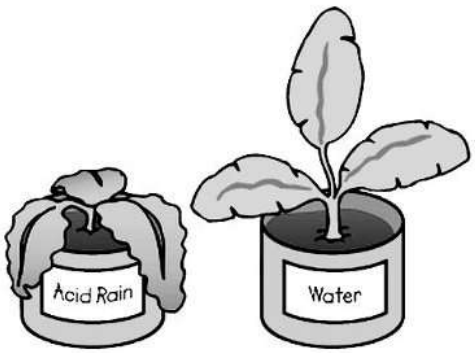
(i) Soil:

Acid rain makes soil more acidic.

It dissolves and washes away nutrients present in the soil which are needed by plants. It can also dissolve toxic substances such as aluminium and mercury which are naturally present in the soil. This process is called leaching of 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, rivers and damages the 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 the acid rain than forest. 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 Structure

Acid rain and the dry deposition of acidic particles damage buildings, statues, automobiles, and other structures made of stone, metal etc.

Historical buildings

Historical buildings like Parthenon in Athens (Greece) and the Taj Mahal in Agra (India) are deteriorating due to acid rain.

EXERCISE

(a) Which acids are made when SO_2 and NO_2 dissolve in rain?

Ans: FORMATION OF ACIDS

When sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) dissolve in rain, they form sulfuric acid and nitric acid, respectively

(b) What happens to the soil if trees are destroyed by acid rain?

Ans: EFFECT OF ACID RAIN ON SOIL

If trees are destroyed by acid rain, it leaches aluminum, minerals and nutrients from the soil. Aluminum may be harmful to plants as well as animals. Removal of minerals and nutrients make the soil infertile.

SHORT QUESTION

Q.1 What is meant by acid rain? ***(Knowledge Base)***

Ans: ACID RAIN

Definition:

"A rain having a pH lower than that of natural rain due to the presence of H_2SO_4 and HNO_3 is called acid rain".

Formation:

Burning of fossil fuels produces oxides of sulphur and nitrogen in air. Rain water converts SO_2 into H_2SO_4 and NO_x to HNO_2 and HNO_3.

Q.2 How does aluminium harm the fish? ***(Knowledge Base)*** **(RWP 2017)**

Ans: **HARM OF ALUMINIUM TO THE FISH**

High concentration of aluminium metal clogs fish gills. It causes suffocation and ultimately death of fish.

Q.3 How acid rain is produced? *(Knowledge Base)* (GRW 2013, SWL 2016 G-I, 17, SGD 2017)

Ans: **PRODUCTION OF ACID RAIN**

Definition:

"*Acid rain means the presence of excessive acids in rain waters".*

Production:

This rain is produced when normal rain water dissolves oxides of sulphur and nitrogen in air. The rain water converts SO_2 into H_2SO_4, NOx into HNO_2 and HNO_3.

Q.4 Why acid rain damages buildings? *(Knowledge Base)* (GRW 2014, FSD 2016 G-II)

Ans: **ACID RAIN DAMAGES BUILDINGS**

Acid rain attacks the calcium carbonate present in the marble and limestone of buildings and monuments. Thus, these buildings are getting dull and eroded day by day.

Q.5 How aquatic life is affected by acid rain? *(Knowledge Base)*

Ans: **EFFECTS OF ACID RAIN**

Acid rain on soil and rocks dissolves heavy metals (Al, Hg, Pb, Cr, etc.) with it and discharges these metals into rivers and lakes. The high concentration of these metals, especially high concentration of aluminium metal clogs the fish gills. It causes suffocation and ultimately death of fish.

Q.6 Why plants are dying day by day? Comment. *(Knowledge Base)*

OR

How acid rain affects the trees and plants? (GRW 2017)

Ans: **DYING OF PLANTS DAY BY DAY**

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.

MULTIPLE CHOICE QUESTION

6. Which one is heavy metal? *(K.B)*

(A) Na (B) Hg

(C) K (D) Both A and C

7. Buildings are being damaged by acid rain because it attacks: *(K.B)* (SWL 2017)

(A) $CaSO_4$ (B) $Ca(NO_3)_2$

(C) $CaCO_3$ (D) CaC_2O_4

8. pH of normal rain water is: *(K.B)*

(A) 5.6 to 6 (B) 6 to 7

(C) 8 (D) 9

9. pH of acid rain is: *(K.B)*

(A) 7 (B) 5

(C) 6 (D) 4

10.4 GLOBAL WARMING (GREENHOUSE EFFECT)

LONG QUESTION

Q.1 Write a complete note on greenhouse effect and global warming.

(Knowledge+Understanding Base) **(SWL 2016 G-II)**

OR

CO_2 is necessary for plants but why its increasing concentration is alarming for?

(LHR 2015, BWP 2016 G-I)

Ans:

GREEN HOUSE EFFECT

Definition:

The progressive warming up of the Earth's surface due to blanketing effect of man-made carbon dioxide, methane and other gases in the atmosphere is called Greenhouse Effect.

OR

Trapping of solar radiations due to presence of carbon dioxide, water vapours, methane, ozone etc. in the Earth's atmosphere is called Green House Effect.

OR

*"The **concentration** of CO_2 in air increases, less heat energy is lost from the surface of the Earth. Therefore, the average temperature of the surface gradually increases. This is called greenhouse effect".*

Mechanism of Green House Effect

The sun emits short wave radiation that passes through greenhouse gases to heat the surface of the Earth. At night, the hot Earth's surface emits longwave radiation that is mostly absorbed by greenhouse gases. This process of absorption prevents the radiation to reach space, reducing the speed at which the Earth can cool off (Fig 10.2).

Fig. 10.2 Global warming/greenhouse effect

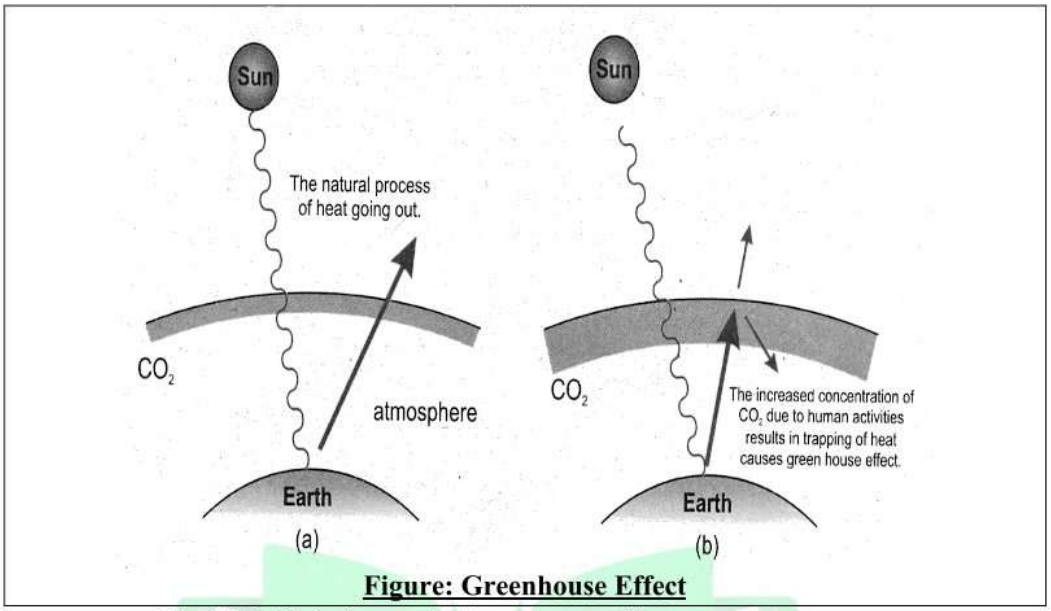


Figure: Greenhouse Effect

Fig 10.2: Global warming/greenhouse effect

Relationship between Global warming and Concentration of Green House Gases

Higher the concentration of carbon dioxide and other gases, greater will be the absorption of thermal and radiation the increase in global warming.

Global Warming $\propto$ Concentration of Green House Gases

DO YOU KNOW?

Green House effect, depletion of ozone and acid rain are the global effects of pollution.

SOURCES OF GREEN HOUSE GASES

(A) Carbon dioxide and other gases

(i) Burning of coal, oil and natural gas:

Due to the burning of the large amount 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.

Disturbance in balance of CO_2

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 C02 from the air is diminished.

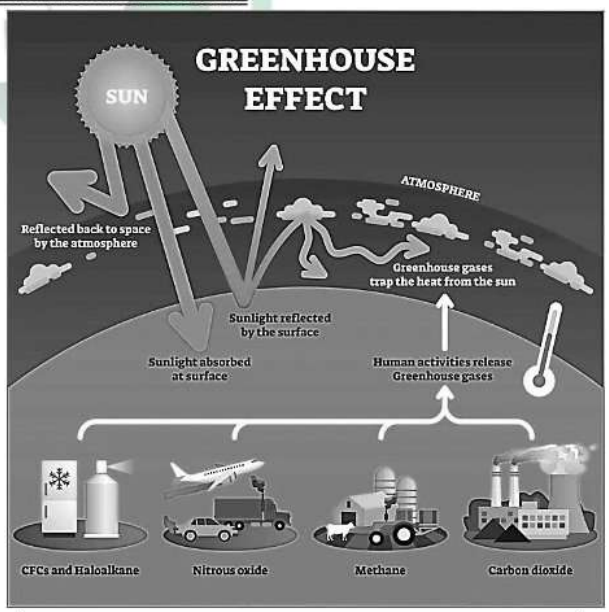


Fig (10.3): GREENHOUSE GASES

(B) Methane

Methane is another greenhouse gas which causes adverse effects. The increase in its concentration in air is due to the following reasons.

- increased decay of vegetation matter
- digestion in animals
- increased farming of the rice fields

Sunlight passes through the greenhouse gases and warms everything on the Earth.

Sunlight passes t h r o u g h t h e greenhouse gases and warms everything on the Earth.
The Earth warms up and gives out heat. Some heat passes through the greenhouse gases but some are trapped inside, warming up the Earth.

CO_2 as a glass sheet of greenhouse

The remaining carbon dioxide goes on accumulating in the lower areas of the atmosphere and forms a thick dense layer. This layer behaves like glass sheet of 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.

INTERESTING INFORMATION

WATER VAPOURS AS GREENHOUSE GAS

Water vapours also act as greenhouse gas. When released into the atmosphere, water soon comes earth as acid rain.

Q.2 What is global warming. Describe effects of Global warming in detail.
***(Knowledge+Understanding Base)* (LHR 2015, BWP 2016 G-I) (SWL 2016 G-II)**

Ans: **GLOBAL WARMING**

Definition:

GLOBAL WARMING

"The increase in average temperature of Earth's atmosphere and oceanic temperature due to greenhouse effect (resulting especially due to pollution) is called global warming".

Relationship between CO_2 Conc. and Global Warming

Global Warming $\propto$ amount of CO_2 in air

Adverse Effects of Global Warming on Climate

A rise of a few degrees -in temperature may seem small, but it can be enough to cause significant changes in the climate. At the moment, it is difficult for scientists to say how big the changes will be and where the worse effects will occur. This can damage agriculture and food production as well.

Nature of effects of climate change

The effects of climate change may be physical, ecological, social or economic.
Following are four adverse effects of the global warming:

(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 and it results in higher sea levels.

Effect of Rise in sea level

This phenomenon will threaten the low lying coastal areas of the world such as:

- Netherlands
- Bangladesh

- Maldives
- Fig (10.4).

(ii) Increase in Rain Fall

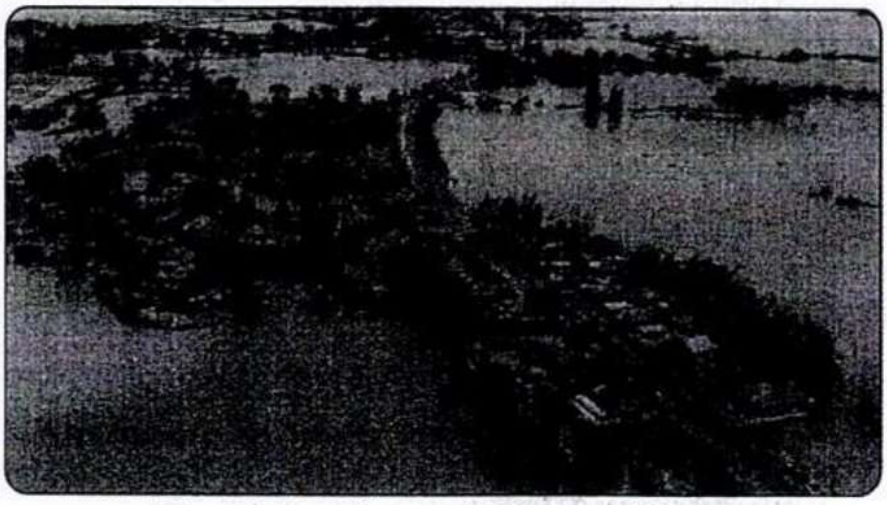


Fig (10.5): Effects of Climate Change

There may be enormous increase in rainfall which may increase the sea level. This ultimately will cause worldwide floods endangering survival of living species. Fig (10.5)

(iii) Effects on Agriculture

Fig (10.7): Summer and winter

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 in higher temperature but other plants such as maize and sugarcane do not Fig (10.6).

(iv) Hot Summer and Winter

In moderate region, the winter will be shorter and warmer and the summer will be longer and hotter. Fig (10.7).

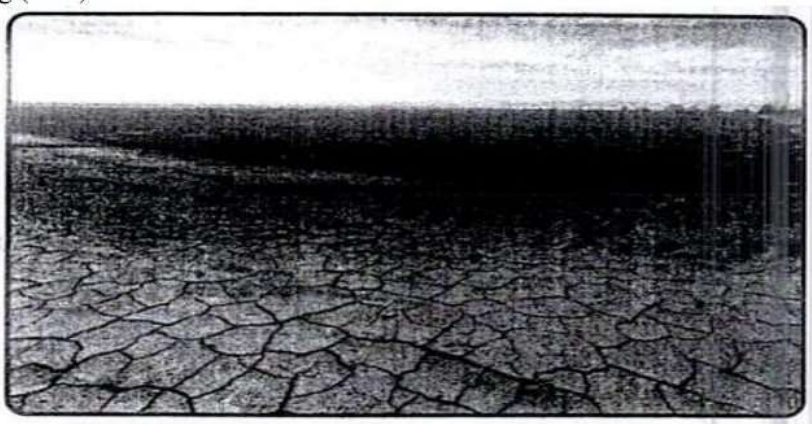


Fig (10.6): Global warming risking the agriculture drought.

EXERCISE

a. How do living things add and plants remove carbon dioxide from the air?

Ans: **LIVING THINGS ADD AND PLANTS REMOVE CO_2**

Addition of carbon dioxide

Living things, including animals and humans, add carbon dioxide to the air through the process of respiration. They breathe in oxygen and exhale carbon dioxide.

Removal of carbon dioxide

Plants remove carbon dioxide from the air through photosynthesis. During this process plants use carbon dioxide and water and produce sugar and oxygen.

b. Which gas do rice plants produce?

Ans: **GAS BY RICE PLANTS**

Rice plants produce methane (CH_4). It is a greenhouse gas and causes Global warming.

c. **Which gas is given out by rotting garbage?**

Ans: **GAS BY ROTTING GARBAGE**

Landfill gas (LFG) is given out by rotting garbage. LFG is a mixture of 50 percent methane and 50 percent carbon dioxide (CO_2) gas.

INTERESTING INFORMATION

MELTING RATE OF ICE

Since 1990, we have lost around 28 trillion tons of ice. At presents, its melting rate is 1.2 trillion tons per year.

SHORT QUESTION

Q.1 Define global warming? ***(Knowledge Base)*** **(RWP 2016 G-II)**

Ans: **GLOBAL WARMING**

Definition:

"The increase in average temperature of earth's atmosphere and oceanic temperature due to greenhouse effect (resulting especially due to pollution) is called global warming".

Effects of Global Warming:

- Rising of temperature
- Weather changes
- Melting of glaciers and snow caps

- Rise of sea level
- Increase in rain fall

Q.2 What are life gases for plants and animals? ***(Knowledge Base)***

Ans:

LIFE GASES

- CO_2 is the life gas for plants used for photosynthesis.
- O_2 is for the respiration of human beings and animals.

Q.3 How CO_2 is responsible for existance of life on earth? ***(Knowledge Base)***

(Interesting Information Pg. # 125)

Ans:

ROLE OF CO_2

CO_2 is responsible for existance of life on earth. It absorbes infrared radiations emitted by the Earth. Although CO_2 is negligible as compared to N_2 and O_2 yet its heat retaining capacity is tremendous. Without CO_2, life on Earth would have been impossible.

Q.4 Why CO_2 is called a greenhouse gas? ***(Knowledge Base)***

(LHR 2013, DGK 2016 G-I, GRW 2017)

Ans:

CO_2 AS A GREENHOUSE GAS

Carbon dioxide is called as a greenhouse gas because it acts like a glass wall of green house.

Mechanism:

It allows UV radiations to pass through it but does not allow the IR radiations to pass through it. As concentration of CO_2 increases, less heat is lost from the surface. So, average temperature of earth's surface gradually increases. This is called green house effect.

Q.5 Why the flood risks are increasing? ***(Knowledge Base)*** **(SWL 2016 G-II)**

Ans:

INCREASING FLOOD RISKS

Flood risks are increasing because Global Warming is melting the glaciers and snow caps.

Q.6 Comment: burning in open air is preferred. ***(Knowledge Base)***

And:

BURNING IN OPEN AIR IS PREFERRED

Burning in open air is preferred because in open air, burning produces CO_2 gas which is not poisonous and becomes part of atmosphere where as in closed places, CO is produced due to limited supply of oxygen, CO is poisonous gas and can be fatal.

MULTIPLE CHOICE QUESTION

1. A group of gases that maintains the temperature of atmosphere is: ***(K.B)***

(A) Carbon dioxide and water vapours (B) Nitrogen and carbon dioxide
(C) Oxygen and water vapours (D) Nitrogen and oxygen

2. Which one of the following is a greenhouse effect? ***(K.B)***

(A) Increasing atmosphere temperature (B) Both A and C
(C) Increasing flood risks (D) None of these

3. Cause of global warming is: ***(K.B)*** **(LHR 2014, GRW 2014, MTN 2017)**

(A) CO_2 (B) SO_2
(C) NO_2 (D) SO_3

4. When wood burns in limited supply of oxygen which gas is produced? ***(K.B)***

(A) CO_2 (B) CO
(C) SO_2 (D) SO_3

5. Which pollutant is not found in car exhaust gases? ***(K.B)*** **(LHR 2014)**

(A) CO (B) O_3
(C) NO_2 (D) SO_2

6. Which gas is inert? ***(K.B)*** **(GRW 2014, LHR 2016)**

(A) O_2 (B) CO
(C) N_2 (D) O_3

7. Photosynthesis process produces: ***(K.B)*** **(GRW 2015)**

(A) Starch (B) Cellulose
(C) Sucrose (D) Glucose

8. Carbon monoxide gas is harmful to us because: ***(K.B)*** **(DGK 2016 G-I)**

(A) It paralysis the lungs
(B) It damages lung tissues
(C) It reduces oxygen carrying ability of hemoglobin
(D) It makes the blood coagulate

10.5 STRATEGIES TO REDUCE ENVIRONMENTAL ISSUES

LONG QUESTION

Q.1 Describe the strategies to reduce the environmental pollution. ***(Application Base)***

Ans: **STRATEGIES TO REDUCE ENVIRONMENTAL POLLUTION**

Main Cause of Extremely Polluted Air

Huge amount of pollutant gases are thrown out in the atmosphere by burning fossil fuels. Following are mainly responsible for the extremely polluted air especially in big cities:

- houses
- automobiles
- aeroplanes
- industrial machines
- Coal-fired electricity generating plants, etc

WAYS TO CONTROL POLLUTION

Scientists have developed a number of different ways to control this menace of pollution.

(i) Planting Trees

Planting trees is thought to be very helpful in removing the air pollution.

(a) Absorption of CO2 and release of O2

A well-known process carried out by plants is photosynthesis in which plants clean the air through absorption of carbon dioxide and releasing oxygen. This famous reaction takes place in the presence of sunlight and it is catalysed by chlorophyll, the green pigments present in leaves.

$$6\,CO_{2\,(g)} + 6H_2O_{(l)} \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} C_6H_{12}O_{6(s)} + 6O_{2\,(g)}$$

(b) Removal of Particulate Matter

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

(ii) Using Catalytic converters

Catalytic converters are used in the exhaust system of modern-day automobiles to reduce the emissions from an internal combustion engine. Due to non-availability of enough oxygen the carbon fuel in engine does not burn completely into carbon dioxide and water. Thus, toxic by-products like CO and hydrocarbons are produced.

Three-way catalytic inverter

A three-way catalytic inverter performed the following three functions simultaneously.

1. It reduces nitrogen oxide into elemental nitrogen and oxygen.

$$2NO_{x\,(g)} \longrightarrow N_{2(g)} + xO_{2\,(g)}$$

2. It oxidizes CO to CO_2

$$2CO_{(g)} + O_{2\,(g)} \longrightarrow 2CO_{2\,(g)}$$

3. It oxidizes hydrocarbons into CO_2 and H_2O.

$$C_xH_{4x\,(g)} + 2xO_{2(g)} \longrightarrow x\,CO_{2(g)} + 2x\,H_2O_{(l)}$$

(iii) Using fuels with less sulphur

Similarly, the emission of sulphur dioxide can be decreased either by using fuels which have significantly less sulphur contents.

(iv) Flue gas desulphurization Process

Using flue gas desulphurization process. This process can remove sulphur dioxide gas from the exhaust gases of fossil fuel.

Flue Gas

Flue gas is the emitted material produced when fossil fuels are burnt in power plants.

Desulphurization process

The desulphurization process involves the addition of absorbents like calcium oxide which can remove upto 95% of the sulphur dioxide from the flue gas.

(v) Use of Renewable Source of Energy

Renewable Resources

Definition

Renewable resources are those resources that can continue to exist despite being consumed over a period of time even as they are used.

To discourage the excessive use of fossil fuels in our daily lives it is urgently required to use the renewable resources to meet our energy needs.

Examples

These resources include:

Sun, wind, water, geothermal, biomass and hydrogen gas.

Significance of Solar Energy and Wind Energy

Solar energy and wind energy have been proved to be very effective ways of generating electricity without damaing the environment.

Q.2 Describe the strategies to avoid the harmful effects of air pollution. ***(Application Base)***

OR

How to avoid the harmful effects of air pollution?

Ans: TO VOID THE HARMFUL EFFECTS OF AIR POLLUTION

Air quality index (AQI)

Air quality index (AQI) is a rating system that shows how bad is the atmosphere around you.

AQI with good quality air

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. As the (AQI) number increases, so does the risk to health.

Hazardous AQI

An (AQI) **over 300** is considered hazardous.

High Risk Group

- Children under 18
- Adults over 65
- People with chronic heart or lung disease
- Diabetic people are high risk groups
- Outdoor workers can also be considered at higher risk because of prolonged exposure

STEPS TO AVOID THE HARMFUL EFFECTS

The following steps should be taken when air quality is bad.

1. **Reduced the time you spend outdoors**

   Reduced the time you spend outdoors. Also reduce the intensity of outdoor activity. According to experts the chances of being affected by unhealthy atmosphere increase the longer a person is active outdoors and the more laborious the activity.

2. **Wearing a mask**

   If you are forced to go out, then consider wearing a mask. Unfortunately, not all the mask provides adequate safety against particulate matter. Cloth or dust mask may not effectively filter out the finer particles.

   Better Filtration Capabilities and Safer Masks

   However, well fitted N95 masks have better filtration capabilities and may be safer to use.

3. **Keep Windows and Doors Closed**

   Keep your indoor healthy by keeping the windows and doors closed. If it is difficult to maintain clean air in the entire room then create a clean room by switching on air conditioner or air cleaner.

4. **Talk to Doctor**
   If you experience such symptoms that worry you, talk to your doctor.
5. **Install carbon monoxide detector**
   Install carbon monoxide detector to detect the increased level of carbon monoxide. These higher levels of CO may occur due to faulty fuel burning appliances.

Efects of Breathing in Polluted Air for High Risk Groups

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

SHORT QUESTION

Q.1 How can we improve the quality of fuel? ***(Knowledge+Application Base)***

Ans:

TO IMPROVE THE QUALITY OF FUEL

Quality of fuel must be improved by adding anti-knocking agents in fuels. At the same time, automobiles combustion engines must be efficient so that they should burn the fuel completely. No unburned hydrocarbon molecules (fuel) should come out of the exhaust. So government must guide the people to use converters in auto exhausts.

Q.2 What are alternative fuels? Give their advantages. ***(Knowledge+Application Base)***

Ans:

ALTERNATIVE FUELS

The fuels produced by human other than fossil fuels are called alternative fuels.

Examples:

- Methanol
- ethanol
- Bio-diesel

Advantages:

- These fuels are less polluting than hydrocarbons fuel, as their molecules are simple, and burn completely in the engine.
- Their burning produces less carbon monoxide and other pollutants.

MULTIPLE CHOICE QUESTION

1. The government must plan to avoid using the fuels which produce greenhouse gas called: ***(K.B+A.B)***

(A) CO_2 (B) CO
(C) NO (D) NO_2

2. No unburned _____ molecules (fuel) should come out of the exhaust. ***(K.B+A.B)***

(A) Hydrocarbon (B) Ethanol
(C) O_2 (D) N_2

3. Which fuels are less polluting than hydrocarbon fuel? ***(K.B+A.B)***

(A) Ethanol (B) Methanol
(C) bio-diesel (D) All of these

4. Quality of fuel must be improved by adding: ***(K.B+A.B)***

(A) Water (B) Hydrocarbon
(C) Acid (D) Anti-knocking agents

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

INTRODUCTION

1	A	**2**	C	**3**	A	**4**	A

10.1 COMPOSITION OF ATMOSPHERE

1	A	**2**	C	**3**	A	**4**	A

10.2 AIR POLLUTANTS

1	A	**2**	B	**3**	B	4	A	5	A
6	A	**7**	A	**8**	B	9	C	10	D
11	C								

10.3 ACID RAIN

1	B	**2**	C	**3**	A	**4**	D

10.4 GLOBAL WARMING (GREENHOUSE EFFECT)

1	A	**2**	B	**3**	A	**4**	B
5	A	**6**	C	**7**	D	**8**	C

10.5 STRATEGIES TO REDUCE ENVIRONMENTAL ISSUES

1	A	**2**	A	**3**	D	**4**	D

EXERCISE SOLUTION
MULTIPLE CHOICE QUESTIONS

Tick (V) the correct answer.

1. Which gases are responsible for greenhouse effect?
(A) SO_2, NO2 (B) NO_2, CO
(C) CO_2, CH_4 (D) O_2, N_2

2. Indicate the source of sulphur which is responsible for the presence of oxides of sulphur in the atmosphere.
(A) Decomposition of vegetation
(B) Waste gases from digestion of animals
(C) Photochemical of smog
(D) Combustion of fossil fuels

3. Concentration of which gas in the atmosphere is decreased by photosynthesis in plants
(A) Oxygen (B) Nitrogen
(C) Carbon dioxide (D) Water vapour

4. Which substance remains unaffected in the catalytic converter fixed in the exhaust of the automobiles?
(A) CO_2 (B) CO
(C) NO (D) NO_2

5. People of which age groups are the most affected by the air pollution?
(A) Young adults
(B) Middle age people
(C) Children
(D) Both children and aged people

6. In which area there is a greater possibility of acid rain?
(A) Around village (B) Around big cities
(C) Around industrial area (D) Around water bodies

7. Why is smog not felt in summer?
(A) Because fog is not present in summer
(B) Because due to heat of the earth the smoke rises up
(C) Because in summer smoke and fog cannot mix with each other
(D) Because less fossil fuels are burnt in summer

8. Which catalyst is used in the catalytic converter fixed in the exhaust systems of automobiles?
(A) Ni **(B) Cu** **(C)** Pt, Pd and Rh (D) CaO

9. Which components are essential for the formation of photochemical smog?
(A) CO, NO_2, CO_2
(B) NO_2, volatile organic compounds, sunlight
(C) CO_2 NO_2, sunlight
(D) Volatile organic compounds, NO_2, CO

10. Which gases contribute towards the formation of acid rain?
(A) Oxides of carbon (B) Oxides of sulphur
(B) Oxides of nitrogen (D) Both the oxides of nitrogen and sulphur

ANSWER KEY

1	C	**2**	D	**3**	B	**4**	A	**5**	D

6	C	7	C	8	C	9	C	10	D

QUESTIOS FOR SHORT ANSWERS

4. Questions for Short Answers.

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

Ans:

OBJECTIVE OF ENVIRONMENTAL EDUCATION

The main objective of environmental chemistry is to enlighten the people. Particularly the students, about the importance of protection and conservation of our environment.

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

Ans:

RELEASE OF PARTICULATE MATTER

Particulate matter is released into the atmosphere through direct emissions from various sources like:

- combustion processes (burning of fuels)
- industrial activities
- dust from unpaved roads
- construction sites
- forest fires
- agricultural processes etc

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

Ans:

MORE POISONOUS GAS

CO is more poisonous than CO_2 because CO combines with hemoglobin of blood and reduces the oxygen supply of blood.

Q.4 How does acid rain affect forests?

Ans:

EFFECT OF ACID RAIN ON FORESTS

Acid rain significantly damages forests by leaching essential nutrients like calcium and magnesium from the soil. Thus it becomes difficult for trees to absorb water and release toxic aluminum into the soil. Plants become weak and susceptible to diseases.

Q.5 In what way sulphur present in fossil fuels becomes dangerous?

Ans:

SULPHUR IN FOSSIL FUELS AS DANGEROUS

The sulphur present in fossil fuels is dangerous because when burning of fossil fuels produces oxides of sulphur (SO_2 and SO_3) which cause acid rain, respiratory problems in human beings and other infectious diseases.

Q.6 Name any three major sources responsible for the greenhouse effect.

Ans:

SOURCES OF GREENHOUSE EFFECT

The three major sources responsible for the greenhouse effect are as follows:

carbon dioxide
methane
nitrous oxide
water vapor

Q.7 How is geothermal energy useful for us?

Ans:

USE OF GEOTHERMAL ENERGY

Geothermal energy is useful for us because it provides a renewable and clean source of heat which can be used directly for heating the buildings and other applications. It can also be converted into electricity.

CONSTRUCTED RESPONSE QUESTIONS

2. Constructed Response Questions

Q.1 How is the excessive use of insecticides and pesticides harmful for birds?

Ans:

HARM OF INSECTICIDES AND PESTICIDES

Excessive use of insecticides and pesticides is harmful for birds in the following ways:

- Endocrine disruption
- Reduced mobility
- Behavioral changes
- Compromised immune systems
- Reduced chick survival

- Loss of safe habitat
- Population decline
- Lethal poisoning
- Weight loss

Q.2 Percentage of CO_2 in air is only 0.03%. Then how does it become harmful for the ecosystem?

Ans: **HARM OF CO_2 FOR ECOSYSTEM**

It acts as a greenhouse gas and traps heat from the sun. Thus it warms the planet significantly when its concentration increases due to burning fossil fuels. The greenhouse effect causes the climate change and results in severe consequences like rising sea levels, extreme weather conditions and becomes harmful for ecosystems.

Q.3 Why only some pollutant gases present in the atmosphere cause greenhouse effect while others do not?

Ans: **SOME GASES CAUSE GREEN HOUSE EFFECT**

Only some pollutant gases present in the atmosphere cause greenhouse effect while others do not because some gases have the specific chemical structure due to which they can absorb infrared radiations, effectively and thus trap heat.

Q.4 How can you reduce the emission of CO present in the gases emitted by the burning of fuel in the automobile engines?

Ans: **TO REDUCE EMISSION OF CO**

To reduce the emission of carbon monoxide (CO) present in the gases emitted by the burning of fuel in the automobile engines, the most effective method is to install and maintain a catalytic converter. Catalytic converter chemically reacts with the exhaust gases to convert CO into carbon dioxide (CO_2).

Q.5 Mention three different ways in which solar energy can be useful for us.

Ans: **USE OF SOLAR ENERGY**

Following are three different ways in which solar energy can be useful for us.

- powering homes with photovoltaic panels which generate electricity
- heating water with solar thermal collector
- using solar ovens for cooking food

DESCRIPTIVE QUESTIONS

3. Descriptive Questions.

Q.1 Describe the harmful effects of the major pollutants present in the air.

Ans: Answer given on page # 259, 260

Q.2 Explain greenhouse effect. How is global warming dangerous for us?

Ans: Answer given on page # 267, 268, 269

Q.3 What is air quality index? What information does it convey?

Ans: Answer given on page # 274

Q.4 Who are at high-risk groups and why is pollution more dangerous for them?

Ans: Answer given on page # 274

Q.5 Describe three strategies to address environmental issues.

Ans: Answer given on page # 273

INVESTIGATIVE QUESTIONS

4. Investigative Questions

Q.1 Major Pakistani cities experience a very high AQI in winter which renders them the most polluted cities in the world. Point out some of the major causes of high AQI in these cities.

Ans: **MAJOR CAUSES OF HIGH AQI IN PAKISTANI CITIES**

Major causes of high AQI in Pakistani cities are as follows:

- Pollution due to vehicles
- Burning of remains of crops in the winter months

Q.2 Why does AQI not rise in Pakistan in hot days of summer?

Ans: **AQ IN PAKISTAN IN SUMMER**

AQI not rise in Pakistan in hot days of summer due to extreme heat and stagnant air. The heat waves increase the amount of ozone pollution and particulate pollution.

Q.3 How has climate change affected Pakistan during the last five years?

Ans: **EFFECT OF CLIMATE CHANGE ON PAKISTAN**

During the last five years, climate change has significantly affected the Pakistan.

Major Effects due to Climate Change

Climate change has caused:

- Intense extreme weather events like devastating floods, heatwaves, droughts, and erratic monsoon rains.
- It has caused damage to infrastructure, agriculture, and livelihoods.
- Millions of people have been displaced.

Example

2022 floods is an important example of devastating.

- Pakistan has become one of the most vulnerable countries to climate change due to changing rainfall patterns and glacier melt.

TERMS TO KNOW

Terms	Definitions
Atmosphere	Earth is covered with a blanket of air called atmosphere which is made up of several layers of gases
Pollutant	Any substance in the air which has an adverse effect on human health, quality of life and natural functioning of the ecosystem is called a pollutant.
Main Pollutants in Air	Oxides of carbon nitrogen and sulphur along with methane and particulate matter are the main pollutants in the air.
Major sources of pollutants	Major sources of pollutants are due to human activities especially the burning of fossil fuels.
Effects of Pollutants	Pollutants have extremely adverse and harmful effects not only on the human beings but on the whole ecosystem.
Formation of Acid Rain	Acid rain is formed due to the presence of oxides of nitrogen and sulphur when they are mixed with the moisture present in the atmosphere.
Green House Effect	The progressive Warming of Earth's surface due to blanketing effect of C02, CH4 and other gases present in the atmosphere •is called greenhouse effect. This effect has increased the temperature of the Earth.
Ways to Reduce Pollution	Every effort should be made to reduce the harmful effects of the-pollutants. These efforts include discouraging the use of fossil fuels, planting trees and using the renewables out of energy.
Precautions to Reduce Pollution	Steps should be taken to avoid the harmful effects of pollution especially on the people who are at higher risk.