

Exercise A

1. Define the terms: (i) pollution, (ii) pollutant, (iii) air pollution

- (1) Pollution – Pollution may be defined as contamination of air, water or soil by undesirable amounts of materials or heat and is caused by the concentration of substances which have harmful effects.
- (2) Pollutant – Toxic and otherwise harmful substances which have an undesirable impact on different components of the environment and life forms are known as pollutants.
- (3) air pollution – Air pollution means degradation of air quality due to concentration of harmful contaminants which affect human, plant and animal lives.

2. Name any four gaseous pollutants.

Sulphur dioxide, hydrogen sulphide, carbon monoxide and hydrocarbons

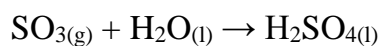
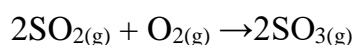
3. Name the compounds of sulphur that cause air pollution. Also state the harmful effects of sulphur compounds.

Compounds of sulphur like sulphur dioxide, sulphur trioxide and hydrogen sulphide are pollutants.

Harmful effects of oxides of sulphur:

- (a) It causes headache, vomiting and even death due to respiratory failure.
- (b) It destroys vegetation and weakens building materials/constructions.
- (c) It mixes with smoke and fog to form smog, which is very harmful.

It is oxidised by atmospheric oxygen into sulphur trioxide (SO₃) which combines with water to form sulphuric acid.



4. State:

(i) natural sources of air pollution,

Volcanoes, decaying vegetation, forest fires and dust storms

(ii) man-made sources of air pollution.

Automobiles, factories, industrial processes and decay of crop residue in rural areas

5. (a) How do oxides of nitrogen enter the atmosphere?

Oxides of nitrogen enter the atmosphere in the following ways:

- (1) On burning of fuels in furnaces, the temperature increases. At high temperature, nitrogen and oxygen present in the air combine to form oxides of nitrogen.
- (2) Oxides of nitrogen are produced during the burning of fuel in an internal combustion engine. They enter the atmosphere as exhaust gases.
- (3) During thunderstorms, nitric oxide is formed by the reaction between atmospheric nitrogen and oxygen in the presence of electric discharge.
- (4) Nitric oxide further reacts with atmospheric oxygen and ozone to form nitrogen dioxide.

(b) What are their harmful effects?

Harmful effects of the oxide of nitrogen:

- (1) Nitrogen dioxide is very harmful to plants and animals.
- (2) It causes irritation in the mucous membrane.
- (3) Large concentrations of NO₂ may cause serious lung diseases.
- (4) Nitrogen dioxide causes serious injury to vegetation; it damages plant leaves.
- (5) In sunlight, nitrogen dioxide oxidises hydrocarbons to form photochemical smog.
Photochemical smog causes eye irritation, asthma attacks and nasal and throat infections.

6. State the origin and health impact of smog.

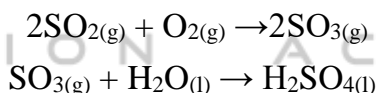
Smog is a dark, thick, dust and soot-laden fog pollutant which is a combination of oxides of nitrogen and sulphur and of partially oxidised hydrocarbons and their derivatives produced by industries and automobiles. Smog is noxious and irritating. It reduces visibility, induces respiratory troubles and can cause death by suffocation.

7. What are the harmful effects of oxides of sulphur?

Harmful effects of oxides of sulphur:

- (1) It causes headache, vomiting and even death due to respiratory failure.
- (2) It destroys vegetation and weakens building materials/constructions.
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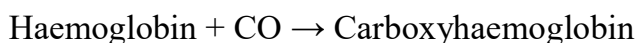


8. State the main sources and effects of carbon monoxide.

Carbon monoxide is formed by incomplete combustion of fuels in homes, factories and automobiles.

Effects of carbon monoxide are as follows:

- (1) It is a highly poisonous gas.
- (2) It reduces the oxygen-carrying capacity of blood by an amount equivalent to the amount of haemoglobin converted to carboxy haemoglobin.
- (3) It reduces the oxygen-carrying capacity of blood by an amount equivalent to the amount of haemoglobin converted to carboxyhaemoglobin.

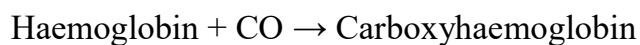


- (4) Because heart and brain are the two tissues most sensitive to oxygen depletion, they show the most serious effects of carbon monoxide exposure.
- (5) In high concentrations, carbon monoxide may kill by paralysing normal brain action.

9. Give the mechanism of the action of carbon monoxide.

It is a highly poisonous gas. When inhaled, it passes through the lungs directly into the blood stream. There it combines with haemoglobin, the substance which carries oxygen to body tissues. Because

haemoglobin binds with carbon monoxide 200 times more strongly than oxygen, even low concentrations of carbon monoxide in air have magnified effects on the body. It reduces the oxygen-carrying capacity of blood by an amount equivalent to the amount of haemoglobin converted to carboxyhaemoglobin.



10. How can we control carbon monoxide poisoning?

Carbon monoxide pollution can be controlled in the following ways:

- (1) By switching over from internal combustion engines to electrically powered cars.
- (2) Although the latter would transfer source of pollution to power companies, it is easy to control the pollution created by power companies
- (3) Many pollution Control devices are now installed in cars. Most of these devices help reduce pollution by burning gasoline completely. Complete combustion of gasoline produces only carbon dioxide and water vapour
- (4) By using substitute fuels for gasoline: Natural gas in both compressed(CNG) and liquefied forms(LNG)is now increasingly being used as fuel. Alcohols are other feasible substitutes
- (5) By using catalytic convertors Nitrogen oxide is reduced to nitrogen and oxygen in the presence of finely divided platinum or palladium as catalyst.

Exercise B

1. Why does rain water have pH less than 7?

Carbon dioxide reacts with water to form weak carbonic acid which is slightly acidic having pH about 5.6. Hence, the pH of rain water usually ranges between 5.6 and 3.5; at times, it can be as low as 2.

2. pH of acid rain is sometimes as low as 2. Explain.

Normal rain is only slightly acidic having pH about 5.6. This is because carbon dioxide reacts with it to form weak carbonic acid.

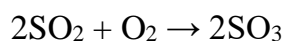
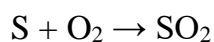


pH of acid rain usually ranges between 5.6 and 3.5; at times, it can be as low as 2.

3. Explain the formation of acid rain due to: (i) Oxides of sulphur, (ii) Oxides of nitrogen:

(i) *Oxides of sulphur:*

Sulphur is a non-metallic element found in coal and fuel oil. When these fuels are burned, sulphur combines with oxygen in the air to form its gaseous oxides, sulphur dioxide (SO₂) and sulphur trioxide (SO₃).



Sulphur dioxide and sulphur trioxide react with water to form H₂SO₄ which is the main cause of acid rain.

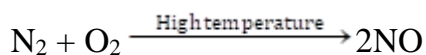




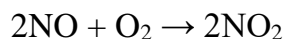
(ii) *Oxides of nitrogen:*

Oxides of nitrogen:

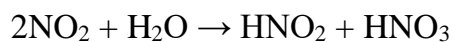
Nitric acid is formed by the combination of nitrogen and oxygen. Nitrogen and oxygen combine in the presence of thunder and lightning. Oxides of nitrogen are also produced by internal combustion engines.



Nitrogen oxide then gets oxidised in the atmosphere to nitrogen dioxide.



Nitrogen dioxide combines with water to form a mixture of nitrous acid and nitric acid.



4. What are the causes of acid rain?

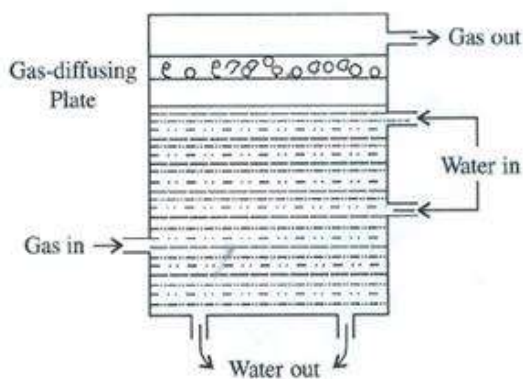
The main causes of acid rain are the formation of mineral acids such as carbonic acid, nitric acid and sulphuric acid during rains.

5. Give the impact of acid rain: (i) on plants, (ii) on soil, (iii) on water bodies.

- (1) Acid rain causes loss of nutrients from plants, thus damaging their leaves.
- (2) It removes calcium and potassium (elements of soil), thus making it lose its fertility which ultimately damages forests.
- (3) Acid rain has serious ecological impacts as it affects water bodies too. Water in lakes and rivers is gradually becoming acidic due to acid rain. This adversely affects aquatic life.

6. How does a scrubber help in reducing the formation of acid rain?

A scrubber can also be used to reduce the formation of acid rain. It is a device which absorbs gaseous pollutants. It is used for removing sulphur dioxide from a smoke stack, and usually consists of a fine spray of water and gas rising from the stack, which is passed through the scrubber where water absorbs sulphur dioxide.



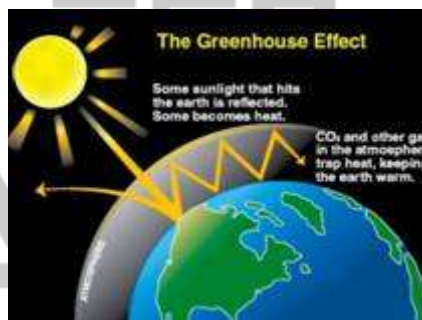
Exercise C

1. What do you understand by Green House effect?

Heating of the Earth and its environment due to solar radiation trapped by carbon dioxide and water vapour in the atmosphere is called greenhouse effect.

2. What are greenhouse gases? How are they responsible for global warming?

Gases which contribute to the greenhouse effect are called greenhouse gases. These gases are carbon dioxide, water vapour, oxides of nitrogen, methane, ozone and chlorofluorocarbons. Sunlight reaching Earth consists of three types of radiation-UV radiation, visible radiation and IR radiation. As sunlight passes through the atmosphere, most UV radiation is absorbed by ozone; 30% of IR radiation reaches the Earth's surface, heating it up. As the Earth's surface becomes hot, it starts emitting radiation with less energy than the incoming radiation and thus with longer wavelength. Some emitted IR radiation escapes from the Earth's surface and some are absorbed by CO₂, thus remaining on the Earth. Trapped radiation warms the Earth's surface and lower layers of the atmosphere.



3. State the sources and effects of the following gases: (i) Carbon dioxide, (ii) Methane, (iii) Water vapour

(1) Carbon dioxide:

- (a) Sources of carbon dioxide: Burning of fossil fuels such as coal, natural gas and petroleum, Industrial processes such as manufacture of lime and those in fermentation units, Biological decay of plants, Respiration by animals, human beings and plants
- (b) Effects of carbon dioxide: Greenhouse effect and global warming.

(2) Methane

- (a) Sources of methane: Anaerobic decomposition of organic matter in soil, water and sediments, Incomplete combustion of fossil fuels
- (b) Effects of methane: Greenhouse effect and global warming.

(3) Water vapour:

- (a) Sources of water vapour: Burning of hydrocarbons, Evaporation and transpiration
- (b) Effects of water vapour: Greenhouse effect and global warming.

4. State the ways of reducing the presence of green house gases.

- (1) Minimise the use of automobiles: Depending on the situation, one can use a bicycle, the public transport system and car pools.
- (2) Plant more trees to increase green cover.

- (3) Avoid burning of dry leaves and wood.
- (4) Avoid smoking. It is illegal to smoke in public places and work places, because smoke is harmful not only for the one who is smoking but also for others sitting nearby.
- (5) Help people in understanding global warming; most people are unaware of it.

5. State the effects of greenhouse gases on the atmosphere.

- (1) Rise in sea level: Due to global warming, glaciers and polar ice caps have started to melt, and gradually this may lead to an increase in the sea level. This will in turn flood several coastal areas in countries such as India, Bangladesh, the Netherlands and the Maldives.
- (2) Global warming will cause more water to evaporate from water bodies, thus forming more water vapour. Because water vapour also contributes to the greenhouse effect, global warming will further increase.
- (3) Global warming can lead to changes in the rain pattern and thus shift in crop zones. For example, wheat-producing zones will shift from Russia and Canada to the less fertile polar regions.
- (4) Change in rain pattern due to global warming will affect trees and plants in forests which are natural habitats of wild life. With destruction of forests, many species of wild life will also begin to die out.

6. State the role of a green house in growing plants.

A greenhouse collects light and converts it to heat. It also stores thermal energy and helps moderate temperature and produces a controlled environment for plants to grow and thrive. It even offers protection from wind, rain, snow and other weather elements and protects fruits from invading pests and animals.

7. Our atmosphere acts as a green house. Explain.

Our atmosphere contains greenhouse gases such as CO_2 , water vapour, O_3 , CH_4 , oxides of nitrogen and CFCs and allows the sunrays to come in. Sunlight reaching the Earth consists of three types of radiation-UV, visible and IR radiation. As sunlight passes through the atmosphere, most UV radiation is absorbed by ozone; 30% of IR radiation reaches the Earth's surface, heating it up. As the Earth's surface becomes hot, it starts emitting radiation with less energy than the incoming radiation and thus with longer wavelength. Some emitted IR radiation escapes from the Earth's surface and some are absorbed by CO_2 , thus remaining on the Earth. Trapped radiation warms the Earth's surface and lower layers of the atmosphere.

8. How can we reduce global warming?

- (1) Minimise the use of automobiles: Depending on the situation, one can use a bicycle, the public transport system and car pools.
- (2) Plant more trees to increase green cover.
- (3) Avoid burning of dry leaves and wood.
- (4) Help people in understanding global warming; most people are unaware of it.

(5) Avoid smoking. It is illegal to smoke in public places and work places, because smoke is harmful not only for the one who is smoking but also for others sitting nearby.

Exercise D

1. What is a pollutant?

Toxic and otherwise harmful substances which have an undesirable impact on different components of the environment and life forms are known as pollutants.

2. What is the effect of the following pollutants on living beings (one in each case)?

(a) Fluorides, (b) Smoke particles, (c) Lead, (d) Mercury compounds, (e) Smog, (f) Nitrogen oxide

(a) Fluorides – Fluorides cause destruction of vegetation and affect teeth and bones.

(b) Smoke particles – Smoke particles cause asthma and other lung diseases.

(c) Lead – Lead impairs the body's metabolic activities.

(d) Mercury compounds – They cause disease like Minamata commonly found in fishermen.

(e) Smog – Smog reduces visibility and induces respiratory troubles.

(f) Nitrogen oxide – Nitrogen dioxide causes death of many animals.

3. What is air pollution? How does this pollution take place?

Deterioration of air quality around us is called air pollution. Air pollution occurs because of the presence of gaseous pollutants such as oxides of sulphur, hydrocarbons, smoke, oxides of carbon, oxides of nitrogen, dust and particulate pollutants such as mist, spray and fumes.

4. What are the components of clean, dry air?

Pure Air Components	By Volume (% Proportion)	Concentration (ppm)
Nitrogen	78.09	780900
Oxygen	20.94	209400
<u>Inert gases</u>		
Argon	0.93	9300
Neon		18
Helium		5
Krypton		1
Xenon		1
Carbon dioxide	0.03	315
Methane		1
Hydrogen		0.5
<u>Natural pollutants</u>		
Oxides of Nitrogen		0.52
Ozone		0.52

5. Name some particulate pollutants.

Particulate pollutants are dust, smoke, mist, spray and fumes

6. Why is cigarette-smoking harmful?

Cigarette smoking is harmful not only for the one who is smoking but also for those sitting nearby, and so one should avoid smoking. Tobacco smoke causes lung cancer and asthma.

7. What is smog? State its damaging effects.

A combination of oxides of nitrogen and sulphur, partially oxidised hydrocarbons and their derivatives produced by industries and automobiles form a dark, thick dust and soot-laden fog known as smog. Damaging effect: Smog is noxious and irritating. It reduces visibility, induces respiratory troubles and can cause death by suffocation. Photochemical smog: Damages the tissues of certain plants and even decreases the yield of citrus fruits and grapes.

8. What do you understand by ppm?

ppm is parts per million, i.e. share in 1,000,000.

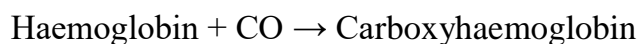
9. Describe the major air pollutants. How does carbon monoxide pollute our environment?

Major air pollutants: Carbon monoxide, carbon dioxide, chlorofluorocarbons, lead, ozone, oxides of nitrogen, sulphur dioxide, suspended particulate matter

Carbon monoxide is a highly poisonous gas.

When inhaled, it passes through the lungs directly into the blood stream. There it combines with haemoglobin, the substance which carries oxygen to body tissues. Because haemoglobin binds with carbon monoxide more than 200 times more strongly than oxygen, even low concentrations of carbon monoxide in air have magnified effects on the body.

It reduces the oxygen-carrying capacity of blood by an amount equivalent to the amount of haemoglobin converted to carboxyhaemoglobin.



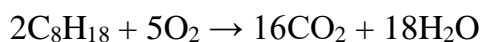
Because the heart and brain are two organs most sensitive to oxygen depletion, they show the most serious effects of carbon monoxide exposure.

In high concentration, carbon monoxide may kill by paralysing normal brain action

10. How do you propose to control: (a) carbon monoxide emission, (b) SO_x emission

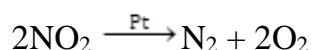
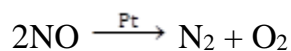
(a) Carbon monoxide pollution can be controlled in the following ways:

- (i) By switching over from internal combustion engines to electrically powered cars.
- (ii) Many pollution control devices are now installed in cars. Most of these devices help reduce pollution by burning gasoline completely. Complete combustion of gasoline produces only carbon dioxide and water vapour.

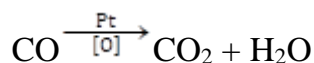


- (iii) By using substitute fuels for gasoline: Natural gas [both compressed (CNG) and liquefied (LNG)] is now increasingly being used as fuel. Alcohols are other feasible substitutes.

- (iv) By using catalytic convertors, Nitrogen oxide is reduced to nitrogen and oxygen in the presence of finely divided platinum or palladium as a catalyst.



- (v) Carbon monoxide changes to carbon dioxide in the presence of finely divided platinum as a catalyst.



- (b) SO_x of sulphur emission:

- (i) By using coal or oil which has low sulphur content.
- (ii) By using a scrubber, a device which absorbs gaseous pollutants.

11. Give the composition, causes and effects of acid rain.

Composition:

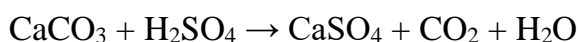
When oxides of sulphur and nitrogen of air come in contact with water of rain, they form corresponding acids and constitute acid rain.

Causes of acid rain:

The cause of acid rain is the formation of mineral acids such as nitric acid, sulphuric acid and carbonic acid.

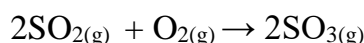
Effects of acid rain:

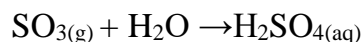
- (1) Acid rain removes or leaches away elements in soil such as calcium and potassium, and soil thus loses its fertility. In this way, it damages forests.
- (2) It makes water in lakes and rivers acidic and may no longer support aquatic life.
- (3) Acid rain causes extensive damage to buildings and monuments or marble, limestone, slate and mortar. These materials become pitted and weakened mechanically. The Taj Mahal is one such example.
- (4) Acid rain causes extensive damage to buildings and monuments or marble, limestone, slate and mortar. These materials become pitted and weakened mechanically. The Taj Mahal is one such example.



12. Explain the effect of sulphur dioxide on the atmosphere.

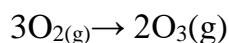
- (1) It causes headache, vomiting and even death due to respiratory failure.
- (2) It destroys vegetation and weakens building materials/constructions.
- (3) It mixes with smoke and fog to form smog, which is very harmful.
- (4) It is oxidised by atmospheric oxygen into sulphur trioxide (SO_3) which combines with water to form sulphuric acid (H_2SO_4). Sulphuric acid is the cause of acid rain.





13. Explain the formation of ozone in the atmosphere.

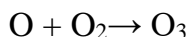
In the atmosphere, ozone is formed by the action of ultraviolet rays of the Sun on oxygen.



High-energy UV radiation break oxygen molecules into oxygen atoms.



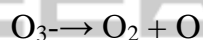
Oxygen atom reacts with oxygen molecule to form ozone.



Net reaction is $2\text{O}_2 + \text{Far UV} \rightarrow 2\text{O}_3$

14. What is the function of ozone in the atmosphere?

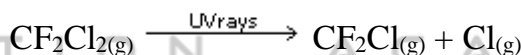
The ozone layer acts as a blanket in the atmosphere by absorbing harmful UV rays coming from the Sun and prevents them from reaching Earth. Ozone absorbs UV radiation of comparatively longer wavelength forming oxygen molecule and oxygen atom.



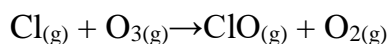
Thus, the ozone layer protects life on Earth from the harmful effects of ultraviolet rays which can cause skin cancer and destroy many organic species necessary for life.

15. State the chemicals responsible for ozone layer destruction.

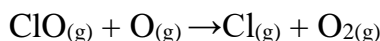
(1) Excessive use of CFCs – CFCs enter the atmosphere because of their excessive use in solvents, aerosol sprays, propellants, refrigerants and blowing agents for plastic foams. CFCs are decomposed by UV rays to highly reactive chlorine which is produced in the atomic form.



This free radical [Cl] reacts with ozone, and chlorine monoxide is formed.

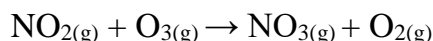
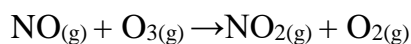


This causes depletion of ozone, and chlorine monoxide further reacts with atomic oxygen to produce more free radicals of chlorine.



Again this free radical [Cl] destroys ozone, and the process continues giving rise to large-scale ozone depletion.

(2) Fuel of planes – When the fuel of planes burns, a large quantity of nitric oxide and other gases is emitted in the atmosphere. Nitric oxide reacts with ozone to form nitrogen dioxide and nitrogen trioxide.



This also causes depletion of ozone.

16. Name any two: (a) natural sources of atmospheric pollution, (b) gases which are responsible for the formation of acid rain.

(a) Natural sources of atmospheric pollution – (i) Decay of plants and animals, (ii) Disintegration of rocks and soil

(b) SO₂ and NO₂ are gases responsible for acid rain.

17. Explain the term 'global warming'. State two ways by which global warming can be reduced.

Global warming is the increase in temperature of Earth due to enhanced concentration of greenhouse gases (CFCs) in the atmosphere.

Two ways to reduce global warming: (i) Plant more trees to increase green cover, (ii) Minimise the use of automobiles.

18. State two effects of ozone depletion.

(1) UV rays of the Sun reach Earth and cause sun burn, premature ageing of the skin and skin cancer

(2) UV radiation can also damage several parts of the eyes, including the lens, cornea, retina and conjunctiva.

19. What is the cause of acid rain? Give any two impacts of acid rain.

Causes: Sulphur and nitrogen oxides are emitted by burning fossil fuels. Such smoke and gases entering the atmosphere make a dilute soup of sulphuric and nitric acids. This falls on the land surface in the form of acid rain damaging the things on Earth.

Impacts: (i) Acid rain accelerates the decay of building materials and paints, including buildings, statues and sculptures which are part of our nation's culture and heritage. (ii) Acid rain causes respiratory problems in humans, especially for people suffering from asthma. It may cause throat irritation, dry cough and severe headache.

20. Explain the methods of preventing acid rain.

(1) By using coal or oil which has low sulphur content. This reduces the emission of oxides of sulphur and nitrogen responsible for acid rain.

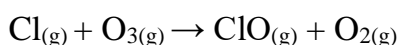
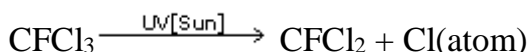
(2) By using a scrubber, a device which absorbs gaseous pollutants.

21. State an advantage of CNG (Compressed Natural Gas).

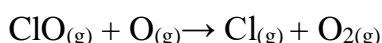
Using CNG causes less pollution. It does not contain lead, and it has low maintenance cost.

22. State how CFC break ozone layer.

CFC is broken by UV rays of sunlight to produce [Cl] atom or free radical [Cl] which is highly reactive in the atomic form and it forms ClO_(g) with O₂.



This depletes ozone. ClO further produces more [Cl] free radical and destroys more of O₃, thereby resulting in ozone depletion.



23. Describe the methods of saving ozone layer.

(1) Using alternative products such as HCFCs (hydrochlorofluorocarbons)

(2) Montreal Protocol, an international treaty, helps prevent ozone depletion.

24. Fill in the blanks:

- (1) The pollutants such as NO_2 , SO_2 and SO_3 dissolved in the moisture of air are the cause of _____. (*acid rain*)
- (2) Excessive release of carbon dioxide in the atmosphere is the cause of _____ effect which produces global warming. (*greenhouse*)
- (3) Ozone layer prevents the harmful _____ radiation of the sun to reach the earth. (*ultraviolet*)
- (4) Decrease of the concentration of ozone in the stratosphere is the cause of formation of _____ holes. (*ozone*)
- (5) Ozone depletion is mainly caused by the active _____ atoms generated from CFC in the presence of UV radiation. (*chlorine*)

25. Select the correct answer:

- (1) Excessive release of carbon dioxide in the atmosphere is the cause of
 - (a) Depletion of ozone,
 - (b) formation of polar vortex,
 - (c) global warming,
 - (d) formation of smog
- (2) Inhalation of air polluted with carbon monoxide is dangerous because
 - (a) CO combines with O_2 dissolved in blood,
 - (b) CO combines with haemoglobin of blood,
 - (c) CO removes water from the body and causes dehydration,
 - (d) CO causes coagulation of proteins in the body
- (3) Decrease of amount of ozone in stratosphere is called depletion of zone and it is caused by
 - (a) UV radiations of sun,
 - (b) Use of CFC compounds,
 - (c) excessive use of detergents,
 - (d) Use of polychlorinated biphenyls