

CHAPTER # 14

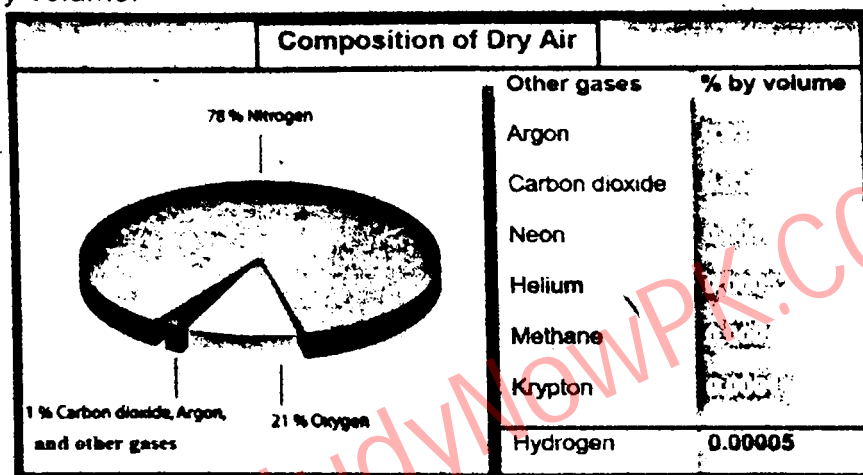
ENVIRONMENTAL CHEMISTRY-I:

THE ATMOSPHERE

Q1. Explain composition of atmosphere?

Ans: Composition of Atmosphere:

Air is a mixture of gases. The pie chart given below shows the composition of dry air by volume.



Q2. Define atmosphere.

Ans: Atmosphere:

The envelope of gases and water vapour surrounding the planet earth is called atmosphere.

Self-Assessment Exercise 14.1

1. What two gases make up most of the air?
2. Which gas has highest percentage in the air?
3. Which gas has lowest percentage in the air?
4. Why the percentage of water has not been mentioned in the pie chart?

Solution:

1. What two gases make up most of the air?
Nitrogen = 78 % and Oxygen = 21 %
2. Which gas has highest percentage in the air?
Nitrogen = 78 %
3. Which gas has lowest percentage in the air?
Hydrogen = 0.00005 %

Q3. Why the percentage of water has not been mentioned in the pie chart?
Besides gases, there are varying amount of water vapour in the air. There is little water in the air over the desert.

Whereas in the tropical rain forest, the air may contain up to 4% water vapour. This means the amount of water vapour in air varies from place to place and time to time.

That is why the percentage of water has not been mentioned in the pie chart.

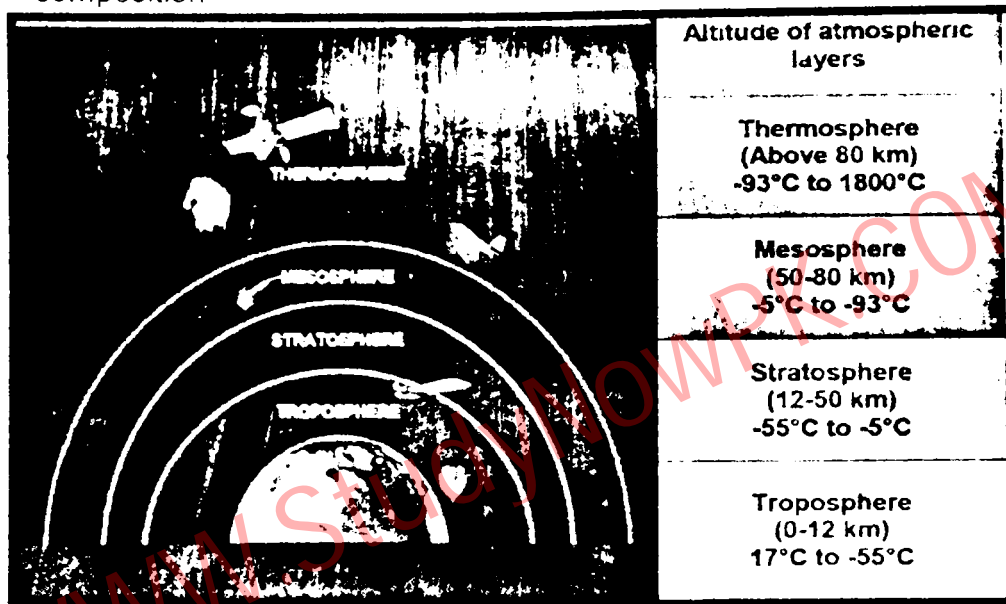
Q4. List the layers of atmosphere?

Ans: Layers of Atmosphere:

The atmosphere is divided into four layers:

- i. The troposphere
- ii. The stratosphere
- iii. The mesosphere
- iv. The thermosphere

Note: The thermosphere is further divided into the ionosphere and the exosphere. Each atmospheric layer has its own temperature and precise chemical composition.



Layers of Atmosphere

Q5. What is the height of the troposphere? What is the minimum and maximum temperature of this layer?

Ans: Height of the troposphere is 12 km. Minimum temperature of troposphere is -55 °C and maximum temperature is 17 °C

Q6. What is the height of the stratosphere? What are the minimum and the maximum temperature of this layer?

Ans: Height of the stratosphere is 50 km. Minimum temperature of stratosphere is -55 °C and maximum temperature is -5 °C.

Q7. Explain temperature variation in mesosphere. List the components of mesosphere.

Ans: The Mesosphere:

The mesosphere extends from the top of stratosphere to about 80 km from the earth's surface. Meso- means "middle" so the mesosphere is the middle layer of the atmosphere. Above the stratosphere, a drop in temperature is observed. In the outer mesosphere, temperature approaches -93°C. This layer protects Earth's surface from being hit by most meteoroids.

Q8. Explain temperature variation in thermosphere. List the components of thermosphere.

Ans: Thermosphere:

The outermost layer of atmosphere is the thermosphere. It extends from 80 km above Earth's surface outward into space. Thermo- means heat. This layer is very hot up to 1800°C. This is because sunlight strikes the thermosphere first. Oxygen and nitrogen molecules convert this energy into heat.

Layers of thermosphere:

The thermosphere is divided into two layers.

i. Ionosphere:

The lower layer called the ionosphere extends from 80 km to 400 km above the surface of Earth.

ii. Exosphere:

The outer layer of thermosphere is the exosphere. It extends from 400 km to thousands of kilometers from Earth's surface.

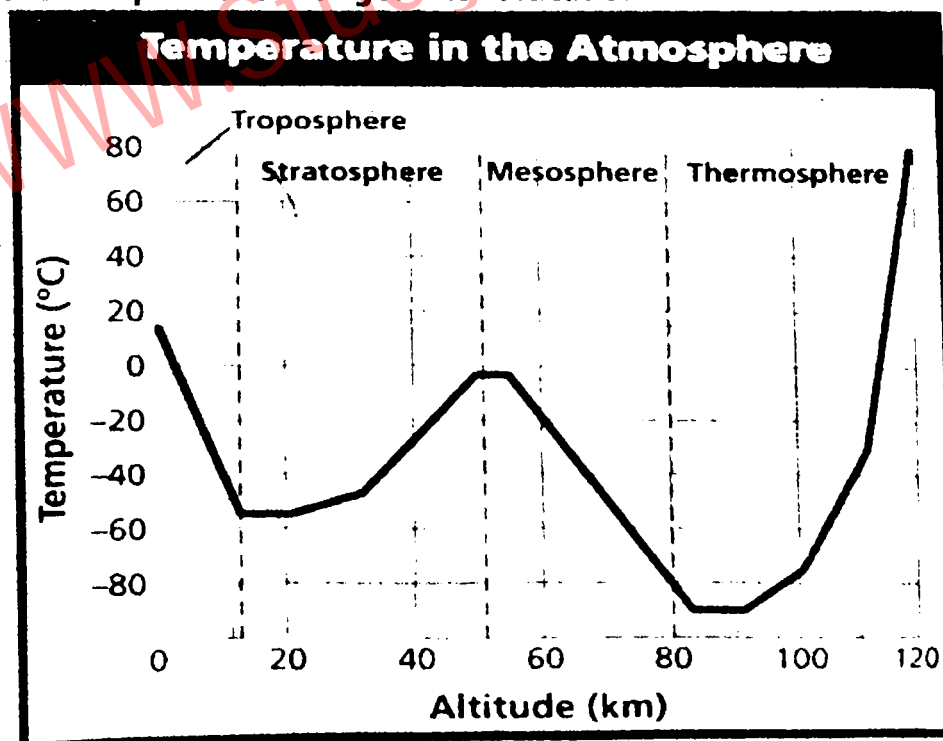
DO YOU KNOW?

Aurora Borealis:

In the northern hemisphere, brilliant light displays, such as shown in the figure occur in the ionosphere.

These light displays are called aurora borealis. Auroras are caused by particles from the sun that enter the ionosphere near the poles. These particles strike atoms in the ionosphere, causing them to glow.

Q9. Activity 14.1: The following graph (figure 14.3) shows how the temperature changes with altitude?



Temperature variations in the troposphere and the stratosphere

Complete the following table.

Layer of atmosphere	Temperature (°C)	
	At the bottom	At the highest point
Troposphere	17 °C	-55 °C
Stratosphere	-55 °C	-5 °C

Self-Assessment Exercise 14.2

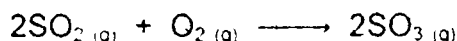
Describe how temperature changes as one moves from Earth's surface into the atmosphere up to 50 km?

Solution: 1 km increase in altitude = 6.5 °C cooler
 50 km increase in altitude = 6.5 °C × 50 = 325 °C cooler

Q10. Explain sources and effects of air pollutant sulphur oxides?

Ans: Sulphur Oxides (SO_x):

In the air sulphur dioxide is converted into sulphur trioxide, which is responsible for acid rain.



Sulphur dioxide is readily absorbed in the respiratory system. Being powerful irritant, it aggravates the symptoms of people who suffer from asthma, bronchitis, emphysema and other lung diseases.

Q11. You might have noticed that the colour of silk clothes fades away, if left in open air for a week or so. What due to it is?

Ans: Photodegradation:

The technical term for color fading is photodegradation. There are light absorbing color bodies called chromophores that are present in dyes. The color(s) we see are based upon these chemical bonds and the amount of light that is absorbed in a particular wavelength.

Ultraviolet rays can break down the chemical bonds and thus fade the color(s) in an object. It is a bleaching effect.

Self-Assessment Exercise 14.3

1. What are pollutants?
2. List some effects of sulphur dioxide on human beings.
3. List some of the air pollutants.

Solution:

1. What are pollutants?

Anything that is in the air, water or soil which has a harmful effect on some part of the environment is called pollutant.

2. List some effects of sulphur dioxide on human beings.

Sulphur dioxide is readily absorbed in the respiratory system. Being powerful irritant, it aggravates the symptoms of people who suffer from asthma, bronchitis, emphysema and other lung diseases.

3. List some of the air pollutants.

Important air pollutants are as follows:

- | | |
|---|---------------------|
| i. Sulphur Oxides (SO _x) | ii. Carbon Monoxide |
| iii. Nitrogen Oxides (NO _x) | iv. Methane |

- v. Chlorofluorocarbons (CFCs) vi. Lead Compounds
vii. Ozone

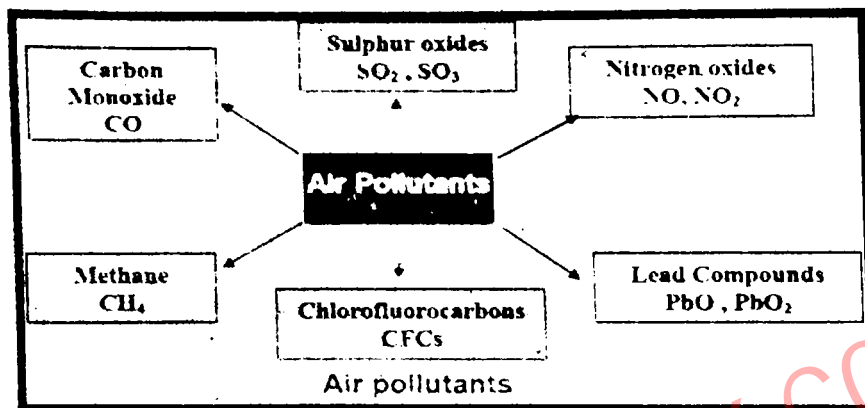
Q12. Explain sources and effects of air pollutant ozone?

Ans: Ozone:

Ozone is a light blue gas and has an unpleasant odour. In the troposphere, ozone causes breathing difficulties, asthma and eye irritation.

Q13. Draw flow diagram to represent air pollutants?

Ans:



Self-Assessment Exercise 14.4

- Write the names of main pollutants in the air.
- Complete the following reactions.
 - $\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow$
 - $\text{C}(\text{s}) + \text{O}_2(\text{g}) \longrightarrow$
 - $\text{CO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow$

Solution:

- Write the names of main pollutants in the air.

Important air pollutants are as follows:

- | | |
|--|---------------------|
| i. Sulphur Oxides (SO_x) | ii. Carbon Monoxide |
| iii. Nitrogen Oxides (NO_x) | iv. Methane |
| v. Chlorofluorocarbons (CFCs) | vi. Lead Compounds |
| vii. Ozone | |

- Complete the following reactions.

- $$\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow$$

$$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{SO}_3$$
- $$\text{C}(\text{s}) + \text{O}_2(\text{g}) \longrightarrow$$

$$2\text{C}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{CO}$$
- $$\text{CO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow$$

$$2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{CO}_2$$

Q14. Which gas is emitted by volcanoes?

Ans: The largest portion of gases released into the atmosphere is water vapor. Other gases include carbon dioxide (CO_2), sulfur dioxide (SO_2), hydrochloric acid (HCl), hydrogen fluoride (HF), hydrogen sulfide (H_2S), carbon monoxide (CO), hydrogen gas (H_2), NH_3 , methane (CH_4), and SiF_4 .

Self-Assessment Exercise 14.5

- Write three human activities that are responsible for air pollution.
- Write three natural processes that are contributing in air pollution.
- List main sources of the following air pollutants.
 - SO₂
 - CO
 - NO₂

Solution:

- Write three human activities that are responsible for air pollution.
Human activities that damage the environment:
 - Burning fossil fuel
 - Cutting trees
 - Use of Freon gas
- Write three natural processes that are contributing in air pollution.
Natural Sources:
 Many natural processes such as forest fires and dust storms release smoke and dust particles into the air. Volcanoes emit clouds of dust and poisonous gases along with ash. Termites and cows also release large amount of methane in the air. Considerable electrical discharges in the atmosphere produce nitrogen oxides.
- List main sources of the following air pollutants.
 - SO₂ Power stations and industries using fossil fuels.
 - CO Incomplete burning of wood, fuels and vehicle exhaust.
 - NO₂ Exhaust fumes of motor vehicles, power stations and industries using fossil fuels

Q15. Describe sources and harmful effects of air pollutants?

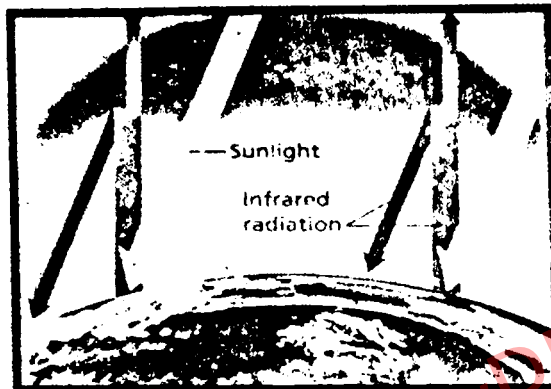
Ans: Effect produced by air pollutants:

Air pollutant	Physical properties	Sources	Harmful effects
Carbon monoxide (CO)	Colourless, odourless and poisonous gas	Incomplete burning of wood, fuels and vehicle exhaust.	Headache, brain damage, death
Sulphur dioxide (SO ₂)	Colourless gas with unpleasant and irritating odour	Power stations and industries using fossil fuels	Breathing difficulties, bronchitis, emphysema, lung cancer, acid rain and green house effect
Oxides of nitrogen (NO, NO ₂)	NO is colourless, odourless gas soluble in water. NO ₂ is reddish brown gas with pungent odour soluble in water. Both are highly toxic gases	Exhaust fumes of motor vehicles, power stations and industries using fossil fuels	Coughs, headaches lung diseases, acid rain and greenhouse effect (global warming)
CFCs chlorofluorocarbons	Colourless gases	Aerosol sprays foams, refrigerants, air-conditioning systems.	Green house effect (Global warming), thinning of ozone layer
Lead compounds	Poisonous solid particles	Exhaust fumes from motor vehicles	Brain damage, forest decline

Q16. What do you understand by green house gases?**Ans: Green house gases:**

The increasing use of fossil fuels and the deforestation have led to an increase in the levels of CO₂ in the air. Gases like water vapour, methane and CFCs also act in a similar way in the atmosphere. These gases are called green house gases. Molecules of these gases absorb much of the infrared radiation given out by the surface of earth. This increases their kinetic energy. So the atmosphere becomes hotter.

The higher the concentration of green house gases in the air, the greater is the green house effect, and greater will be the increase in temperature. The green-house effect is a natural phenomenon of the energy distribution mechanism of the earth.



Greenhouse effect

Q17. Certain human activity is threatening to cause a significant increase in the greenhouse effect. What are such activities?

Ans: Certain human activities add to the levels of most of these naturally occurring gases:

Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned.

Methane emissions result from the rise production, the decomposition of organic wastes in municipal solid waste landfills, and the raising of livestock. Methane also is emitted during the production and transport of coal, natural gas, and oil.

Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.

Greenhouse gases that are not naturally occurring include by products of foam production, refrigeration, and air conditioning called **chlorofluorocarbons (CFCs)**, as well as **hydrofluorocarbons (HFCs)** and **perfluorocarbons (PFCs)** generated by industrial processes.

DO YOU KNOW?**Green-houses:**

Green-houses are constructed from glass or transparent polymer films. Sun light can pass through these materials and is used by the plants for photosynthesis. The plants radiate some energy in the form of infrared or heat radiations which cannot pass through these materials and is reflected back. As a result the atmosphere inside the green-house becomes hot enough to promote plant growth. The temperature inside a greenhouse can be 10°C to 15°C higher than outside.

Self-Assessment Exercise 14.6

1. **Define global warming**
2. **List some effects of global warming**
3. **List some substances that are responsible for global warming.**

Solution: 1. **Define global warming:**

The warming of the atmosphere which is due to our influence on the greenhouse effect is known as global warming.

2. **List some effects of global warming**

Effects of global warming:

Global warming is due to an upset in the natural balance of the concentration of greenhouse gases in the atmosphere. If global warming continues, then

- Temperature of the earth will gradually increase.
- The earth climate may change, affecting both where there is rainfall and how much there is of it. This could cause both increased risks of flooding in some regions and drought in others.
- Polar ice may melt and cause significant increase in sea levels.
- So the atmosphere becomes hotter.

3. **List some substances that are responsible for global warming.**

The main causes of global warming, in order of the magnitude of their impact, are:

1. **Carbon Dioxide from:** i. Fossil Fuel ii. Deforestation

2. **Methane from:**

i. Cattle and Rice Paddies

3. **Nitrogen Oxides from Farming**

Nitrogen oxides have 300 times more heat-trapping capacity per unit of volume than does carbon dioxide, and we release them every time we apply fertilizer to soil.

4. **CFCs and HCFCs** (chlorofluorocarbons and hydrochlorofluorocarbons) used in refrigeration are also powerful greenhouse gases. These gases occur in lower concentrations in the atmosphere, but because they are so much more potent than carbon dioxide in some cases hundreds of times more potent per unit of volume they contribute to global warming as well.

Society, Technology and Science

Incineration:

Incineration is a waste treatment process in which solid waste is burned at high temperature. Incineration consumes all combustible materials, leaving behind ash residue and non-combustible material. This process generally reduces the volume of waste by two third, but it is not a clean process. It produces air pollution. It generates considerable smoke and odour. This smoke may contain oxides of nitrogen and sulphur.

Self-Assessment Exercise 14.7

1. **Define acid rain.**
2. **Write names of gases that cause acid rain.**

3. What is the effect of acid rain on iron and marble? Give balanced chemical equation.
4. List some effects caused by acid rain.

Solution:

1. Define acid rain.

Acid rain is defined as rain having pH less than 5.6.

2. Write names of gases that cause acid rain.

SO₂ and NO₂

3. What is the effect of acid rain on iron and marble? Give balanced chemical equation.

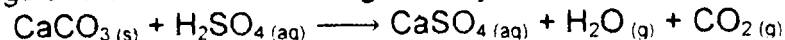
Sulphuric acid and metals:

Sulphuric acid eats away metals to form water soluble salts and hydrogen



Marble buildings and statues:

Marble buildings and statues are disintegrated by acid rain



4. List some effects caused by acid rain.

Acid rain corrodes metals, stone buildings and statues. Marble statues are slowly eroded by acid rain.

Society, Technology and Science

Catalytic converter:

A catalytic converter transforms CO into CO₂, NO into N₂ and O₂, and unburned hydrocarbons to CO₂ and H₂O. Metals like platinum, palladium and rhodium are used as catalyst in the converter. Government of Pakistan should direct car manufacturers to install catalytic converters in car exhaust system. Government should make strict laws in this regards.

Q18. Is chlorine free radical, a catalyst in the destruction of ozone?

Ans: Yes, chlorine free radical is a catalyst in the destruction of ozone.

Q19. Suggest reason for the presence of CO in the car's exhaust fumes.

Ans: Carbon monoxide consists of a single carbon atom and a single oxygen atom linked together (CO), and is the product of incomplete combustion of fuel. Most Carbon monoxide is produced when air-to-fuel ratios are too low in the engine during vehicle starting or when the vehicle is not tuned properly, and at higher altitudes, where thin air reduces the amount of oxygen available for combustion.

KEY POINTS

- i. **Atmosphere:** The envelope of gases and water vapour surrounding the planet earth is called atmosphere.
- ii. **Layers of atmosphere:** The atmosphere is divided into four layers, the troposphere, the stratosphere, the mesosphere and the thermosphere.

- iii. **Troposphere:** The atmospheric layer closest to the Earth's surface is called troposphere. Earth's weather occurs in this layer.
- iv. **Stratosphere:** The stratosphere is the second layer of the atmosphere and contains the ozone layer
- v. Each atmospheric layer has its own temperature and precise chemical composition.
- vi. **Pollutant:** Anything that is in the air, water or soil which has a harmful effect on some part of the environment is called pollutant.
- vii. Some air pollution occurs naturally. But many types of air pollution are the result of human activities.
- viii. **Methane:** Methane is produced when dead plant material decays in the absence of air.
- ix. Air that contains harmful particles and gases is said to be polluted.
- x. Ozone is produced when electrical discharges pass through oxygen in the air.
- xi. **Global warming:** The warming of the atmosphere which is due to our influence on the greenhouse effect is known as global warming.
- xii. **Acid rain:** Acid rain is defined as rain having pH less than 5.6.
- xiii. **Ozone:** Ozone is an allotropic form of oxygen comprising three oxygen atoms, O₃.
- xiv. Most of the ultraviolet (UV) radiations coming from sun are **filtered** or **screened** out by the ozone layer.
- xv. **Ozone hole:** The region in which the amount of ozone has been reduced is called as ozone hole.

REVIEW QUESTIONS

1. Select the correct answer.
 - i) Which gas has highest percentage in the air

A. O ₂	B. CO ₂
C. N ₂	D. O ₃
 - ii) Lowest temperature in stratosphere is

A. -5°C	B. -55°C
C. 5°C	D. 55°C
 - iii) Which is/are responsible for acid rain?

A. SO ₂	B. NO ₂
C. Both NO ₂ and SO ₂	D. O ₃
 - iv) Which is reddish brown gas?

A. NO	B. NO ₂
C. SO ₂	D. O ₃
 - v) Troposphere extends up to

A. 50 km	B. 12 km
C. 18 km	D. 80 km
 - vi) Stratosphere extends up to

A. 12 km	B. 15 km
C. 50 km	D. 80 km

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- iii. **Troposphere:** The atmospheric layer closest to the Earth's surface is called troposphere. Earth's weather occurs in this layer.
- iv. **Stratosphere:** The stratosphere is the second layer of the atmosphere and contains the ozone layer
- v. Each atmospheric layer has its own temperature and precise chemical composition.
- vi. **Pollutant:** Anything that is in the air, water or soil which has a harmful effect on some part of the environment is called pollutant.
- vii. Some air pollution occurs naturally. But many types of air pollution are the result of human activities.
- viii. **Methane:** Methane is produced when dead plant material decays in the absence of air.
- ix. Air that contains harmful particles and gases is said to be polluted.
- x. Ozone is produced when electrical discharges pass through oxygen in the air.
- xi. **Global warming:** The warming of the atmosphere which is due to our influence on the greenhouse effect is known as global warming.
- xii. **Acid rain:** Acid rain is defined as rain having pH less than 5.6.
- xiii. **Ozone:** Ozone is an allotropic form of oxygen comprising three oxygen atoms, O_3 .
- xiv. Most of the ultraviolet (UV) radiations coming from sun are **filtered** or **screened** out by the ozone layer.
- xv. **Ozone hole:** The region in which the amount of ozone has been reduced is called as ozone hole.

REVIEW QUESTIONS

1. Select the correct answer.
 - i) Which gas has highest percentage in the air

A. O_2	B. CO_2
C. N_2	D. O_3
 - ii) Lowest temperature in stratosphere is

A. $-5^\circ C$	B. $-55^\circ C$
C. $5^\circ C$	D. $55^\circ C$
 - iii) Which is/are responsible for acid rain?

A. SO_2	B. NO_2
C. Both NO_2 and SO_2	D. O_3
 - iv) Which is reddish brown gas?

A. NO	B. NO_2
C. SO_2	D. O_3
 - v) Troposphere extends up to

A. 50 km	B. 12 km
C. 18 km	D. 80 km
 - vi) Stratosphere extends up to

A. 12 km	B. 15 km
C. 50 km	D. 80 km

vii) The ozone layer is found in

- A. The troposphere
 B. The mesosphere
 C. The thermosphere
 D. The stratosphere

viii) Most air pollution is caused by

- A. Ozone
 B. Acid rain
 C. Carbon monoxide
 D. The burning of fossil fuels

ix) Which layer is closest to the Earth?

- A. The stratosphere
 B. The troposphere
 C. The mesosphere
 D. The thermosphere

x) The outermost layer of earth atmosphere is

- A. The mesosphere
 B. The stratosphere
 C. The troposphere
 D. The thermosphere

Answers

i. C	ii. B	iii. C	iv. B	v. B
vi. B	vii. D	viii. D	ix. B	x. D

2. Give short answer

i) List two main sources of acid rain.

Ans: Acid rain is caused mainly by the burning of fossil fuels such as coal and gasoline. Oxides of nitrogen and sulphur are released into the air when fossil fuels are burnt and when they mix with the precipitation in clouds acid rain is formed.

ii) List four human activities which contribute to air pollution.

- Ans:** i. Burning fossil fuel
 ii. Cutting trees
 iii. Use of Freon gas
 iv. Production of methane from dead plant material decay.

iii) What is the importance of stratospheric ozone?

Ans: Importance of stratospheric ozone:

Ozone saves us from harmful effects of incoming ultraviolet radiations from the sun. When ozone absorbs energy from the sun, the energy is converted into heat, warming the air. The ozone layer protects the living things on the Earth from dangerous ultraviolet radiation from the sun

iv) What is the role of automobile in air pollution?

Ans: Exhaust fumes of automobiles including dangerous gases such as carbon monoxide, oxides of nitrogen, hydrocarbons and particulates. These exhaust fumes of automobile are responsible for air pollution.

v) Define atmosphere.

Ans: Atmosphere: The envelope of gases and water vapour surrounding the planet earth is called atmosphere

3. Explain temperature variation in stratosphere and troposphere.

Ans: Temperature variation in stratosphere:

In the stratosphere, temperature varies from -55°C to -5°C

Temperature variation in troposphere:

As altitude increases in the troposphere, the temperature decreases from 17°C to about -55°C . On average, for every 1 km increase in altitude, the air gets about 6.5°C cooler.

4. List components of stratosphere and troposphere.**Ans: Component of stratosphere:**

This layer contains little water vapours. Interesting information about this layer is that it contains maximum amount of ozone (about 10ppm/parts per million). The presence of ozone is responsible for the rise in temperature in stratosphere.

Components of troposphere:

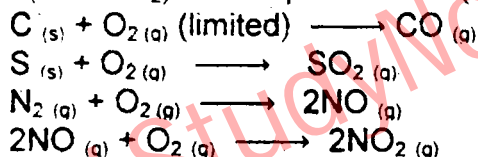
Nearly all the dust particles and water vapours are in the troposphere. Weather occurs in this layer. Most of the clouds are formed in the troposphere. Aircrafts fly in this region.

5. Describe sources of air pollutants.**Ans: Sources of Air Pollution:****i. Natural Sources:**

Many natural processes such as forest fires and dust storms release smoke and dust particles into the air. Volcanoes emit clouds of dust and poisonous gases along with ash. Termites and cows also release large amount of methane in the air. Considerable electrical discharges in the atmosphere produce nitrogen oxides.

ii. Human Activities:

Most of the air pollution is the result of burning fossil fuels, such as coal, petroleum and natural gas. Nearly half of the air pollution comes from cars and other motor vehicles. Factories and power plants that burn coal or oil release poisonous gases in the air. Burning fossil fuels and incineration release carbon monoxide (CO), nitrogen oxides (NO, NO₂) and sulphur oxides (SO₂, SO₃).

**Chlorofluorocarbons:**

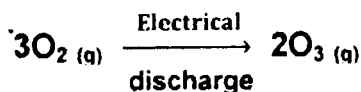
Chlorofluorocarbons have been widely used as solvents for cleaning electronic circuit boards, as refrigerant in fridges and air-conditioning units and as propellants in aerosol sprays (air fresheners, hairsprays, deodorants, spray paints). Such products are not "Environment friendly" During manufacture, in use and after disposal, these compounds escape into the air.

Lead particles:

Lead particles in the air come mainly due to the combustion of leaded petrol or fuel used in motor vehicles or from lead based paints.

Ozone:

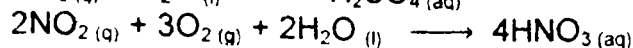
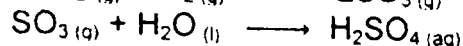
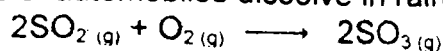
Ozone is produced when electrical discharges pass through oxygen in the air. You can feel its presence near photocopier, television set, microwave oven and other electrical equipment.

**6. Describe acid rain and its effects.****Ans: Acid Rain and Its Effects:**

Acid rain is defined as rain having pH less than 5.6.

Normal rain water is saturated with carbon dioxide. It has pH of 5.6 However; the acidity of rain greatly increases in polluted areas during thunderstorm.

Sulphur dioxide from power plants using fossil fuels and nitrogen oxides from exhaust fumes of automobiles dissolve in rain water producing acids.



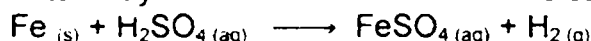
Therefore, during thunderstorm, the pH of rain water can be much lower because of sulphuric acid and nitric acids formed by lightening. This rain may have pH as low as 2.1. This value is lower than the pH of vinegar or lemon juice.

Effect of acid rain:

Acid rain may often fall hundreds of kilometer away from their sources. Acid rain corrodes metals, stone buildings and statues. Marble statues are slowly eroded by acid rain.

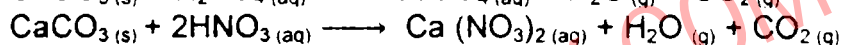
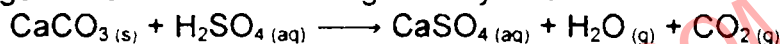
Sulphuric acid and metals:

Sulphuric acid eats away metals to form water soluble salts and hydrogen



Marble buildings and statues:

Marble buildings and statues are disintegrated by acid rain



Acid rain also kills fish, and destroys trees. Lakes and river may become too acidic for living things to survive. Trees destroyed by acid rain. Fish are killed by acid rain.

7. Describe ozone depletion and its effects.

Ans: Ozone Depletion and Its Effects:

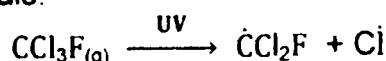
Over recent years, scientists have discovered a reduction in the amount of ozone in the stratosphere.

Ozone hole:

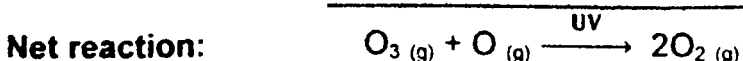
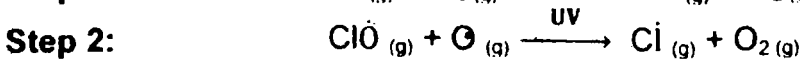
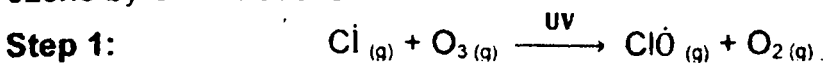
The region in which the amount of ozone has been reduced is called as ozone hole. Ozone hole was first observed in October, 1980 over Antarctica.

Chlorofluorocarbons:

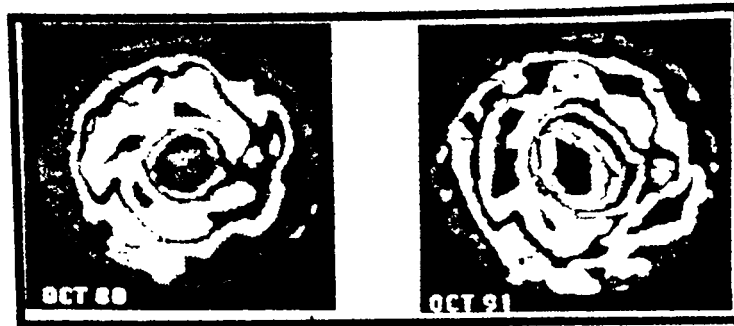
Chlorofluorocarbons (from aerosol cans, air conditioning systems, refrigerators etc) escape into the atmosphere. CFCs are gases or low boiling liquids. They are so inert that they do not react with any other chemicals in the troposphere. They slowly diffuse into the ozone layer. UV radiation break CFCs molecule producing chlorine free radicals.



Chlorine free radical reacts with ozone to form chlorine monoxide (ClO) and molecular oxygen. ClO reacts with atomic oxygen produced by the decomposition of ozone by UV radiations.



The chlorine free radical that reacts in step 1 is regenerated in step 2. One Cl can, therefore, destroy thousands of ozone molecules. Figure 14.10 shows depletion of ozone layer over the years.



Satellite images, the blue area of normal ozone level is getting progressively smaller as time goes

8. Describe global warming.

Ans: Global warming:

The warming of the atmosphere which is due to our influence on the greenhouse effect is known as global warming.

Global warming as a green house effect:

Global warming is due to an upset in the natural balance of the concentration of greenhouse gases in the atmosphere. If global warming continues, then

- Temperature of the earth will gradually increase.
- The earth climate may change, affecting both where there is rainfall and how much there is of it. This could cause both increased risks of flooding in some regions and drought in others.
- Polar ice may melt and cause significant increase in sea levels.
- So the atmosphere becomes hotter.

9. Differentiate between stratosphere and troposphere.

Ans: Location:

The troposphere is the layer of the atmosphere that touches Earth. From the surface of the earth, the troposphere extends out 6-8 kilometers from the poles and 17 kilometers from the equator.

Between the troposphere and stratosphere is a small layer of the atmosphere called tropopause. The stratosphere is about 50 kilometers from the surface of the earth.

Temperatures:

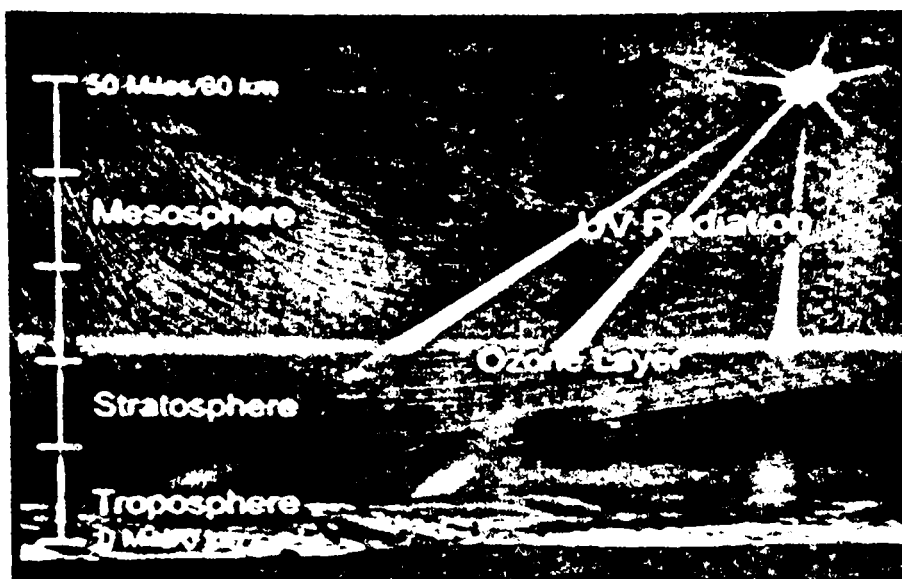
The temperatures in the troposphere decrease by 6.5 degrees Celsius for every kilometer away from the earth's surface. The temperature stabilizes at around 12 kilometers.

The stratosphere's temperature is about -50 degrees Celsius where it is closest to the earth. The upper layers are actually warmer and average -18 degrees Celsius. The reason for the warming, as this layer gets farther from the earth, is the presence of Ozone. Ozone absorbs sunlight and reflects it away from the earth.

10. Explain ozone formation.

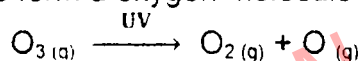
Ans: Formation of ozone:

Ozone is an allotropic form of oxygen comprising three oxygen atoms. O_3 Ozone is an important gas in the stratosphere.

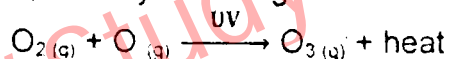


Ozone Layer

Most of the ultraviolet (UV) radiations coming from sun are **filtered** or **screened** out by the ozone layer. Otherwise, sunlight would be much more hazardous for human beings, animals and plants. On absorbing UV radiation, ozone molecule breaks up to form an oxygen molecule and atomic oxygen.



Atomic oxygen is very reactive. Atomic oxygen reacts readily with an oxygen molecule to form ozone, thereby releasing heat.



These reactions maintain the level of ozone in the stratosphere. Both the destruction and the reformation of ozone are powered by UV radiation. In the absence of outside intervention, the rates of ozone destruction and formation are equal. However, human activities disturb this natural balance.

11. Why is global warming often referred to as the greenhouse effect?

Ans: The **enhanced greenhouse effect** (or accelerated greenhouse effect) is the warming effect caused by all the **extra** carbon-dioxide greenhouse gas that man has put into the atmosphere in the past 100 years by burning fossil fuels (coal, oil and natural gas). Global warming is the warming of the earth because of this enhanced greenhouse effect.

12. There is scientific evidence that CFCs contribute to the depletion of ozone. Why?

Ans: Ozone hole:

The region in which the amount of ozone has been reduced is called an ozone hole. Ozone hole was first observed in October, 1980 over Antarctica.

The CFCs are so stable that only exposure to strong UV radiation breaks them down. When that happens, the CFC molecule releases atomic chlorine. One chlorine atom can destroy over 100,000 ozone molecules.

13. Sulphur dioxide is a common pollutant from burning coal. State two effects caused by this pollutant.

Ans: Sulphur Oxides (SO_x):

In the air sulphur dioxide is converted into sulphur trioxide, which is responsible for acid rain.

Sulphur dioxide is readily absorbed in the respiratory system. Being powerful irritant, it aggravates the symptoms of people who suffer from asthma, bronchitis, emphysema and other lung diseases.

THINK-TANK

14. Dibenzothiophene (C₁₂H₈S) is a common sulphur containing compound of coal. It is responsible for acid rain. How?

Ans: Dibenzothiophene (C₁₂H₈S) is a sulphur containing compound of coal on burning it produces sulphur dioxide. In the air sulphur dioxide is converted into sulphur trioxide, which is responsible for acid rain.

15. There have been various attempts to remove sulphur from coal before it is burned. Suggest reason.

Ans: Sulphur containing compound of coal on burning produces sulphur dioxide. In the air sulphur dioxide is converted into sulphur trioxide, which is responsible for acid rain. Therefore various attempts to remove sulphur from coal before it is burned have been done.

16. Examine the option there are some ways to reduce pollution caused by cars?

Ans: Catalytic converter:

A catalytic converter transforms CO into CO₂, NO into N₂ and O₂, and unburned hydrocarbons to CO₂ and H₂O. Metals like platinum, palladium and rhodium are used as catalyst in the converter. Government of Pakistan should direct car manufacturers to install catalytic converters in car exhaust system. Government should make strict laws in this regards.

Similar to scrubbers on power plants, catalytic converters reduce NO_x emissions from cars.

17. Certain human activities are responsible for a significant increase in green house effect, argue.

Ans: Primarily by two actions: **Burning fossil fuels**, with a smaller contribution from **clear cutting forests**, known as deforestation.

Greenhouse gases trap heat:

When we extract and burn fossil fuels such as coal or petroleum, we cause the release of carbon dioxide carbon dioxide and other heat-trapping "greenhouse gases" into the atmosphere.

Losing forests makes it worse:

Clearing forests also releases large amounts of carbon dioxide. On top of that, plants and trees use it to grow. Worldwide deforestation means we don't have as many trees to absorb the extra carbon dioxide.

This means more of carbon dioxide stays in the atmosphere, trapping more heat.

So what do we do about it?

To make real progress at the global level we need to **convince leaders** to create laws that improve our energy policy, and **push companies** to adopt sustainable business practices.

18. As a global citizen, how can you play a part to reduce air pollution at a personal level? Argue.

Ans:

- i. Encourage your family to walk to the neighbourhood market.
- ii. As far as possible use public forms of transport.
- iii. Reduce the use of aerosols in the household.
- iv. Look after the trees in your neighbourhood.
- v. If possible share your room with others when the airconditioner, cooler or fan is on.
- vi. Do not burn leaves in your garden; put them in a compost pit.
- vii. Cars should, as far as possible, be fitted with catalytic converters.
- viii. Use only unleaded petrol.

19. Compare and contrast between stratosphere and troposphere.

Ans: i. Stratosphere:

The second layer as one moves upward from the Earth's surface is called stratosphere. The stratosphere extends from top of the troposphere to about 50km above earth's surface. Strato- means "layer" or "spread out". The lower stratosphere is cold about -55°C , but the upper stratosphere is warmer than the lower stratosphere.

Component of stratosphere:

This layer contains little water vapours. Interesting information about this layer is that it contains maximum amount of ozone (about 10 ppm/parts per million). The presence of ozone is responsible for the rise in temperature in stratosphere.

Function of ozone:

Ozone saves us from harmful effects of incoming ultraviolet radiations from the sun. When ozone absorbs energy from the sun, the energy is converted into heat, warming the air. The ozone layer protects the living things on the Earth from dangerous ultraviolet radiation from the sun.

Temperature variation in stratosphere:

In the stratosphere, temperature varies from -55°C to -5°C

ii. Troposphere:

Tropo- means "turning" or "changing". Conditions in troposphere are more variable than in the other layers. Troposphere extends to about 12km above earth's surface. The atmospheric layer closest to the Earth's surface is called troposphere. Troposphere contains most of the mass (75-80%) of the atmosphere. It is the layer of atmosphere in which we live.

Components of troposphere:

Nearly all the dust particles and water vapours are in the troposphere. Weather occurs in this layer. Most of the clouds are formed in the troposphere. Aircrafts fly in this region.

Temperature variation in troposphere:

As altitude increases in the troposphere, the temperature decreases from 17°C to about -55°C. On average, for every 1 km increase in altitude, the air gets about 6.5°C cooler.

Project

Global warming has become one of the most serious environmental issues in the world in recent times. Prepare a report on this issue in terms of:

- a) The gases contributing to the problem and their sources.**
- b) Which of these gases are causing the most concern?**
- c) Suggest some ways to reduce this problem.**

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