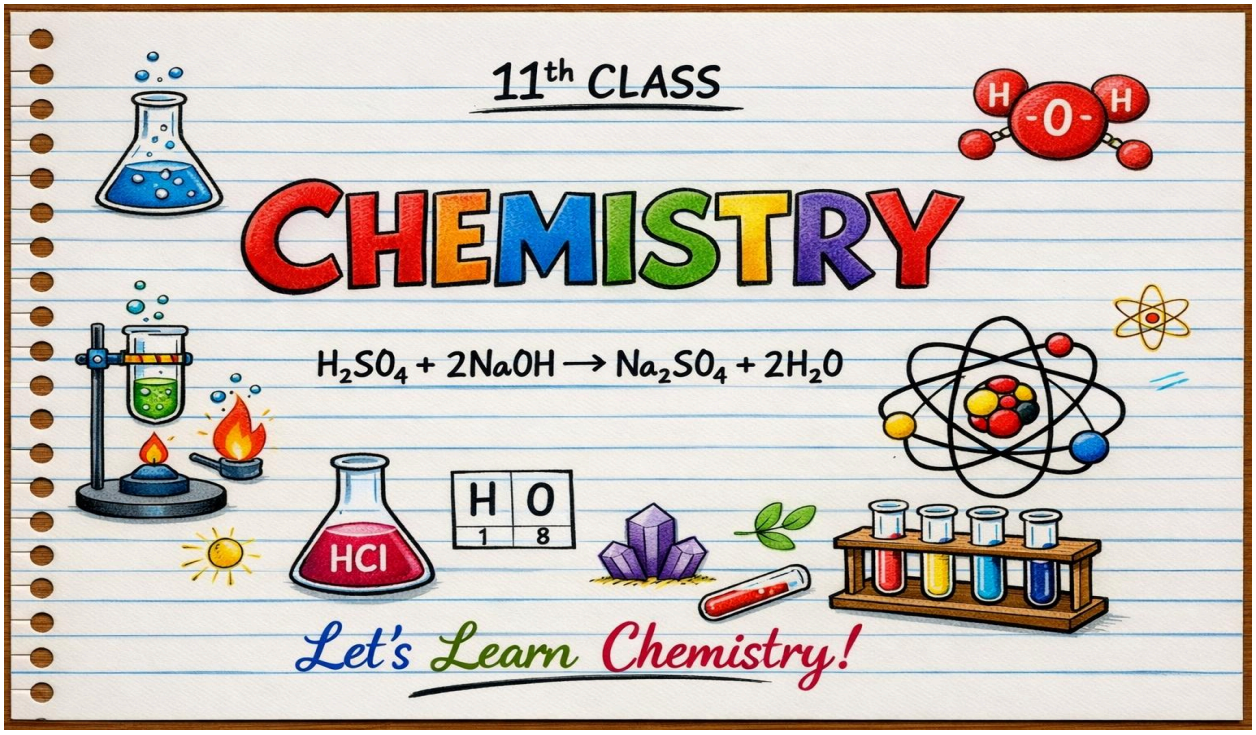

Class: 11th

Subject: Chemistry

Unit 14: ATMOSPHERE

❖ Important MCQs:

1. Which gas makes up about 78% of the Earth's atmosphere?

(a) Oxygen

(b) Nitrogen ✅

(c) Carbon dioxide

(d) Argon

2. Which of the following is a minor component of the atmosphere?

(a) Nitrogen

(b) Oxygen

(c) Argon ✅

(d) Methane

3. Which gas is present in trace amounts in the atmosphere?

(a) Oxygen

(b) Nitrogen

(c) Methane ✅

(d) Carbon dioxide

4. The approximate percentage of carbon dioxide in the atmosphere is:

(a) 1%

(b) 0.5%

(c) 0.04% ✅

(d) 2%

5. Which of the following is NOT a trace gas?

(a) Helium

(b) Neon

(c) Argon ✅

(d) Krypton

6. The troposphere extends up to about:

(a) 12 km ✅

(b) 50 km

(c) 80 km

(d) 600 km

7. Temperature in the troposphere:

(a) Increases with altitude

(b) Decreases with altitude ✅

(c) Remains constant

(d) First increases then decreases

8. Which events mainly occur in the troposphere?

(a) Ozone formation

(b) Weather phenomena ✅

(c) UV absorption

(d) X-ray absorption

Stratosphere

9. The stratosphere is located between:

(a) 0–12 km

(b) 12–50 km ✅

(c) 50–80 km

(d) 80–600 km

10. Temperature in the stratosphere:

(a) Decreases continuously

(b) Increases with altitude ✅

(c) Remains constant

(d) Becomes zero

11. Ozone layer is mainly found in the:

(a) Troposphere

(b) Stratosphere ✅

(c) Mesosphere

(d) Thermosphere

12. Ozone formation in the stratosphere is:

(a) Endothermic

(b) Exothermic ✅

(c) Neutral

(d) Impossible

Mesosphere

13. The mesosphere extends from:

(a) 12–50 km

(b) 50–80 km ✅

(c) 80–600 km

(d) 0–12 km

14. The coldest layer of the atmosphere is:

(a) Troposphere

(b) Stratosphere

(c) Mesosphere ✅

(d) Thermosphere

15. Temperature in the mesosphere:

(a) Increases

(b) Decreases with altitude ✅

(c) Remains constant

(d) Fluctuates randomly

Thermosphere

16. The thermosphere extends up to about:

(a) 80 km

(b) 200 km

(c) 600 km ✅

(d) 1000 km

17. High temperature in the thermosphere is due to:

(a) Infrared rays

(b) Visible light

(c) UV and X-rays ✅

(d) Wind currents

18. Temperature in the thermosphere may reach:

(a) 100°C

(b) 300°C

(c) 2000°C or higher ✅

(d) 50°C

19. Which layer is the densest part of the atmosphere?

(a) Stratosphere

(b) Mesosphere

(c) Thermosphere

(d) Troposphere ✅

20. Which statement is correct about ozone cycle?

(a) Ozone only forms

(b) Ozone only decomposes

(c) Ozone continuously forms and breaks down ✅

(d) Ozone is stable and inactive

21. Air pollutants are substances that are:

(a) Useful for environment

(b) Harmful to environment ✅

(c) Only gases

(d) Only solids

22. Which of the following is a primary pollutant?

(a) Ozone

(b) Carbon monoxide ✅

(c) Acid rain

(d) Smog

23. Secondary pollutants are formed by:

(a) Direct emission

(b) Natural processes only

(c) Chemical reactions of primary pollutants ✅

(d) Water evaporation

24. Which of the following is an oxide of carbon?

(a) NO_2

(b) SO_2

(c) CO_2 ✅

(d) CH_4

25. Oxides of nitrogen are collectively represented as:

(a) SO_x

(b) NO_x ✅

(c) CO_x

(d) VOCs

26. Which of the following is a hydrocarbon pollutant?

(a) Methane ✅

(b) Carbon dioxide

(c) Sulphur dioxide

(d) Nitrogen dioxide

27. Low altitude ozone is considered:

(a) Beneficial gas

(b) Primary pollutant

(c) Secondary pollutant ✅

(d) Inert gas

28. Chlorofluorocarbons (CFCs) are responsible for:

(a) Acid rain

(b) Ozone layer depletion ✅

(c) Global cooling

(d) Oxygen production

29. Which of the following is an example of heavy metal pollutant?

(a) Oxygen

(b) Nitrogen

(c) Lead (Pb) ✅

(d) Methane

30. Particulate matter (PM) mainly consists of:

(a) Only gases

(b) Solid and liquid particles suspended in air ✅

(c) Only liquids

(d) Only metals

31. Which of the following is a natural source of air pollution?

(a) Vehicle exhaust

(b) Industrial smoke

(c) Wind erosion of soil particles ✅

(d) Brick kilns

32. Thunderbolt produces significant amounts of:

(a) Carbon monoxide

(b) Oxides of nitrogen (NO_x) ✅

(c) Methane

(d) Sulphur dioxide

33. Hydrogen sulphide (H_2S) in the atmosphere is mainly released by:

(a) Algae on ocean surface ✅

(b) Vehicles

(c) Factories

(d) Volcanoes only

34. Which of the following is a mobile source of air pollution?

(a) Power plant

(b) Factory

(c) Airplane ✅

(d) Brick kiln

35. Combustion of fossil fuels produces mainly:

(a) Oxygen and nitrogen

(b) Carbon dioxide, carbon monoxide and hydrocarbons ✅

(c) Helium and neon

(d) Water vapor only

36. Carbon monoxide (CO) is mainly produced due to:

(a) Complete combustion of fuels

(b) Incomplete combustion of fossil fuels ✅

(c) Photosynthesis

(d) Respiration

37. Carbon dioxide is best described as:

(a) Toxic gas only

(b) Primary greenhouse gas ✅

(c) Inert gas

(d) Ozone destroyer only

38. Which of the following is collectively known as NO_x?

(a) CO and CO_2

(b) NO and NO_2 ✅

(c) SO_2 and SO_3

(d) CH_4 and C_2H_6

39. Major human source of NO_x emissions is:

(a) Photosynthesis

(b) Burning of fossil fuels and fertilizers use ✅

(c) Rainfall

(d) Ocean evaporation

40. Oxides of sulphur (SO_x) mainly include:

(a) SO and SO_2

(b) SO_2 and SO_3 ✅

(c) SO_3 and CO_2

(d) NO and NO_2

41. SO_2 is mainly responsible for:

(a) Global cooling

(b) Acid rain formation ✅

(c) Oxygen production

(d) Ozone formation

42. Which of the following is the most common hydrocarbon pollutant?

(a) Ethane

(b) Methane ✅

(c) Propane

(d) Butane

43. Major anthropogenic source of hydrocarbons is:

(a) Volcanic eruption

(b) Automobile emissions and fossil fuel burning ✅

(c) Ocean algae

(d) Wind erosion

44. Low-altitude ozone (O_3) is:

(a) Always beneficial

(b) Harmless gas

(c) Harmful pollutant at high concentration ✅

(d) Inert gas

45. Ozone becomes toxic above:

(a) 10 ppm

(b) 50 ppm

(c) 100 ppm ✅

(d) 500 ppm

46. CFCs are mainly used as:

(a) Fertilizers

(b) Refrigerants and aerosols ✅

(c) Fuels

(d) Medicines

47. Ozone depletion is caused by CFCs due to formation of:

(a) Oxygen radicals

(b) Chlorine free radicals (Cl•) ✅

(c) Hydrogen radicals

(d) Nitrogen radicals

48. Which of the following is an example of PAH?

(a) Methane

(b) Naphthalene ✅

(c) Oxygen

(d) Carbon monoxide

49. PAHs are mainly produced by:

(a) Complete combustion

(b) Incomplete combustion of fossil fuels ✅

(c) Photosynthesis

(d) Rainfall

50. Persistent Organic Pollutants (POPs) are characterized by:

(a) Easy degradation

(b) Resistance to degradation and toxicity ✅

(c) High solubility in water

(d) No environmental impact

51. Which of the following is a primary pollutant?

(a) Ozone

(b) Carbon monoxide ✅

(c) Acid rain

(d) Smog

52. Volatile Organic Compounds (VOCs) are best described as:

(a) Non-evaporating solids

(b) Gases released only from metals

(c) Organic compounds that evaporate easily at room temperature ✅

(d) Inorganic gases only

53. Major source of VOCs in the environment is:

(a) Solar radiation

(b) Liquid fuels and vehicle exhausts ✅

(c) Rainwater

(d) Oxygen combustion

54. Short-term exposure to VOCs may cause:

(a) Bone strengthening

(b) Eye, nose and throat irritation ✅

(c) Improved breathing

(d) Increased oxygen levels

55. Long-term exposure to VOCs can damage:

(a) Skin only

(b) Liver, kidney and central nervous system ✅

(c) Hair only

(d) Teeth only

56. Which of the following is a VOC?

(a) Nitrogen

(b) Benzene ✅

(c) Oxygen

(d) Carbon dioxide

57. Particulate matter (PM) in air mainly consists of:

(a) Only gases

(b) Solid particles, liquid droplets or both suspended in air ✅

(c) Only oxygen molecules

(d) Only water vapor

58. Natural source of particulate matter includes:

(a) Vehicles

(b) Factories

(c) Volcanoes and dust storms ✅

(d) Power plants only

59. Which of the following is a heavy metal pollutant?

(a) Nitrogen

(b) Oxygen

(c) Mercury (Hg) ✅

(d) Methane

60. Major sources of heavy metal pollution include:

(a) Photosynthesis

(b) Metallurgy, battery waste and incineration ✅

(c) Rainfall

(d) Ocean evaporation

61. The major human activities affecting atmosphere are:

(a) Photosynthesis and respiration

(b) Burning fossil fuels and deforestation ✅

(c) Rainfall and evaporation

(d) Ocean currents

62. In urban areas, major air pollution comes from:

(a) Natural forests

(b) Human-made sources ✅

(c) Oceans

(d) Mountains

63. Which of the following is a mobile source of air pollution?

(a) Power plant

(b) Factory

(c) Cars and trucks ✅

(d) Brick kiln

64. Burning of fossil fuels mainly contributes to:

(a) Oxygen increase

(b) Greenhouse gas emission and air pollution ✅

(c) Ozone formation only

(d) Soil formation

65. Deforestation means:

(a) Planting trees

(b) Cutting or clearing forests by humans ✅

(c) Growing forests

(d) Natural forest growth

66. Forests help reduce climate change by absorbing:

(a) Oxygen

(b) Greenhouse gases (CO_2) ✅

(c) Nitrogen

(d) Helium

67. One major effect of deforestation is:

(a) Increase in oxygen only

(b) Loss of biodiversity and climate change ✅

(c) Increased rainfall everywhere

(d) Soil fertility improvement only

68. Smog is best described as:

(a) Pure air

(b) Thick haze of polluted air ✅

(c) Clean fog

(d) Oxygen-rich air

69. Classical smog is also known as:

(a) Photochemical smog

(b) London smog / reducing smog ✅

(c) Clean smog

(d) Ozone smog

70. Classical smog is mainly caused by:

(a) Oxygen

(b) Sulphur oxides (SO_x) ✅

(c) Nitrogen only

(d) Carbon dioxide

71. Photochemical smog is formed in the presence of:

(a) Moonlight

(b) Sunlight ✅

(c) Rain

(d) Wind only

72. Photochemical smog is mainly produced from:

(a) SO_2 only

(b) NO_x, VOCs and hydrocarbons ✅

(c) Oxygen only

(d) Nitrogen only

73. A harmful secondary pollutant in photochemical smog is:

(a) Oxygen

(b) Ozone (O_3) ✅

(c) Nitrogen

(d) Helium

74. Photochemical smog can cause:

(a) Improved breathing

(b) Lung cancer and respiratory problems ✅

(c) Strong immunity

(d) Bone growth

75. Acid rain is formed when pH of rainwater is below:

(a) 7

(b) 6

(c) 5.6 ✅

(d) 4

76. Acid rain is mainly caused by:

(a) Oxygen and nitrogen

(b) SO_2 and NO_x gases ✅

(c) Helium and neon

(d) Methane only

77. SO_2 in the atmosphere forms acid rain by converting into:

(a) Nitric acid

(b) Sulphuric acid (H_2SO_4) ✅

(c) Hydrochloric acid

(d) Carbonic acid

78. Acid rain can occur in form of:

(a) Only rain

(b) Rain, snow, hail and fog ✅

(c) Only fog

(d) Only snow

79. Acid rain is dangerous because it is:

(a) Sweet in taste

(b) Corrosive in nature ✅

(c) Neutral

(d) Inert

80. The oxidation of SO_2 to SO_3 is an example of:

(a) Physical change

(b) Chemical reaction in atmosphere leading to acid rain formation ✅

(c) Photosynthesis

(d) Evaporation

81. Global warming is primarily caused by:

(a) Increase in oxygen level

(b) Emission of greenhouse gases due to fossil fuels burning ✅

(c) Decrease in nitrogen

(d) Increase in ozone only

82. Greenhouse effect refers to:

(a) Cooling of Earth

(b) Trapping of heat by atmospheric gases leading to warming of Earth ✅

(c) Formation of clouds

(d) Acid rain formation

83. Which type of radiation is trapped by greenhouse gases?

(a) UV radiation

(b) Infrared radiation (heat) ✅

(c) X-rays

(d) Gamma rays

84. Carbon dioxide and water vapour mainly act by:

(a) Absorbing short wave radiation

(b) Reflecting long wave heat radiation back to Earth surface ✅

(c) Destroying ozone

(d) Producing oxygen

85. Higher CO_2 concentration results in:

(a) Lower temperature

(b) Higher global temperature due to heat trapping ✅

(c) No change

(d) Oxygen increase

86. AQI stands for:

(a) Air Quality Instrument

(b) Air Quality Index ✅

(c) Atmospheric Quality Indicator

(d) Air Quantity Index

87. AQI below 50 is considered:

(a) Hazardous

(b) Moderate

(c) Good air quality ✅

(d) Unhealthy

88. AQI above 300 is classified as:

(a) Good

(b) Moderate

(c) Hazardous condition ✅

(d) Safe

89. People most affected by poor AQI include:

(a) Healthy teenagers only

(b) Children, elderly and patients with heart/lung disease ✅

(c) Athletes only

(d) Farmers only

90. Which of the following is NOT an emission source of air pollution?

(a) Vehicles

(b) Factories

(c) Power plants

(d) Wind movement of clean air ✅

91. Vehicles mainly release:

(a) Oxygen

(b) CO, PM and VOCs ✅

(c) Nitrogen only

(d) Hydrogen

92. Meteorological conditions affecting air quality include:

(a) Soil type

(b) Wind, temperature and humidity ✅

(c) Rocks

(d) Ocean salinity

93. Warm air trapping pollutants near the ground leads to:

(a) Clean air

(b) Poor air quality ✅

(c) Oxygen increase

(d) Rainfall increase

94. Natural events affecting air quality include:

(a) Cooking food

(b) Wildfires and dust storms ✅

(c) Driving cars

(d) Factory emissions

95. Seasonal changes affect air quality due to:

(a) Ocean tides

(b) Heating/cooling emissions and pollen concentration ✅

(c) Earth rotation

(d) Gravity changes

96. Poor air quality mainly affects:

(a) Only plants

(b) Human health directly and indirectly ✅

(c) Only animals

(d) Only water systems

97. Particulate matter (PM2.5–PM10) mainly causes:

(a) Improved breathing

(b) Airway inflammation and respiratory diseases ✅

(c) Bone strengthening

(d) Increased oxygen level

98. Inhalation of particulate matter can lead to:

(a) Asthma and bronchitis ✅

(b) Diabetes

(c) Kidney stones

(d) Eye growth

99. Nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) mainly affect:

(a) Digestive system

(b) Respiratory system irritation ✅

(c) Skin only

(d) Bones only

100. Long-term exposure to NO_2 and SO_2 increases risk of:

(a) Better immunity

(b) Respiratory infections and asthma ✅

(c) Hair growth

(d) Improved lung capacity

101. Air pollution health effects are classified as:

(a) Simple and complex

(b) Acute and chronic ✅

(c) Fast and slow

(d) Direct and indirect only

102. Which pollutant is strongly linked with asthma attacks?

(a) Oxygen

(b) Ozone (O_3) and PM and NO_2 ✅

(c) Nitrogen only

(d) Helium

103. Long-term exposure to air pollution may cause:

(a) Chronic cough and pneumonia ✅

(b) Strong bones

(c) Better vision

(d) Increased energy

104. Air pollution increases risk of cardiovascular disease by causing:

(a) Oxygen increase

(b) Blood vessel damage and inflammation ✅

(c) Hair loss

(d) Skin glow

105. One major health effect of particulate matter is:

(a) Improved blood flow

(b) Heart attack risk increase ✅

(c) Bone repair

(d) Muscle growth

106. Cancer risk from air pollution is mainly linked with:

(a) Oxygen

(b) PM and carcinogenic compounds like benzene ✅

(c) Nitrogen

(d) Water vapor

107. Which organ is most affected in pollution-related cancer cases?

(a) Heart

(b) Lungs ✅

(c) Liver

(d) Kidney

108. Air pollution may affect reproductive health by causing:

(a) Increased fertility

(b) Fertility problems and developmental issues ✅

(c) Strong immunity

(d) Faster growth

109. Premature birth is associated with exposure to:

(a) Clean air

(b) Air pollution and toxic gases ✅

(c) Oxygen only

(d) Nitrogen only

110. The severity of air pollution health effects depends on:

(a) Only age

(b) Type, concentration and duration of exposure ✅

(c) Only weather

(d) Only gender

111. Air quality is mainly measured in terms of:

(a) Temperature

(b) Air Quality Index (AQI) ✅

(c) Wind speed

(d) Humidity

112. AQI is a measure of:

(a) Oxygen level only

(b) Concentration of pollutants in air ✅

(c) Rainfall amount

(d) Soil quality

113. Which instrument is used to measure AQI and particulate matter (PM)?

(a) Barometer

(b) Nephelometer ✅

(c) Thermometer

(d) Hygrometer

114. Nephelometer works by measuring:

(a) Air pressure

(b) Light scattering by particles in air ✅

(c) Temperature change

(d) Wind direction

115. Which of the following pollutants can be monitored by CEMS?

(a) Only oxygen

(b) CO, SO_2, NO_2, O_3 and VOCs ✅

(c) Only nitrogen

(d) Only water vapor

116. Continuous Emission Monitoring System (CEMS) is mainly used in:

(a) Schools

(b) Industrial sites ✅

(c) Oceans

(d) Forests

117. Air Quality Monitoring Stations (AQMS) are used for:

(a) Weather prediction only

(b) Real-time measurement of air pollutants ✅

(c) Soil testing

(d) Water purification

118. AQMS are usually located in:

(a) Deserts only

(b) Urban and industrial areas ✅

(c) Mountains only

(d) Oceans

119. Remote sensing techniques for air quality use:

(a) Ground sensors only

(b) Satellites equipped with sensors ✅

(c) Human observation

(d) Water sampling

120. Remote sensing is mainly useful for:

(a) Small room analysis

(b) Regional and global air quality monitoring ✅

(c) Cooking gas measurement

(d) Soil fertility

121. First step in designing an air quality experiment is:

(a) Data analysis

(b) Hypothesis formulation ✅

(c) Conclusion writing

(d) Instrument calibration

122. A hypothesis is best described as:

(a) Final result

(b) A testable statement or prediction ✅

(c) Instrument used

(d) Pollution control method

123. Which of the following hypotheses is correct for air quality study?

(a) Air is always clean

(b) PM2.5 increases during peak traffic hours ✅

(c) Oxygen decreases at night

(d) Nitrogen increases in rain

124. In air quality experiments, data is mainly collected from:

(a) Books only

(b) Monitoring stations and instruments ✅

(c) Internet only

(d) Guesswork

125. Which areas are commonly selected for air quality monitoring?

(a) Only mountains

(b) Busy roads and residential areas ✅

(c) Oceans only

(d) Deserts only

126. Data collection in air quality studies includes:

(a) Temperature only

(b) Traffic volume and pollutant levels ✅

(c) Soil moisture only

(d) Rainfall only

127. The main purpose of analyzing air quality data is to:

(a) Store data only

(b) Confirm or reject hypothesis ✅

(c) Increase pollution

(d) Change weather

128. Air quality data interpretation helps in:

(a) Cooking food

(b) Understanding pollution trends over time ✅

(c) Growing plants

(d) Making fuel

129. A catalytic converter is used in:

(a) Air conditioners

(b) Vehicle exhaust systems ✅

(c) Water tanks

(d) Refrigerators

130. Catalytic converters mainly convert CO into:

(a) CO_2 ✅

(b) O_2

(c) N_2

(d) H_2

131. Nitrogen oxides (NO_x) in catalytic converters are converted into:

(a) CO_2

(b) N_2 (nitrogen gas) ✅

(c) O_2

(d) SO_2

132. Diesel particulate filters (DPF) are used to remove:

(a) CO_2

(b) PM (soot particles) ✅

(c) Oxygen

(d) Nitrogen

133. Selective Catalytic Reduction (SCR) mainly reduces:

(a) CO

(b) NO_x emissions to N_2 ✅

(c) Oxygen

(d) Water vapor

134. Scrubbers are used to remove pollutants using:

(a) Heat only

(b) Liquids like water (H_2O) or chemical solutions ✅

(c) Sunlight

(d) Electricity only

135. Scrubbers can remove which of the following pollutants?

(a) Only oxygen

(b) SO_2, PM, HCl and VOCs ✅

(c) Only nitrogen

(d) Only CO_2

136. Pakistan Environmental Protection Act was passed in:

(a) 1990

(b) 1997 ✅

(c) 2005

(d) 2012

137. NEQS stands for:

(a) National Environmental Quality Standards ✅

(b) Natural Energy Quality System

(c) National Ecology Quality Survey

(d) New Environmental Quality Strategy

138. Punjab Environmental Protection (Amendment) Act was introduced in:

(a) 1997

(b) 2000

(c) 2012 ✅

(d) 2020

139. Vehicle emission standards mainly aim to reduce:

(a) Water pollution

(b) Air pollution from vehicles ✅

(c) Soil erosion

(d) Noise pollution only

140. Cleaner fuels include:

(a) Coal only

(b) CNG and LPG ✅

(c) Wood only

(d) Petrol only

141. Industrial emission control can be improved by:

(a) Increasing smoke release

(b) Cleaner production technologies ✅

(c) Using more coal

(d) Removing filters

142. Public awareness campaigns encourage:

(a) Increased pollution

(b) Use of public transport and carpooling ✅

(c) Burning waste

(d) Cutting trees

143. Urban green infrastructure includes:

(a) Factories

(b) Parks and green belts ✅

(c) Roads only

(d) Parking lots

144. Green belts in cities mainly help to:

(a) Increase traffic

(b) Improve air quality and reduce pollution ✅

(c) Increase smog

(d) Reduce oxygen

145. Smog control measures include:

(a) Burning crops

(b) Smog towers and restriction on crop burning ✅

(c) Increasing smoke

(d) Cutting forests

146. Open burning of waste should be:

(a) Encouraged

(b) Prohibited due to pollution generation ✅

(c) Ignored

(d) Increased

147. One economic impact of air pollution is:

(a) Increased crop yield

(b) Reduced worker productivity due to illness ✅

(c) Free energy production

(d) Lower food prices

148. Air pollution can increase:

(a) Agricultural productivity

(b) Food prices due to crop damage ✅

(c) Oxygen level

(d) Rainfall quality

149. Vulnerable groups most affected by air pollution include:

(a) Only athletes

(b) Children, elderly and low-income communities ✅

(c) Only workers

(d) Only students

150. Effective air pollution control requires:

(a) National efforts only

(b) International cooperation and governance ✅

(c) No regulation

(d) Only local farming

❖ Important Short Questions:

1. Define atmosphere.

Answer:

Atmosphere is a layer of gases surrounding the Earth that is held by gravity. It protects life on Earth by providing oxygen, regulating temperature, and blocking harmful radiation.

Example:

The air we breathe (oxygen, nitrogen, CO_2) is part of the atmosphere.

2. What are major components of the atmosphere?

Answer:

Major components are gases present in large amounts:

- Nitrogen (78%)
- Oxygen (21.01%)

Example:

Nitrogen supports plant growth indirectly, while oxygen is essential for respiration.

3. Differentiate between major and trace gases of atmosphere.

Answer:

- **Major gases:** Present in large amount (Nitrogen, Oxygen).
- **Trace gases:** Present in very small amount (Methane, Neon, Helium, etc.).

Example:

Oxygen is major gas, while methane (CH_4) is a trace gas.

4. Define troposphere. Write its main features.

Answer:

Troposphere is the lowest layer of atmosphere extending up to about 12 km.

Features:

- Contains most air gases
- Temperature decreases with height
- Weather occurs here

Example:

Rain, clouds, and storms form in troposphere.

5. Why troposphere is called weather layer?

Answer:

Because all weather activities such as rain, wind, clouds, lightning, and storms occur in this layer.

Example:

Thunderstorms and rainfall happen in troposphere.

6. Define stratosphere and ozone layer.

Answer:

Stratosphere is the atmospheric layer above troposphere (12–50 km). It contains ozone layer which absorbs harmful UV radiation.

Example:

Airplanes fly in lower stratosphere.

7. What is ozone layer and why is it important?

Answer:

Ozone layer is a region in stratosphere containing O_3 gas. It protects Earth from harmful ultraviolet (UV) rays.

Importance:

- Protects skin cancer
- Protects plants and animals

Example:

Ozone layer blocks UV rays from Sun.

8. What happens in mesosphere?

Answer:

Mesosphere is the layer where temperature decreases with height and most meteors burn due to friction.

Example:

Shooting stars (meteors) burn in mesosphere.

9. Why thermosphere has very high temperature?

Answer:

Because it absorbs high-energy solar radiation such as UV rays and X-rays, which increases temperature.

Example:

Satellite communication occurs in thermosphere.

10. Define air pollutants. Give two examples.

Answer:

Air pollutants are harmful substances present in air that damage the environment and health.

Examples:

- Carbon monoxide (CO)
- Sulphur dioxide (SO_2)

Example in real life:

Vehicle exhaust releases CO, and factories release SO_2.

11. Differentiate between primary and secondary pollutants.

Answer:

- **Primary pollutants:** Directly emitted from sources.
- **Secondary pollutants:** Formed by chemical reactions of primary pollutants in air.

Example:

CO (primary), O_3 (secondary)

12. What are NO_x gases? Write one source.

Answer:

NO_x refers to nitrogen oxides, mainly NO (nitric oxide) and NO_2 (nitrogen dioxide).

Source:

Burning of fossil fuels in vehicles.

13. What are SO_x gases? Why are they harmful?

Answer:

SO_x refers to sulphur oxides (SO_2 and SO_3). They are harmful because they cause acid rain and respiratory problems.

Example:

SO_2 released from coal burning.

14. Define hydrocarbons and give one example.

Answer:

Hydrocarbons are organic compounds made of carbon and hydrogen only.

Example:

Methane (CH_4)

15. What is photochemical smog?

Answer:

It is a type of smog formed when NO_x and VOCs react in presence of sunlight producing ozone and PAN.

Example:

Smog in sunny urban cities with heavy traffic.

16. Differentiate between classical smog and photochemical smog.

Answer:

- **Classical smog:** Caused by SO_2, occurs in cold, humid areas.
- **Photochemical smog:** Caused by NO_x + VOCs + sunlight, forms ozone.

Example:

London smog vs Los Angeles smog

17. What is acid rain? Write its pH range.

Answer:

Acid rain is rainwater containing acids formed by SO_2 and NO_x in air.

pH range: Below 5.6

Example:

Rain mixed with sulphuric acid (H_2SO_4)

18. Write two effects of acid rain on environment.

Answer:

- Damages buildings and monuments
- Harms plants and aquatic life

19. What is greenhouse effect?

Answer:

It is the warming of Earth due to trapping of infrared heat by greenhouse gases like CO_2 and water vapour.

Example:

Heat trapped inside Earth's atmosphere like a blanket.

20. How does CO_2 contribute to global warming?

Answer:

CO_2 traps infrared radiation and prevents heat from escaping Earth, increasing global temperature.

Example:

More CO_2 from vehicles ⟶ higher temperature.

21. Define AQI (Air Quality Index).

Answer:

AQI is a scale used to measure level of air pollution and its impact on health.

Example:

AQI tells if air is good, moderate, or hazardous.

22. What AQI value is considered good and hazardous?

Answer:

- **Good:** Below 50
- **Hazardous:** Above 300

23. Name two natural sources of air pollution.

Answer:

- Volcanic eruptions
- Dust storms

24. Name two human-made sources of air pollution.

Answer:

- Vehicle emissions
- Factories/industries

25. What are VOCs and give two examples.

Answer:

VOCs (Volatile Organic Compounds) are organic chemicals that easily evaporate into air and cause pollution.

Examples:

- Benzene

- Toluene

❖ Important Long Questions:

🌟 Q1. Describe the layers of the atmosphere in detail

The atmosphere is divided into four main layers based on temperature changes with increasing altitude. Each layer has different properties, gases, and importance for life on Earth.

1. Troposphere

The troposphere is the lowest layer of the atmosphere, extending from the Earth's surface up to about 12 km.

Characteristics:

- Contains about 75% of total atmospheric gases
- Includes nitrogen, oxygen, carbon dioxide and water vapour
- Temperature decreases with height (about 17°C to -58°C)
- It is the densest layer of atmosphere

Importance:

- All weather activities occur here
- Supports life and biological processes
- Contains clouds, rainfall, storms, wind, and lightning

Example:

Rain, thunderstorms, and hurricanes all form in this layer.

2. Stratosphere

The stratosphere lies above the troposphere, extending from 12 km to 50 km.

Characteristics:

- Temperature increases with height
- Contains very little water vapour
- Contains the ozone layer

Importance:

- The ozone layer absorbs harmful UV radiation
- Provides protection from skin cancer and genetic damage
- Ideal layer for jet aircraft flying

Example:

Commercial airplanes fly in the lower stratosphere to avoid weather disturbances.

3. Mesosphere

The mesosphere lies above the stratosphere, extending from 50 km to 80 km.

Characteristics:

- Temperature decreases with height
- It is the coldest layer of the atmosphere

- Very low density of gases

Importance:

- Meteors and space debris burn up in this layer
- Protects Earth from falling meteorites

Example:

“Shooting stars” are actually meteors burning in the mesosphere.

4. Thermosphere

The thermosphere is the outermost major layer, extending from 80 km to 600 km.

Characteristics:

- Temperature increases very rapidly with height (can reach 2000°C)
- Contains ionized gases (ions and electrons)
- Very thin air

Importance:

- Contains the ionosphere, important for radio communication
- Satellites orbit in this layer
- Absorbs UV and X-ray radiation

Example:

Satellite communication and GPS systems operate in this layer.

Important Summary Points:

Weather occurs in: Troposphere

- **Ozone layer is in:** Stratosphere
- **Meteor burning occurs in:** Mesosphere
- **Satellites and radio signals:** Thermosphere

🌟 Q2. Explain major air pollutants, their sources and effects on environment

Answer:

Air pollutants are harmful substances present in the atmosphere which damage human health, plants, animals, buildings and climate system. These pollutants may be gases or tiny particles. The main air pollutants are explained below in detail:

1. Carbon Monoxide (CO)

Carbon monoxide is a colourless, odourless and poisonous gas formed when fuels burn without enough oxygen.

Sources:

- Incomplete combustion of petrol and diesel in vehicles
- Engines running in traffic jams
- Burning of coal and wood with limited oxygen

Effects:

- Binds with haemoglobin in blood and reduces oxygen supply
- Causes headache, dizziness, weakness
- High concentration can be fatal

Example: Heavy traffic areas produce high CO levels.

2. Carbon Dioxide (CO_2)

Carbon dioxide is a natural gas but becomes harmful in excess amount.

Sources:

- Burning of fossil fuels (coal, oil, natural gas)
- Deforestation (less CO_2 absorption)
- Industrial activities

Effects:

- Major greenhouse gas
- Causes global warming
- Leads to climate change and melting of glaciers

Example: Power plants release large amounts of CO_2.

3. Nitrogen Oxides (NO_x = NO, NO_2)

Nitrogen oxides are reactive gases produced at high temperatures.

Sources:

- Vehicle engines
- Power plants

- Fertilizer industries
- Lightning (natural source)

Effects:

- Irritates lungs and causes breathing problems
- Forms acid rain
- Helps in ozone depletion in lower atmosphere

Example: City smog contains high NO_2 levels.

4. Sulphur Oxides (SO_x = SO_2, SO_3)

Sulphur oxides are toxic gases released during burning of sulphur-containing fuels.

Sources:

- Coal-burning power plants
- Brick kilns
- Oil refineries

Effects:

- Causes acid rain
- Damages crops, forests and aquatic life
- Causes respiratory diseases like asthma

Example: Acid rain in industrial areas.

5. Hydrocarbons

Hydrocarbons are compounds made of carbon and hydrogen, often released during fuel burning.

Sources:

- Vehicle exhaust
- Oil spills
- Incomplete combustion of fuels
- Natural sources like forests and volcanoes

Effects:

- Contribute to smog formation
- Some are carcinogenic (cause cancer)
- Harm human respiratory system

Example: Methane (CH_4) is a common hydrocarbon pollutant.

6. Volatile Organic Compounds (VOCs)

VOCs are organic chemicals that easily evaporate into air at room temperature.

Sources:

- Paints, solvents, adhesives
- Fuel evaporation
- Burning of waste and fuels

Effects:

- Eye, nose and throat irritation
- Damage to liver, kidney and nervous system
- Formation of photochemical smog

Example: Benzene and formaldehyde are VOCs.

7. Particulate Matter (PM)

Particulate matter consists of tiny solid particles and liquid droplets suspended in air.

Sources:

- Dust storms and soil erosion
- Vehicle exhaust
- Industrial smoke
- Forest fires

Effects:

- Causes asthma, bronchitis and lung infections
- PM2.5 can enter bloodstream
- Leads to heart diseases

Example: Smog in big cities contains PM2.5.

8. Heavy Metals (Pb, Hg, Cd)

Heavy metals are toxic metallic elements present in air pollution.

Sources:

- Industrial emissions
- Battery waste
- Metal smelting processes

Effects:

- Damage nervous system and kidneys
- Cause brain disorders and developmental problems
- Accumulate in food chain (bioaccumulation)

Example: Lead pollution from old fuel and industries.

Natural and Human-Made Sources of Air Pollution

1. Natural Sources

These occur without human activity:

- **Volcanic eruptions:** release ash and SO_2
- **Dust storms:** release large amounts of PM
- **Swamps and wetlands:** produce methane (CH_4)
- **Lightning:** produces NO_x gases
- **Ocean algae:** release gases like H_2S

2. Human-Made Sources

These are caused by human activities:

- **Vehicles:** release CO, NO_x, PM
- **Industries:** release SO_x and CO_2
- **Burning fossil fuels:** major source of pollution

- Brick kilns and domestic burning: produce smoke and CO
- **Deforestation:** increases CO_2 level in atmosphere

Summary:

Air pollutants come from both natural and human activities, but human-made sources are the main contributors. These pollutants are responsible for serious problems like global warming, smog, acid rain, respiratory diseases, and environmental degradation.

🌟 Q3. Describe photochemical smog and classical smog. How are they formed and what are their effects?

Answer:

Smog is a type of air pollution formed by a mixture of smoke, fog, and harmful gases. It mainly occurs in urban and industrial areas. Smog is of two main types: classical smog and photochemical smog.

1. Classical Smog (Industrial Smog / Reducing Smog)

Formation:

Classical smog is formed when sulphur dioxide (SO_2) and smoke particles are released mainly from burning coal and fossil fuels. It usually forms in cold and humid conditions, where fog is already present in the air. SO_2 mixes with moisture in the air and forms acidic droplets.

Main pollutants involved:

Sulphur dioxide (SO_2), smoke, soot particles, and water vapour.

Effects:

Classical smog causes serious respiratory problems such as asthma and bronchitis. It irritates the eyes and lungs and reduces visibility in the atmosphere. It also damages buildings and plants due to its acidic nature.

Example: It was commonly seen in industrial cities like London in the past.

2. Photochemical Smog (Oxidizing Smog)

Formation:

Photochemical smog is formed when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. Sunlight breaks nitrogen dioxide into reactive atoms, which then form ozone and other harmful substances like PAN (peroxyacetyl nitrate). This type of smog is common in warm, sunny, and traffic-heavy cities.

Main pollutants involved:

Nitrogen oxides (NO_x), VOCs, oxygen, and sunlight.

Effects:

Photochemical smog causes eye irritation, coughing, and breathing difficulties. It worsens asthma and can damage lung tissues. It also

harms crops, reduces plant growth, and damages materials like rubber and paint. It reduces visibility and creates a brown haze in the air.

Example: It is common in modern urban cities with heavy traffic, such as Los Angeles-type environments.

Summary:

Classical smog is mainly caused by coal burning and SO_2 in cold weather, while photochemical smog is caused by vehicle emissions (NO_x + VOCs) in sunlight. Both types are harmful and lead to serious health and environmental problems.

🌟 Q4. What is Acid Rain? Explain its formation with chemical reactions and write its effects on environment.

Definition of Acid Rain

Acid rain is a type of precipitation (rain, snow, fog or hail) that contains harmful acidic substances, mainly formed when sulphur dioxide (SO_2) and nitrogen oxides (NO_x) react with water, oxygen, and other chemicals in the atmosphere. When the pH of rain water becomes less than 5.6, it is called acid rain.

✦ Formation of Acid Rain (Chemical Reactions)

Acid rain is mainly formed through two important processes:

1. Formation of Sulphuric Acid (H_2SO_4)

Sulphur dioxide is released from burning fossil fuels (coal, oil). It is oxidized in the atmosphere and reacts with water.

First, sulphur dioxide reacts with oxygen:

$2SO_2 + O_2 \longrightarrow 2SO_3$

Then sulphur trioxide reacts with water vapour:

$SO_3 + H_2O \longrightarrow H_2SO_4$ (Sulphuric acid)

This sulphuric acid dissolves in rainwater and falls as acid rain.

2. Formation of Nitric Acid (HNO_3)

Nitrogen oxides are produced from vehicle engines and industrial combustion. These gases also react in the atmosphere.

Nitrogen dioxide reacts with water and oxygen to form nitric acid:

$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$ (Nitric acid)

This nitric acid also mixes with rainwater and contributes to acid rain.

✦ Effects of Acid Rain on Environment

1. Effects on Buildings and Monuments

- Acid rain reacts with materials like marble and limestone, causing corrosion and damage.
- It slowly destroys historical buildings and statues.

Example: Taj Mahal is affected by acid rain pollution.

2. Effects on Soil

Acid rain increases soil acidity, which reduces soil fertility. It also removes important nutrients like calcium and magnesium from soil, making it less productive for plants.

3. Effects on Aquatic Life

When acid rain flows into rivers and lakes, it lowers the pH of water. This harms fish and other aquatic organisms, sometimes leading to death of aquatic life.

4. Effects on Plants

Acid rain damages leaves, reduces chlorophyll content, and slows down plant growth. It weakens forests and reduces agricultural productivity.

Summary:

Acid rain is a serious environmental problem caused mainly by SO_2 and NO_x emissions from human activities. It leads to environmental degradation, damage to buildings, soil infertility, and harm to aquatic and plant life. Controlling industrial emissions and vehicle pollution is essential to reduce acid rain.

🌟 Q5. Explain greenhouse effect and global warming in detail. Discuss causes, mechanism and impacts on environment.

Definition of Greenhouse Effect

The greenhouse effect is a natural process in which certain gases in the atmosphere trap heat and keep the Earth warm enough to support life. These gases are called greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), water vapour, nitrous oxide (N_2O) and others.

✦ Mechanism of Greenhouse Effect

The process works in the following way:

1. Sun sends short-wave solar radiation towards Earth.
2. This radiation passes through the atmosphere and heats the Earth's surface.
3. The Earth then radiates heat back as long-wave infrared radiation.
4. Greenhouse gases absorb part of this outgoing heat and reflect it back to Earth.
5. This trapping of heat keeps the Earth warmer than it would be without atmosphere.

Simple idea: Atmosphere acts like a "blanket" around Earth.

Causes of Enhanced Greenhouse Effect (Human Activities)

Although the greenhouse effect is natural, human activities increase it abnormally:

- Burning of fossil fuels (coal, oil, gas) ⟶ increases CO_2
- Deforestation ⟶ reduces CO_2 absorption by trees
- Industrial emissions ⟶ release CO_2, NO_x, CH_4

- Vehicles ⟶ release greenhouse gases
- Agriculture (livestock, fertilizers) ⟶ methane and nitrous oxide

Definition of Global Warming

Global warming refers to the gradual increase in Earth's average temperature due to excessive accumulation of greenhouse gases in the atmosphere.

Relation between Greenhouse Effect and Global Warming

When greenhouse gases increase, more heat is trapped in the atmosphere. This leads to a rise in Earth's temperature, which is called global warming.

Impacts of Global Warming on Environment

1. Climate Change

Global warming disturbs natural climate patterns, leading to:

- Irregular rainfall
- Heat waves
- Changes in seasons

2. Melting of Ice Caps and Sea Level Rise

Increased temperature causes melting of glaciers and polar ice, which leads to rising sea levels and flooding in coastal areas.

3. Effects on Ecosystems

Many plants and animals cannot survive rapid temperature changes, leading to:

- Loss of biodiversity
- Migration of species
- Disruption of food chains

4. Human Health Effects

Global warming increases:

- Heat strokes
- Spread of diseases
- Respiratory problems due to pollution

5. Agricultural Impact

- Reduced crop production due to heat stress
- Irregular rainfall affects farming
- Soil moisture imbalance

Summary:

The greenhouse effect is essential for life, but human activities have intensified it, leading to global warming. This causes serious environmental problems such as climate change, melting glaciers, biodiversity loss, and health risks. Controlling fossil fuel use and deforestation is necessary to reduce its impact.

🌟 Q6. Discuss sources of air pollution in detail

Air pollution comes from different natural and human-made sources. These sources release harmful gases and particles into the atmosphere, affecting air quality and human health.

1. Natural Sources of Air Pollution

Natural sources are those that occur without human activities. They contribute to air pollution, although usually on a smaller scale compared to human sources.

(i) Volcanic Eruptions

Volcanoes release large amounts of ash, dust, sulphur dioxide (SO_2) and other gases into the atmosphere. These particles can spread over long distances and reduce air quality.

Example: Volcanic ash clouds can block sunlight and affect climate temporarily.

(ii) Dust Storms

Strong winds lift soil particles and dust into the air, increasing particulate matter (PM) levels.

Example: Desert storms can reduce visibility and cause breathing problems.

(iii) Swamps and Wetlands

Swamps produce methane gas (CH_4) due to decomposition of organic matter in oxygen-free conditions.

Example: Marshy areas release methane naturally into the atmosphere.

(iv) Ocean Gases

Algae and marine organisms release gases such as hydrogen sulphide (H_2S) and other volatile compounds into the atmosphere.

Example: Ocean surface biological activity contributes to natural gas emissions.

2. Human-Made (Anthropogenic) Sources of Air Pollution

Human activities are the major cause of air pollution, especially in urban and industrial areas.

(i) Vehicles

Cars, buses, trucks, and airplanes burn fossil fuels and release:

- Carbon monoxide (CO)
- Nitrogen oxides (NO_x)
- Particulate matter (PM)
- Hydrocarbons

Example: Heavy traffic in cities increases smog formation.

(ii) Industries

Factories and power plants burn fossil fuels and release large amounts of:

- Sulphur dioxide (SO_2)
- Carbon dioxide (CO_2)
- Nitrogen oxides (NO_x)
- Toxic chemicals

Example: Industrial zones often have high air pollution levels.

(iii) Burning of Fossil Fuels

Coal, oil, and natural gas are burned for electricity and energy production. This releases:

- CO_2 (major greenhouse gas)
- CO (from incomplete combustion)
- SO_2 and NO_x

Example: Thermal power plants contribute heavily to air pollution.

(iv) Domestic Activities

Burning wood, coal, and waste in homes releases smoke, carbon monoxide, and particulate matter.

Summary:

Air pollution originates from both natural and human-made sources. However, human activities such as vehicles, industries, and fossil fuel burning are the main contributors. These pollutants degrade air quality and cause serious environmental and health problems.

🌟 Q7. Explain Air Quality Index (AQI) and its importance. What AQI values represent good and hazardous air quality? Also explain health effects of poor AQI.

Definition:

Air Quality Index (AQI) is a numerical scale used to measure and report the level of air pollution in a particular area. It tells how clean or polluted the air is and what health effects may be expected.

AQI is calculated based on the concentration of major air pollutants such as:

- Particulate matter (PM2.5 and PM10)
- Carbon monoxide (CO)
- Sulphur dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Ozone (O_3)

Importance of AQI

AQI is important because:

- It helps people understand air quality status in simple form
- It warns the public about health risks
- It helps governments take pollution control measures
- It is useful for children, elderly, and patients with lung or heart diseases
- It supports environmental monitoring and planning

AQI Levels (Good and Hazardous Air Quality)

- Good Air Quality: AQI 0–50
- Air is clean and safe for outdoor activities with no health risk.
- Moderate Air Quality: AQI 51–100
- Air is acceptable but sensitive people may experience mild discomfort.
- Hazardous Air Quality: AQI above 300
- Air is extremely polluted and dangerous for everyone.

Health Effects of Poor AQI

Poor AQI means high pollution levels, which can seriously affect human health:

1. Respiratory Problems

Air pollutants like PM, NO_2, and O_3 cause:

- Asthma attacks
- Bronchitis
- Difficulty in breathing
- Chronic cough

2. Cardiovascular Diseases

Fine particles enter the bloodstream and can lead to:

- Heart attacks
- High blood pressure

- Stroke

3. Eye, Nose and Throat Irritation

Poor air quality causes:

- Burning eyes
- Throat irritation
- Nasal discomfort

4. Cancer Risk

Long-term exposure to polluted air, especially PM and toxic gases, increases the risk of:

- Lung cancer

5. Effects on Sensitive Groups

Children, elderly people, and patients with heart or lung diseases are at higher risk of severe health complications.

Summary:

AQI is a very important tool to measure air pollution and protect public health. A low AQI (0–50) is safe, while a high AQI (above 300) is hazardous and dangerous for human health. Poor AQI can lead to serious respiratory, cardiovascular, and long-term health diseases.

🌟 Q8. Describe the effects of air pollutants on human health

Answer:

Air pollution has serious impacts on human health. When people inhale polluted air containing gases and particles such as PM, NO_2, SO_2, CO, VOCs, and heavy metals, these pollutants enter the respiratory system and sometimes the bloodstream, causing both short-term and long-term diseases.

1. Respiratory Diseases

Air pollutants mainly affect the lungs and breathing system.

Effects:

- Irritation of airways
- Asthma attacks
- Bronchitis (inflammation of bronchial tubes)
- Chronic cough and breathing difficulty
- Lung infections such as pneumonia

Fine particles like PM2.5 can penetrate deep into lungs and damage lung tissues.

Example: People living in heavy traffic cities often suffer from asthma and breathing problems due to smog.

2. Cardiovascular Diseases

Air pollution does not only affect lungs but also the heart and blood system.

Effects:

- Increased risk of heart attack
- High blood pressure
- Stroke
- Damage to blood vessels due to inflammation

Fine particulate matter enters the bloodstream and affects heart function.

Example: Long-term exposure to industrial pollution increases risk of heart diseases in urban populations.

3. Cancer

Certain air pollutants are carcinogenic (cancer-causing).

Effects:

- Lung cancer due to long-term exposure
- DNA damage caused by toxic chemicals
- Increased risk from pollutants like benzene and PAHs

Example: Industrial workers exposed to chemical fumes have higher chances of lung cancer.

4. Reproductive and Developmental Effects

Air pollution also affects reproductive health in both males and females.

Effects:

- Reduced fertility
- Hormonal imbalance
- Premature birth in pregnant women
- Low birth weight in newborns
- Developmental problems in children

Example: Pregnant women exposed to high air pollution may deliver babies with health complications.

Summary:

Air pollution affects almost every system of the human body. It leads to respiratory diseases, heart problems, cancer, and reproductive issues, especially in people living in polluted urban and industrial areas. Reducing air pollution is essential for protecting human health.

🌟 Q9. Discuss methods and technologies used to control air pollution

Answer:

Air pollution can be controlled using different technologies and engineering methods. These methods mainly reduce harmful gases and particles from vehicles and industries before they enter the atmosphere.

1. Catalytic Converter (CC)

A catalytic converter is a device fitted in vehicle exhaust systems to reduce harmful gases.

Working principle:

It uses catalysts like platinum, palladium, and rhodium to convert toxic gases into less harmful substances.

Process:

- Carbon monoxide (CO) is oxidized into carbon dioxide (CO_2)
- Nitrogen oxides (NO_x) are reduced into nitrogen (N_2)
- Unburnt hydrocarbons are converted into CO_2 and water vapour

Importance:

- Reduces vehicle pollution
- Controls smog formation
- Improves air quality in cities

2. Diesel Particulate Filter (DPF)

A diesel particulate filter is used in diesel engines to reduce soot and particulate matter (PM).

Working principle:

It traps fine carbon particles (soot) from exhaust gases and stores them. Later, these particles are burned at high temperature to clean the filter.

Importance:

- Reduces PM2.5 emissions
- Prevents respiratory diseases
- Improves engine efficiency and air quality

3. Selective Catalytic Reduction (SCR)

SCR is a technology used in diesel engines and power plants to reduce nitrogen oxide emissions.

Working principle:

A chemical (usually ammonia or urea solution) is injected into exhaust gases. In the presence of a catalyst, it converts NO_x into harmless nitrogen and water.

Process:

$NO_x \longrightarrow N_2 + H_2O$ (harmless gases)

Importance:

- Strong reduction of NO_x emissions
- Helps in preventing acid rain
- Improves environmental safety

4. Scrubbers

Scrubbers are devices used in industrial plants to remove air pollutants using a liquid (usually water or chemical solution).

Working principle:

Polluted gases are passed through a liquid spray. Harmful gases and particles dissolve or react with the liquid and get removed.

Pollutants removed:

- Sulphur dioxide (SO_2)
- Hydrogen chloride (HCl)
- Ammonia (NH_3)
- Particulate matter (PM)
- Some VOCs

Importance:

- Reduces industrial air pollution
- Controls acid rain formation
- Improves air quality near factories

Summary:

Air pollution control technologies like catalytic converters, diesel particulate filters, selective catalytic reduction, and scrubbers are very important for reducing harmful emissions. These methods help in protecting human health, environment, and climate system.

📘 EXERCISE

Q.1 Four choices are given for each question. Select the correct choice.

I. Which gas causes yellow color in photochemical smog?

a) CO

b) SO_3

✔ c) NO_2

d) SO_2

II. The depletion of ozone in stratosphere region is mainly due to reaction of O_3 with:

a) CO_2

b) SO_2

c) O_2

✔ d) CFCs

III. Which particulate matter size is most harmful to human health?

a) PM 10.0

b) PM 5.0

✔ c) PM 2.5

d) PM 1.0

IV. Which natural factor improves air quality?

a) Wildfire

b) Urbanization

✔ c) Rainfall

d) Industrial emission

V. Common human activity increasing CO level:

a) Tree planting

✔ b) Gasoline driven vehicles

c) Using electric appliances

d) Solar panel installation

VI. CFCs are primarily used in:

a) Fertilizers

✔ b) Refrigerants and aerosol propellants

c) Pharmaceuticals

d) Pesticides

VII. Primary process that removes CO_2 from atmosphere:

a) Combustion

✔ b) Photosynthesis

c) Respiration

d) Volcanic activity

VIII. AQI 51–100 indicates:

a) Good

✔ b) Moderate

c) Unhealthy

d) Fatal

IX. Acid rain is caused by release of:

a) CO_2 and CH_4

✔ b) SO_2 and NO_x

c) CFCs and halons

d) O_3 and CO

X. VOCs + NO_x + sunlight form:

a) Acid rain

b) Ozone depletion

✔ c) Photochemical smog

d) Greenhouse gases

XI. Photochemical smog is a:

a) Primary pollutant

✔ b) Secondary pollutant

c) Naturally occurring gas

d) Harmless byproduct

Q.2 Attempt the following short-answer questions:

a. Identify and briefly explain three major natural sources of air pollutants.

Natural sources of air pollution occur without human involvement.

Volcanic eruptions: Release ash, dust, sulphur dioxide (SO_2) and other gases into the atmosphere, reducing air quality and sometimes affecting climate.

Dust storms: Strong winds lift soil and sand particles into the air, increasing particulate matter (PM) and reducing visibility.

Swamps and wetlands: Produce methane (CH_4) due to decomposition of organic matter in oxygen-free conditions.

b. How can deforestation impact air quality?

Deforestation reduces the number of trees that absorb carbon dioxide (CO_2). As a result, CO_2 concentration increases in the atmosphere. Since CO_2 is a greenhouse gas, it leads to global warming and poor air quality.

Deforestation also increases dust levels and reduces oxygen production, further disturbing atmospheric balance.

c. Explain temperature trends in the troposphere and stratosphere.

Troposphere: Temperature decreases with altitude because the Earth's surface absorbs solar energy and heats the lower air. As height increases, air becomes thinner and cooler.

Stratosphere: Temperature increases with altitude because the ozone layer absorbs ultraviolet (UV) radiation from the Sun, releasing heat and warming this layer.

d. Four anthropogenic activities contributing to air pollution (with pollutants).

- **Vehicle emissions:** Release carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM).
- **Industrial processes:** Emit sulphur dioxide (SO_2), CO_2, and toxic chemicals.
- **Burning fossil fuels (power plants):** Produce CO_2, SO_2, and NO_x.
- **Agricultural activities:** Use fertilizers that release nitrous oxide (N_2O) and ammonia (NH_3), contributing to pollution and climate change.

e. What are the environmental impacts of persistent organic pollutants (POPs)?

Persistent organic pollutants (POPs) are toxic chemicals that do not easily break down in the environment. Their impacts include:

- Long-term contamination of soil, water, and air
- Bioaccumulation in food chains, affecting animals and humans
- Harm to wildlife reproduction and survival
- Global transport through wind and water, affecting distant regions

Example: DDT and PCBs remain in the environment for long periods.

f. How does polycyclic aromatic hydrocarbons (PAHs) affect human health?

Polycyclic aromatic hydrocarbons (PAHs) are formed during incomplete combustion of fossil fuels, wood, and waste.

- They are carcinogenic (cancer-causing) substances
- Long-term exposure increases risk of lung cancer
- They can damage DNA and affect cell function
- Also cause respiratory irritation and weaken immune system

Example: Exposure occurs from vehicle exhaust and grilled or burnt food.

g. What is photochemical smog? Under what conditions does it form?

Photochemical smog is a type of air pollution formed when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. It produces harmful substances like ozone (O_3) and PAN (peroxyacetyl nitrate).

It forms mainly in:

- Sunny and warm weather
- Areas with heavy traffic
- Cities with high vehicle emissions

It appears as a brownish haze in the atmosphere.

h. What type of data does Air Quality Index (AQI) provide?

AQI provides numerical data about the level of air pollution in a specific area. It shows:

- Concentration of pollutants ($PM_{2.5}$, PM_{10}, CO, SO_2, NO_2, O_3)
- Overall air quality status (good, moderate, unhealthy, hazardous)
- Health risk level for humans

It helps people understand how safe or dangerous the air is for breathing.

i. Distinguish between PM_{10} and $PM_{2.5}$ and explain which is more harmful.

PM_{10}: Particulate matter with size 10 micrometers or less. It can enter the nose and upper respiratory tract.

$PM_{2.5}$: Fine particulate matter with size 2.5 micrometers or less. It is much smaller.

Why $PM_{2.5}$ is more harmful:

- It can penetrate deep into lungs
- It can enter the bloodstream
- Causes serious heart and lung diseases
- Therefore, $PM_{2.5}$ is more dangerous than PM_{10}.

j. What are the main chemical processes involved in acid rain formation?

Acid rain is formed when SO_2 and NO_x react with water and oxygen in the atmosphere.

Main reactions:

$2SO_2 + O_2 \longrightarrow 2SO_3$

$SO_3 + H_2O \longrightarrow H_2SO_4$ (sulphuric acid)

$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$ (nitric acid)

These acids dissolve in rainwater and fall as acid rain.

k. What are the specific measures to control smog?

Smog can be controlled by:

- Reducing vehicle emissions using public transport
- Using clean fuels like CNG and LPG

- Installing catalytic converters in vehicles
- Controlling industrial emissions
- Planting trees to absorb pollutants
- Restricting burning of fossil fuels and waste

l. How does a catalytic converter reduce harmful vehicle emissions?

A catalytic converter is fitted in vehicle exhaust systems. It uses catalysts like platinum and palladium to convert harmful gases into less harmful ones.

It works by:

- Converting CO into CO_2
- Converting NO_x into N_2 (nitrogen gas)
- Converting unburnt hydrocarbons into CO_2 and water

This reduces air pollution from vehicles significantly.

m. Describe the sources of lead and mercury pollution.

Lead and mercury are toxic heavy metals released from:

- **Industrial processes:** metal smelting and chemical industries
- **Battery waste:** especially lead-acid batteries
- **Burning of waste:** incineration of industrial and municipal waste
- **Mining activities:** release mercury and lead into air and water

These metals are dangerous because they accumulate in the body and cause brain, kidney, and nervous system damage.

DESCRIPTIVE QUESTIONS

🌟 Q.3 Discuss sources and effects of following air pollutants on environment

Air pollutants such as heavy metals, VOCs, PAHs and POPs are highly dangerous because they affect air quality, human health, and ecosystems even at low concentrations.

i) Heavy Metals (Lead, Mercury, Cadmium)

Sources:

Heavy metals are released mainly from industrial and human activities, such as:

- Metal smelting and refining industries
- Battery manufacturing and battery waste disposal
- Waste incineration (burning of garbage and industrial waste)
- Vehicle emissions (especially older fuels containing lead)

Effects:

- Cause severe toxicity in living organisms
- Damage the nervous system, kidneys, and brain
- Lead exposure reduces learning ability in children
- Mercury can contaminate water and enter food chains (fish)

- They bioaccumulate, meaning they build up in organisms over time

ii) Volatile Organic Compounds (VOCs)

Sources:

VOCs are released from substances that easily evaporate, such as:

- Vehicle exhaust and fuel evaporation
- Paints, solvents, and cleaning chemicals
- Industrial emissions
- Burning of fossil fuels and waste

Effects:

- Cause eye, nose, and throat irritation
- Lead to headaches, dizziness, and nausea
- Long-term exposure can damage liver, kidneys, and nervous system
- Contribute to photochemical smog formation
- Some VOCs (like benzene) are carcinogenic

iii) Polycyclic Aromatic Hydrocarbons (PAHs)

Sources:

PAHs are produced during incomplete combustion of carbon-based materials, such as:

- Burning of coal, oil, petrol, and wood

- Vehicle exhaust emissions
- Industrial processes
- Forest fires and natural burning
- Grilled or charred food

Effects:

- Many PAHs are carcinogenic (cause cancer)
- Damage DNA and cells in the human body
- Cause lung and skin cancers
- Irritate eyes and respiratory system
- Accumulate in soil and water, affecting ecosystems

iv) Persistent Organic Pollutants (POPs)

Sources:

POPs are stable organic chemicals released from:

- Agricultural pesticides (e.g., DDT)
- Electrical equipment (e.g., PCBs)
- Industrial chemical processes
- Waste burning and chemical industries

Effects:

- Remain in environment for long periods without breaking down
- Travel long distances through air and water
- Accumulate in fat tissues of animals and humans
- Cause hormonal imbalance and reproductive disorders

- Harm wildlife, especially birds and aquatic life
- Long-term exposure may lead to cancer and immune system damage

Summary:

Heavy metals, VOCs, PAHs, and POPs are highly toxic pollutants that originate mainly from human activities. They persist in the environment, spread widely, and cause serious health risks and ecological damage. Controlling industrial emissions and chemical use is essential to reduce their impact.

🌟 Q.4 Short Notes

i) CFCs and Ozone Layer Depletion

Chlorofluorocarbons (CFCs) are synthetic gases used mainly in refrigerators, air conditioners, aerosol sprays, and foam production. They are chemically stable in the lower atmosphere, so they slowly reach the stratosphere.

In the stratosphere, CFCs are broken down by ultraviolet (UV) radiation, releasing chlorine free radicals (Cl·). These radicals are highly reactive and destroy ozone molecules.

Ozone destruction process:

$Cl\cdot + O_3 \longrightarrow ClO + O_2$

$ClO + O \longrightarrow Cl\cdot + O_2$

The chlorine radical is regenerated again and again, so a single CFC molecule can destroy many ozone molecules.

Effects of ozone depletion:

- Increased UV radiation reaches Earth
- Causes skin cancer and eye cataracts
- Damages crops and marine life
- Weakens immune system in humans

ii) Greenhouse Effect and Global Warming

The greenhouse effect is a natural process in which gases like CO_2, CH_4, and water vapour trap heat in the Earth's atmosphere and keep the planet warm enough for life.

These gases allow sunlight (short-wave radiation) to enter but absorb and re-emit heat (long-wave infrared radiation) back to Earth, acting like a "blanket."

Enhanced greenhouse effect:

Human activities such as burning fossil fuels, deforestation, and industrial emissions increase greenhouse gases, trapping more heat than normal.

Global warming:

Global warming is the gradual increase in Earth's average temperature due to excess greenhouse gases.

Effects of global warming:

- Melting of glaciers and polar ice
- Rise in sea levels
- Climate change and extreme weather
- Loss of biodiversity
- Impact on agriculture and human health

Summary:

CFCs mainly damage the ozone layer, while greenhouse gases increase Earth's temperature. Both are serious environmental problems caused largely by human activities and need strict control.

🌟 Q.5 How fossil fuel burning causes acid rain?

Acid rain is a form of environmental pollution that occurs when gases released from the burning of fossil fuels mix with water vapour in the atmosphere and form strong acids. These acids then return to Earth through rain, snow, fog, or dry particles.

Fossil fuels such as coal, petrol, diesel, and natural gas are widely used in vehicles, industries, and power plants. When these fuels burn, they release two major harmful gases:

- Sulphur dioxide (SO_2)
- Nitrogen oxides (NO_x)

These gases are the main causes of acid rain.

1. Formation of Sulphuric Acid (H_2SO_4)

Coal and oil contain small amounts of sulphur. When they are burned, sulphur reacts with oxygen in air and forms sulphur dioxide:

SO_2 is then further oxidized in the atmosphere:

$SO_2 + O_2 \longrightarrow SO_3$

After this, sulphur trioxide reacts with water vapour present in clouds:

$SO_3 + H_2O \longrightarrow H_2SO_4$

This produces sulphuric acid, which is a strong acid and a major component of acid rain.

2. Formation of Nitric Acid (HNO_3)

High temperature combustion in vehicles and industries causes nitrogen and oxygen from air to react, forming nitrogen oxides (NO_x), mainly NO and NO_2.

These nitrogen oxides react with oxygen and water vapour in the atmosphere:

$4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$

This produces nitric acid, which also contributes significantly to acid rain.

3. Transport and Deposition of Acids

After formation, these acids mix with cloud droplets. Wind can carry them over long distances. Finally, they fall to the Earth in different forms:

- Acid rain
- Acid snow
- Acid fog

Even dry particles containing acids can settle on surfaces.

4. Environmental Effects of Acid Rain

(i) Damage to buildings and monuments

Acid rain reacts with materials like limestone and marble, causing erosion and weakening historical buildings.

(ii) Soil degradation

It removes essential nutrients from soil, making it less fertile and harmful for plant growth.

(iii) Water pollution

When acid rain enters rivers and lakes, it lowers the pH of water, which can kill fish and other aquatic organisms.

(iv) Plant damage

Acid rain damages leaves, reduces chlorophyll content, and slows down photosynthesis, affecting crop yield.

Summary:

Fossil fuel burning releases SO_2 and NO_x, which react with oxygen and water in the atmosphere to form sulphuric acid (H_2SO_4) and nitric acid (HNO_3). These acids fall as acid rain and cause serious damage to the environment, ecosystems, and human infrastructure.

🌟 Q.6 What is meant by Air Quality Index (AQI)? Describe the factors affecting air quality.

Meaning of Air Quality Index (AQI)

Air Quality Index (AQI) is a numerical scale used to measure and report how clean or polluted the air is in a specific location. It is calculated from the concentration of major air pollutants such as:

- Particulate matter ($PM_{2.5}$ and PM_{10})
- Carbon monoxide (CO)
- Nitrogen dioxide (NO_2)
- Sulphur dioxide (SO_2)
- Ozone (O_3)

AQI converts complex pollution data into a simple number that tells the level of health risk.

- 0–50: Good air quality (safe for all)
- 51–100: Moderate air quality
- Above 300: Hazardous (very dangerous for health)

Factors Affecting Air Quality

Air quality is affected by several natural and human-related factors:

1. Emission Sources

These are the main contributors to air pollution.

- Vehicles: Release CO, NO_x, VOCs, and particulate matter.
- Industries and power plants: Emit SO_2, NO_x, CO_2, and toxic chemicals.
- Burning of fossil fuels and wood: Produces smoke, CO, and PM.

These emissions directly increase pollution levels in the air.

2. Meteorological Conditions (Weather Factors)

Weather plays an important role in air quality.

- **Wind speed:** Helps disperse pollutants or trap them in one area.
- **Temperature:** Warm air can trap pollutants near the ground (temperature inversion).
- **Humidity:** Moist air can increase formation of smog and acid particles.

3. Natural Events

Natural processes can also worsen air quality.

- **Wildfires:** Produce large amounts of smoke and particulate matter.

- **Dust storms:** Increase dust and PM levels in the atmosphere.
- **Volcanic eruptions:** Release ash and gases like SO_2.

4. Seasonal Changes

Air quality changes with seasons.

- In winter, temperature inversion traps pollutants near the ground.
- In summer, sunlight increases photochemical smog formation.

Pollen levels increase in spring, affecting air quality.

Summary:

AQI is an important tool that shows how polluted the air is and helps protect public health. Air quality is influenced by emission sources, weather conditions, natural events, and seasonal changes. Controlling emissions is the most effective way to improve AQI.

Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

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Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.