Class: 12th

Subject: Chemistry

chapter 16: ENVIRONMENTAL CHEMISTRY

🩸 Important MCQs (From key points)

1. Environmental chemistry deals with:

(a) Composition of metals

(b) Study of pollutants and their effects on environment ✅

(c) Study of rocks only

(d) Study of medicines

2. The environment consists of how many main components?

(a) Two

(b) Three

(c) Four ✅

(d) Five

3. Primary air pollutants include:

(a) Oxygen and nitrogen

(b) Water vapours only

(c) CO, SO_2, SO_3, NO_x and hydrocarbons ✅

(d) Noble gases

4. Acid rain is mainly caused by:

(a) Carbon dioxide

(b) Oxides of sulphur and nitrogen mixing with rain water ✅

(c) Hydrogen gas

(d) Methane

5. Photochemical smog is primarily caused by:

(a) Water vapours

(b) Oxidants like nitrogen oxides and hydrocarbons ✅

(c) Dust particles

(d) Oxygen molecules

6. Ozone layer protects life by absorbing:

(a) Infrared radiation

(b) Visible light

(c) Ultraviolet radiation from the sun ✅

(d) Sound waves

7. Water pollution may cause diseases such as:

(a) Diabetes

(b) Dysentery, typhoid, hepatitis, cancer in some cases ✅

(c) Asthma only

(d) Blood pressure

8. Potable water is purified by:

(a) Freezing and boiling

(b) Aeration, coagulation and chlorination ✅

(c) Mixing sand

(d) Sedimentation only

9. Domestic municipal solid waste includes:

(a) Only plastics

(b) Only metals

(c) Paper, plastic, vegetables, glass, textiles, food waste etc. ✅

(d) Only wood

10. Recycling of waste materials like paper, plastic, glass and aluminium helps in:

(a) Increasing pollution

(b) Increasing waste volume

(c) Making waste reusable and reducing waste volume ✅

(d) Producing more toxic gases

🩸 Important MCQs:

1. Environmental chemistry deals with:

(a) Minerals

(b) Space reactions

(c) Chemicals and pollutants in the environment ✅

(d) Nuclear particles

2. The layer of gases surrounding the Earth is called:

(a) Biosphere

(b) Hydrosphere

(c) Atmosphere ✅

(d) Lithosphere

3. Nitrogen gas in the atmosphere is present about:

(a) 21%

(b) 0.03%

(c) 78% ✅

(d) 0.9%

4. Carbon dioxide in the atmosphere is:

(a) 0.03% ✅

(b) 0.9%

(c) 21%

(d) 78%

5. Half of the atmospheric mass lies in the lower:

(a) 10 km

(b) 5.6 km ✅

(c) 20 km

(d) 100 km

6. Which gas is essential for photosynthesis?

(a) Nitrogen

(b) Argon

(c) Oxygen

(d) Carbon dioxide ✅

7. The hydrosphere includes:

(a) Only oceans

(b) Only rivers

(c) All water bodies on Earth ✅

(d) Only lakes

8. Oceans contain how much percent of Earth's total water?

(a) 50%

(b) 30%

(c) 97% ✅

(d) 10%

9. Fresh water available for human use is:

(a) 2%

(b) 1% ✅

(c) 10%

(d) 5%

10. Agriculture uses how much of fresh water?

(a) 23%

(b) 69% ✅

(c) 8%

(d) 50%

11. Lithosphere mainly consists of:

(a) Gases

(b) Rocky crust of Earth ✅

(c) Clouds

(d) Water vapours

12. The most abundant element in lithosphere is:

(a) Silicon

(b) Iron

(c) Aluminium

(d) Oxygen ✅

13. Biosphere is the region:

(a) Without life

(b) Only of oceans

(c) Supporting life on Earth ✅

(d) Only atmosphere

14. Ecosystem consists of:

(a) Only plants

(b) Rocks and minerals

(c) Community of organisms and their environment ✅

(d) Only animals

15. Any substance causing damage to human health or ecosystems is called:

(a) Nutrient

(b) Mineral

(c) Environmental pollutant ✅

(d) Fertilizer

16. The substances released directly into the air from industries and vehicles are called:

(a) Secondary pollutants

(b) Greenhouse gases

(c) Primary pollutants ✅

(d) Natural pollutants

17. Secondary pollutants are formed by:

(a) Combustion of coal only

(b) Direct emission from vehicles

(c) Chemical reactions of primary pollutants in air ✅

(d) Oxidation of metals only

18. Carbon monoxide is:

(a) Coloured and fragrant

(b) Colourless and odourless gas ✅

(c) Yellowish solid

(d) Greenish toxic liquid

19. Major human source of CO emission is:

(a) Power plants

(b) Industries

(c) Transportation (vehicles) 75% ✅

(d) Forests

20. Carbon monoxide poisoning occurs because it binds strongly with:

(a) Plasma

(b) Red blood cells

(c) Haemoglobin more strongly than oxygen ✅

(d) Platelets

21. Natural source of nitrogen oxides (NOx) is:

(a) Burning coal

(b) Forest fires

(c) Bacterial action in soil ✅

(d) CFC sprays

22. Nitrogen dioxide (NO_2) is produced when:

(a) NO reacts with oxygen ✅

(b) CO reacts with water

(c) SO_2 reacts with nitrogen

(d) O_3 reacts with CO

23. Major natural source of SO_2 on global scale is:

(a) Coal burning

(b) Volcanoes producing 67% SO_2 ✅

(c) Forest burning

(d) Automobile exhaust

24. Burning of coal containing sulphur produces:

(a) Only SO_3

(b) Only SO_2

(c) SO_2 and SO_3 both ✅

(d) Carbonic acid

25. A major natural source of methane (CH_4) is:

(a) Oxidation of metals

(b) Decomposition of organic matter by bacteria (anaerobic) ✅

(c) Burning of plastics

(d) Rusting of iron

26. Photochemical smog is mainly formed by reactions of:

(a) SO_2 and dust

(b) NO and hydrocarbons in sunlight ✅

(c) CO_2 and water vapour

(d) Methane and nitrogen

27. Yellowish-brown colour of photochemical smog is due to:

(a) Carbon monoxide

(b) Nitric oxide

(c) Nitrogen dioxide (NO_2) ✅

(d) Ozone

28. Eye irritation in photochemical smog is mainly caused by:

(a) SO_2

(b) PAN (Peroxyacetyl nitrate) ✅

(c) CO

(d) H_2SO_3

29. Ozone layer is located at a height of:

(a) 0–10 km

(b) 25–28 km in stratosphere ✅

(c) 60–70 km

(d) 100 km and above

30. Unit used to measure ozone concentration is:

(a) Pascal

(b) Poise

(c) Dobson Unit (DU) ✅

(d) ppm

31. The ozone hole was discovered in:

(a) 1960s

(b) 1970s

(c) 1980s over Antarctica ✅

(d) 1990s

32. CFCs damage ozone layer by producing:

(a) O_2 molecules

(b) Cl° free radicals that destroy O_3 molecules ✅

(c) SO_2 gas

(d) CO_2 gas

33. Oil spillage in oceans mainly affects:

(a) Only land plants

(b) Only domestic animals

(c) Marine life and aquatic organisms severely ✅

(d) Mountain animals

34. Detergents in wastewater mobilize toxic ions of:

(a) Sodium only

(b) Heavy metals like Pb, Cd, Hg from sediments into water ✅

(c) Noble gases

(d) Nitrogen oxides

35. Excessive use of pesticides results in:

(a) Increase in oxygen level in water

(b) No effect on soil

(c) Contamination of food chain and drinking water supply ✅

(d) Removal of heavy metals

36. Heavy metals such as Pb, Cd, Hg are harmful because they:

(a) Are biodegradable

(b) Have accumulation effects in the body ✅

(c) Improve metabolism

(d) Are nutrients

37. Chromium (VI) used in leather tanning is:

(a) Harmless

(b) A disinfectant

(c) Highly toxic ✅

(d) Non-reactive

38. Dissolved oxygen (DO) less than 4 ppm indicates:

(a) Clean water

(b) Polluted water ✅

(c) Distilled water

(d) Hard water

39. The normal range of dissolved oxygen (DO) in natural water is:

(a) 1–3 ppm

(b) 4–8 ppm ✅

(c) 10–15 ppm

(d) 20–30 ppm

40. BOD is measured over a period of:

(a) 24 hours

(b) 3 days

(c) 5 days ✅

(d) 10 days

41. Higher BOD value indicates:

(a) Less organic matter

(b) More organic pollution ✅

(c) Higher DO

(d) Hard water

42. COD of water is measured using:

(a) Potassium chloride

(b) Dichromate ions ✅

(c) Sodium bicarbonate

(d) Sulphuric acid

43. High COD value means that water:

(a) Is pure

(b) Has more chemically oxidizable matter ✅

(c) Contains no organic matter

(d) Is soft

44. Aeration of water helps remove:

(a) Iron only

(b) Volatile organic compounds ✅

(c) Sodium ions

(d) Chlorine

45. Aeration converts Fe^{2+} into Fe^{3+} which forms:

(a) $FeCl_2$

(b) FeO

(c) $Fe(OH)_3$ ✅

(d) Fe_2O_3

46. Coagulation removes suspended impurities by forming:

(a) Aluminium hydroxide precipitate ✅

(b) Hydrogen gas

(c) Chloramines

(d) Sodium sulphate

47. The most common coagulant used in water treatment is:

(a) NaCl

(b) Alum ✅

(c) Glucose

(d) Urea

48. The most commonly used disinfecting agent in water treatment is:

(a) Ozone

(b) Hydrogen peroxide

(c) Hypochlorous acid ✅

(d) Ethanol

49. Hypochlorous acid (HOCl) is produced when chlorine reacts with:

(a) Air

(b) Water ✅

(c) Alcohol

(d) Sodium chloride

50. Chloramines in water are formed when HOCl reacts with:

(a) Carbon dioxide

(b) Ammonia ✅

(c) Sodium ions

(d) Iron ions

51. Solid waste management deals with the disposal of:

(a) Gases only

(b) Domestic, commercial and industrial wastes ✅

(c) Only liquids

(d) Only radioactive materials

52. Municipal solid waste mostly consists of:

(a) Only metals

(b) Only plastics

(c) Paper, plastics, glass, food waste etc. ✅

(d) Only chemicals

53. Dumping waste in seas and rivers causes:

(a) Increased oxygen

(b) Marine damage and health hazards ✅

(c) Purification of water

(d) No effect

54. Landfill is:

(a) Burning waste in air

(b) A large hole used for dumping waste ✅

(c) Filtering water

(d) Chemical oxidation

55. The liquid flowing through landfill waste is called:

(a) Slurry

(b) Leachate ✅

(c) Sludge

(d) Filtrate

56. Leachate contains:

(a) Only pure water

(b) Dissolved and microbial contaminants ✅

(c) Only gases

(d) Only metals

57. Gases produced in landfills include:

(a) Oxygen and nitrogen

(b) Methane, ammonia, hydrogen sulphide ✅

(c) Helium only

(d) Neon only

58. The process that reduces waste volume by two-thirds is:

(a) Recycling

(b) Landfill

(c) Incineration ✅

(d) Filtration

59. Incineration temperature range for municipal waste is:

(a) 100–200°C

(b) 900–1000°C ✅

(c) 2000–3000°C

(d) 100–150°C

60. The ash produced after incineration is disposed in:

(a) Rivers

(b) Lakes

(c) Landfills ✅

(d) Atmosphere

61. Hazardous industrial waste landfills have:

(a) No lining

(b) Less monitoring

(c) More lining of clay and plastic ✅

(d) No restrictions

62. Rotary kiln incineration burns waste at:

(a) 100–200°C

(b) 650–1100°C ✅

(c) 50–60°C

(d) 1500–2000°C

63. Secondary chamber temperature for hazardous waste incineration is:

(a) 100–150°C

(b) 300–500°C

(c) 950–1300°C ✅

(d) 1500–2000°C

64. Cooling of gases in incineration is achieved by:

(a) Passing through sand

(b) Evaporating water spray ✅

(c) Compressing air

(d) Freezing

65. Incineration of solid waste produces harmful:

(a) Vitamins

(b) Dioxins (carcinogenic compounds) ✅

(c) Carbohydrates

(d) Proteins

66. Oxides of nitrogen and sulphur emitted from incinerators cause:

(a) Fog

(b) Acid rain ✅

(c) Photosynthesis

(d) Sedimentation

67. Recycling is done to:

(a) Increase waste

(b) Reduce fuel

(c) Conserve resources and energy ✅

(d) Produce toxic gases

68. The largest recycled domestic waste item is:

(a) Plastic

(b) Glass

(c) Newspaper ✅

(d) Metal

69. In recycling newspaper, the release of chlorine and solvents is:

(a) Increased

(b) Reduced significantly ✅

(c) Unchanged

(d) Doubled

70. Depolymerization converts plastics into:

(a) Ash

(b) Low-quality waste

(c) Their original components again ✅

(d) Metals

🩸 Important Short Questions (From Key Points)

1. What is environmental chemistry?

Answer:

👉 Environmental chemistry is the study of the sources, reactions, movement, and effects of pollutants in the environment.

2. Name the four components of the environment.

Answer:

👉 The four components of the environment are atmosphere, hydrosphere, lithosphere, and biosphere.

3. What are primary air pollutants? Give any two examples.

Answer:

👉 Primary air pollutants are pollutants directly released into the air. Examples include carbon monoxide and sulphur dioxide.

4. How is acid rain formed?

Answer:

👉 Acid rain forms when oxides of sulphur and nitrogen react with rainwater to produce sulphuric and nitric acids.

5. Write any two harmful effects of acid rain.

Answer:

👉 Acid rain damages soil fertility and corrodes buildings and monuments.

6. What is photochemical smog and what causes it?

Answer:

👉 Photochemical smog is formed by the reaction of nitrogen oxides and hydrocarbons in sunlight.

7. Why is the ozone layer important for life on Earth?

Answer:

👉 The ozone layer absorbs harmful ultraviolet (UV) radiation from the sun, protecting life on Earth.

8. Write any two major sources of water pollution.

Answer:

👉 Major sources of water pollution include livestock waste and industrial waste.

9. What is potable water and how is it purified?

Answer:

👉 Potable water is safe drinking water. It is purified by aeration, coagulation, and chlorination.

10. What is recycling and why is it important?

Answer:

👉 Recycling is the process of reusing waste materials like paper, plastic, glass, and aluminium. It reduces the volume of waste and conserves resources.

🩸 Important Short Questions

1. Define environmental chemistry.

Answer:

👉 Environmental chemistry is the study of chemicals and pollutants in the environment, including their sources, reactions, transport, and effects on human beings and ecosystems.

2. Name the four components of the environment.

Answer:

👉 The four components of the environment are atmosphere, hydrosphere, lithosphere, and biosphere.

3. What is the atmosphere?

Answer:

👉 The atmosphere is the layer of gases surrounding the Earth, essential for sustaining life and protecting Earth from harmful radiation.

4. List the major gases present in the atmosphere with their approximate percentages.

Answer:

👉 Nitrogen (78%), Oxygen (21%), Argon (0.9%), Carbon dioxide (0.03%), and trace amounts of water vapour, methane, carbon monoxide, helium, neon, krypton, and xenon.

5. What is the hydrosphere?

Answer:

👉 The hydrosphere includes all water bodies such as oceans, rivers, lakes, glaciers, and groundwater reservoirs.

6. What percentage of Earth's water is fresh water available for human use?

Answer:

👉 Only 1% of Earth's total water is available as fresh water for human use.

7. Define lithosphere.

Answer:

👉 The lithosphere is the rigid rocky crust of the Earth extending up to 100 km depth, composed mainly of minerals and 11 major elements.

8. What is the biosphere?

Answer:

👉 The biosphere is the region of Earth capable of supporting life, including air, water, soil, and all living organisms.

9. What is an ecosystem?

Answer:

👉 An ecosystem is a smaller unit of the biosphere, consisting of a community of organisms and their interaction with the physical environment.

10. Define environmental pollutant.

Answer:

👉 An environmental pollutant is any substance in the environment that adversely affects human health, quality of life, or the natural functioning of an ecosystem.

11. Define air pollution.

Answer:

👉 Air pollution occurs when harmful substances are mixed in the atmosphere, damaging the environment, human health, and quality of life.

12. Name the primary air pollutants.

Answer:

👉 Carbon monoxide (CO), sulphur dioxide (SO_2), sulphur trioxide (SO_3), nitrogen oxides (NO, NO_2), hydrocarbons, ammonia, fluorine compounds, and radioactive materials.

13. Give two natural and two human sources of carbon monoxide.

Answer:

👉 **Natural:** volcanic eruptions, oxidation of methane; Human: fuel burning in vehicles, combustion in industries.

14. What are nitrogen oxides and how are they formed?

Answer:

👉 Nitrogen oxides (NO, NO_2) are gases formed by combustion of nitrogen-containing fuels at high temperatures and by bacterial action.

15. List the sources of sulphur oxides in the atmosphere.

Answer:

👉 **Natural**: volcanic eruptions, decomposition of organic matter; Human: combustion of coal, crude oil, and fossil fuels.

16. What is acid rain and how is it formed?

Answer:

👉 Acid rain is precipitation containing H_2SO_4 and HNO_3 formed when SO_2 and NOx react with water in the atmosphere.

17. Define smog and its types.

Answer:

👉 Smog is a combination of smoke and fog. Reducing smog contains SO_2; photochemical (oxidizing) smog contains oxidants like ozone and PAN.

18. What is ozone and what is its role in the atmosphere?

Answer:

👉 Ozone (O_3) is a gas in the stratosphere that absorbs harmful UV radiation, protecting life on Earth.

19. Explain the role of CFCs in ozone depletion.

Answer:

👉 CFCs release Cl° radicals in the stratosphere under UV light, which destroy ozone molecules.

20. List some human activities causing water pollution.

Answer:

👉 Livestock waste, oil spillage, detergents, pesticides, industrial effluents, mining, and petroleum or natural gas production.

21. How does livestock waste pollute water?

Answer:

👉 It contaminates surface and ground water with chemical and bacterial contents, causing diseases like dysentery, typhoid, and hepatitis.

22. Explain the effect of oil spillage on marine life.

Answer:

👉 Oil forms a layer on water reducing light penetration, affecting photosynthesis and oxygen levels, and hydrocarbons are toxic and carcinogenic to marine organisms.

23. How do detergents cause water pollution?

Answer:

👉 Detergents in wastewater mobilize heavy metals like Pb, Cd, and Hg, contaminating water and harming aquatic life.

24. What are pesticides and their environmental risks?

Answer:

👉 Pesticides are chemicals that kill or control pests. Improper use contaminates soil, plants, and water, entering the food chain and posing health risks.

25. Give examples of industrial waste pollutants.

Answer:

👉 Heavy metals (Pb, Cd, Cr, Hg, As, Sb), toxic organic compounds, oils, greases, and mineral acids from industries like tanneries, fertilizers, petrochemicals, textiles, and leather.

26. Why are heavy metals like Pb, Cd, Cr, As, and Hg considered highly toxic?

Answer:

👉 They have no safe limits, accumulate in the body through food or water, and cause anemia, kidney diseases, nervous disorders, and high blood pressure.

27. How do leather tanneries pollute the environment?

Answer:

👉 Leather tanneries use chromium (VI) salts, and untreated effluents discharged into land or sewage cause chromium (VI) pollution, which is highly toxic and carcinogenic.

28. What is Dissolved Oxygen (DO) in water?

Answer:

👉 DO is the concentration of molecular oxygen in water, ranging from 4–8 ppm, and is a key parameter to determine water quality.

29. What does a DO value less than 4 ppm indicate?

Answer:

👉 It indicates that the water is polluted.

30. Define Biochemical Oxygen Demand (BOD).

Answer:

👉 BOD is the amount of oxygen consumed by biological oxidation of dissolved organic matter in water over a period of five days.

31. Define Chemical Oxygen Demand (COD).

Answer:

👉 COD measures the amount of oxygen required to chemically oxidize organic matter in water using a strong oxidizing agent like dichromate ions.

32. Why is COD important in water quality assessment?

Answer:

👉 Higher COD values indicate more chemically oxidizable organic matter and thus higher pollution levels in water.

33. What is the purpose of aeration in water treatment?

Answer:

👉 Aeration removes dissolved gases, foul odors, oxidizes Fe^{2+} to Fe^{3+}, produces CO_2 from organic matter, and improves the oxygen level in water.

34. How does coagulation help in water purification?

Answer:

👉 Coagulants like alum cause suspended or colloidal particles to precipitate, removing more than 80% of impurities from water.

35. Which coagulants are commonly used in water treatment?

Answer:

👉 Aluminium sulphate (alum) and ferric salts.

36. Why is water disinfection necessary?

Answer:

👉 To kill pathogens that cause water-borne diseases such as typhoid and cholera.

37. What is the main disinfecting agent used in chlorination?

Answer:

👉 Hypochlorous acid (HOCl).

38. How is hypochlorous acid generated in water treatment?

Answer:

👉 By dissolving chlorine gas, sodium hypochlorite, or calcium hypochlorite in water.

39. What are the harmful effects of chlorination?

Answer:

👉 It can react with ammonia and organic matter to form toxic compounds like chloramines, nitrogen trichloride, chlorinated phenols, and chloroform, which are harmful and carcinogenic.

40. How can the formation of toxic chlorinated compounds be avoided in water treatment?

Answer:

👉 By using alternative disinfectants like ozone or chlorine dioxide instead of chlorine.

41. What is solid waste management?

Answer:

👉 It is the study and practice of disposing domestic, commercial, and industrial solid or semi-solid wastes.

42. What are the main components of municipal solid waste?

Answer:

👉 Papers, vegetables, plastics, wood, glass, rubber, leather, textile, metals, and food wastes.

43. What are the effects of dumping waste in seas and rivers?

Answer:

👉 It damages the marine environment and causes health hazards to humans.

44. What is a landfill?

Answer:

👉 A landfill is a large hole or piece of land where municipal solid waste is dumped and covered with soil or clay when full.

45. Which factors are considered while selecting a landfill site?

Answer:

👉 Topography, location, water table, nature of waste, soil and rock type, and surface/groundwater flow.

46. What are leachates and what do they contain?

Answer:

👉 Leachates are liquids from waste in landfills that contain dissolved, suspended, and microbial contaminants, heavy metals, and volatile organic acids.

47. What gases are produced in landfills?

Answer:

👉 Methane, ammonia, hydrogen sulphide, and nitrogen.

48. What is incineration of municipal solid waste?

Answer:

👉 It is the burning of solid waste at high temperatures (900–1000°C) to reduce its volume and produce ash residues.

49. How is the volume of waste reduced by incineration?

Answer:

👉 Combustible materials like paper, plastics, and wood are burned, reducing waste volume by up to two-thirds.

50. What is the treatment process for industrial and hazardous waste?

Answer:

👉 They are either disposed in landfills or first incinerated at high temperatures, and the residual ash is disposed in landfills with proper lining.

51. Describe the general high-temperature incineration system.

Answer:

👉 Waste is burned in a rotary kiln (650–1100°C), ash is collected, gases pass to a secondary chamber (950–1300°C), then cooled and scrubbed before disposal.

52. What are the environmental hazards of incineration?

Answer:

👉 Air pollution, toxic ash, release of dioxins (carcinogens), oxides of nitrogen and sulphur, and heavy metals in leachate.

53. What is recycling of waste?

Answer:

👉 Recycling is processing used or waste materials to make them reusable, conserving raw materials and energy, and reducing waste volume.

54. Which domestic materials are commonly recycled?

Answer:

👉 Paper, plastic, glass, and aluminium.

55. Explain the depolymerization process in plastic recycling.

Answer:

👉 Used plastics are chemically or thermally broken down into their original components, which can then be polymerized again.

🩸EXERCISE

Q. 1 Fill in the blanks

1. Only _____ of the total earth's water resources are available as fresh water.

Answer: 1% ✅

2. _____ is a smaller unit of biosphere which consists of community of organisms and their interaction with environment.

Answer: Ecosystem ✅

3. Carbon monoxide is highly poisonous gas and causes suffocation if inhaled, it binds blood _____ more strongly than oxygen thus excluding oxygen from normal respiration.

Answer: haemoglobin ✅

4. The elevated concentration of _____ is harmful for fish as it clogs the gills thus causing suffocation.

Answer: aluminium ✅

5. The ozone layer in the _____ surrounds the globe and filters most of the harmful UV rays in the sunlight before they could reach the earth.

Answer: stratosphere ✅

6. The presence of _____ in livestock waste can contaminate surface and ground water causing various infectious diseases.

Answer: chemical and bacterial contents ✅

7. The substances which can directly kill the unwanted organisms are called _____.

Answer: pesticides ✅

8. _____ is frequently used to disinfect water.

Answer: Chlorine ✅

9. Incineration is not a clean process because it produces air pollution and toxic _____.

Answer: ash ✅

10. A process in which some of the used or waste materials are not discarded after their initial use but are processed so that it can be used again is called _____.

Answer: recycling ✅

Q. 2 Indicate true or false.

1. Half of the mass of the atmosphere is concentrated in lower 10 km.

Answer: ❌ False

Explanation: Half of the mass of the atmosphere is concentrated in the lower 5.6 km, not 10 km.

2. The oceans cover approximately 71 percent of the earth.

Answer: ✅ True

3. The volcanoes produce 55% of SO_2.

Answer: ❌ False

Explanation: Volcanoes produce 67% of SO_2.

4. The reducing smog is due to the presence of nitric oxide.

Answer: ❌ False

Explanation: Reducing smog is mainly due to SO_2 and smoke from coal combustion, not nitric oxide.

5. Ozone is produced in the polar regions by the photochemical reaction of oxygen.

Answer: ❌ False

Explanation: Ozone is produced mainly in tropical regions and transported to polar regions.

6. The temperature in the troposphere decreases with the increasing altitude from 15 to -56°C.

Answer: ✅ True

7. Incineration is a waste treatment process in which solid waste is dumped in a land fill.

Answer: ❌ False

Explanation: Incineration burns the solid waste at high temperatures, it is not dumped in a landfill.

8. Acid rain is due to the presence of oxides of sulphur and nitrogen which get mixed with the rain water.

Answer: ✅ True

9. The heavy metals have a safe limit where they are not toxic.

Answer: ❌ False

Explanation: Heavy metals such as Pb, Cd, Cr, As, Hg do not have any safe limits; they are toxic even at low concentrations.

10. The reprocessing of the plastics is to convert back to their components by a chemical or thermal process so that these can be used again.

Answer: ❌ False

Explanation: This process is called depolymerization, while reprocessing is remelting and reshaping the plastics for reuse.

Q. 3 Multiple choice questions. Encircle the correct answer.

(i) The pH range of the acid rain is

(a) 7–6.5

(b) 6.5–6

(c) 6–5.6 ✅

(d) less than 5

(ii) Peroxyacetylnitrate (PAN) is an irritant to human beings and it affects

(a) eyes ✅

(b) ears

(c) stomach

(d) nose

(iii) To avoid the formation of toxic compounds with chlorine, which substance is used for disinfecting water?

(a) $KMnO_4$

(b) O_3 ✅

(c) Alums

(d) Chloramines

(iv) A single chloride free radical can destroy how many ozone molecules?

(a) 100

(b) 100000 ✅

(c) 10000

(d) 10

(v) Fungicides are the pesticides which

(a) control the growth of fungus ✅

(b) kill insects

(c) kill plants

(d) kill herbs

(vi) Ecosystem is a smaller unit of

(a) lithosphere

(b) hydrosphere

(c) atmosphere

(d) biosphere ✅

(vii) The main pollutant of leather tanneries in the waste water is due to the salt of:

(a) lead

(b) chromium (VI) ✅

(c) copper

(d) chromium (III)

(viii) In purification of potable water the coagulant used is

(a) nickel sulphate

(b) copper sulphate

(c) barium sulphate

(d) alum ✅

(ix) The temperature in the non-rotating chamber in the incineration of industrial and hazardous waste process has a range

(a) 900 to 1000 °C

(b) 250 to 500 °C

(c) 950 to 1300 °C ✅

(d) 500 to 900 °C

(x) Newspaper can be recycled again and again by how many times?

(a) 2

(b) 3

(c) 4

(d) 5 ✅

🌟 **Q.4 Discuss in detail the components of the environment**

❖ **Answer:**

The environment is the surrounding in which living organisms exist and interact with air, water, soil and other living beings. It is divided into four main components: atmosphere, hydrosphere, lithosphere and biosphere. Each

component plays a vital role in maintaining balance and supporting life on earth.

✦ Atmosphere

The atmosphere is the layer of gases surrounding the earth. It is composed mainly of nitrogen (78%), oxygen (21%), argon (0.9%), carbon dioxide (0.03%) and trace gases such as water vapour, methane, carbon monoxide, helium, neon, krypton and xenon. Its thickness is about 1000 km, with half of its mass concentrated in the lower 5.6 km. The atmosphere protects life by absorbing harmful cosmic rays and ultraviolet radiation. It also maintains the heat balance of the earth and provides essential gases: oxygen for respiration, carbon dioxide for photosynthesis and nitrogen for fixation by bacteria.

✦ Hydrosphere

The hydrosphere includes all water bodies such as oceans, rivers, lakes, glaciers and groundwater. Oceans contain 97% of the earth's water but it is salty and not suitable for drinking. Ice caps and glaciers contain 2% of water. Only 1% of the total water is fresh and usable. Fresh water is consumed by agriculture (69%), industry (23%) and domestic purposes (8%).

The hydrosphere is essential for sustaining life and regulating climate.

✦ Lithosphere

The lithosphere is the rigid rocky crust of the earth extending to about 100 km depth. It consists mainly of oxygen (46.6%), silicon (27.7%), aluminium (8.1%), iron (5%), calcium (3.6%), sodium (2.8%), potassium (2.6%) and magnesium (2.1%). Trace elements such as carbon, manganese, sulphur, barium, chlorine, chromium, nickel and vanadium are also present. These elements occur mostly in the form of minerals. The lithosphere provides raw materials and minerals necessary for human use and industrial development.

✦ Biosphere

The biosphere is the region of earth capable of supporting life. It includes the lower atmosphere, oceans, rivers, lakes, soils and sediments. Within the biosphere, ecosystems are smaller units consisting of organisms and their interaction with the environment. The biosphere supports humans, animals, plants and microorganisms. Pollution caused by industrialization, urbanization and transportation disturbs

the natural balance of ecosystems and adversely affects health and biodiversity.

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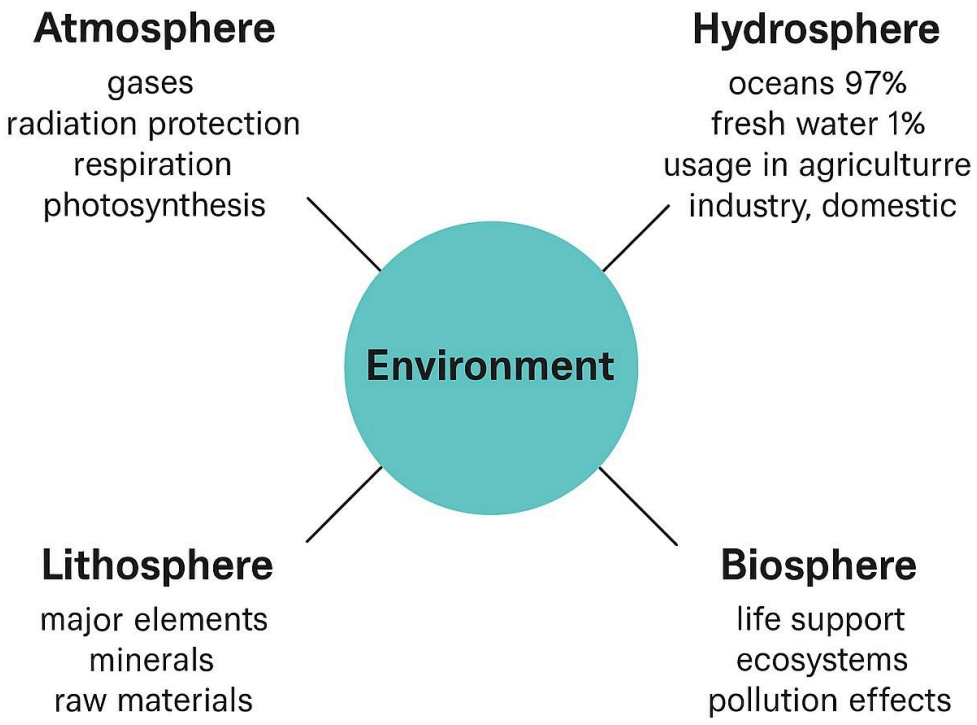

✦ Summary:

The environment is made up of four components. The atmosphere provides gases and protects life. The hydrosphere supplies water resources. The lithosphere provides minerals and raw materials. The biosphere supports all forms of life and ecosystems. Together these components maintain balance and sustain life on earth.

🌟 Q.5 Describe the natural and human sources of carbon monoxide, nitrogen oxides and sulphur oxides

❖ **Answer:**

Carbon Monoxide (CO)

Natural Sources

- Volcanic eruptions release carbon monoxide.
- Forest fires and natural combustion of organic matter.
- **Oxidation** of methane in the atmosphere.

Human Sources

- Incomplete combustion of fuels in automobiles.
- Industrial processes such as steel manufacturing.
- Domestic burning of coal, wood and other fuels.
- Cigarette smoke.

Nitrogen Oxides (NO and NO_2)

Natural Sources

- Lightning converts atmospheric nitrogen into oxides.
- Microbial activity in soils produces nitrogen oxides.
- Natural forest fires.

Human Sources

- Emissions from motor vehicles and aircraft engines.
- Power plants burning fossil fuels.
- Industrial processes such as nitric acid production.
- Burning of biomass and agricultural waste.

Sulphur Oxides (SO_2 and SO_3)

Natural Sources

- Volcanic eruptions release large amounts of sulphur dioxide.
- Oxidation of hydrogen sulphide in the atmosphere.
- Decay of organic matter containing sulphur.

Human Sources

- Burning of coal and oil containing sulphur.

- Petroleum refining and smelting of sulphide ores.
- Industrial processes such as paper and cement manufacturing.
- Power plants using fossil fuels.

✦ **Summary:**

Carbon monoxide, nitrogen oxides and sulphur oxides are important atmospheric pollutants. They originate from both natural and human sources. Natural sources include volcanic eruptions, forest fires, lightning and microbial activity. Human sources are mainly industrial processes, combustion of fossil fuels, vehicle emissions and domestic burning. These gases contribute to air pollution, acid rain, smog formation and adverse health effects.

🌟 **Q.6 – What is Acid Rain and How Does It Affect Our Environment?**

❖ **Answer:**

Meaning of Acid Rain

- Acid rain is rainwater that becomes more acidic than normal due to the presence of harmful gases in the atmosphere.
- Pure rainwater has a pH of around 5.6, but acid rain has a pH below 5.6, which means it is stronger and more harmful.
- It may fall as rain, snow, fog, dew, or hail.

⭐ How Acid Rain is Formed

1. Release of Harmful Gases:

- Factories, vehicles, power plants and industries release gases like
- Sulphur dioxide (SO_2) and Nitrogen oxides (NO_x).

2. Mixing with Water Vapours:

- These gases mix with water vapours, oxygen, and other chemicals in the atmosphere.

3. Formation of Acids:

- SO_2 ⟶ forms Sulphuric acid (H_2SO_4)
- NO_x ⟶ forms Nitric acid (HNO_3)

4. Falling as Acid Rain:

- These acids dissolve in clouds and fall to Earth as acid rain.

⭐ Effects of Acid Rain on Environment

1. Effects on Plants and Forests

- Damages leaves, reducing photosynthesis.
- Removes essential nutrients from soil like calcium and magnesium.
- Weakens trees and makes them more vulnerable to diseases.
- Slows down the growth of crops and forests.

2. Effects on Aquatic Life

- Lakes and rivers become more acidic.

- Fish, frogs, plankton, and other organisms cannot survive in low pH water.
- Reproduction in aquatic animals decreases.
- Leads to loss of biodiversity in water bodies.

3. Effects on Soil

- Acid rain washes away minerals and nutrients needed for plant growth.
- Increases toxic elements like aluminium in soil.
- Makes soil less fertile for agriculture.

4. Effects on Buildings and Monuments

- Damages buildings made of marble, limestone, and metal.
- Causes corrosion, cracks, and surface weakening.
- Historic monuments like Taj Mahal have faced acid rain damage.

5. Effects on Human Health

Acid rain does not directly harm skin, but:

- Polluted air causes asthma, coughing, and breathing problems.
- Contaminated water affects human health indirectly.
- Harmful chemicals enter the food chain.

6. Effects on Atmosphere

- Reduces visibility.
- Makes fog and smog more harmful.
- Contributes to overall atmospheric pollution.

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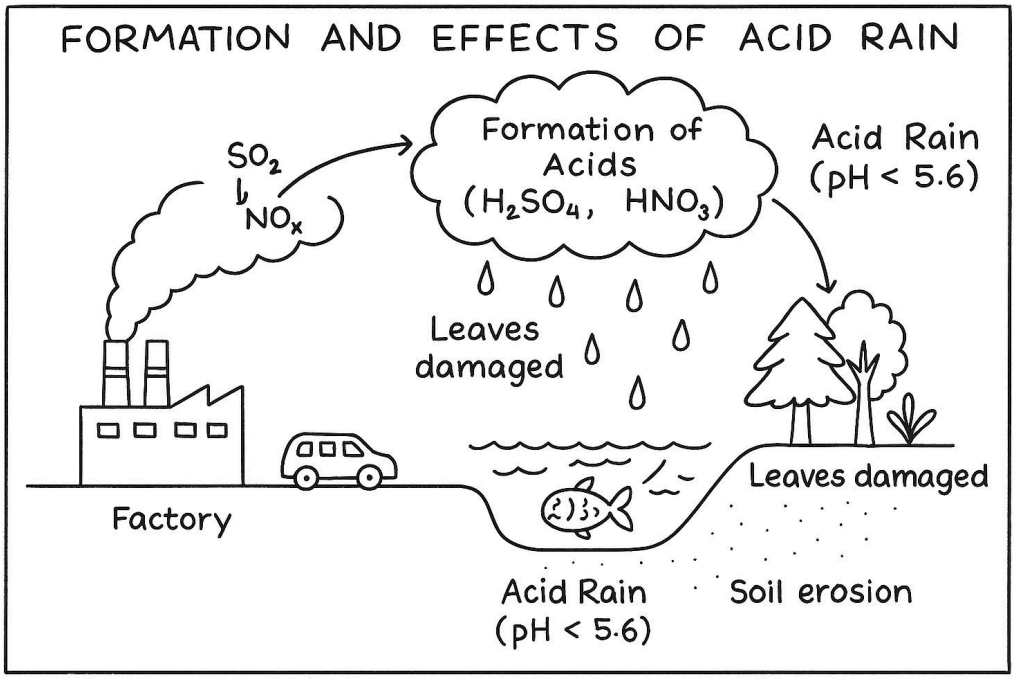

✦ **Summary:**

- Acid rain is rainwater that becomes highly acidic due to SO_2 and NO_x gases.
- It **harms plants**, soil, water bodies, buildings, and human health.
- **The main** sources are factories, vehicles, and power stations.
- **Acid rain** reduces biodiversity, pollutes air and water, and damages monuments.

🌟 Q.7 – What is Smog? Explain the Pollutants Which Are the Main Cause of Photochemical Smog.

What is Smog?

- The word smog comes from “smoke + fog”.
- It is a type of air pollution formed when smoke, dust, and harmful gases mix with fog in the atmosphere.
- Smog makes the air hazy, brownish, and harmful to breathe.
- It mostly occurs in large cities with heavy traffic, industries, and sunlight.

⭐ What is Photochemical Smog?

- Photochemical smog is formed when sunlight reacts with pollutants present in the air, especially from vehicles.
- It appears as a brown or yellow haze in the atmosphere.
- It is common in hot, sunny cities because strong sunlight increases the chemical reactions that produce this smog.

⭐ Main Pollutants That Cause Photochemical Smog

1. Nitrogen Oxides (NO and NO_2)

- Produced mainly by vehicles, industries, power plants, burning of fuels.
- Sunlight converts these gases into nitrogen dioxide (NO_2) which gives smog its brownish color.
- **NO_2** further reacts to form ozone (O_3) and other toxic chemicals.

2. Volatile Organic Compounds (VOCs)

VOCs are gases released from:

- Petrol and diesel
- Paints and solvents

- Chemical industries
- Evaporation of fuel

When VOCs combine with nitrogen oxides in the presence of sunlight, they form harmful chemicals like peroxyacetyl nitrate (PAN) which is a main component of photochemical smog.

3. Ozone (O_3) – Ground-Level Ozone

- Not released directly.
- Formed when NO_x + VOCs + Sunlight ⟶ Ozone.

Ozone at ground level is harmful:

- Causes breathing problems
- Irritates eyes and throat
- Damages crops and plants
- It is the most dangerous component of photochemical smog.

4. Peroxyacetyl Nitrate (PAN)

- Formed when VOCs react with NO_2 in the presence of sunlight.

PAN is toxic and causes:

- Eye irritation
- Breathing difficulty
- Damage to plants (leaf burn)

5. Particulate Matter ($PM_{2.5}$ and PM_{10})

- Tiny solid or liquid particles suspended in air.

Released from:

- Vehicle exhaust
- Industrial smoke
- Burning of wood or garbage

These particles trap sunlight and increase the density of smog.

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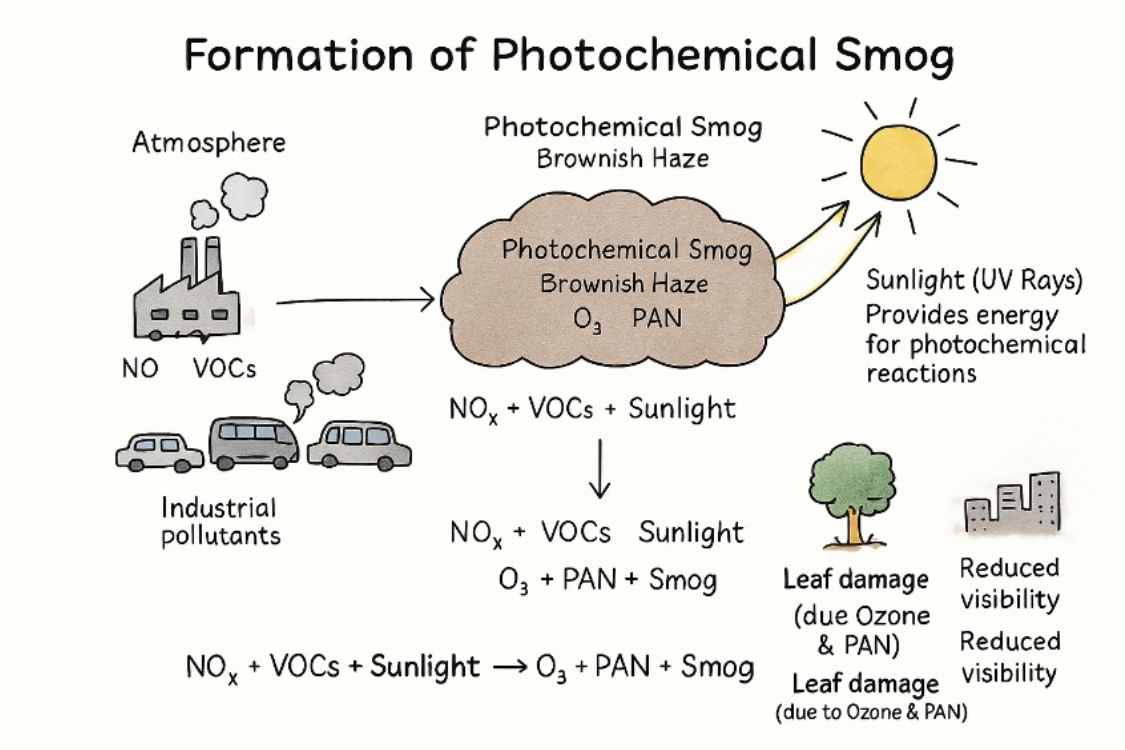

✦ **Summary:**

- Smog is polluted air formed by the mixing of smoke, fog, dust, and harmful gases.
- Photochemical smog forms when sunlight reacts with pollutants like NO_x and VOCs.

Major pollutants responsible for photochemical smog are:

- Nitrogen oxides (NO, NO_2)
- Volatile Organic Compounds (VOCs)
- Ground-level ozone (O_3)

- Peroxyacetyl Nitrate (PAN)
- Particulate matter (PM)

These pollutants cause serious harm to humans, animals, plants, and the environment.

🌟 Q.8 – Why is Ozone Layer Depleting? What Will Happen When the Concentration of Ozone Decreases?

⭐ Part 1: Why is the Ozone Layer Depleting?

The ozone layer is thinning mainly because of human-made chemicals that destroy ozone molecules (O_3). The major reasons are:

1. Chlorofluorocarbons (CFCs)

These are the biggest cause of ozone depletion.

Released from:

- Refrigerators
- Air conditioners
- Aerosol sprays

- Fire extinguishers
- Foam-making industries

CFCs rise to the upper atmosphere (stratosphere) and break down under UV light, releasing chlorine atoms, which destroy ozone.

Reaction concept:

- 1 chlorine atom can destroy thousands of ozone molecules.

2. Halons

- Used in fire extinguishers.
- Release bromine, which destroys ozone even faster than chlorine.

3. Nitrogen Oxides (NO and NO_2)

Released from:

- Jet aircraft
- Vehicles and industries

- Fertilizers

These gases react with ozone and reduce its concentration.

4. Carbon Tetrachloride & Methyl Chloroform

- Used in cleaning and industrial processes.
- Release chlorine when broken down, causing ozone depletion.

5. Natural Causes (Minor contribution)

- Volcanic eruptions
- Lightning

These produce gases that can damage ozone but their impact is far less than human-made chemicals.

⭐ Part 2: What Will Happen When the Concentration of Ozone Decreases?

When the ozone layer becomes thinner, more harmful UV (Ultraviolet) radiation from the sun reaches the Earth. This causes many serious effects:

1. Effects on Human Health

- Skin cancer rates increase due to stronger UV exposure.
- Causes sunburn and premature aging of skin.
- Increases risk of eye diseases like cataracts.
- Weakens the human immune system.

2. Effects on Plants

- UV rays reduce the process of photosynthesis.
- Slow growth of crops (e.g., wheat, rice, maize).
- **Damage to leaf tissues.**
- Decrease in agricultural productivity.

3. Effects on Marine Life

- UV rays kill phytoplankton (tiny organisms in oceans).
- Phytoplankton are the base of the aquatic food chain.
- Their death affects fish, whales, and entire marine ecosystems.
- Reduces fish population.

4. Effects on Animals

- Animals also experience eye damage and skin diseases.
- Food chains are disturbed.

5. Effects on Environment

- Increased UV rays disturb ecosystems.
- Reduce biodiversity.
- Damage forests and vegetation.

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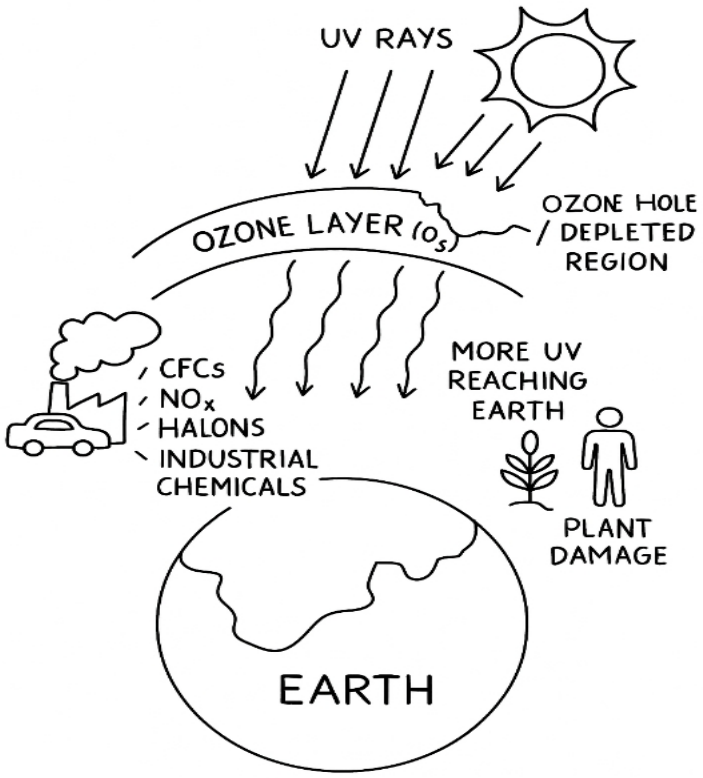

✦ **Summary:**

- The ozone layer is depleting mainly due to CFCs, halons, nitrogen oxides, and industrial chemicals.
- When ozone concentration decreases, more UV radiation reaches Earth.

This leads to:

- Skin cancer, eye diseases, weak immunity in humans
- Damage to crops and plants
- Death of marine life
- Disturbance of ecosystems
- Ozone depletion is a global environmental threat.

🌟 Q.9 – How is Oil Spillage Affecting Marine Life?

❖ **Answer:**

Oil spillage means the accidental release of crude oil or petroleum products into oceans and seas. It usually occurs due to ship accidents, leakage in oil tankers, offshore drilling problems, or pipeline breakage. Oil spills have devastating effects on marine life.

⭐ 1. Effects on Marine Animals (Fish, Dolphins, Whales, Turtles)

a. Difficulty in Breathing

- Oil spreads on the surface of water and blocks oxygen from dissolving in it.
- Marine animals find it hard to breathe, especially those that use gills.

b. Poisoning of Animals

Fish and turtles swallow oil-contaminated water.

This causes:

- Damage to internal organs
- Stomach poisoning
- Weakness and death

c. Damage to Skin and Body Tissues

Oil sticks to the skin of marine animals, causing:

- Sores
- Infections
- Loss of natural body protection

d. Interference with Communication

- Whales and dolphins depend on sound (echo).
- Oil in water disturbs their sound waves, making it hard to communicate or find food.

⭐ 2. Effects on Birds (Seabirds, Penguins, Seagulls)

a. Damages Feathers

- Oil coats bird feathers, removing their natural waterproofing.
- Feathers become heavy, sticky, and unable to trap air for insulation.

b. Birds Cannot Fly

- Oil-covered wings make flying difficult or impossible.
- Birds become vulnerable to predators.

c. Hypothermia (Loss of Body Heat)

- Without waterproof feathers, birds lose heat rapidly and may die due to cold.

d. Poisoning

- When birds try to clean their feathers, they swallow oil, causing internal damage.

⭐ 3. Effects on Marine Plants (Seaweeds, Sea Grasses, Algae)

a. Blocking Sunlight

- Oil forms a thick layer on the water surface.
- Sunlight cannot reach underwater plants.
- Photosynthesis decreases or stops.

b. Death of Algae and Plankton

- These are the base of the food chain.

- Their death affects all marine organisms that depend on them.

⭐ 4. Effects on Food Chain & Ecosystem

a. Collapse of Food Chain

- If plankton die → small fish die → bigger fish die → entire ecosystem collapses.

b. Long-Term Damage

- Oil stays in water for months or even years.
- Marine life takes a long time to recover.

c. Loss of Biodiversity

- Many species either migrate or become extinct in affected areas.

⭐ 5. Effects on Reproduction

a. Eggs and Larvae Are Most Sensitive

- Oil coats eggs and blocks oxygen.
- Many marine animals fail to reproduce successfully.

b. Genetic Damage

- Oil chemicals cause mutations and developmental problems in young organisms.

⭐ 6. Effects on Beaches and Coral Reefs

a. Coral Damage

- Oil blocks light and toxins kill young corals.
- Coral reefs may take decades to recover.

b. Dirty and Polluted Beaches

- Oil covers sand and rocks, destroying habitats of crabs, turtles, and shoreline plants.

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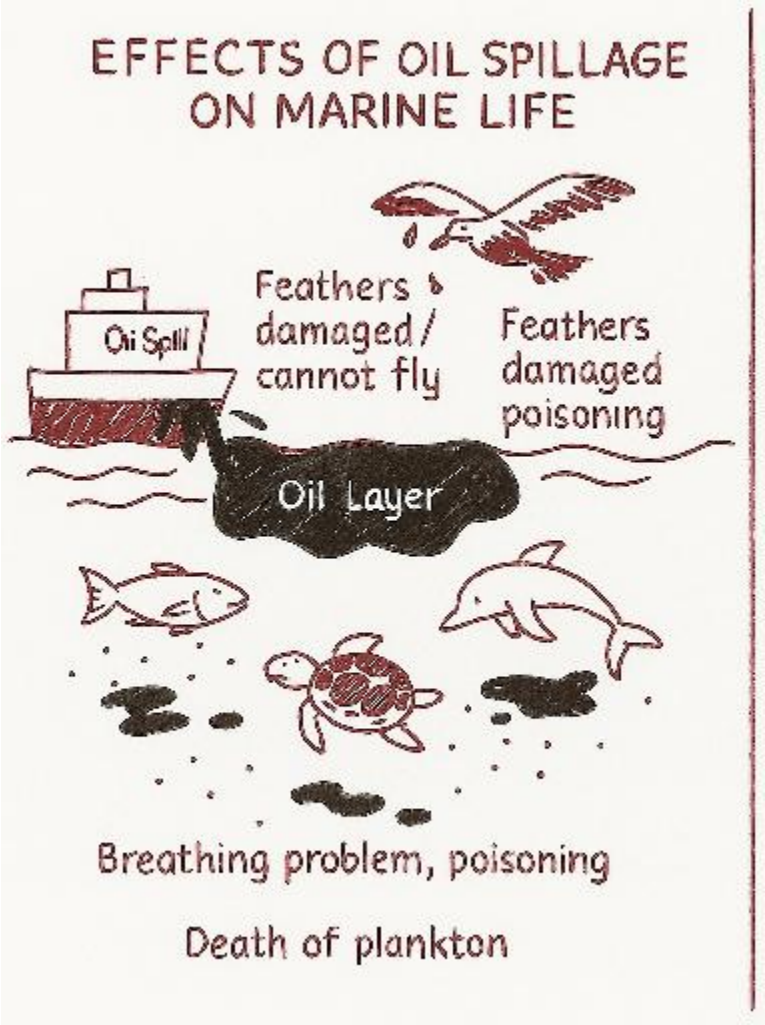

✦ **Summary:**

- Oil spills are extremely harmful to marine life.
- They cause breathing problems, poisoning, loss of insulation, death of plants, and collapse of food chains.
- Birds, fish, corals, and plankton are heavily affected.
- Oil blocks sunlight, reduces oxygen, and damages entire marine ecosystems for years.

🌟 Q.10 – How Are Detergents a Threat to Aquatic Animal Life?

Detergents are chemical cleaning agents used in homes and industries. When they enter rivers, lakes, or oceans through sewage and drainage, they become a serious threat to aquatic life. Their harmful chemicals disturb natural water chemistry and damage organisms that live in water.

⭐ 1. Harmful Chemicals in Detergents

Detergents contain:

- Phosphates
- Surfactants (surface-active agents)
- Bleaching agents
- Artificial perfumes and dyes

These substances remain active in water and react with aquatic organisms, causing harmful effects.

⭐ 2. Eutrophication (Excess Plant and Algae Growth)

- Phosphate-rich detergents cause eutrophication, which is one of the biggest threats.

How it happens:

1. Phosphates act as fertilizers.

2. They increase the growth of algae on the water surface (algal bloom).

3. This thick layer blocks sunlight from reaching underwater plants.

4. When algae die, they are decomposed by bacteria.

5. Bacteria use up dissolved oxygen during decomposition.

6. Oxygen levels drop, causing fish and other aquatic animals to die.

Result:

Fish, insects, and small organisms suffer due to lack of oxygen and sunlight.

⭐ 3. Toxicity to Aquatic Animals

- Surfactants in detergents are poisonous for aquatic animals.

Effects:

- Damage gills of fish, making breathing difficult.
- Reduce their ability to absorb oxygen.
- Cause irritation, infections, and internal damage.
- May lead to death if concentration is high.

⭐ 4. Destruction of Protective Mucus Layer in Fish

Fish have a thin mucus layer on their skin that protects them from:

- Infections
- Bacteria
- Fungi

Detergents dissolve this protective coating, making fish weak and vulnerable to diseases.

⭐ 5. Harmful Effects on Reproduction

Detergent chemicals interfere with the reproductive system of aquatic animals.

- Eggs fail to develop normally.
- Many young fish and aquatic insects die early.
- Populations of aquatic animals decrease.

⭐ 6. pH Imbalance in Water

Detergents change the pH level of water.

- Slight increase in pH can be harmful for delicate species like plankton and baby fish.
- Many aquatic animals cannot survive in chemically changed water.

⭐ 7. Foam Formation

Detergents create foam on the surface of water bodies.

Problems caused:

- Blocks entry of oxygen from the atmosphere into the water.
- Prevents sunlight from reaching underwater plants.
- Disturbs natural gas exchange.
- Creates an unhealthy aquatic environment.

⭐ 8. Long-Term Accumulation

- Some detergent components do not degrade quickly.
- They stay in water for a long time.
- They accumulate in the bodies of aquatic animals.

These toxins move up the food chain and may affect even humans.

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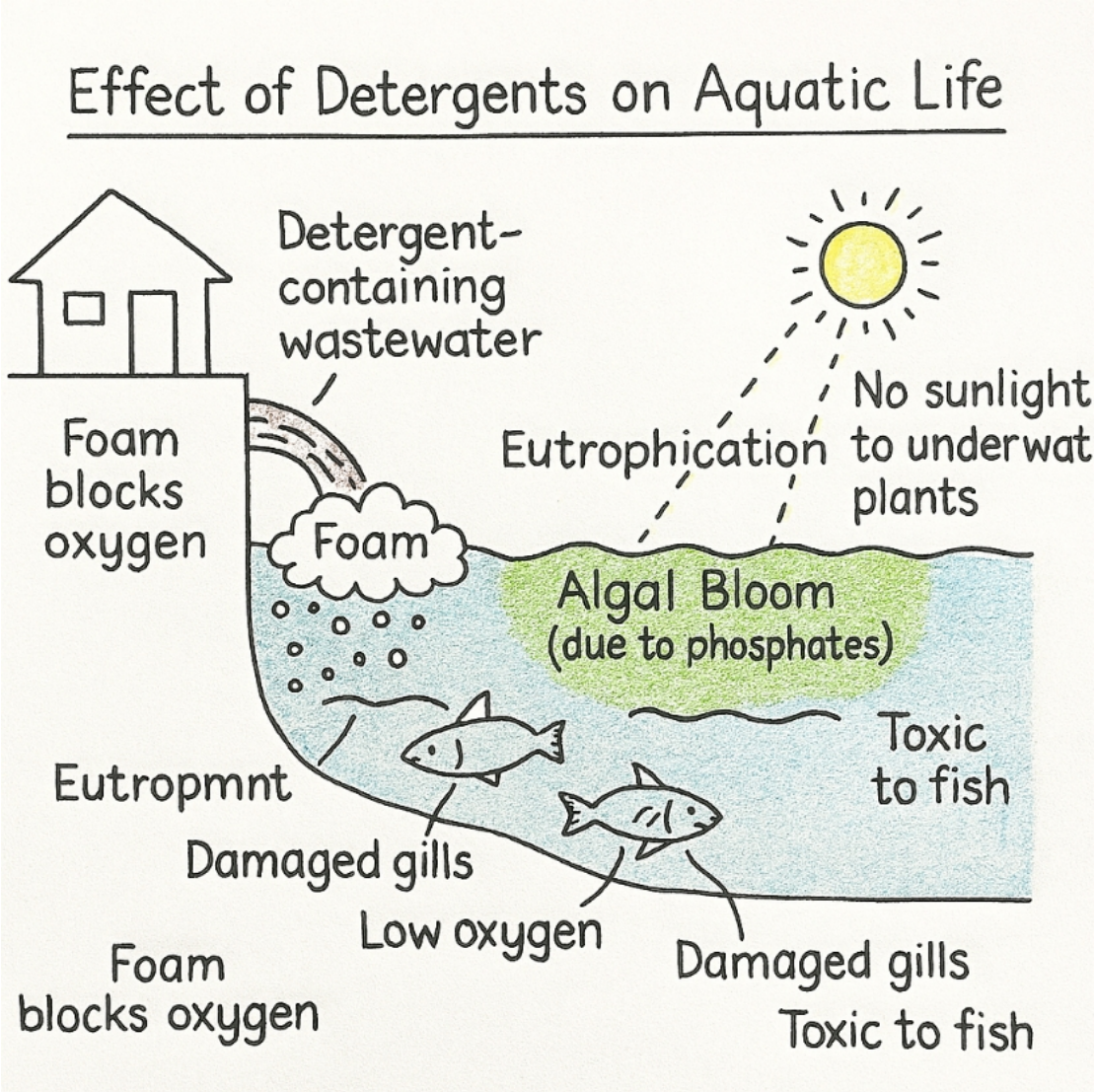

✦ **Summary:**

- Detergents pollute water bodies and harm aquatic animals.
- Phosphates cause eutrophication, lowering oxygen levels.

- Surfactants damage fish gills, skin, and protective mucus.
- Detergents create foam, block sunlight, and disturb pH balance.
- They reduce growth, reproduction, and survival of aquatic organisms.
- Overall, detergents are a major threat to aquatic ecosystems.

🌟 Q.12 – Explain How Pesticides Are Dangerous to Human Beings.

Pesticides are chemical substances used to kill insects, weeds, fungi, and other pests that damage crops. Although they help in increasing food production, they are extremely dangerous to human health when they enter the body through food, air, water, or skin.

⭐ 1. Entry of Pesticides Into the Human Body

Pesticides enter the human body in several ways:

- Eating contaminated fruits and vegetables
- Drinking polluted water
- Breathing pesticide spray in air

- Touching plants recently sprayed

Once inside the body, these chemicals may cause serious health problems.

⭐ 2. Damage to the Nervous System

Many pesticides contain chemicals that directly affect the brain and nerves.

Effects:

- Headache and dizziness
- Memory problems
- Weakness and fatigue
- **In severe cases**: nerve damage, tremors, or paralysis

Some pesticides interfere with the normal movement of nerve signals, making them extremely harmful.

⭐ 3. Respiratory Problems

When pesticides are sprayed, tiny droplets float in the air and are inhaled.

Effects:

- Irritation of throat and lungs
- Coughing and difficulty in breathing
- Increased risk of asthma
- Long-term exposure can damage lung tissues

⭐ 4. Skin and Eye Irritation

Direct exposure to pesticides can cause:

Skin:

- Redness and rashes
- Blisters
- Burning sensation
- Allergic reactions

Eyes:

- Irritation
- Watering
- Damage to eye tissues in concentrated exposure

⭐ 5. Digestive System Damage

When pesticide-contaminated food is eaten, it harms the digestive system.

Effects:

- Nausea and vomiting
- Stomach pain
- Diarrhoea
- Chemical poisoning

⭐ 6. Effects on Liver and Kidneys

The liver and kidneys help in detoxifying harmful chemicals.

Continued pesticide exposure places extra burden on these organs.

Results:

- Liver damage
- Kidney failure

- Slow removal of toxins from the body

⭐ 7. Cancer Risk

Some pesticides are carcinogenic (cancer-causing).

Long-term exposure can increase the risk of:

- Skin cancer
- Lung cancer
- Blood cancer (leukemia)
- Liver and kidney cancers

⭐ 8. Hormonal Imbalance

Certain pesticides act as endocrine disruptors, meaning they interfere with hormones.

Effects:

- Reproductive problems
- Early puberty in children
- Infertility
- Reduced sperm count

- Hormonal diseases

These effects may appear slowly over many years.

⭐ 9. Birth Defects in Babies

When pregnant women are exposed to pesticides:

The chemicals can cross the placenta

Affect the growth of the baby

Possible outcomes:

- Low birth weight
- Premature birth
- Brain development problems
- Physical deformities

⭐ 10. Long-Term Accumulation in the Body

- Pesticides do not leave the body quickly.
- They accumulate in fat tissues and slowly damage organs over time.

- This long-term exposure is the main reason behind chronic diseases.

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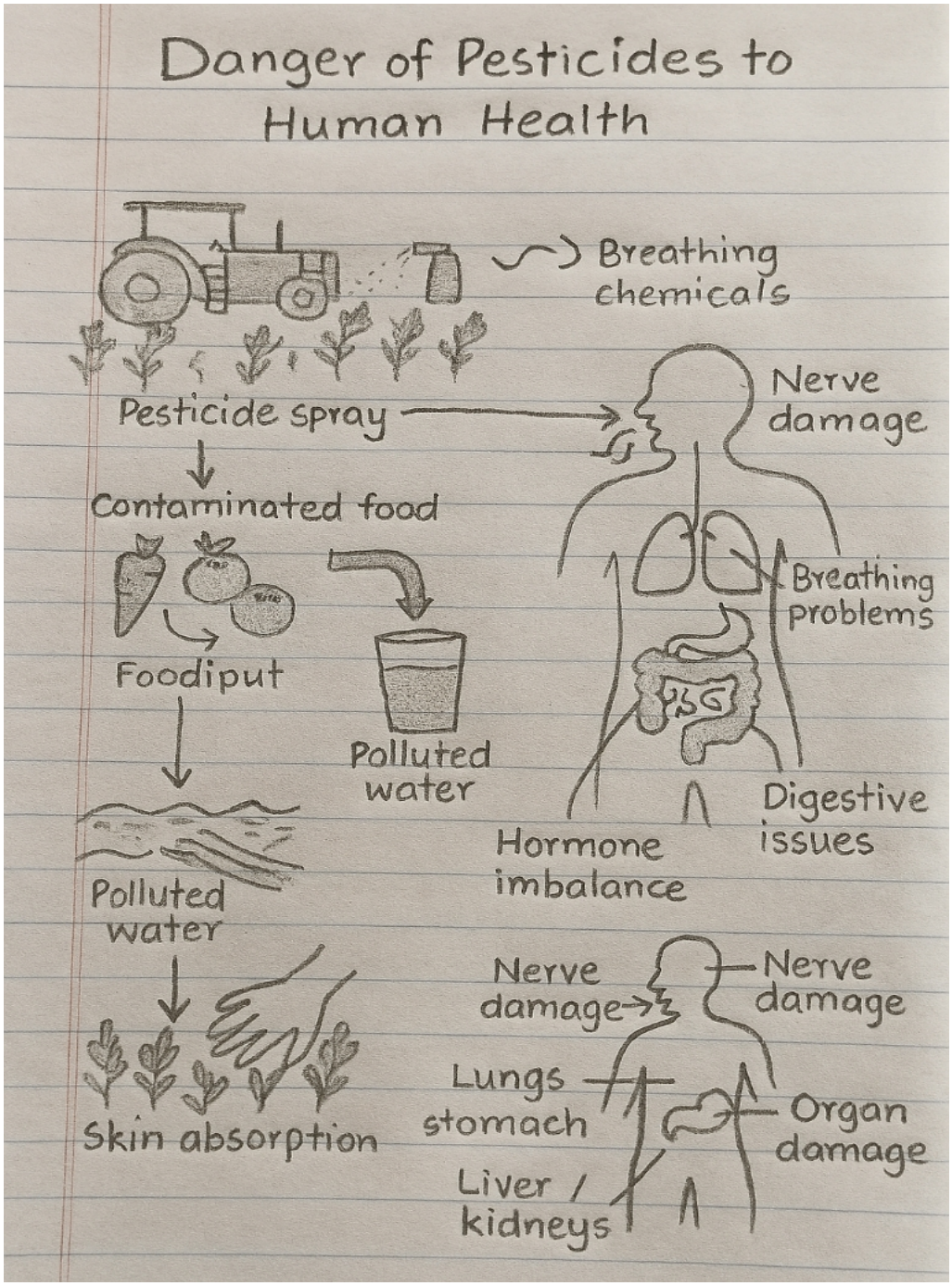

✦ **Summary:**

- **Pesticides** enter the human body through food, water, air, and skin.
- **They damage** the nervous system, respiratory system, liver, kidneys, and digestive system.
- Pesticides can cause skin and eye irritation, hormonal imbalance, and cancer.
- Pregnant women and children are at greater risk.
- Long-term exposure leads to serious health problems and chronic diseases.

🌟 Q.13 Discuss Industrial Waste Effluents

Industrial waste effluents refer to the liquid waste discharged by industries during manufacturing and processing activities. These effluents contain a wide variety of harmful chemicals, metals, toxins, acids, alkalis, dyes, oils, and suspended solids which can severely damage the environment if released untreated. They are one of the major sources of water pollution, soil degradation, and health problems in humans and animals.

1. Sources of Industrial Effluents

Industries release wastewater during:

- Washing, cleaning, and cooling processes
- Chemical reactions and mixing
- Dyeing, tanning, bleaching, and textile processes
- Extraction of metals and minerals
- Oil refining and food processing

Examples of industries producing harmful effluents:

Chemical industries, textile mills, fertilizer factories, oil refineries, paper mills, tanneries, sugar mills, and metal-processing plants.

2. Harmful Components in Industrial Effluents

Industrial wastewater commonly contains:

1. Heavy metals like lead (Pb), mercury (Hg), cadmium (Cd), chromium (Cr) – highly toxic.

2. Toxic chemicals such as acids, alkalis, pesticides, and organic solvents.

3. Dyes and pigments from textile industries – non-biodegradable.

4. Oil and grease from refineries – form surface films on water.

5. Suspended solids – sand, grit, metallic particles.

6. Pathogens from food and animal-based industries.

These pollutants may remain in the environment for long periods and accumulate in living organisms.

3. Environmental Effects of Industrial Effluents

a) Water Pollution

- Chemical waste contaminates rivers, lakes, and groundwater.
- Decreases oxygen levels in water (oxygen depletion).
- Leads to fish death and destruction of aquatic ecosystems.
- Makes water unsafe for drinking and agriculture.

b) Soil Degradation

- **Chemicals** seep into soil and reduce fertility.
- **Heavy metals** remain in soil and enter food chains through crops.
- **Plants** show stunted growth, yellowing, and reduced yield.

c) Air Pollution

- **Some** effluents release harmful vapours (ammonia, chlorine, sulfur dioxide).
- These **gases** contribute to acid rain and respiratory diseases.

d) Harm to Human Health

People exposed to polluted water suffer from:

- Skin diseases
- Stomach infections
- Liver and kidney damage
- Nervous system problems due to heavy metals
- Cancer-causing effects due to long-term exposure

e) Destruction of Aquatic Life

- Oil and chemicals poison fish, plankton, and sea plants.
- **Harmful** substances accumulate in food chains (bio-magnification).
- **Coral reefs** and **marine** ecosystems become damaged.

4. Control and Treatment of Industrial Effluents

Industries must adopt proper treatment before releasing wastewater. Methods include:

a) Primary Treatment

- Removal of large solids by filtration and sedimentation.

b) Secondary Treatment

- Biological treatment using bacteria to break down organic waste.

c) Tertiary Treatment

- Advanced purification such as charcoal adsorption, chemical precipitation, membrane filtration, and disinfecting.

d) Recycling and Reuse

- Treated water should be reused in cooling, washing, and processing.

e) Legal Measures

- **Government** should strictly enforce environmental laws
- **Industries** must follow National Environmental Quality Standards (NEQS)

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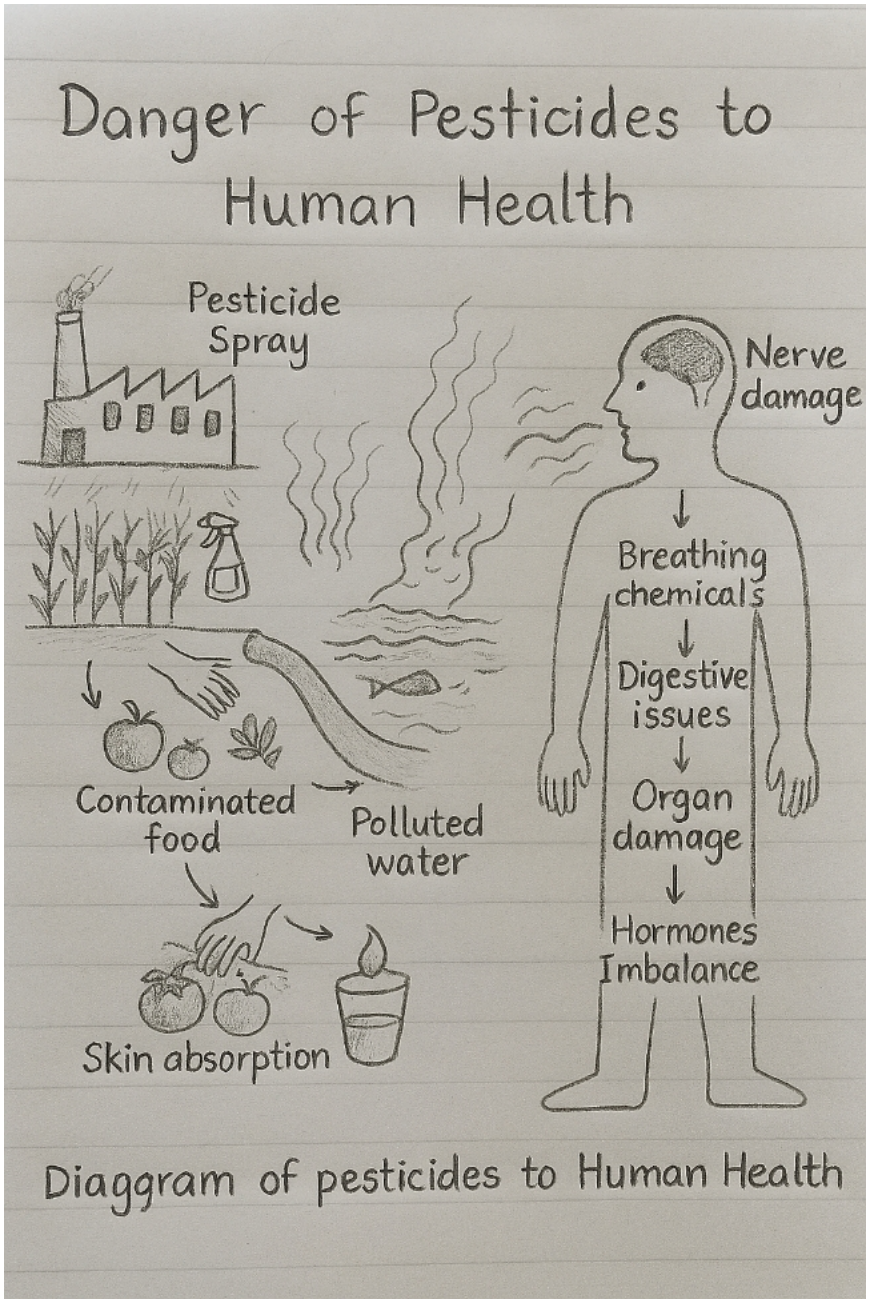


✦ **Summary:**

- **Industrial effluents** are liquid wastes released by industries.

- **They contain heavy metals**, toxic chemicals, dyes, oils, and pathogens.
- These **effluents pollute** water, degrade soil, poison aquatic life, and affect human health.
- **Effluents must** be treated using **primary**, **secondary**, and tertiary treatment before discharge.
- Government rules and strict monitoring are essential to control industrial pollution.

🌟 Q.14 How water is purified i.e., made potable? Discuss in detail.

Water purification is the process through which impure, contaminated, or unsafe water is treated to make it safe for drinking, also called potable water. Natural water sources like rivers, lakes, wells, and canals often contain dust, mud, germs, dissolved salts, harmful chemicals, and microorganisms. To make this water fit for human consumption, it must undergo several purification steps.

Potable water must be clear, colourless, odourless and free from harmful microbes and chemicals.

1. Sedimentation

- Sedimentation is the first step in water purification.
- Water is stored in large tanks or reservoirs for several hours.
- Heavy particles like sand, mud, stones, grit settle down due to gravity.
- The clear water remains at the top, while impurities form a layer of sediment at the bottom.

Purpose: Removes large and heavy insoluble impurities.

2. Coagulation and Flocculation

- Sometimes water contains very fine particles that do not settle easily.
- To remove them, coagulants such as alum ($Al_2(SO_4)_3$) are added.
- Alum reacts with water to form sticky flocs.
- These flocs trap small dirt particles and form larger lumps.
- These lumps (flocs) settle down quickly.

Purpose*:* Helps in removing fine suspended particles.

3. Filtration

The sedimented water is then passed through different types of filters:

a) Sand and Gravel Filters

Water passes through layers of:

- Coarse gravel
- Fine gravel
- Coarse sand
- Fine sand

These layers trap remaining suspended impurities.

b) Activated Charcoal Filter

- Removes bad smell, colour, and organic chemicals.
- Makes water clearer and improves taste.

Purpose: Removes small particles, microorganisms, and organic impurities.

4. Chlorination / Disinfection

To kill disease-causing microorganisms (bacteria, viruses, protozoa), the filtered water is disinfected.

Chlorination

- A small amount of chlorine gas or bleaching powder (calcium hypochlorite) is added.
- Chlorine kills germs and prevents future contamination.

Other Methods of Disinfection

- **Ozonation:** Passing ozone gas through water to kill germs.
- **UV Treatment:** Ultraviolet light destroys DNA of microorganisms.

Purpose: Ensures water is germ-free and safe for drinking.

5. Aeration

In this step, water is exposed to air or oxygen.

- Removes bad smells (like rotten egg smell due to hydrogen sulfide).
- Adds oxygen which improves taste.
- Helps in oxidation of dissolved metals such as iron and manganese.

Purpose: Improves taste and freshness of water.

6. pH Adjustment

- Some water may be too acidic or too basic.
- If water is acidic → lime (CaO) is added to neutralize it.
- If water is basic → carbon dioxide or mild acids are added.

Purpose: To make water chemically balanced and safe.

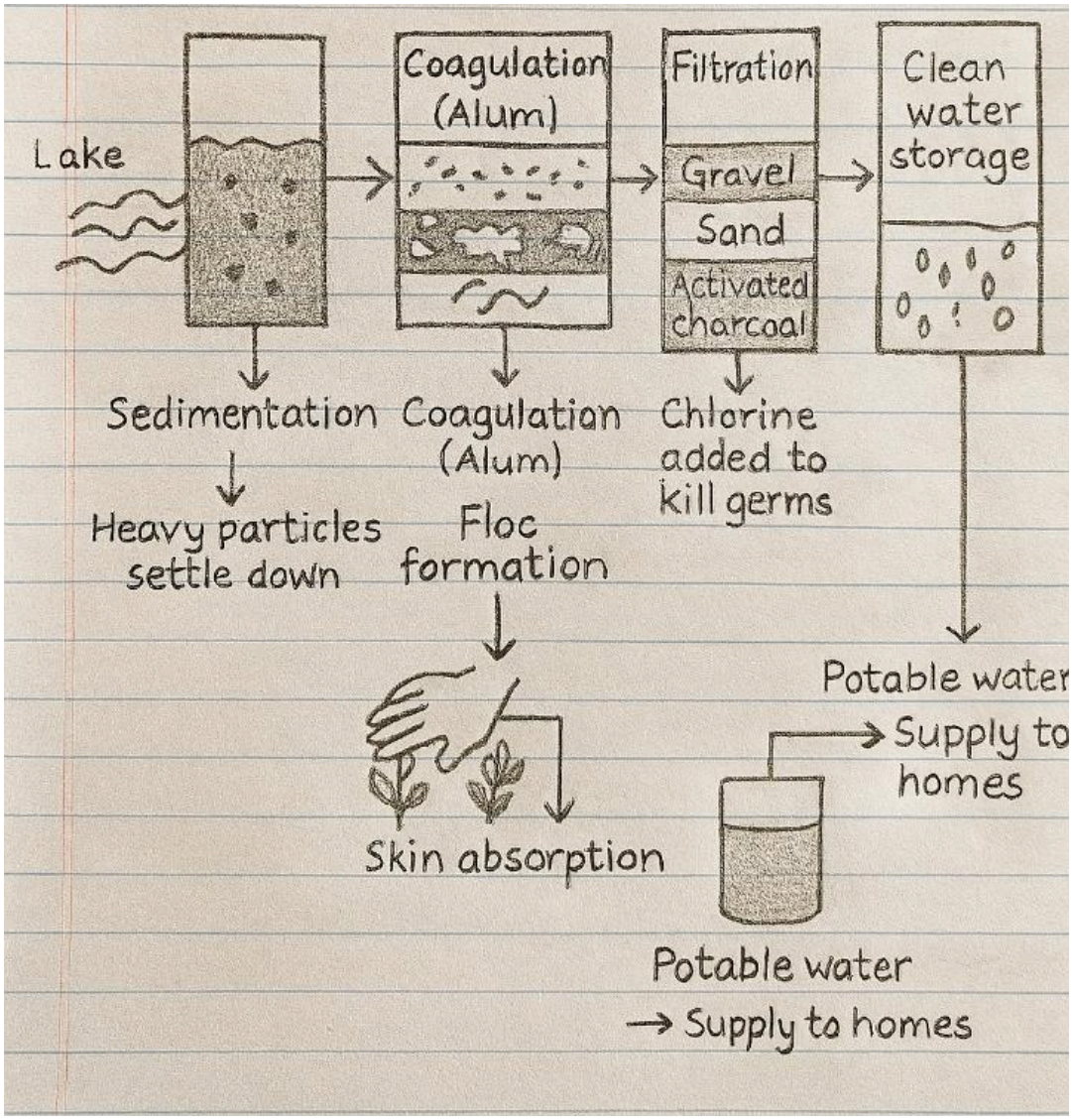
7. Storage and Distribution

After all treatments:

- Purified water is stored in covered reservoirs.

- It is distributed through pipes to homes, schools, hospitals, and industries.
- Continuous monitoring ensures purity is maintained.

✦ **Diagram of Water Purification Plant:**



✦ Summary:

- Water purification makes water fit for drinking (potable).

- Steps include sedimentation, coagulation, filtration, chlorination, aeration, pH adjustment, and safe storage.
- Sedimentation removes heavy particles.
- Coagulation removes fine suspended particles.
- Filtration removes remaining impurities.
- Chlorination kills germs.
- Aeration improves taste and smell.
- pH adjustment makes water chemically safe.
- Finally, clean water is stored and supplied for use.

🌟 Q.15 – What Are Leachates?

1. Meaning of Leachates

- **Leachates** are liquid wastes that form when water percolates through waste **materials**, especially in **landfills**, **dumpsites**, or industrial waste piles.
- **As water** passes through waste, it dissolves **harmful chemicals**, metals, and organic matter, forming a **toxic liquid** called leachate.
- **Leachates** are highly **polluted** and can contaminate soil and **groundwater**.

2. How Leachates Are Formed

1. Rainwater or surface water infiltrates a landfill or waste dump.

2. Water dissolves soluble substances such as:

- Heavy metals (lead, mercury, cadmium)
- Organic matter (food waste, paper, plastics)
- Chemicals from industrial waste

3. The resulting contaminated liquid accumulates at the bottom or flows into nearby water bodies.

Example:

- Municipal landfill sites produce leachates containing organic waste and metals.
- Industrial waste piles produce chemical-rich leachates.

3. Composition of Leachates

Leachates may contain:

- Organic matter (food waste, paper, textile residues)

- Inorganic salts (chlorides, sulfates, nitrates)
- Heavy metals (lead, cadmium, mercury)
- Pathogens (bacteria and viruses from bio-waste)
- Toxic chemicals (pesticides, dyes, solvents)
- Acidic or alkaline compounds, depending on the type of waste

The composition varies depending on the type of waste and the water passing through it.

4. Environmental Hazards of Leachates

- Leachates are highly dangerous for soil, water, and living organisms.

a) Soil Pollution

- Leachates seep into soil and reduce fertility.
- Heavy metals accumulate in crops through the soil.
- Plants show stunted growth and low yield.

b) Water Pollution

- Leachates reach groundwater or rivers.
- Contaminate drinking water sources.

- Poison aquatic life.

c) Human Health Hazards

Drinking water contaminated with leachates can cause:

- Gastrointestinal infections
- Organ damage (liver, kidney)
- Heavy metal poisoning
- Chronic diseases including cancer

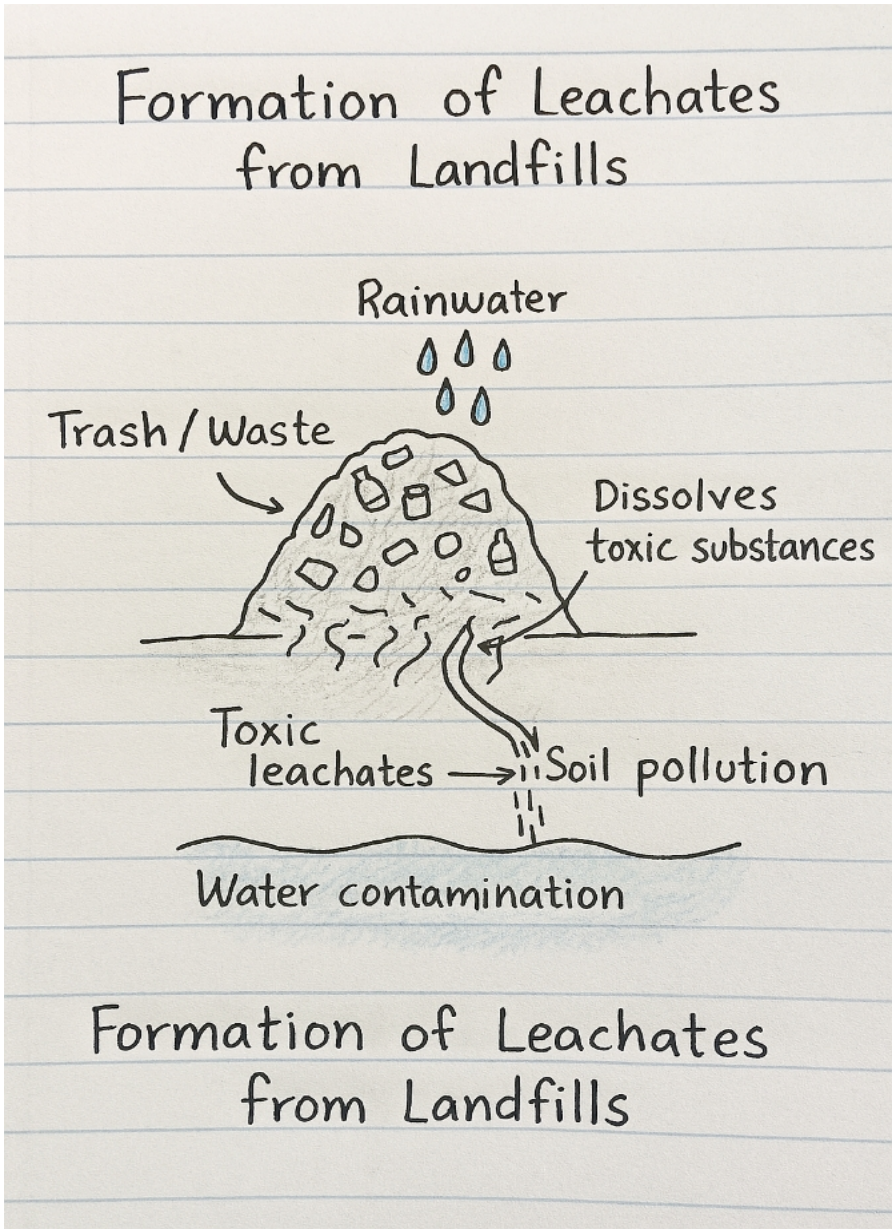
d) Ecosystem Disruption

- Toxic leachates affect plants, fish, and animals.
- Reduce biodiversity in affected areas.

5. Control of Leachates

- Use of lining systems in landfills (clay or plastic liners) to prevent seepage.
- Collection of leachates through pipes and treatment tanks.
- Treatment using biological, chemical, or physical methods before discharge.
- Minimizing hazardous waste disposal in landfills.

✦ **Digram:**



✦ **Summary:**

- Leachates are toxic liquids formed when water passes through waste.

- They contain heavy metals, chemicals, organic matter, and pathogens.
- **Leachates pollute soil,** water, and harm living organisms, including humans.
- **Proper collection,** treatment, and landfill management are essential to prevent leachate contamination.

🌟 Q.16 – Explain the Process of Incineration of Industrial Waste

Incineration is a method of waste disposal where solid, liquid, or gaseous industrial wastes are burned at high temperatures in a controlled environment to convert them into ash, gases, and heat energy. This method is widely used to reduce the volume of hazardous industrial wastes and to recover energy.

1. Purpose of Incineration

- To reduce the volume of industrial waste (up to 90% in some cases).
- To destroy toxic and hazardous substances.
- To recover energy from combustible waste.
- To prevent pollution caused by uncontrolled dumping of waste.

2. Types of Industrial Waste Suitable for Incineration

- Organic chemical waste (solvents, paints, pesticides)
- Medical and hazardous waste from industries
- Paper, plastics, rubber
- Sludge from treatment plants
- Oil and petroleum residues

Non-combustible waste like metals and glass are removed before incineration.

3. Steps in the Incineration Process

Step 1: Waste Collection and Sorting

- Industrial waste is collected from factories and storage areas.
- Waste is sorted to remove metals, stones, and other non-combustible materials.
- Hazardous and highly toxic materials are handled separately.

Step 2: Feeding Waste into the Incinerator

Waste is fed into the incinerator chamber.

Incinerators can be of different types:

- Rotary kiln – for sludge and chemical waste
- Fixed grate incinerator – for solid wastes
- Fluidized bed incinerator – for powdered or granular waste

Step 3: Combustion

Waste is burned at high temperatures (typically 800–1200°C).

Complete combustion converts waste into:

- Ash (solid residue)
- Flue gases (CO_2, H_2O, and other gases)
- Heat energy (can be recovered)

Step 4: Gas Treatment

Flue gases contain toxic substances such as SO_2, NO_x, and dioxins.

They are passed through:

- Scrubbers – remove acidic gases
- Filters – trap particulate matter
- Catalytic converters – reduce toxic compounds
- This ensures safe emission into the atmosphere.

Step 5: Disposal of Ash

- The remaining ash may contain inert metals and minerals.
- Ash is disposed of in landfills or sometimes used in construction materials.
- Toxic ash may require special treatment before disposal.

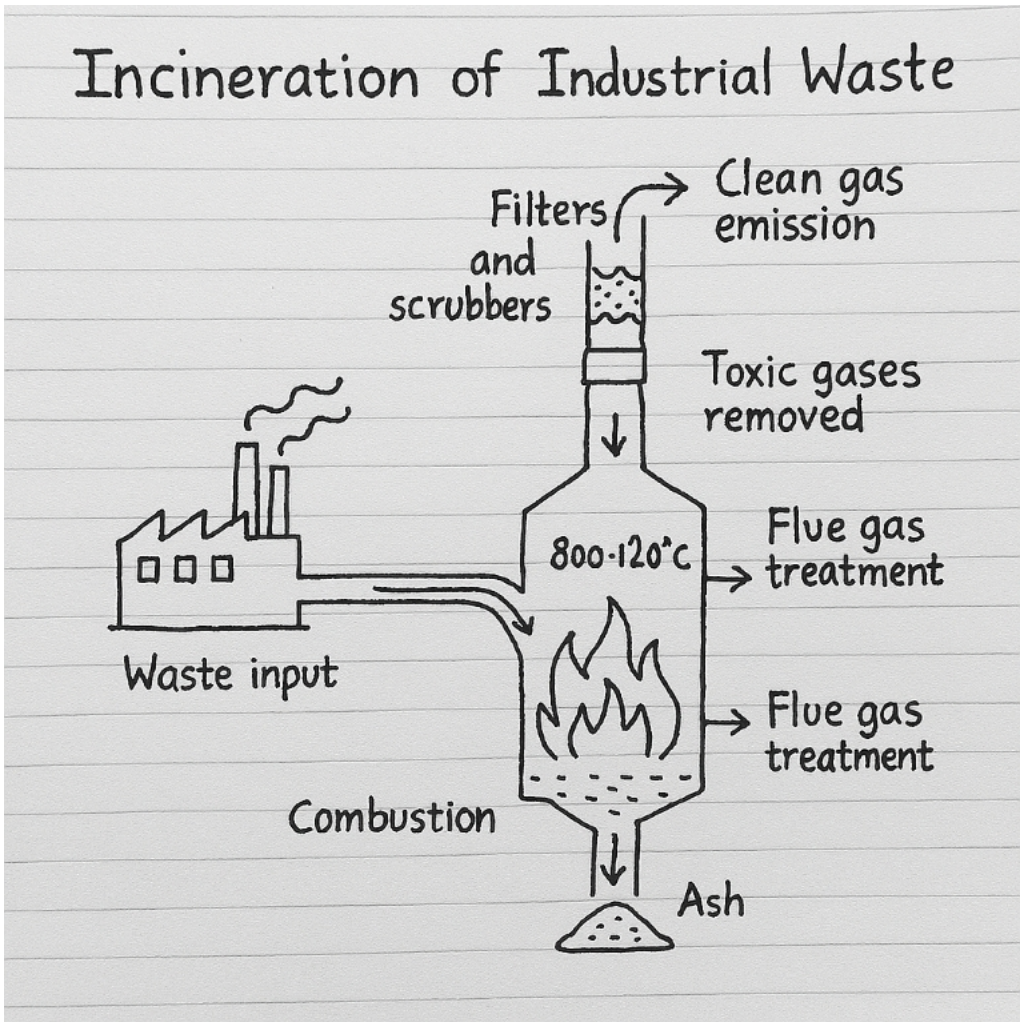
4. Advantages of Incineration

- Reduces waste volume drastically.
- Destroys pathogens, toxins, and hazardous chemicals.
- Recovers energy in the form of heat, which can be used for electricity.
- Reduces the need for large landfill areas.
- Prevents long-term soil and water pollution.

5. Disadvantages / Limitations

- High initial setup cost for incinerators.
- Emission of toxic gases if flue gas treatment is not proper.
- Requires skilled operators.
- Not suitable for non-combustible waste.

✦ **Digram:**



✦ Summary:

- Incineration is burning industrial waste at high temperatures to reduce volume and destroy toxins.
- Waste is first sorted and collected, then fed into the incinerator.
- Combustion produces ash, gases, and heat energy, which can be recovered.
- Flue gases are treated to remove pollutants, and ash is safely disposed of.
- Incineration is effective for hazardous organic wastes, but requires careful management to prevent air pollution.

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.

Author: Muhammad Asghar

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