

KARACHI EDU • CHEMISTRY CHAPTER 5

Environmental Chemistry

Comprehensive coaching notes on atmosphere, air pollution, global warming, water pollution, and water treatment for Class X.

Introduction to Environmental Chemistry

Study of chemical and biochemical phenomena in the environment, encompassing interactions between earth's spheres.



Atmosphere & Hydrosphere

Atmosphere provides gaseous envelope (Nitrogen 78%, Oxygen 21%); Hydrosphere covers 71% of earth with saline and freshwater systems.



Pollution Impact

Anthropogenic activities release toxic pollutants altering natural equilibrium, threatening ecological and human health.

Structure of the Atmosphere

Divided into distinct thermal layers based on temperature gradients and altitude.

Troposphere (0–12 km)

Lowest layer containing 75% atmospheric mass. Weather phenomena occur here; temperature decreases with height.

Stratosphere (12–50 km)

Contains the ozone layer (O_3) which absorbs harmful UV radiation. Temperature increases with altitude.

Meso & Thermosphere

Mesosphere (coldest layer) and Thermosphere (ionized gases, auroras, satellite orbits up to 500+ km).

Major Air Pollutants

Harmful gaseous and particulate substances introduced into the atmosphere by human actions.

Carbon Monoxide & Oxides

CO: Produced by incomplete combustion of fossil fuels; binds with hemoglobin reducing oxygen transport.

SO_2 & NO_x : Industrial emissions causing respiratory distress and smog.

Primary source: Vehicles & Power plants

Particulate Matter (PM)

Dust, smoke, soot, and liquid droplets suspended in air (PM_{2.5} and PM₁₀). Penetrates deep into human lungs causing severe cardiovascular illness.

Urban smog & industrial smoke

Acid Rain & Ozone Depletion

Secondary atmospheric phenomena causing widespread ecological destruction.

Acid Rain Chemistry

- $\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$ (Sulfuric acid)
- $2\text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_3 + \text{HNO}_2$ (Nitric acid)
- Lowers soil pH, damages historical marble monuments (CaCO_3), and aquatic life.

Ozone Layer Depletion

CFCs (Chlorofluorocarbons) released from refrigerators and aerosols release chlorine radicals in stratosphere, catalyzing destruction of ozone molecules ($\text{O}_3 \rightarrow \text{O}_2$).

Results in increased skin cancer & cataracts

Global Warming & Greenhouse Effect

Trapping of thermal radiation by atmospheric greenhouse gases.

Greenhouse Gases

Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), and water vapor absorb infrared radiation reflected from earth's surface, maintaining planetary warmth.

Consequences of Global Warming

Melting of polar ice caps, rising sea levels, extreme weather anomalies, disruption of agricultural crop cycles, and loss of global biodiversity.

Water Pollution & Treatment

Contamination of water bodies by industrial effluents, sewage, and agricultural runoff.

Eutrophication & Heavy Metals

Nitrates and phosphates from fertilizers trigger algal blooms, depleting dissolved oxygen (BOD increase). Heavy metals (Lead, Mercury, Arsenic) cause neurological damage.

Municipal Water Treatment

Involves sedimentation (removal of suspended solids), filtration (sand filters), and chlorination/disinfection to eliminate pathogenic bacteria before public supply.

Key Takeaways

- **Atmospheric Layers:** Troposphere and stratosphere play vital roles in weather and UV protection.
- **Air Pollution:** CO , SO_2 , and NO_x cause acid rain, smog, and respiratory illnesses.
- **Climate Change:** Greenhouse gases drive global warming and polar ice melting.
- **Water Quality:** Eutrophication and heavy metals require rigorous municipal water treatment.