UNIT -1

INDIAN CHEMISTRY – ATOMIC PHILOSOPY

(Acharya Kanad)

Around 600 BCE, Acharya Kanad introduced a revolutionary idea that all matter is composed of extremely small particles called Anu (atoms). This was long before modern science.

He proposed:

- *Matter is not continuous → it is made of discrete particles.*

Atoms are:

- *Indivisible (cannot be broken further)*
- *Indestructible*
- *Invisible*

Atoms combine in different ways to form substances.

Philosophical Depth

- *He also introduced the idea of:*
- *Dravya (substance)*
- *Guna (properties)*
- *Karma (motion)*

Example:

Different arrangements of atoms produce different materials:
Like clay → pot, brick, etc.

Comparison with Modern Theory:

1. *KandaModern Chemistry*

Atom indivisible Atom divisible (protons, neutrons, electrons)
Philosophical Experimental

2. Rutherford Atomic Model
(Ernest Rutherford)

Gold Foil Experiment (Detailed):

- *Alpha particles (+2 charge) were fired at a thin gold foil.*
- *A fluorescent screen detected where particles went*

Observations:
1. ~99% passed straight → atom is mostly empty
2. Some deflected slightly → positive charge exists
3. Very few bounced back → strong central mass

Interpretation:
Entire positive charge + most mass is concentrated in nucleus
Electrons revolve around it

Structure:
Nucleus = tiny, dense, positive
Electron cloud around it

Limitations:
Could not explain:
- *Why electrons don't fall into nucleus*
- *Atomic spectra*

3. Bohr's Atomic Theory

(Niels Bohr)
🔬 *Postulates Explained :*
1. Quantized Orbits:
- *Electrons move in fixed circular paths (K, L, M shells)*
- *Each orbit has definite energy*

2. No Energy Loss:
- ➢ *While moving in orbit → no radiation*

3. Energy Transition:
- ➢ *Electron jumps between orbits → energy absorbed/emitted*

4. Hydrogen Spectrum

- *When an electron in hydrogen atom:*
- *Moves from higher orbit → lower orbit*
- *It releases energy as photon*

This produces discrete spectral lines, not continuous light.

🧠 *Why Lines?*

- ➢ *Because energy levels are fixed → only specific transitions possible.*

Series

- ➔ *Lyman (UV)*
- ➔ *Balmer (Visible)*
- ➔ *Paschen (IR)*

5. Heisenberg Uncertainty Principle

(Werner Heisenberg)

Mathematical Meaning:
$\Delta x \times \Delta p \geq h/4\pi$

Physical Meaning:
- ➢ *If you know position accurately → momentum uncertain*
- ➢ *If momentum known → position uncertain*

Why?

- ➢ *Measuring electron disturbs it*

Result:
- ➢ *Fixed orbit concept is wrong*
- ➢ *Leads to probability-based model*

6. Quantum Numbers & Orbital Concept

- ➢ *Electrons exist in orbitals (regions of probability), not paths.*

Quantum Numbers:

1. Principal (n):
- ➢ *Energy level*
- ➢ *Larger n → larger size*

2. Azimuthal (l):

- ➢ *Shape of orbital*
- ➢ *s (0), p (1), d (2), f (3)*

3. Magnetic (m):
Orientation
Example: p → 3 orientations
4. Spin (s):

- ➢ *Electron spins like a top*

❖ ***Shapes of Orbitals***

1. s-Orbital:
Spherical → equal probability in all directions

2. p-Orbital:

- ➢ *Dumbbell-shaped*
- ➢ *Node at nucleus*

3. d-Orbital:
- ➢ *Cloverleaf*
- ➢ *Complex distribution*

🧠*Importance:*

- ➢ *Orbital shape determines:*
- ➢ *Bond angle*
- ➢ *Molecular geometry*

🔗 *8. Chemical Bonding (Electronic Theory)*

🔬 *Deep Concept:*

- ➢ *Atoms combine because:*
- ➢ *Lower energy state is more stable*

🧠 *Octet Rule:*

Atoms try to achieve:

- ➢ *8 electrons in valence shell*

Exceptions:

- ➢ *H → 2 electrons*
- ➢ *B → 6 electrons*

Ionic Bond (NaCl)

Mechanism:

1. Sodium loses electron:
$Na \rightarrow Na^{+} + e^{-}$

2. Chlorine gains electron:
$Cl + e^{-} \rightarrow Cl^{-}$

🧠 *Attraction:*

- ➢ *Electrostatic force holds ions*

📌 *Crystal Structure:*

- ➢ *Forms lattice (3D structure)*

🔥 *Properties:*

- ➢ *High melting point*
- ➢ *Soluble in water*

🔗 ***10. Covalent Bond***

Atoms share electrons to complete octet.

Types:

1. *Nonpolar:*
   - ➢ *Equal sharing*
     - ➔ H_2, F_2
2. *Polar:*
   - ➢ *Unequal sharing*

- ➔ *HF*

  - ❖ ***Bond Types:***
- ➢ *Single*
- ➢ *Double*
- ➢ *Triple*

11. Hybridization
Why Needed?
- ➢ *Pure orbitals cannot explain geometry → hybrid orbitals formed.*

Examples:
CH_4:
sp^3 → tetrahedral (109.5°)
NH_3:
Lone pair compresses angle → pyramidal
H_2O:
Two lone pairs → bent shape
12. Coordinate Bond (NH_4^+)

Detailed:
- ➢ *NH_3 has lone pair*
- ➢ *H^+ accepts electron pair*

Special Case:
- ➢ *Both electrons come from same atom*

13. Hydrogen Bonding
- ➢ *Occurs when H is bonded to:*

F, O, N

Types:

1. Intermolecular
2. Intramolecular

Effects:

Water:
- ➢ *High boiling point*
- ➢ *Ice floats*

NH_3:

➢ *Higher boiling point than expected*

14. Metallic Bonding

Electron Sea Model:
➢ *Metal atoms release electrons → form "sea"*
Result:

➢ *Electrons move freely*
Explains:
➢ *Conductivity*
➢ *Luster*
➢ *Strength*
15. States of Matter
Molecular Arrangement:
➢ *State Arrangement Motion*
➢ *Solid Fixed Vibrate*
➢ *Liquid Close Slide*
16. Structure of Solids
Crystalline:
Regular repeating pattern
Amorphous:
No long-range order

Smallest repeating unit in crystal.

Types:

➢ *SC → least packing*
➢ *BCC → medium*
➢ *FCC → highest packing*
➢ *HCP → very dense*

18. Metallic Solids Properties
Due to free electrons:
➢ *Electrical conductivity*
➢ *Thermal conductivity*
Ductility:

Malleability

UNIT-2
SOLUTION

A solution is a homogeneous mixture in which two or more substances are mixed uniformly at the molecular or ionic level. This means that the composition of the mixture is the same throughout and you cannot distinguish the components by naked eye.

Every solution has two main components:

🔷 *Solute:*
- ➢ *The substance that is dissolved*
- ➢ *Usually present in smaller amount*

🔷 *Solvent:*
- ➢ *The substance that dissolves the solute*
- ➢ *Present in larger amount*

Important Characteristics of Solutions:

1. *Homogeneous (uniform composition)*
2. *Stable (particles do not settle down)*
3. *Very small particle size (less than 1 nm)*
4. *Cannot be separated by simple filtration*

Examples:

1. Salt in water
Salt = solute
Water = solvent

2. Sugar solution
Sugar dissolves completely in water

3. Air
Mixture of gases
Nitrogen = solvent (major component)

🔍 *Types of Solutions:*

Type Solute Solvent Example

- *Solid in liquid	Salt	Water	Salt solution*
- *Liquid in liquid	Alcohol	Water	Alcohol solution*
- *Gas in liquid	CO_2	Water	Soda*

2. Methods to Express Concentration

Concentration tells us how much solute is present in a given amount of solution.

🔷 ***(A) Molarity (M)***

Definition:

Molarity is the number of moles of solute per liter of solution.

$M = \frac{\text{moles of solute}}{\text{volume of solution in liters}}$

Important Points:

- *Depends on temperature (because volume changes)*
- *Most commonly used in laboratory*

📌 *Example:*

If 1 mole of NaCl is dissolved in 1 liter of water:

$M = \frac{1}{1} = 1M$

Numerical Example:

If 2 moles of solute are present in 500 mL solution:

$M = \frac{2}{0.5} = 4M$

🔷 *(B) Molality (m)*

🔬 *Definition:*

Molality is the number of moles of solute per kilogram of solvent.

$m = \frac{\text{moles of solute}}{\text{mass of solvent in kg}}$

Key Feature:

➢ *Independent of temperature (mass does not change)*

📌 *Example:*

➢ *1 mole solute in 1 kg solvent → 1 m*

Numerical:

2 moles solute in 2 kg solvent:
$m = \frac{2}{2} = 1m$

🔷 (C) Normality (N)
🔬 Definition:
Normality is the number of gram equivalents per liter of solution.
N = \frac{\text{equivalents}}{\text{volume in liters

🧠 Important:

- Used in acid-base and redox reactions
- Depends on n-factor

📌 Example:
H_2SO_4 (dibasic acid) → 1M = 2N

🔷 (D) Parts Per Million (ppm)
🔬 Definition:
Amount of solute present in 1 million parts of solution.
$ppm = \frac{\text{solute}}{\text{solution}} \times 10^6$

📌 Example:
Used in:

- Water quality analysis
- Pollution measurement

If 1 mg solute in 1 L water → 1 ppm

🔷 (E) Mass Percentage
$\% = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$

📌 Example:

10 g salt in 100 g solution:
$\% = \frac{10}{100} \times 100 = 10\%$

🔷 (F) Volume Percentage
$\% = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100$

📌 Example:
20 mL alcohol in 100 mL solution → 20%

🔷 ***(G) Mole Fraction***
$X_A = \frac{\text{moles of component}}{\text{total moles}}$

Important:
Sum of mole fractions = 1

📌 *Example:*

1 mole A + 1 mole B:
$X_A = \frac{1}{2} = 0.5$

⚖️ ***3. Buffer Solution***
🔬 *Detailed Explanation:*
A buffer solution is a solution that resists change in pH when small amounts of acid or base are added.
🧠 ***Types:***

1. *Acidic buffer → weak acid + its salt*
2. *Basic buffer → weak base + its salt*

Mechanism:
Example:
Acetic acid + Sodium acetate

Case 1: Add Acid (H^+)
- *Acetate ions neutralize added H^+*
- *Prevents pH change*

Case 2: Add Base (OH^-)
- *Acid neutralizes OH^-*

Real-Life Example:
Human blood maintains pH ~7.4 using buffer system

4. Indicator and Its Theory
An indicator is a substance that changes color depending on the pH of solution.

🧠 *Theory:*

- *Indicators are weak acids or bases.*
- *HIn ⇌ H^+ + In^-*
- *HIn = one color*
- *In^- = different color*

Examples:
Phenolphthalein:
Acid → colorless
Base → pink

Methyl Orange:
Acid → red
Base → yellow

⚛️ 5. Nano-Particles
🔬 Definition:
Particles with size between 1–100 nanometers.

🧠 Deep Concept:
At nanoscale:

- ➢ *Surface area increases drastically*
- ➢ *Properties change (optical, electrical, chemical)*

📌 Example:
Gold:
Bulk → yellow
Nano → red/purple

🌍 6. Importance of Nano-Particles
🔬 Key Features:

- ➢ *High surface area → high reactivity*
- ➢ *Stronger materials*
- ➢ *Better efficiency*

📌 Examples:
Nano silver → kills bacteria
Nano coatings → corrosion resistance

7. Applications in Engineering

🔷 *Mechanical Engineering*
Uses:

- *Strong and lightweight materials*
- *Wear-resistant coatings*

Example:
➢ *Nano-coated tools last longer*

🔷 *Electrical Engineering*
🔬 *Uses:*
- *High conductivity materials*
- *Efficient batteries*

📌 *Example:*
Lithium-ion batteries with nano material

🔷 *Electronics*
🔬 *Uses:*
- *Smaller and faster devices*
- *Nano transistors*

📌 *Example:*
➢ *Modern processors use nano-scale components*

🔷 *Medical Applications*
- *Drug delivery systems*
- *Cancer treatment*
- *Imaging techniques*

UNIT -3
WATER TECHNOLOGY

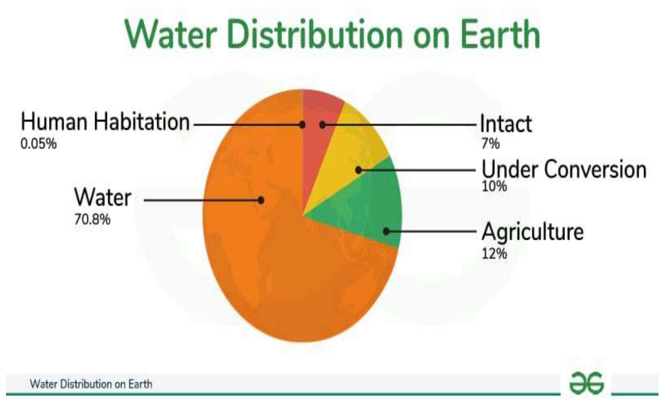
1. Distribution of Water on Earth (Graphical Idea)

🔷 *Brief Idea:*
Water on Earth is unevenly distributed, and only a very small portion is usable for humans.

Detailed Explanation:

➢ *If we represent water distribution using a pie chart or bar diagram, it shows:*

🌊 *97% → Oceans (salt water)*
❄️ *~2% → Glaciers and ice caps*
💧 *~1% → Fresh water (usable)*



Groundwater

- *Rivers and lakes (very small fraction)*
- *From that 1%:*

🧠 *Key Understanding:*

➢ *Even though Earth looks like a "water planet", drinking water is extremely limited.*

📌 *Example:*

➢ *Rivers like Ganga contain only a tiny fraction of Earth's total water.*

💧 *2. Soft Water and Hard Water*

Soft water → forms lather easily with soap

Hard water → does not form lather easily

🧪 *Soap Test:*

Add soap to water and shake

Result:

Soft water → more foam (lather)

Hard water → less foam + scum formation

🧠 *Why Hardness Occurs:*

Due to dissolved salts of:

- *Calcium (Ca^{2+})*
- *Magnesium (Mg^{2+})*

📌 *Types of Hardness:*

1. Temporary Hardness:

➢ $Ca(HCO_3)_2$, $Mg(HCO_3)_2$

➢ *Removed by boiling*

2. Permanent Hardness:

➢ $CaSO_4$, $MgCl_2$

➢ *Cannot be removed by boiling*

3. Units of Hardness

🔬 *Common Units:*

- *ppm (parts per million)*
- *mg/L (milligrams per liter)*
- *°Clarke, °French (less common)*

📌 *Example:*

100 mg $CaCO_3$ per liter = 100 ppm hardness

🔢 *Simple Numerical:*

1.If 50 mg $CaCO_3$ is present in 1 L water: 👉 Hardness = 50 ppm

🧼 *4. Cause of Poor Lathering of Soap*

Soap reacts with Ca^{2+} and Mg^{2+} ions to form insoluble precipitate (scum).

Reaction:

Soap + Ca^{2+} → Calcium soap (insoluble)

🧠 *Result:*

- ➢ *Soap gets wasted*
- ➢ *Less foam formation*

📌 *Example:*

- ➢ *When washing clothes in hard water → more soap required*

⚠️ *5. Problems Caused by Hard Water in Boilers*

🔷 *(A) Scale Formation*

Hard salts deposit on boiler walls forming hard layer (scale).

🧠 *Effects:*

- *Reduces heat transfer*
- *Wastes fuel*

🔷 *(B) Sludge Formation*

Soft loose deposits settle at bottom

🔷 *(C) Foaming and Priming*

🔬 *Foaming:*

- ➢ *Formation of bubbles due to impurities*

🔬 *Priming:*

- ➢ *Water droplets carried with steam*

🔷 *(D) Corrosion*

- ➢ *Chemical reactions damage metal*

📌 *Example:*

- ➢ *Rusting of boiler pipes*

🧪 ***6. EDTA Method for Hardness Measurement***

➢ *A titration method using EDTA to measure hardness.*

➢ *EDTA forms stable complex with Ca^{2+} and Mg^{2+}*

➢ *Indicator (Eriochrome Black T) used*

🧠 *Process:*

1. *Add indicator → wine red color*
2. *Add EDTA → color changes to blue*
3. *Endpoint indicates hardness*

📌 *Importance:*

➢ *Accurate measurement of water hardness*

💧 *7. Total Dissolved Solids (TDS)*

➢ *Total amount of dissolved substances in water.*

🔬 *Includes:*

- *Salts*
- *Minerals*
- *Organic matter*

📌 *Example:*

High TDS → salty or bad taste water

🧠 *Importance:*

➢ *Indicates water quality*

⚗️ *8. Alkalinity Estimation*

➢ *Measures ability of water to neutralize acids.*

🔬 *Caused by:*

- *Carbonates (CO_3^{2-})*
- *Bicarbonates (HCO_3^-)*
- *Hydroxides (OH^-)*

🧠 *Importance:*

- *Affects pH*
- *Important for treatment processes*

⚙️ ***9. Water Softening Techniques***

🔷 *(A) Soda Lime Process*

Uses:

- ➢ *$Ca(OH)_2$ (lime)*
- ➢ *Na_2CO_3 (soda)*

🧠 *Function:*

- ➢ *Removes Ca^{2+} and Mg^{2+} as precipitates*

🔷 *(B) Zeolite Process*

Uses sodium zeolite (Na_2Z)

Reaction:

$Ca^{2+} + Na_2Z \rightarrow CaZ + 2Na^+$

🧠 *Advantage:*

- *Fast and efficient*

🔷 *(C) Ion Exchange Process*

Uses resins to exchange ions.

Types:

- *Cation exchange → removes Ca^{2+}*
- *Anion exchange → removes Cl^-*

🧠 *Result:*

Produces deionized water (pure water)

🏭 *10. Municipal Water Treatment*

🔷 *Steps:*

(1) Sedimentation

- ➢ *Heavy particles settle down*

(2) Coagulation

➢ *Alum added → forms flocs*

(3) Filtration

➢ *Sand filters remove impurities*

(4) Sterilization

➢ *Chlorination kills bacteria*

📌 *Result:*

- *Safe drinking water*

🚰 *11. Drinking Water Standards (India)*

🔷 *Based on:*

➢ *Bureau of Indian Standards (BIS)*

🔬 *Key Standards:*

Parameter   Acceptable Limit

➔ *pH   6.5 – 8.5*

➔ *TDS   ≤ 500 mg/L*

➔ *Hardness   ≤ 200 mg/L*

➔ *Fluoride   1.0 mg/L*

➔ *Chloride   ≤ 250 mg/L*

🧠 *Importance:*

➢ *Ensures water is:*

➢ *Safe*

➢ *Non-toxic*

➢ *Suitable for drinking and cooking*

UNIT -4
ELECTRO CHEMISTRY

⚡ ***1. pH and pOH***

🔷 *Definition of pH:*

- ➢ *pH is a measure of acidity or basicity of a solution.*

  pH = -\log[H^+]

It tells how many hydrogen ions (H^+) are present.

- *More H^+ → more acidic → lower pH*
- *Less H^+ → more basic → higher pH*

🔷 *pOH:*

pOH = -\log[OH^-]

🧠 *Relation:*

pH + pOH = 14

📊 *pH Scale:*

- ➢ *0–7 → Acidic*
- ➢ *7 → Neutral*
- ➢ *7–14 → Basic*

📌 *Examples:*

- *Lemon juice → pH ~2 (acidic)*
- *Pure water → pH 7*
- *NaOH → pH ~13 (basic)*

🔢 *Numerical:*

If

pH = -\log(10^{-3}) = 3

🧠 *Importance:*

- *Agriculture (soil pH)*
- *Medicine (blood pH ~7.4)*
- *Industry*

🔄 *2. Oxidation, Reduction and Redox*

🔷 *Electronic Concept:*

🔬 *Oxidation:*

- *Loss of electrons*

Reduction

- *Gain of electrons*

Redox Reaction:

- *Both occur together*

Example:

$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

Zn loses electrons → oxidation

Cu^{2+} *gains electrons → reduction*

3. Electrolytes and Related Terms

Electrolytes:

- *Substances that conduct electricity in solution.*

Example:

NaCl, HCl

Non-electrolytes:

- *Do not conduct electricity*

Example:

- *Sugar, urea*

Ionization:

- *Formation of ions from molecules*

Example: $HCl \rightarrow H^{+} + Cl^{-}$

Dissociation:

- *Separation of already existing ions*
  - *Example:* $NaCl \rightarrow Na^{+} + Cl^{-}$

Cathode and Anode:

Term	*Definition*
Cathode	*Reduction occurs*
Anode	*Oxidation occurs*

Example:

In electrolysis:
Cathode → metal deposition
Anode → dissolution

4. Electrochemical Series
Definition:
- ➢ Arrangement of elements based on their tendency to lose electrons.

🧠 Importance:
- ➢ Predict reactivity
- ➢ Predict displacement reactions

📌 Example:
Zn is above Cu → Zn displaces Cu

🧪 5. Electrolysis of $CuSO_4$ Solution
🔬 Setup:
Electrolyte: $CuSO_4$
Electrodes: copper

🔷 At Cathode:
$Cu^{2+} + 2e^- \rightarrow Cu$
👉 Copper deposited

🔷 At Anode:
$Cu \rightarrow Cu^{2+} + 2e^-$
👉 Copper dissolve

🧠 Result:
- ➢ Pure copper transferred

⚖️ 6. Faraday's Laws of Electrolysis
🔷 First Law:
- ➢ Amount of substance deposited is directly proportional to charge passed

  $m \propto Q$

🔷 Second Law:
- ➢ Amount deposited depends on equivalent weight

🔬 Relation:
$Z = \frac{E}{F}$
Where:

Z = electrochemical equivalent
E = equivalent weight
F = Faraday constant

🔢 *Numerical Example:*
If 2A current flows for 10 sec:
$Q = I \times t = 2 \times 10 = 20\ C$

🏭 *7. Industrial Applications of Electrolysis*
🔷 *(A) Electrometallurgy*

🔬 *Explanation:*
Extraction of metals using electricity
📌 *Example:*
Aluminium extraction

🔷 *(B) Electroplating*

🔬 *Explanation:*
Coating one metal over another
📌 *Example:*
Gold plating on jewelry

🔷 *(C) Electrolytic Refining*
🔬 *Explanation:*
Purification of metals
📌 *Example:*
Copper refining

8. Electrochemical Cells
🔷 *(A) Primary Cells (Dry Cell)*
Explanation:

- *Cannot be recharged*
- *Chemical energy → electrical energy*

Example:
Torch battery
🔷 *(B) Secondary Cell (Lead Storage Battery)*
🔬 *Explanation:*
Rechargeable

Example:

Car battery

Reaction:

Lead + Lead dioxide + acid

◆ *(C) Fuel Cells*

Explanation:

Convert chemical energy directly into electricity

Example:

➢ *Hydrogen fuel cell:*

$H_2 + O_2 \rightarrow H_2O$ + *energ*◆

(D) Solar Cells

Explanation:Convert sunlight into electricity

UNIT - 5
ENVIRONMENTAL CHEMISTRY

1. General Concept of Pollution and Pollutants

Detailed Explanation:

Pollution refers to the introduction of harmful substances or energy into the environment, which causes undesirable changes in physical, chemical, or biological characteristics of air, water, or land.

These harmful substances are called pollutants.

Types of Pollutants:

🔷 *Primary Pollutants:*
Directly released into environment
👉 *Example: CO, SO_2 from vehicles*

🔷 *Secondary Pollutants:*
Formed by reactions in atmosphere
👉 *Example: Ozone (O_3), smog*

📌 *Example:*
Smoke from factories → primary pollutant
Acid rain → secondary pollutant

🌬 *2. Air Pollution*
🔷 *Definition:*

- ➢ *Air pollution is the contamination of air by harmful gases, dust, smoke, or chemicals.*

🔬 *Air Pollutants:*

- ➢ *Carbon monoxide (CO)*
- ➢ *Sulfur dioxide (SO_2)*
- ➢ *Nitrogen oxides (NO_x)*
- ➢ *Particulate matter (PM2.5, PM10)*
- ➢ *Hydrocarbons*

🔷 *Sources:*

1. Vehicles
2. Industries
3. Burning of fossil fuels

4. Forest fires

🔷 Harmful Effects:

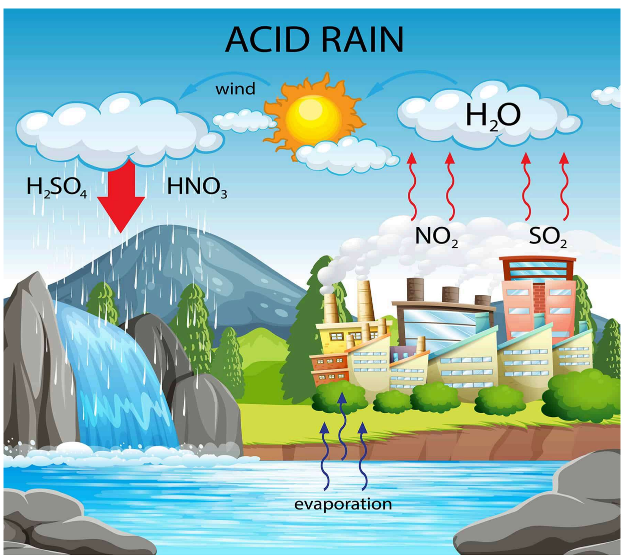
- Respiratory diseases (asthma)
- Eye irritation
- Damage to crops
- Climate change

☔ 3. Acid Rain

🔬 Formation:

SO_2 + NO_x react with water vapor → form acids

$SO_2 + H_2O \rightarrow H_2SO_4$



Effects:

Damages buildings (marble corrosion)
Harms plants
Acidifies lakes → kills fish

📌 Example:

- Damage to monuments like
- Taj Mahal

🌡 *4. Greenhouse Effect and Global Warming*

Concept:

- ➢ *Greenhouse gases trap heat in atmosphere.*

🔷 *Gases:*

- *CO_2*
- *CH_4*
- *N_2O*

🧠 *Mechanism:*

- ➢ *Sunlight enters Earth*
- ➢ *Heat tries to escape*
- ➢ *Gases trap heat → warming*

🔷 *Global Warming Effects:*

I. *Rising temperature*
II. *Melting glaciers*
III. *Sea level rise*
IV. *Climate change*

📌 *Example:*

Flooding in coastal are

🛡 *5. Ozone Layer*

🔬 *Importance:*

- ➢ *Ozone layer absorbs harmful UV radiation from sun.*

🔷 *Depletion Causes:*

CFCs (chlorofluorocarbons)

Refrigerants

🧠 *Effects:*

I. *Skin cancer*
II. *Eye damage*
III. *Crop damage*

📌 *Example:*

Ozone hole over Antarctica

🌫 *6. Smog*

🔬 *Definition:*

➢ *Mixture of smoke + fog.*

🔷 *Types:*

1. *Classical smog (SO_2)*
2. *Photochemical smog (NO_x + sunlight)*

🧠 *Effects:*

Breathing problems

Reduced visibility

Example:

➢ *Smog in Delhi*

Control of Air Pollution

Methods:

- *Use clean fuels (CNG)*
- *Install filters in industries*
- *Use public transport*
- *Plant trees*

8. Water Pollution

Definition:

➢ *Contamination of water making it unsafe.*

🔷 *Causes:*

- *Sewage*
- *Industrial waste*
- *Agricultural chemicals*

9. Sewage and Its Effects

Sewage:

➢ *Wastewater from homes.*

Effects:

- *Spread of diseases*
- *Oxygen depletion in water*
-

Disposal:

- *Treatment plants*
- *Biological processes*

10. Industrial Effluents

Definition:

- ➢ *Liquid waste from industries.*

Effects:

- *Toxic to aquatic life*
- *Pollutes drinking water*

Heavy Metal Pollution

Metals:

I. *Lead (Pb)*
II. *Cadmium (Cd)*
III. *Zinc (Zn)*
IV. *Copper (Cu)*

Effects:

Lead:

- ➢ *Brain damage*

Cadmium:

- ➢ *Kidney damage*

Copper:

- ➢ *Toxic in excess*

Example:

- ➢ *Industrial discharge into rivers*

12. Treatment of Effluents

Methods:

Physical → filtration

Chemical → precipitation

Biological → bacteria

13. Eutrophication

Definition:

- ➢ *Excess nutrients cause rapid growth of algae.*

Effects:

- *Oxygen depletion*
- *Death of aquatic life*

Example:

- ➢ *Algal bloom in lakes*

Solid Waste Management

Definition:

- ➢ *Handling and disposal of solid waste.*

Types:

1. *Biodegradable*

2. *Non-biodegradable*

Problems:

1. *Land pollution*
2. *Health hazards*

🔷 *Disposal Methods:*

Landfill:

➢ *Waste buried*

Incineration:

➢ *Waste burned*

Green Chemistry

Definition:

➢ *Designing processes that reduce pollution.*

Goal:

Minimize waste

Use safe chemicals

Protect environment

♻️ ***16. Recycling***

Definition:

➢ *Reusing materials instead of discarding them.*

Advantages:

- *Saves resources*
- *Reduces pollution*
- *Energy efficient*

Example:

Recycling plastic bottles


RECYCLING PROCESS
SEGREGATION
DISMANTLING
TRANSPORTATION
SEPARATION
COLLECTION
REUSE AND
RECYCLE