Question 1 (Any Seven) [14 marks]

1. Define the terms: 'Ecology' and 'Ecosystem'.

Answer:
Ecology is the scientific study of relationships between living organisms and their environment. **Ecosystem** is a biological community of interacting organisms and their physical environment functioning as a unit.

Table:

Term	Definition	Example
Ecology	Study of organism-environment relationships	Forest ecology
Ecosystem	Living and non-living components interaction	Pond ecosystem

- **Biotic components**: Living organisms in the system
- **Abiotic components**: Non-living factors like air, water, soil

Mnemonic: "Every Component Lives Together" (Ecology Creates Living Together)

2. Define the terms: 'Pollution' and 'Pollutant'.

Answer:
Pollution is the introduction of harmful substances into the environment causing adverse effects.
Pollutant is any substance that causes pollution when present in excessive amounts.

Table:

Term	Definition	Types
Pollution	Environmental contamination	Air, Water, Soil, Noise
Pollutant	Harmful substance	Physical, Chemical, Biological

- **Primary pollutants**: Directly emitted substances
- **Secondary pollutants**: Formed by reactions in atmosphere

Mnemonic: "Pollution Produces Problems" (Pollutants Produce Problems)

3. What is noise pollution? What is unit of intensity of sound?

Answer:
Noise pollution is unwanted or excessive sound that disrupts human activities and harms living beings. The unit of sound intensity is **decibel (dB)**.

Table:

Sound Level	Source	Effect
30-40 dB	Library	Comfortable
60-70 dB	Traffic	Annoying
90+ dB	Industry	Harmful

- **Threshold of hearing**: 0 dB
- **Threshold of pain**: 120 dB

Mnemonic: "Decibels Determine Damage" (dB Determines Damage)

4. What is solid waste management? Give its objectives.

Answer:
Solid waste management is systematic handling of waste from generation to final disposal to minimize environmental impact and protect public health.

Objectives:

- **Public health protection**: Prevent disease transmission
- **Environmental protection**: Reduce pollution and contamination
- **Resource recovery**: Recycle and reuse materials
- **Cost effectiveness**: Economic waste handling

Mnemonic: "People Expect Resource Conservation" (Protection, Environment, Resource, Cost)

5. Enlist types of solar cells.

Answer:
Solar cells convert sunlight directly into electricity through photovoltaic effect.

Table:

Type	Efficiency	Cost	Application
Monocrystalline	15-20%	High	Residential
Polycrystalline	13-16%	Medium	Commercial
Thin Film	7-13%	Low	Large scale

- **Silicon-based**: Most common type
- **Non-silicon**: Emerging technologies

Mnemonic: "Most People Think" (Mono, Poly, Thin-film)

6. What is climate change?

Answer:
Climate change refers to long-term shifts in global temperatures and weather patterns, primarily caused by human activities and greenhouse gas emissions.

Causes:

- **Greenhouse gases**: CO_2, CH_4, N_2O emissions
- **Deforestation**: Reduced carbon absorption
- **Industrial activities**: Fossil fuel burning

Effects:

- **Rising temperatures**: Global warming
- **Sea level rise**: Melting ice caps

Mnemonic: "Change Creates Consequences" (Climate Change Creates Consequences)

7. What is C.F.C?

Answer:
CFC (Chlorofluorocarbon) are synthetic compounds containing carbon, fluorine, and chlorine atoms, previously used in refrigeration and aerosols.

Properties:

- **Ozone depleting**: Destroys stratospheric ozone
- **Greenhouse gas**: Contributes to global warming
- **Stable compounds**: Long atmospheric lifetime
- **Montreal Protocol**: International ban agreement

Mnemonic: "Chlorine Fluorine Carbon" (CFC components)

8. Give advantages of ISO-14000.

Answer:
ISO 14000 is international standard for environmental management systems.

Advantages:

- **Environmental compliance**: Meet legal requirements
- **Cost reduction**: Efficient resource use
- **Market advantage**: Enhanced company image
- **Risk management**: Prevent environmental incidents

Table:

Benefit	Impact	Result
Compliance	Legal safety	Avoid penalties
Efficiency	Resource saving	Cost reduction
Image	Market position	Competitive advantage

Mnemonic: "Companies Gain Market Recognition" (Compliance, Cost, Market, Risk)

9. Enlist various Acts related to environment in India.

Answer:
India has comprehensive environmental legislation framework.

Major Acts:

- **Air Act (1981)**: Air pollution control
- **Water Act (1974)**: Water pollution prevention
- **Environment Protection Act (1986)**: Comprehensive environmental law
- **Wildlife Protection Act (1972)**: Biodiversity conservation
- **Forest Conservation Act (1980)**: Forest protection

Mnemonic: "All Water Environments Wildlife Forests" (AWEWF)

10. Enlist various methods of rainwater harvesting.

Answer:
Rainwater harvesting collects and stores rainwater for future use.

Methods:

- **Rooftop harvesting**: Direct collection from roofs
- **Surface runoff harvesting**: From ground surfaces
- **Recharge pits**: Groundwater recharging
- **Check dams**: Stream water collection

Table:

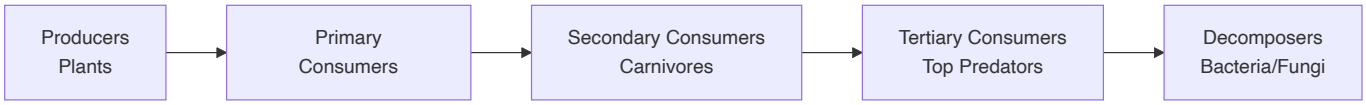
Method	Application	Benefit
Rooftop	Urban areas	Direct use
Surface	Rural areas	Large volume
Recharge	Water table	Groundwater

Mnemonic: "Roofs Surface Recharge Check" (RSRC)

Question 2(a) [3 marks]

Write short note on: Food chain.

Answer:
Food chain represents the flow of energy and nutrients through different trophic levels in an ecosystem.



- **Energy transfer**: Only 10% passes to next level
- **Biomass pyramid**: Decreases at higher levels

Mnemonic: "Plants Provide Primary Power" (Producer to Predator Path)

OR

Explain factors affecting ecosystem.

Answer:
Ecosystems are influenced by various biotic and abiotic factors.

Factors:

- **Climate factors**: Temperature, rainfall, humidity
- **Soil factors**: pH, nutrients, texture
- **Biotic factors**: Species interactions, population density
- **Human factors**: Pollution, habitat destruction

Table:

Factor Type	Components	Impact
Abiotic	Climate, Soil	Habitat conditions
Biotic	Organisms	Species interactions
Anthropogenic	Human activities	Ecosystem disruption

Mnemonic: "Climate Soil Biology Humans" (CSBH)

Question 2(b) [3 marks]

Write short note on: Virtual water

Answer:
Virtual water is the hidden water used in production of goods and services, representing total water consumption in supply chain.

Examples:

- **1 kg wheat**: 1,300 liters virtual water
- **1 kg beef**: 15,400 liters virtual water
- **1 cotton t-shirt**: 2,700 liters virtual water
- **Water footprint**: Total virtual water consumption
- **Trade implications**: Water-rich countries export virtual water

Mnemonic: "Virtual Water Worldwide" (VWW)

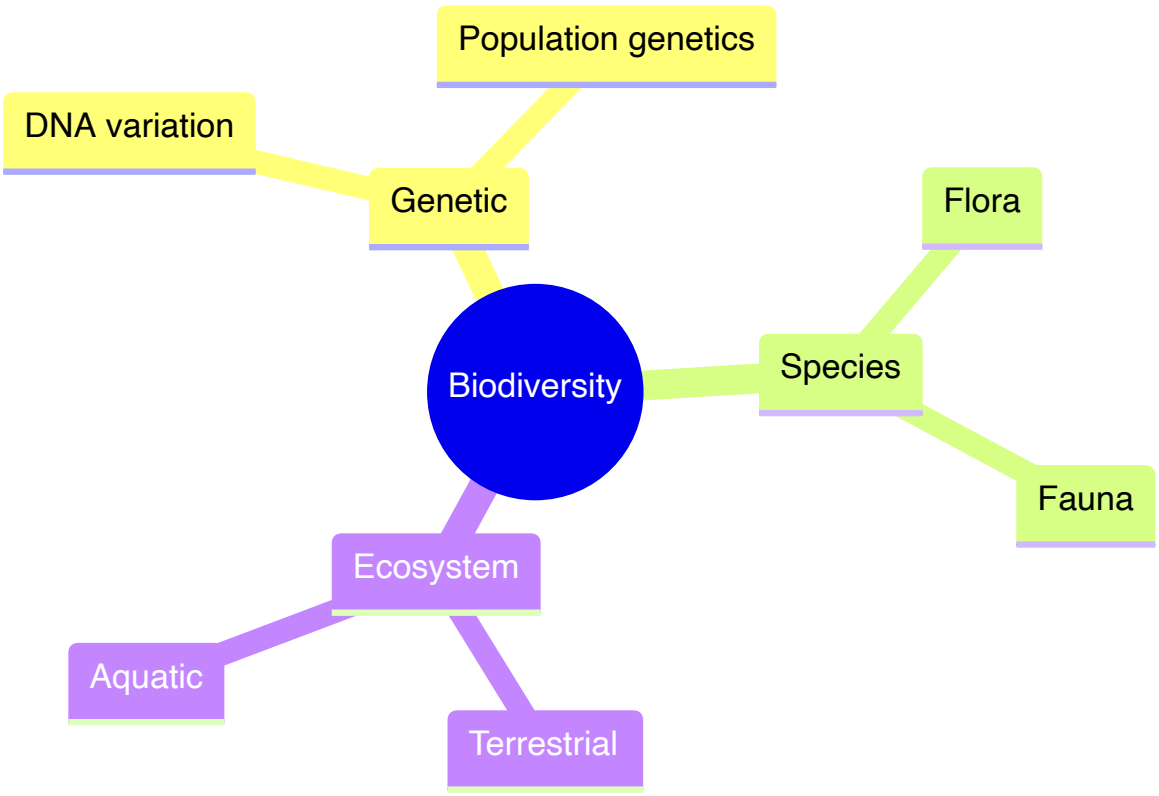
OR

What is biodiversity? Give its types.

Answer:
Biodiversity is the variety of life forms at genetic, species, and ecosystem levels on Earth.

Types:

- **Genetic diversity**: Variation within species
- **Species diversity**: Number of different species
- **Ecosystem diversity**: Variety of habitats and communities

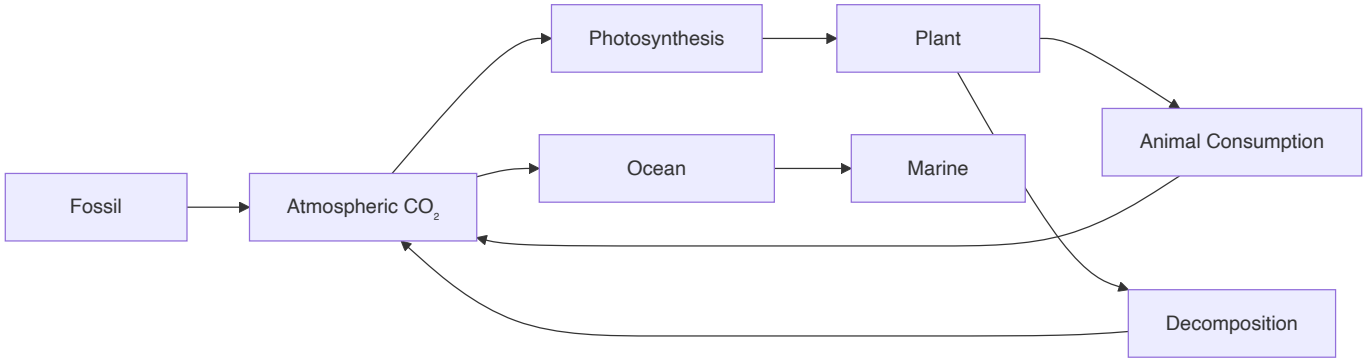


Mnemonic: "Genes Species Ecosystems" (GSE)

Question 2(c) [4 marks]

Explain: Carbon cycle

Answer:
Carbon cycle describes the movement of carbon through Earth's atmosphere, land, water, and organisms.



Processes:

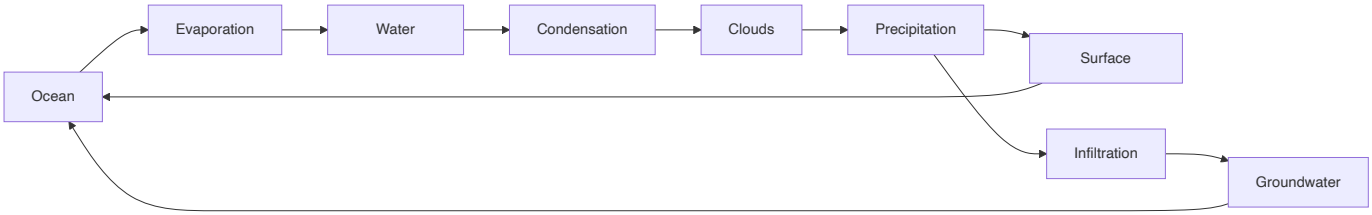
- **Photosynthesis**: CO_2 absorption by plants
- **Respiration**: CO_2 release by organisms
- **Decomposition**: Carbon return to atmosphere
- **Ocean exchange**: CO_2 dissolution in seawater

Mnemonic: "Plants Breathe, Die, Ocean" (PBDO)

OR

Draw and explain the hydrologic cycle

Answer:
Hydrologic cycle is the continuous movement of water through atmosphere, land, and oceans.



Processes:

- **Evaporation**: Water to vapor conversion
- **Condensation**: Vapor to liquid conversion
- **Precipitation**: Rain, snow formation
- **Infiltration**: Groundwater recharge

Mnemonic: "Every Cloud Produces Rain" (ECPR)

Question 2(d) [4 marks]

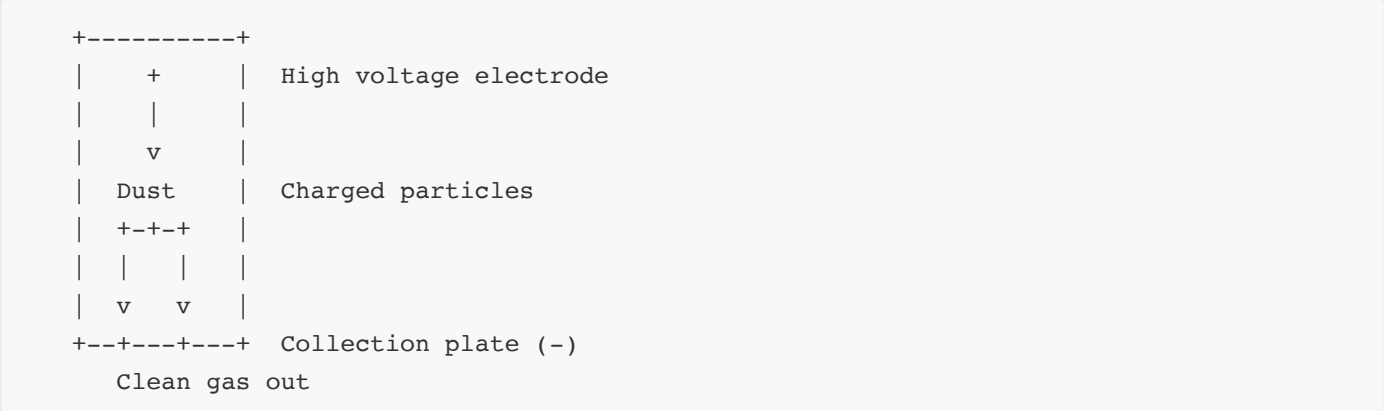
Enlist equipments used to control air pollution and explain any one.

Answer:
Air pollution control equipment removes pollutants from industrial emissions.

Equipment List:

- **Cyclone separators**: Particulate removal
- **Electrostatic precipitators**: Fine particle collection
- **Bag filters**: Fabric filtration
- **Scrubbers**: Gas absorption

Electrostatic Precipitator:



- **Charging**: Particles acquire electric charge
- **Collection**: Charged particles attracted to plates
- **Efficiency**: 99% removal of fine particles

Mnemonic: "Charge Collect Clean" (CCC)

OR

Enlist the types of environmental pollution and give the effects of noise pollution

Answer:
Environmental pollution types:

- **Air pollution**: Atmospheric contamination
- **Water pollution**: Aquatic contamination
- **Soil pollution**: Land contamination
- **Noise pollution**: Sound contamination

Noise Pollution Effects:

- **Health effects**: Hearing loss, stress, hypertension
- **Psychological effects**: Irritation, sleep disturbance
- **Performance effects**: Reduced concentration, productivity
- **Communication effects**: Speech interference

Table:

Effect Type	Symptoms	Impact
Physical	Hearing damage	Permanent loss
Mental	Stress, anxiety	Health issues
Social	Communication problems	Relationship strain

Mnemonic: "Air Water Soil Sound" (AWSS)

Question 3(a) [3 marks]

What is e-waste? Give effects of e-waste on environment and humans.

Answer:
E-waste (Electronic waste) consists of discarded electrical and electronic devices containing hazardous materials.

Environmental Effects:

- **Soil contamination**: Heavy metals leaching
- **Water pollution**: Toxic chemical runoff
- **Air pollution**: Burning releases toxic fumes

Human Effects:

- **Health hazards**: Lead, mercury poisoning
- **Respiratory problems**: Toxic gas inhalation
- **Skin disorders**: Direct contact with chemicals

Table:

Component	Hazard	Impact
Lead	Neurotoxin	Brain damage
Mercury	Toxic metal	Kidney damage
Cadmium	Carcinogen	Cancer risk

Mnemonic: "Electronic Equipment Endangers Everyone" (E4)

OR

What is plastic waste? Give effects of plastic waste.

Answer:
Plastic waste consists of discarded plastic materials that persist in environment due to non-biodegradable nature.

Effects:

- **Marine pollution**: Ocean plastic accumulation
- **Wildlife impact**: Entanglement, ingestion by animals
- **Soil degradation**: Reduced fertility and water infiltration
- **Human health**: Microplastics in food chain

Categories:

- **Single-use plastics**: Bags, bottles, straws
- **Packaging waste**: Food containers, wrappings
- **Industrial plastic**: Manufacturing waste

Mnemonic: "Plastic Persists, Problems Persist" (PPPP)

Question 3(b) [3 marks]

Give main sources of solid waste.

Answer:
Solid waste originates from various human activities and natural processes.

Sources:

- **Residential**: Household garbage, food waste
- **Commercial**: Office waste, packaging materials
- **Industrial**: Manufacturing waste, chemicals
- **Agricultural**: Crop residues, animal waste
- **Municipal**: Street sweeping, park maintenance

Table:

Source	Waste Type	Management
Domestic	Organic, Plastic	Collection
Industrial	Hazardous, Non-hazardous	Treatment
Agricultural	Biodegradable	Composting

Mnemonic: "Residential Commercial Industrial Agricultural Municipal" (RCIAM)

OR

Enlist various methods of solid waste disposal and explain any one.

Answer:
Disposal Methods:

- **Landfilling**: Controlled waste burial
- **Incineration**: Waste burning with energy recovery
- **Composting**: Organic waste decomposition
- **Recycling**: Material recovery and reuse

Sanitary Landfill:

```
Daily cover
+----------+
|  Waste   |  Compacted layers
+----------+
|   Clay   |  Liner system
+----------+
| Drainage |  Leachate collection
+----------+
```

- **Design**: Engineered system with liners
- **Operation**: Daily cover, compaction
- **Environmental protection**: Leachate and gas control

Mnemonic: "Land Incinerate Compost Recycle" (LICR)

Question 3(c) [4 marks]

Explain the working of Liquid Flat Plate Collector with a neat sketch.

Answer:
Liquid Flat Plate Collector converts solar radiation into thermal energy for heating water.

```
    Glass cover
    +================+
    |  ~~~~~~~~~~~~  |  Air gap
    +================+
    |  ||||||||||||  |  Absorber plate (black)
    |  [----------]  |  Fluid tubes
    +================+
    |  Insulation    |  Back insulation
    +================+
         ^      ^
    Cold water  Hot water
    inlet       outlet
```

Working:

- **Solar absorption**: Black absorber plate captures solar energy
- **Heat transfer**: Absorbed heat transfers to flowing liquid
- **Circulation**: Heated liquid rises, cool liquid enters
- **Insulation**: Minimizes heat losses

Components:

- **Transparent cover**: Reduces convection losses
- **Absorber plate**: Maximum solar absorption
- **Heat transfer fluid**: Water or antifreeze solution

Mnemonic: "Solar Absorption Creates Heat Transfer" (SACHT)

OR

Write short note on solar pond

Answer:
Solar pond is a pool of saltwater that acts as both solar collector and thermal storage system.

Structure:

- **Upper zone**: Low salt concentration
- **Middle zone**: Increasing salt gradient
- **Lower zone**: High salt concentration

Working:

- **Density gradient**: Prevents convection mixing
- **Heat storage**: Bottom layer stores thermal energy
- **Temperature**: Can reach 70-85°C at bottom

Applications:

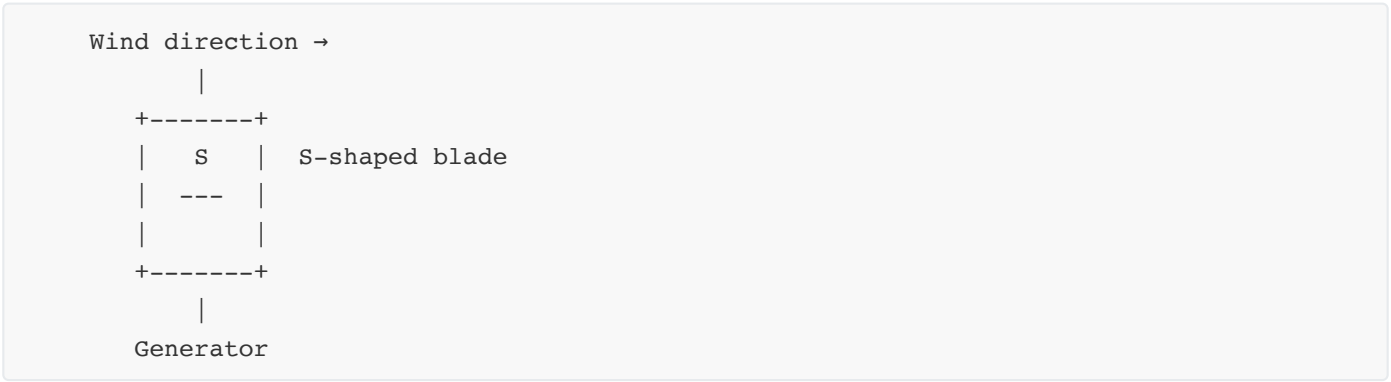
- **Power generation**: Steam production
- **Industrial heating**: Process heat supply
- **Desalination**: Water purification

Mnemonic: "Salt Stores Solar Thermal" (SSST)

Question 3(d) [4 marks]

Explain Savonious wind mill with a neat sketch.

Answer:
Savonius wind turbine is a vertical axis wind turbine with S-shaped rotor blades.



Working:

- **Drag principle**: Wind creates differential drag on blades
- **Rotation**: S-shape causes continuous rotation
- **Self-starting**: Starts at low wind speeds
- **Vertical axis**: Independent of wind direction

Advantages:

- **Simple design**: Low maintenance requirements
- **Low noise**: Quiet operation
- **All wind directions**: Omnidirectional capability

Disadvantages:

- **Lower efficiency**: 20-30% compared to HAWT
- **Space requirement**: Larger area needed

Mnemonic: "S-Shape Starts Slowly" (SSS)

OR

Give the comparison between Horizontal Axis and Vertical Axis wind mills.

Answer:
Wind turbines are classified based on rotor axis orientation.

Comparison Table:

Parameter	Horizontal Axis (HAWT)	Vertical Axis (VAWT)
Efficiency	35-45%	20-30%
Wind direction	Must face wind	Any direction
Installation	Tower required	Ground level possible
Maintenance	Difficult access	Easy access
Noise	Higher	Lower
Cost	Higher	Lower

HAWT Features:

- **Upwind design**: Rotor faces wind
- **Pitch control**: Blade angle adjustment
- **Yaw system**: Wind direction tracking

VAWT Features:

- **Omnidirectional**: No wind tracking needed
- **Ground installation**: Easier maintenance
- **Lower wind speeds**: Better performance

Mnemonic: "Horizontal High, Vertical Versatile" (HHVV)

Question 4(a) [3 marks]

Give effects of climate change.

Answer:
Climate change causes widespread environmental and socio-economic impacts globally.

Environmental Effects:

- **Temperature rise**: Global average increase
- **Sea level rise**: Thermal expansion and ice melting
- **Weather extremes**: Intense storms, droughts, floods
- **Ecosystem shifts**: Species migration and extinction

Socio-economic Effects:

- **Agricultural impact**: Crop yield changes

- **Water resources**: Availability and quality issues
- **Human health**: Heat stress, disease spread
- **Economic losses**: Infrastructure damage

Table:

Impact Category	Examples	Severity
Environmental	Melting glaciers	High
Agricultural	Crop failure	Medium
Health	Heat waves	High

Mnemonic: "Temperature Sea Weather Ecosystem" (TSWE)

OR

Write a short note on Green House gases.

Answer:
Greenhouse gases trap heat in Earth's atmosphere, causing global warming through greenhouse effect.

Major Greenhouse Gases:

- **Carbon dioxide (CO_2)**: 76% of emissions
- **Methane (CH_4)**: 16% of emissions
- **Nitrous oxide (N_2O)**: 6% of emissions
- **Fluorinated gases**: 2% of emissions

Sources:

- **CO_2**: Fossil fuel burning, deforestation
- **CH_4**: Agriculture, landfills, livestock
- **N_2O**: Fertilizers, fossil fuel combustion

Global Warming Potential:

- **CO_2**: Reference (GWP = 1)
- **CH_4**: 25 times CO_2
- **N_2O**: 298 times CO_2

Mnemonic: "Carbon Methane Nitrous Fluorine" (CMNF)

Question 4(b) [4 marks]

Explain climate change Management.

Answer:
Climate change management involves strategies to reduce greenhouse gas emissions and adapt to climate impacts.

Mitigation Strategies:

- **Renewable energy**: Solar, wind, hydroelectric power
- **Energy efficiency**: Improved building designs, LED lighting
- **Carbon sequestration**: Forest conservation, tree planting
- **Sustainable transport**: Electric vehicles, public transport

Adaptation Strategies:

- **Infrastructure resilience**: Flood defenses, drought-resistant crops
- **Water management**: Rainwater harvesting, efficient irrigation
- **Coastal protection**: Sea walls, mangrove restoration
- **Emergency preparedness**: Early warning systems

Policy Measures:

- **Carbon pricing**: Tax on emissions
- **Renewable energy targets**: Clean energy goals
- **Building codes**: Energy efficiency standards

Mnemonic: "Mitigation Adaptation Policy" (MAP)

OR

Give effects of ozone layer depletion.

Answer:
Ozone layer depletion reduces stratospheric ozone, allowing harmful UV radiation to reach Earth.

Effects on Humans:

- **Skin cancer**: Increased UV-B radiation exposure
- **Eye cataracts**: UV damage to eye lens
- **Immune suppression**: Weakened immune system
- **Premature aging**: Skin damage acceleration

Effects on Environment:

- **Crop damage**: Reduced agricultural productivity
- **Marine ecosystem**: Phytoplankton reduction
- **Material degradation**: Plastic and rubber damage
- **Climate change**: Ozone as greenhouse gas

Table:

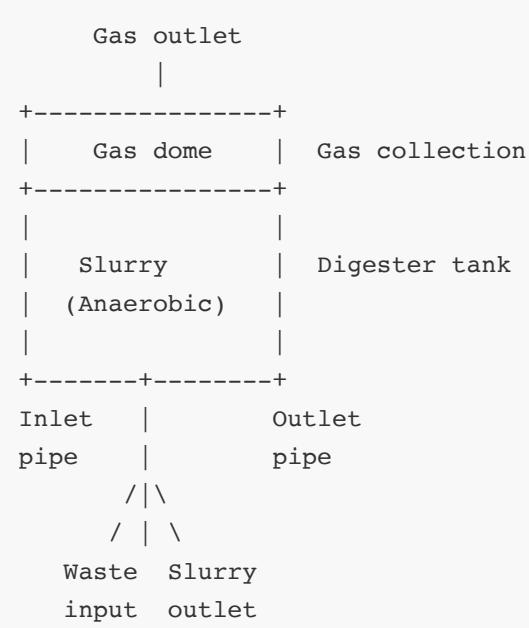
UV Type	Wavelength	Effect
UV-A	320-400 nm	Skin aging
UV-B	280-320 nm	Sunburn, cancer
UV-C	200-280 nm	Blocked by ozone

Mnemonic: "Skin Eyes Immunity Climate" (SEIC)

Question 4(c) [7 marks]

Explain biogas plant with sketch.

Answer:
Biogas plant produces methane-rich gas through anaerobic digestion of organic waste.



Components:

- **Digester tank**: Anaerobic fermentation chamber
- **Gas dome**: Biogas collection and storage
- **Inlet pipe**: Waste material feeding
- **Outlet pipe**: Digested slurry removal

Process:

- **Hydrolysis**: Complex organics break down
- **Acidogenesis**: Acid-forming bacteria action
- **Methanogenesis**: Methane-producing bacteria

- **Gas production**: 50-70% methane, 30-40% CO_2

Operating Conditions:

- **Temperature**: 30-40°C optimal
- **pH**: 6.8-7.2 range
- **Retention time**: 15-30 days
- **C:N ratio**: 20-30:1 optimal

Applications:

- **Cooking fuel**: Household energy needs
- **Lighting**: Gas lamp illumination
- **Electricity**: Generator power
- **Fertilizer**: Nutrient-rich slurry

Advantages:

- **Renewable energy**: Sustainable fuel source
- **Waste management**: Organic waste utilization
- **Environmental benefits**: Reduced methane emissions
- **Economic benefits**: Cost savings on fuel

Mnemonic: "Biogas Benefits: Renewable Waste Environment Economy" (BRWEE)

Question 5(a) [4 marks]

Write short note on global warming.

Answer:
Global warming refers to long-term increase in Earth's average surface temperature due to human activities.

Causes:

- **Greenhouse gases**: CO_2, CH_4, N_2O emissions
- **Deforestation**: Reduced carbon absorption
- **Industrial activities**: Fossil fuel combustion
- **Transportation**: Vehicle emissions

Effects:

- **Temperature rise**: 1.1°C since pre-industrial times
- **Ice melting**: Arctic sea ice, glaciers shrinking
- **Sea level rise**: Coastal flooding threat
- **Weather changes**: Extreme events frequency

Evidence:

- **Temperature records**: Warmest years in recent decades
- **Ice core data**: Historical CO_2 levels
- **Satellite measurements**: Global temperature monitoring

Solutions:

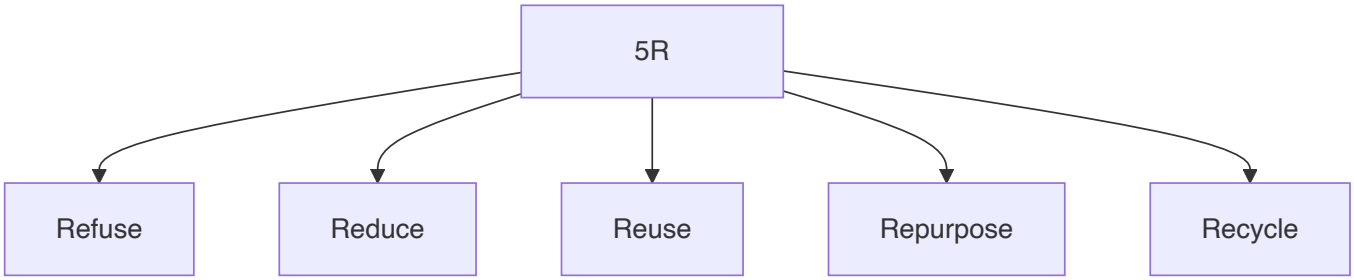
- **Renewable energy**: Clean power sources
- **Energy efficiency**: Reduced consumption
- **Carbon capture**: Technology development
- **International cooperation**: Paris Agreement

Mnemonic: "Greenhouse Gases Generate Global Change" (GGGC)

Question 5(b) [4 marks]

Explain 5R concept.

Answer:
5R concept is waste management hierarchy for sustainable resource utilization.



The 5 R's:

1. Refuse:

- **Avoid unnecessary items**: Say no to single-use products
- **Examples**: Plastic bags, straws, excessive packaging

2. Reduce:

- **Minimize consumption**: Use less resources
- **Examples**: Energy conservation, water saving

3. Reuse:

- **Multiple use**: Extend product life
- **Examples**: Glass jars as containers, paper both sides

4. Repurpose:

- **Creative reuse**: New function for old items

- **Examples**: Tire planters, bottle bird feeders

5. Recycle:

- **Material recovery**: Process into new products
- **Examples**: Paper, plastic, metal recycling

Benefits:

- **Waste reduction**: Less landfill burden
- **Resource conservation**: Natural resource preservation
- **Cost savings**: Economic benefits
- **Environmental protection**: Pollution reduction

Mnemonic: "Refuse Reduce Reuse Repurpose Recycle" (R5)

Question 5(c) [3 marks]

Explain the benefits of Green building.

Answer:
Green building incorporates sustainable design and construction practices for environmental and human benefits.

Environmental Benefits:

- **Energy efficiency**: Reduced power consumption
- **Water conservation**: Efficient water systems
- **Waste reduction**: Construction and operational waste minimization

Economic Benefits:

- **Operating cost savings**: Lower utility bills
- **Increased property value**: Market premium
- **Tax incentives**: Government rebates

Health Benefits:

- **Indoor air quality**: Better ventilation systems
- **Natural lighting**: Improved occupant comfort
- **Toxic material reduction**: Healthier environment

Table:

Benefit Type	Examples	Impact
Environmental	Energy saving	30-50% reduction
Economic	Cost savings	20% operating costs
Health	Air quality	Productivity increase

Mnemonic: "Green Buildings Give Environmental Economic Health" (GBEEH)

Question 5(d) [3 marks]

Enlist various Acts related to environment in India and explain any one.

Answer:
Environmental Acts in India:

- **Water (Prevention and Control of Pollution) Act, 1974**
- **Air (Prevention and Control of Pollution) Act, 1981**
- **Environment Protection Act, 1986**
- **Wildlife Protection Act, 1972**
- **Forest (Conservation) Act, 1980**
- **Biodiversity Act, 2002**

Environment Protection Act, 1986:
Objectives:

- **Comprehensive framework**: Overall environmental protection
- **Pollution prevention**: Air, water, soil contamination control
- **Standard setting**: Environmental quality standards
- **Enforcement**: Penalties for violations

Powers:

- **Central government authority**: Environmental regulations
- **Inspection rights**: Industrial facilities monitoring
- **Closure orders**: Non-compliant industries
- **Emergency measures**: Environmental hazards response

Significance:

- **Umbrella legislation**: Covers all environmental aspects
- **Post-Bhopal disaster**: Response to industrial accidents

Mnemonic: "Water Air Environment Wildlife Forest Biodiversity" (WAEWFB)