Environment and Sustainability Solutions

4300003 – Winter 2021
Semester 1 Study Material
Detailed Solutions and Explanations

Question 1 (Any Seven) [14 marks]

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

> **Solution**
>
> **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.
>
> | 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)

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

> **Solution**
>
> **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.
>
> | 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)

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

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

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

Solution

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)

0.0.5 5. Enlist types of solar cells.

Solution

Solar cells convert sunlight directly into electricity through photovoltaic effect.

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)

0.0.6 6. What is climate change?

Solution

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)

0.0.7 7. What is C.F.C?

> **Solution**
>
> **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)

0.0.8 8. Give advantages of ISO-14000.

> **Solution**
>
> **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
>
> | 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)

0.0.9 9. Enlist various Acts related to environment in India.

> **Solution**
>
> 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)

0.0.10 10. Enlist various methods of rainwater harvesting.

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

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

"Roofs Surface Recharge Check" (RSRC)

Question 2(a) [3 marks]

0.0.11 Write short note on: Food chain.

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

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph LR
    A[Producers{br/{}Plants] {-}{-}{} B[Primary Consumers{}br/{}Herbivores]]
    B {-{-}{} C[Secondary Consumers{}br/{}Carnivores]]
    C {-{-}{} D[Tertiary Consumers{}br/{}Top Predators]]
    D {-{-}{} E[Decomposers{}br/{}Bacteria/Fungi]]
{Highlighting}
{Shaded}
```

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

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

0.0.12 OR

0.0.13 Explain factors affecting ecosystem.

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

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]

0.0.14 Write short note on: Virtual water

Solution

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)

0.0.15 OR

0.0.16 What is biodiversity? Give its types.

Solution

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

```
mindmap
  root((Biodiversity))
    Genetic
      DNA variation
      Population genetics
    Species
      Flora
      Fauna
    Ecosystem
      Terrestrial
      Aquatic
```

Mnemonic

"Genes Species Ecosystems" (GSE)

Question 2(c) [4 marks]

0.0.17 Explain: Carbon cycle

Solution

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

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph LR
    A[Atmospheric CO_{2} {-}{-}{} B[Photosynthesis]}
    B {-{-}{} C[Plant Biomass]}
    C {-{-}{} D[Animal Consumption]}
    D {-{-}{} A}
    C {-{-}{} E[Decomposition]}
    E {-{-}{} A}
    F[Fossil Fuels] {-{-}{} A}
    A {-{-}{} G[Ocean Absorption]}
    G {-{-}{} H[Marine Life]}
{Highlighting}
{Shaded}
```

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)

0.0.18 OR

0.0.19 Draw and explain the hydrologic cycle

Solution

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

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting}[]
graph LR
    A[Ocean] {-{-}{} B[Evaporation]}
    B {-{-}{} C[Water Vapor]}
    C {-{-}{} D[Condensation]}
    D {-{-}{} E[Clouds]}
    E {-{-}{} F[Precipitation]}
    F {-{-}{} G[Surface Runoff]}
    F {-{-}{} H[Infiltration]}
    G {-{-}{} A}
    H {-{-}{} I[Groundwater]}
    I {-{-}{} A}
{Highlighting}
{Shaded}
```

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]

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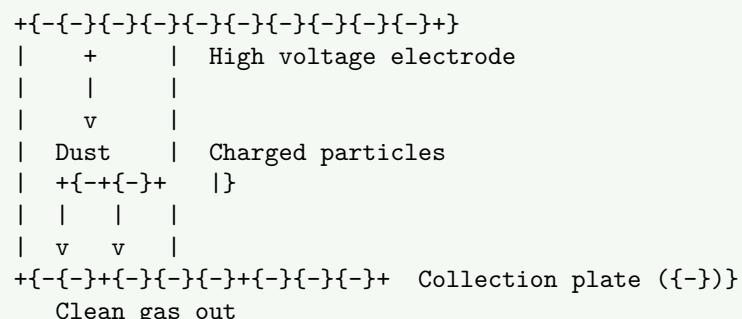
Solution

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:

```
+{-{-}{-}{-}{-}{-}{-}{-}{-}+}
|    +    |  High voltage electrode
|    |    |
|    v    |
|  Dust   |  Charged particles
|  +{-+{-}+   |}
|  |   |   |
|  v   v   |
+{-{-}+{-}{-}{-}+{-}{-}{-}+  Collection plate ({-})}
    Clean gas out
```

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

Mnemonic

"Charge Collect Clean" (CCC)

0.0.21 OR

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

Solution

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

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]

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

Solution

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

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

Mnemonic

"Electronic Equipment Endangers Everyone" (E4)

0.0.24 OR

0.0.25 What is plastic waste? Give effects of plastic waste.

Solution

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]

0.0.26 Give main sources of solid waste.

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

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

"Residential Commercial Industrial Agricultural Municipal" (RCIAM)

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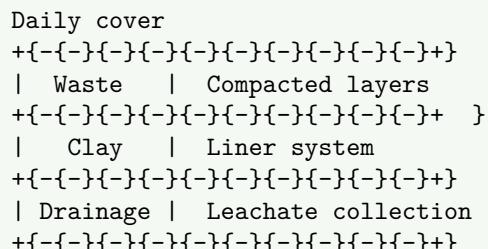
0.0.28 Enlist various methods of solid waste disposal and explain any one.

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
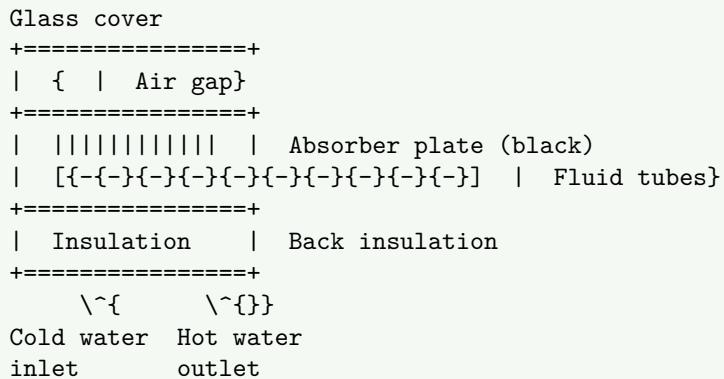
"Land Incinerate Compost Recycle" (LICR)

Question 3(c) [4 marks]

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

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)

0.0.30 OR

0.0.31 Write short note on solar pond

Solution

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^{a}tbottom

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

Mnemonic
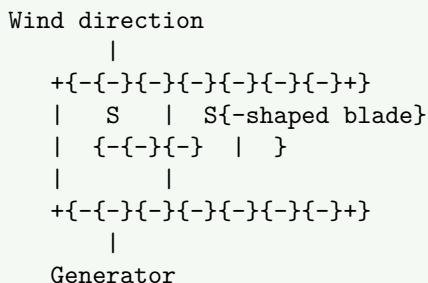
"Salt Stores Solar Thermal" (SSST)

Question 3(d) [4 marks]

0.0.32   Explain Savonious wind mill with a neat sketch.

Solution

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

```
Wind direction
       |
   +{-{-}{-}{-}{-}{-}{-}+}
   |   S   |  S{-shaped blade}
   |  {-{-}{-}  |   }
   |           |
   +{-{-}{-}{-}{-}{-}{-}+}
       |
   Generator
```

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)

0.0.33   OR

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

Solution

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

Question 4(a) [3 marks]

0.0.35 Give effects of climate change.

Solution

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

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

Mnemonic

"Temperature Sea Weather Ecosystem" (TSWE)

0.0.36 OR

0.0.37 Write a short note on Green House gases.

Solution

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]

0.0.38 Explain climate change Management.

> **Solution**
>
> **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)

0.0.39 OR

0.0.40 Give effects of ozone layer depletion.

> **Solution**
>
> **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
>
> | 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 |
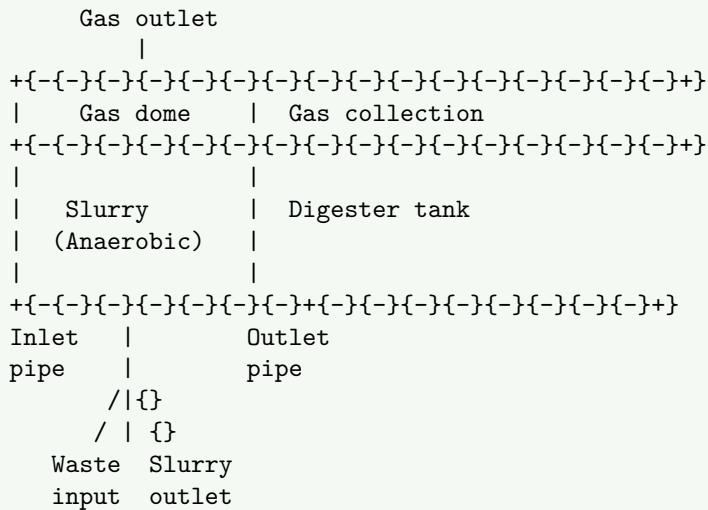
> **Mnemonic**
>
> "Skin Eyes Immunity Climate" (SEIC)

Question 4(c) [7 marks]

0.0.41 Explain biogas plant with sketch.

> **Solution**
>
> **Biogas plant** produces methane-rich gas through anaerobic digestion of organic waste.
>
> ```
>         Gas outlet
>             |
>   +{-{-}{-}{-}{-}{-}{-}{-}{-}{-}{-}{-}+}
>   |    Gas dome    |  Gas collection
>   +{-{-}{-}{-}{-}{-}{-}{-}{-}{-}{-}{-}{-}+}
>   |                |
>   |    Slurry      |  Digester tank
>   |  (Anaerobic)   |
>   |                |
>   +{-{-}{-}{-}{-}{-}+{-}{-}{-}{-}{-}{-}{-}+}
>   Inlet   |        Outlet
>   pipe    |        pipe
>         /|{}
>        / | {}
>     Waste  Slurry
>     input  outlet
> ```
>
> **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°ptimal
> - **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]

0.0.42 Write short note on global warming.

> **Solution**
>
> **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**: $1.1^s incepre-industrial times$
> - **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]

0.0.43 Explain 5R concept.

> **Solution**
>
> **5R concept** is waste management hierarchy for sustainable resource utilization.
>
> **Mermaid Diagram (Code)**
>
> ```
> {Shaded}
> {Highlighting}[]
> graph TD
>     A[5R Hierarchy] {-{-}{} B[Refuse]}
>     A {-{-}{} C[Reduce]}
>     A {-{-}{} D[Reuse]}
>     A {-{-}{} E[Repurpose]}
>     A {-{-}{} F[Recycle]}
> {Highlighting}
> {Shaded}
> ```
>
> **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]

0.0.44   Explain the benefits of Green building.

Solution

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

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]

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

Solution

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)