GS SCORE

TARGET PT - 2023

Test No. 01

PTS2023/TPT-01/082022/01

ENVIRONMENT - 1

Answer Key

Q. 1 (a)	Q. 11 (c)	Q. 21 (b)	Q. 31 (c)	Q. 41 (c)
Q. 2 (b)	Q. 12 (a)	Q. 22 (d)	Q. 32 (c)	Q. 42 (a)
Q. 3 (d)	Q. 13 (a)	Q. 23 (b)	Q. 33 (c)	Q. 43 (a)
Q. 4 (d)	Q. 14 (d)	Q. 24 (d)	Q. 34 (b)	Q. 44 (b)
Q. 5 (d)	Q. 15 (b)	Q. 25 (d)	Q. 35 (b)	Q. 45 (c)
Q. 6 (a)	Q. 16 (c)	Q. 26 (a)	Q. 36 (b)	Q. 46 (a)
Q. 7 (b)	Q. 17 (a)	Q. 27 (a)	Q. 37 (a)	Q. 47 (d)
Q. 8 (d)	Q. 18 (b)	Q. 28 (c)	Q. 38 (c)	Q. 48 (b)
Q. 9 (d)	Q. 19 (b)	Q. 29 (b)	Q. 39 (b)	Q. 49 (c)
Q. 10 (a)	Q. 20 (c)	Q. 30 (c)	Q. 40 (b)	Q. 50 (a)

1. Correct Option: (a)

Explanation:

- **Option (a) is correct**
- An important characteristic of all communities is that composition and structure constantly change orderly and sequentially in response to the changing environmental conditions.
- This gradual and fairly predictable change in the species composition of a given area is called ecological succession.
- Ecological Succession finally leads to an establishment of a relatively stable community that is in near equilibrium with the environment and is called climax community.
- The entire sequences of communities that successively change in a given area are called seres.
- The individual transitional communities are called seral stages or seral communities.
- In the successive seral stages there is a change in the diversity of species of organisms, increase in the number of species and organisms as well as an increase in the total biomass.
- **Ecological Succession is of 2 types:**
  - **Primary Succession**: Succession which starts in areas where no living organisms ever existed is called primary succession. Examples of areas where primary succession occurs are newly cooled lava, bare rock, newly created pond or reservoir etc. The species that invade a bare area are called pioneer species. The establishment of a new biotic community is generally slow as it takes natural processes several hundred to several thousand years to produce fertile soil on bare rock.
  - **Secondary Succession**: It begins in areas where natural biotic communities have been completely or partially destroyed such as in abandoned farm lands, burned or cut forests, lands that have been flooded. Since some soil or sediment is present, secondary succession is faster than primary succession.

Topic: Basic Concepts of Ecology

Sub-topic: Ecological Succession

2. Correct Option: (b)

Explanation:

- **Option (b) is correct:** The correct match is:

	List I		*List II*
A.	Provisioning Services	3.	Drinking Water
B.	Regulating Services	1.	Pollination
C.	Cultural Services	4.	Ecotourism
D.	Supporting Services	2.	Nutrient cycling

- The Millennium Ecosystem Assessment (MA), a major UN-sponsored effort to analyze the impact of human actions on ecosystems and human well-being, identified four major categories of ecosystem services. These are:
- **Provisioning Services:** When people are asked to identify a service provided by nature, most think of food. Fruits, vegetables, trees, fish, and livestock are available to us as direct products of ecosystems. A provisioning service is any type of benefit to people that can be extracted from nature. Along with food, other types of provisioning services include drinking water, timber, wood fuel, natural gas, and oils, plants that can be made into clothes and other materials, and medicinal benefits.
- **Regulating Services:** Ecosystems provide many of the basic services that make life possible for people. Plants clean air and filter water, bacteria decompose wastes, bees pollinate flowers, and tree roots hold soil in place to prevent erosion. All these process work together to make ecosystems clean, sustainable, functional, and resilient to change. A regulating service is the benefit provided by ecosystem processes that moderate natural phenomena. Regulating services include pollination, decomposition, water purification, erosion and flood control, and carbon storage and climate regulation.
- **Cultural Services:** As we interact and alter nature, the natural world has in turn altered us. It has guided our cultural, intellectual, and social development by being a constant force present in our lives. The importance of ecosystems to the human mind can be traced back to the beginning of mankind with ancient civilizations drawing pictures of animals, plants, and weather patterns on cave walls. A cultural service is a non-material benefit that contributes to the development and cultural advancement of people, including how ecosystems play a role in local, national, and global cultures; the building of knowledge and the spreading of ideas; creativity born from interactions with nature (music, art, architecture); and recreation.
- **Supporting Services:** The natural world provides so many services, sometimes we overlook the most fundamental. Ecosystems themselves couldn't be sustained without

the consistency of underlying natural processes, such as photosynthesis, nutrient cycling, the creation of soils, and the water cycle. These processes allow the Earth to sustain basic life forms, let alone whole ecosystems and people. Without supporting services, provisional, regulating, and cultural services wouldn't exist.

Topic: Ecosystem Functions

Sub-topic: The structure/Components of Ecosystem

3. Correct Option: (d)

Explanation:

- **Statement 1 is correct:** Ecotone is a zone of junction between two or more diverse ecosystems. For e.g. the mangrove forests represent an ecotone between marine and terrestrial ecosystem.
- Ecotone also appear where one body of water meets another (e.g., estuaries and lagoons) or at the boundary between the water and the land (e.g., marshes, river bank etc.).
- It has the conditions intermediate to the adjacent ecosystems. Hence it is a zone of transition.
- **Statement 2 is correct**: It is linear as it shows progressive increase in species composition of one in coming community and a simultaneous decrease in species of the other outgoing adjoining community.
- **Statement 3 is correct**: It may be very narrow or quite wide.
- A well-developed ecotone contains some organisms which are entirely different from that of the adjoining communities.

Topic: Adaptation of species & interactions

Sub-topic: Ecotone

4. Correct Option: (d)

Explanation:

- **Option (d) is correct**
- Anything that attempts to alter the balance of the ecosystem potentially threatens the health and existence of that ecosystem. Some of these threats are:
    - **Habitat Destruction:** Economic activities such as logging, mining, farming and construction often involve clearing out places with natural vegetative cover. Very often, tampering with one factor of the ecosystem can have a ripple effect on it and affect many more or all other factors of that ecosystem. For example, clearing a piece of forest for timber can expose the upper layers of the soil to the sun's heat, causing erosion and drying. It can cause a lot of animals and insects that depended on the shade and moisture from the tree to die or migrate to other places.
    - **Pollution:** Water, land and air pollution all together play a crucial role in the health of ecosystems. Pollution may be natural or human-caused, but regardless they potentially release destructive agents or chemicals (pollutants) into the environments of living things.
    - **Eutrophication:** This is the enrichment of water bodies with plant biomass as a result of the continuous inflow of nutrients particularly nitrogen and phosphorus. Eutrophication of water fuels excessive plant and algae growth and also hurts water life, often resulting in the loss of flora and fauna diversity. "The known consequences of cultural eutrophication include blooms of blue-green algae, tainted drinking water supplies, degradation of recreational opportunities, and hypoxia.
    - **Invasive species:** Any foreign species (biological) that finds its way into an ecosystem, either by natural or human introduction can have an effect on the ecosystem. If this alien has the ability to prey on vulnerable and native members of that ecosystem, they will be wiped out, sooner or later.
    - **Overharvesting:** Fish species, game and special plants all do fall victim from time to time as a result of over-harvesting or humans over-dependence on them. Overharvesting leads to the reduction in populations, community structures and distributions, with an overall reduction in recruitment.
    - **UV Radiation:** UV rays come in three main wavelengths: UVA, UVB and UVC. UVB and UVC are more destructive and can cause DNA and cell damage to plants and animals. Ozone depletion is one way that exposes living things to UVB and UVC and the harm caused can wipe lots of species, and affect ecosystems members including humans.

Topic: Basic concepts of ecosystem

Sub-topic: Scope of Ecology

5. Correct Option: (d)

Explanation:

- **All the statements are correct**: Ecosystem restoration is the process of halting and reversing degradation,

resulting in improved ecosystem services and recovered biodiversity. Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choice.

- Depending on objectives, restored ecosystems can follow different trajectories:
- From degraded natural to more intact natural ecosystems (often by assisting natural regeneration)
- From degraded, modified ecosystems to more functional modified ecosystems (e.g. restoration of urban areas and farmlands)
- From modified ecosystems towards more natural ecosystems, providing that the rights and needs of people who depend on that ecosystem are not compromised.

- **Various approaches for ecosystem restoration include:**
  - **Ecological Restoration**: Assisting the recovery of a terrestrial, freshwater or marine ecosystem that has been degraded, damaged, or destroyed.
  - **Forest and Landscape Restoration:** Reversing the degradation of soils, agricultural areas, forests and watersheds thereby regaining their ecological functionality.
  - **Restoration of Aquatic Production Ecosystems**: Maintaining ecosystem structure and function to support food provisioning, while minimizing impacts, rather than restoring ecosystems to an initial state before production activity started.
  - **Regenerative Agriculture**: Farming that uses soil conservation as the entry point to regenerate and contribute to multiple provisioning, regulating and supporting services.
  - **Rewilding:** Rebuilding, following major human disturbance, a natural ecosystem by restoring natural processes and the complete or near complete food-web at all trophic levels as a self-sustaining and resilient ecosystem using biota that would have been present had the disturbance not occurred.

Topic: Ecosystem Functions

Sub-topic: Ecosystem Dynamics

6. Correct option: (a)

Explanation:

- **Statement 1 is correct:** Moist deciduous forests are found throughout India except in the western and the north-western regions. The trees are tall, have broad trunks, branching trunks and roots to hold them firmly to the ground. Some of the taller trees shed their leaves in the dry season. There is a layer of shorter trees and evergreen shrubs in the undergrowth. These forests are dominated by sal and teak, along with mango, bamboo, and rosewood.
- **Statement 2 is incorrect:** Tropical dry deciduous forests are found throughout the northern part of the country except in the North-East.
- **Statement 3 is incorrect:** Tropical dry evergreen forests are found along Tamil Nadu, Andhra Pradesh and Karnataka coast.
- **Tropical Wet Evergreen Forests:** Wet evergreen forests are found along the Western Ghats, the Nicobar and Andaman Islands and all along the north-eastern region. It is characterized by tall, straight evergreen trees. The trees in this forest form a tier pattern: shrubs cover the layer closer to the ground, followed by the short structured trees and then the tall variety.
- **Tropical Semi-evergreen Forests:** Semi-evergreen forests are found in the Western Ghats, Andaman and Nicobar Islands, and the Eastern Himalayas. Such forests have a mixture of the wet evergreen trees and the moist deciduous trees. The forest is dense and is filled with a large variety of trees of both types.
- **Tropical Dry Deciduous Forests:** Dry deciduous forests are found throughout the northern part of the country except in the North-East. It is also found in Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, and Tamil Nadu. The canopy of the trees does not normally exceed 25 metres. The common trees are the sal, a variety of acacia, and bamboo.
- **Tropical Thorn Forests:** This type is found in areas with black soil: North, West, Central, and South India. The trees do not grow beyond 10 metres. Spurge, caper, and cactus are typical of this region.
- **Tropical Dry Evergreen Forests:** Dry evergreens are found along Tamil Nadu, Andhra Pradesh and Karnataka coast. It is mainly hard-leaved evergreen trees with fragrant flowers, along with a few deciduous trees.

Topic: Terrestrial ecosystem

Sub-topic: Forest ecosystem in India

7. Correct Option: (b)

Explanation:

- **Option (b) is correct**
- The Bonn Challenge is a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million hectares by 2030.
- Launched by the Government of Germany and IUCN in 2011, the challenge has already surpassed the 150-million-hectare milestone for pledges in 2017.
- India joined the Bonn Challenge in 2015 with a pledge to restore 21 million hectares of degraded and deforested land.
- This was raised to a target of 26 million hectares by 2030 during the United Nations Convention on Combating Desertification (UNCCD) Conference, held in Delhi in September 2019.
- **Bonn Convention**
  - Its objective is to protect the migratory species of wild animals and their habitats, and it works under the aegis of UNEP.
  - It is also known as the Convention on Conservation of Migratory Species of Wild Animals (CMS).
  - India has been a party to the Bonn Convention since 1983.
- **Desertification**
  - It means the destruction of the biological potential of land, which may ultimately lead to desert-like conditions.
- **Causes of desertification:**
  - Excessive population
  - Overgrazing by the cattle
  - Increased agriculture
  - Development activities
  - Deforestation, etc.
  - In India, desertification is the major issue faced by Rajasthan, Gujarat, and adjoining parts of Punjab and Haryana.
- **Controlling desertification:**
  - Programmes at global level to contain or prevent desertification include the UN Convention to Combat Desertification (UNCCD), Bonn Challenge, SDG 15, Global Environment Facility's initiative - the Great Green Wall, etc.
  - India prepared its National Action Programme in 2001 to address the issue of desertification.
  - The major step to reduce desertification is afforestation.

Topic: Biodiversity

Sub-topic: Global Initiatives

8. Correct Option: (d)

Explanation:

- **Statement 1 is incorrect:** The Montreux Record lists wetlands; whether or not lakes.
- **Statement 3 is incorrect:** Chilika Lake has been removed from the Montreux Record.
- The Montreux Record is a register of wetland sites on the List of Wetlands of International Importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference.
- It is maintained as part of the Ramsar List.
- The Montreux Record was established by Recommendation 4.8 of the Conference of the Contracting Parties (1990).
- Its aim is to identify priority sites for positive national and international conservation attention.
- These sites may be added or removed from the Record, only with the approval of the contracting parties in which they lie.
- The wetlands of India mentioned in the Montreux Record are Keoladeo National Park (Rajasthan) and Loktak Lake (Manipur).
- Chilka lake (Odisha) was placed in the record in 1993, and was removed from it in 2002 following the rehabilitation efforts of the government.
- In 2013, the two schemes of National Wetland Conservation Programme (NWCP) and National Lake Conservation Plan (NLCP) were merged to form NPCA.
  - Therefore, NPCA is a single conservation programme for both wetlands and lakes.
- It is a centrally sponsored scheme, currently being implemented by the Union Ministry of Environment and Forests and Climate Change.
- It seeks to promote better synergy and avoid overlap of administrative functions.

Topic: Aquatic Ecosystem

Sub-topic: Factors affecting the aquatic ecosystem

9. Correct Option: (d)

Explanation:

- **Both statements are correct**
- Each trophic level has a certain mass of living material at a particular time called the standing crop.
- **The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area**.
- **There is no circulation of the standing crops.**
- **Standing state is the amount of inorganic nutrients found in an ecosystem**.
- It represents part of non-living matter. **It circulates between living and non-living components of the ecosystem.**
- It is being regularly depleted and replenished by the living matters.

Topic: Nutrient Cycling

Sub-topic: Concepts

10. Correct Option: (a)

Explanation:

- **Option (a) is correct**
- Primary succession takes place an over a bare or unoccupied areas such as rocks outcrop, newly formed deltas and sand dunes, emerging volcano islands and lava flows as well as glacial moraines (muddy area exposed by a retreating glacier) where no community has existed previously.
- The plants that invade first bare land, where soil is initially absent are called pioneer species. The assemblage of pioneer plants is collectively called pioneer community. A pioneer species generally show high growth rate but short life span.
- **Primary succession is much more difficult to observe than secondary succession because there are relatively very few places on earth that do not already have communities of organisms.**
- Furthermore, primary succession takes a very long time as compared to secondary succession as the soil is to be formed during primary succession while secondary succession starts in an area where soil is already present.
- The community that initially inhabits a bare area is called pioneer community.
- The pioneer community after some time gets replaced by another community with different species combination.
- This second community gets replaced by a third community. This process continues sequence-wise in which a community replaced previous by another community.
- Each transitional (temporary) community that is formed and replaced during succession is called a stage in succession or a seral community.
- The terminal (final) stage of succession forms the community which is called as climax community.
- A climax community is stable, mature, more complex and long lasting. The entire sequence of communities in a given area, succeeding each other, during the course of succession is termed sere.

Topic: Basic concepts of Ecology

Sub-topic: Ecological succession

11. Correct Option: (c)

Explanation:

- **Statement 1 is correct:** The number of species surviving in the world today is the outcome of two processes viz. speciation and extinction.
- **Speciation is the process by which new species are formed and evolution is the mechanism by which speciation is brought about**.
- A species comprises of many populations. Often different populations of a species remain isolated due to some geographic barrier such as mountain, ocean, river, etc.
- Geographic isolation occurs when a physical barrier develops between two populations of a species.
- **Statement 2 is correct: The most common way a population undergoes speciation is by geographic isolation**.

Topic: Adaptation of Species & Interactions

Sub-topic: Interaction between species

12. Correct Option: (a)

Explanation:

- **Option (a) is correct**
- **Ecology was first coined and defined in 1869 by Ernst Haeckel** as the 'study of the interaction of organisms with their environment.

- An **ecosystem** is a community of organisms, their environment, and their interactions as a system. **It was first coined by Arthur Tansley.**
- **Ecological niche was coined by the naturalist Roswell Hill Johnson. But Joseph Grinnell was probably the first to use it in a research program in 1917.**
- It was further described by Charles Sutherland Elton.

Topic: Basic concepts of ecology

Sub-topic: Ecological Hierarchy

13. Correct Option: (a)

Explanation:

- In nature, many species occupy the same habitat but they perform different functions.
- **Statement 1 is correct**: The functional characteristics of a species in its habitat are referred to as "niche" in that common habitat. Habitat of a species is like its 'address' (i.e. where it lives) whereas niche can be thought of as its "profession" (i.e. activities and responses specific to the species).
- **The term niche means the sum of all the activities and relationships of a species by which it uses the resources in its habitat for its survival and reproduction.**
- A niche is unique for a species while many species share the habitat.
- **Statement 2 is incorrect: No two species in a habitat can have the same niche**. **This is because if two species occupy the same niche they will compete with one another until one is displaced.**
- For example, a large number of different species of insects may be pests of the same plant but they can co-exist as they feed on different parts of the same plant.
- Another example is the vegetation of the forest. The forest can support a large number of plant species as they occupy different niches: the tall trees, the short trees, shrubs, bushes and grasses are all part of the forest but because of varying heights they differ in their requirements for sunlight and nutrients and so can survive together.
- The most important resources in the niches of animals are food and shelter while in case of plants, they are moisture and nutrients (phosphorous and nitrogen).

Topic: Basic concepts of ecology

Sub-topic: Ecological Hierarchy

14. Correct Option: (d)

Explanation:

- **Statement 1 is incorrect:** In bioaccumulation, there is an increase in the concentration of a pollutant from the environment to the first organism in a food chain.
- **Statement 2 is incorrect:** Biomagnification can occur only if the pollutant is fat-soluble.
- **Bioaccumulation: In bioaccumulation, there is an increase in the concentration of a pollutant from the environment to the first organism in a food chain**. Thus, it refers to how pollutants enter a food chain.
- **Biomagnification**: In this, there is an increase in the concentration of a pollutant from one trophic level to another.
- **Condition for bioaccumulation** is the high level of pollutants in the environment.
- **Condition for bio-magnifications is that pollutants must be fat-soluble, long-lived, biologically active, etc.**

Topic: Adaptation of species and interactions

Sub-topic: Invasive species

15. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect:** Nutrient cycle of an ecosystem is not unidirectional. They are recycled back to physical environment.
- The nutrient cycle is a concept that describes how nutrients move from the physical environment to the living organisms, **and subsequently recycled back to the physical environment.**
- This movement of nutrients from the environment into plants and animals and again back to the environment is essential for life and it is the vital function of the ecology of any region.
- Based on the replacement period a nutrient cycle is referred to as a Perfect or Imperfect cycle.
- A perfect nutrient cycle is one in which nutrients are replaced as fast as they are utilized.

- **Most gaseous cycles are generally considered as perfect cycles.**

Topic: Nutrient Cycling

Sub-topic: Concepts of Biogeochemical cycles

16. Correct Option: (c)

Explanation:

- **Statement 1 is correct: The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton.**
- The base of a pyramid is broad and it narrows down at the apex. One gets a similar shape, whether you express the food or energy relationship between organisms at different trophic level. Thus, relationship is expressed in terms of number, biomass or energy. The base of each pyramid represents the producers or the first trophic level while the apex represents tertiary or top level consumer.
- **Statement 2 is correct: Pyramid of energy is always upright, can never be inverted**, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. Each bar in the energy pyramid indicates the amount of energy present at each trophic level in a given time or annually per unit area.
- Since only 10% of the energy is transferred from one trophic level to the next, fewer and fewer numbers of individuals can be sustained as we go up the ecological pyramid.

Topic: Basic concepts of ecology

Sub-topic: Ecological community

17. Correct Option: (a)

Explanation:

- **Statement 1 is correct:** Soil Organic Carbon (SOC) represents the largest pool of carbon stock in forests, which has been estimated at 4,004 million tonnes.
- The SOC contributes 56% to the total forest carbon stock of the country.
- **Arunachal Pradesh has the largest carbon stock (1051 million tonnes) in India.**
- **Madhya Pradesh has the second-largest carbon stock despite it has the largest forest cover.** This is because Arunachal Pradesh has tropical wet evergreen and semi-evergreen forests of high canopy and tree diversity.
- **Statement 2 is incorrect:** Arunachal Pradesh has the largest carbon stock.
- Under the current assessment the total carbon stock in the country's forest is estimated 7,124.6 million tonnes and there an increase of 42.6 million tonnes in the carbon stock of country as compared to the last assessment of 2017. The annual increase in the carbon stock is 21.3 million tonnes, which is 78.2 million tonnes CO2 eq.

Topic: Terrestrial ecosystems

Sub-topic: Forest Ecosystems in India

18. Correct option: (b)

Explanation:

- **Statement 1 is incorrect:** Corals generally flourish in clear tropical oceans usually between 30°N and 30°S of the equator.
- **Corals generally flourish in clear tropical oceans usually between 30°N and 30°S of the equator.**
- They grow best in the brightly lighted water about 5 to 10 meters deep. The suspended particles interfere with feeding.
- Corals live in saline water (27%).
- Coral reef can from to depth of 90 meters, but growth rate declines rapidly after 5 to 10 meters depths.
- The reef building corals are found within the 21°C isotherm.
- Corals are not found near the mouths of rivers.
- Temperature below 18°C causes their death.
- The stunning colours in corals come from marine algae called zooxanthellae, which live inside their tissues.
- These algae provide the corals with an easy food supply thanks to photosynthesis, which gives the corals energy, allowing them to grow and reproduce.
- When corals get stressed, from things such as heat or pollution, they react by expelling this algae, leaving a ghostly, transparent skeleton behind. This is known as 'coral bleaching'.
- Some corals can feed themselves, but without the zooxanthellae most corals starve.
- **Warmer water temperatures can result in coral bleaching**. When water is too warm, corals will expel the algae (zooxanthellae) living in their tissues causing the coral to turn completely white.

- **Not all bleaching events are due to warm water.**

Topic: Aquatic Ecosystem

Sub-topic: Marine ecology

19. Correct Option: (b)

Explanation:

- **Option (b) is correct**
- Ecology typically focuses on the living world at and above the level of the individual organism. The levels in ecological hierarchy are as follows:
- **Individuals** are at the first level of the biological hierarchy. Study of this 1st ecological level involves all round development of the individual- Biological, Physiological, and Morphological.
- A **population** consists of all the individual organisms of the same species that live and interact in the same area.
- A **community** refers to all of the populations of different species that live and interact in the same area. The aquatic community that includes the angelfish also includes the populations of other species of fish, corals, and many other organisms.
- An **ecosystem** includes all the living things in a given area, together with the nonliving environment. The nonliving environment includes abiotic factors such as water, minerals, and sunlight.
- A **biome** is a group of similar ecosystems with the same general type of physical environment anywhere in the world. Terrestrial biomes are generally delineated by climate and major types of vegetation. Examples of terrestrial biomes include tropical rainforests and deserts.
- Aquatic biomes are generally defined by the distance from shore and depth of water. Examples of aquatic biomes include the shallow water near shore (littoral zone) and the deepest water at the bottom of a body of water (benthic zone).
- The **biosphere** includes every part of Earth where life exists, including all the land, water, and air where living things can be found. The biosphere is the largest ecological category and consists of many different biomes.

Topic: Basic concepts of ecology

Sub-topic: Scope of Ecosystem

20. Correct Option: (c)

Explanation:

- **Both statements are correct**
- Eugene Odum and others compiled a list of eight general ecological principles.
- These are: Adaptation, Behavior, Diversity, Emergent properties, Energy flow, Growth and development, Limits, and Regulation.
- The adaptation is any attribute of the organism (morphological, physiological, and behavioural) that enables the organism to survive and reproduce in its habitat.
- Many adaptations have evolved over a long evolutionary time and are genetically fixed. Some of the examples are as follows:
  - **Morphological:** Many desert plants have a thick cuticle on their leaf surfaces and have their stomata arranged in deep pits (sunken) to minimise water loss through transpiration.
  - **Physiological**: **Many tribes live in the high altitude of Himalayas have a higher red blood cell count.**
  - **Behavioural**: Animals migrating temporarily to a less stressful habitat.
- **According to Charles Darwin's theory of evolution by natural selection, the organisms adapt to their environment so that they could persist and pass their genes onto the next generation.**
- Adaptation differs from acclimatization. Both terms are about changes.
- However, acclimatization is the physiological adjustment to the new conditions but it does not entail increasing species diversity as adaptation does.
- For a trait to be considered as an adaptation, it has to be heritable, functional, and increases fitness.

Topic: Adaptations of Species & Interactions

Sub-topic: Homeostasis

21. Correct Option: (b)

Explanation:

- **Option (b) is correct:** All species are not equally important in each community.
- **Species Diversity:**
  - Species diversity is determined not only by the number of species within a biological community—i.e., species richness—but also by the relative abundance of individuals in that community.

- Species richness is the number of species within a community or area. It does not take into account the distribution of species within the area or what is referred to as species evenness.

- **Growth From and structure:**
  - Community can be analysed in terms of major growth forms like trees, shrubs, herbs etc. In each growth from as in trees, there may be different kinds of plants as-broad leave trees, evergreen trees etc.
  - These different growth forms determine the structural pattern of a community.

- **Dominance:**
  - **All species are not equally important in each community**. The nature of the community is determined by a few species in a community. These limited species have control and dominating influence in the community.
  - Dominant species (plants/animals) playing crucial and unique role and highly effect community structure and function in relative to its abundance are called Keystone species

- **Self-reliance:**
  - **Each community has a group of autotrophic plants as well as heterotrophic animals**. The autotrophic plants are self-dependent.

- **Relative abundance:**
  - Different populations in a community exist in relative proportions and this idea is called as relative abundance.

- **Trophic structure:**
  - **Each community has a trophic structure that determines the flow of energy and material** from plants to herbivores to carnivores.

Topic: Population Ecology

Sub-topic: Speciation

22. Correct Option: (d)

Explanation:

- <u>Option (d) is correct</u>
- It refers to the exertion of a major controlling influence of one or more species upon all other species by virtue of their number, size, productivity or related activities.
- To be considered as an ecologically dominant species:
  - The organism can compete more successfully than other organisms for essentials of life such as nutrition in the same habitat or the physical environment in which it live,
  - **It has greater adaptability to environmental variables**,
  - **It can exert a greater influence and compete on the habitat in which it lives,**
  - **The population or the size of the individual species constitutes a dominant proportion when compared with other species,** and
  - The organism is **mobile, aggressive and intelligent**, particularly in the case of human beings.
- Example: Caribou are a dominant species on the tundra.

Topic: Adaptation of species

Sub-topic: keystone species

23. Correct Option: (b)

Explanation:

- <u>Statement 1 is incorrect:</u> An organism with a narrow tolerance range is said to be "steno" whereas, that with a wide tolerance range is said to be "eury".
- Just as species have geographic ranges, they also have tolerance ranges for the abiotic environmental conditions. In other words, they can tolerate (or survive within) a certain range of a particular factor, but cannot survive if there is too much or too little of the factor.
- Each organism has an invariably defined range of conditions that it can tolerate, diversity in the resources it utilises and a distinct functional role in the ecological system, all these together comprise its niche.
- **An organism with a narrow tolerance range is said to be "steno" for that factor (e.g. stenothermal or stenohaline).**
- **An organism with a wide tolerance range is said to be "eury" (e.g. eurythermal).**
- Organisms can be steno with respect to one factor and eury with respect to a different one. Centrarchids (bass and sunfish) are eurythermal but stenohaline; salmonids are just the opposite. These tolerance ranges are not independent.
- An organism near the tolerance limits for one factor will probably be under stress, so its ability to tolerate other factors will be reduced.

- **The tolerance ranges against abiotic / environmental factors partly define the organism's niche**. If salinity tolerance is graphed against temperature tolerance, a niche area is defined.
- Ideally then, the organism should try to maintain the constancy of its internal environment (a process called homeostasis) despite varying external environmental conditions that tend to upset its homeostasis.
- This constancy, for example, could be in terms of optimal temperature and osmotic concentration of body fluids.

Responses to Abiotic Factors

- Some organisms are able to maintain homeostasis by physiological (sometimes behavioural also) means which ensures constant body temperature, constant osmotic concentration, etc. This is called regulation.
- **An overwhelming majority (99 per cent) of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature. This is called conformation.**
- The organism can move away temporarily from the stressful habitat to a more hospitable area and return when stressful period is over, called migration.
- **Another means is the suspension i.e. to suspend their physiological process until availability of suitable environment. For example, spores formation in bacteria, fungi and lower plants; 'seed dormancy' in higher plants; and hibernation & aestivation in animals.'**

Topic: Population Ecology

Sub-topic: Types of species

24. Correct option: (d)

Explanation:

- **Option (d) is correct**
- Trophic cascades are powerful indirect interactions that can control entire ecosystems.
- **Trophic cascades occur when predators limit the density and/or behavior of their prey and thereby enhance survival of the next lower trophic level.**
- Predators eat prey. By so doing, predators can impact both prey abundance and behavior (e.g., prey get scared when predators are around and hide or move away).
- When the impact of a predator on its prey's ecology trickles down on more feeding level to affect the density and/or behavior of the prey's prey, ecologists term this interaction a feeding, or trophic cascade.
- In this situation, by controlling densities and/or behavior of their prey, predators indirectly benefit and increase the abundance of their prey's prey.
- Trophic cascades by definition must occur across a minimum of three feeding levels. Indeed, this is how they most commonly occur, although evidence of 4- and 5-level trophic cascades have been shown in nature, but are far less common.

Topic: Adaptation of species & Interactions

Sub-topic: Population Growth models

25. Correct Option: (d)

Explanation:

- **Option (d) is correct**
- Plants need nitrogen to make them. Without nitrogen, a plant cannot make the proteins, amino acids and even its very DNA.
- This is why when there is a nitrogen deficiency in the soil, plants are stunted. They simply cannot make their own cells. If there is nitrogen all around us, as it makes up 78 percent of the air we breathe.
- In order for plants to use the nitrogen in the air, it must be converted in some way to nitrogen in the soil. This can happen through nitrogen fixation, or **nitrogen can be "recycled" by composting plants and manure.**
- There are two routes to go when fixing a nitrogen deficiency in the soil, either organic or non-organic.

Organic

- To correct a nitrogen deficiency using organic methods requires time, but will result in a more even distribution of the added nitrogen over time.
- Some organic methods of adding nitrogen to the soil include:
  - **Adding composted manure to the soil Planting a green manure crop, such as borage Planting**
  - **Nitrogen fixing plants like peas or beans.**
  - **Adding coffee grounds to the soil.**

Non-organic

- Nitrogen as a plant fertilizer is common when purchasing chemical fertilizers.

- When looking to specifically add nitrogen to your garden, choose a fertilizer that has a high first number in the NPK ratio. The NPK ratio will look something like 10-10-10 and the first number tells you the amount of nitrogen.
- **Using a nitrogen fertilizer to fix a nitrogen deficiency in the soil will give a big**, fast boost of nitrogen to the soil, but will fade quickly.

Topic: Nutrient cycling

Sub-topic: Nitrogen Cycle

26. Correct option: (a)

Explanation:

- **Option (a) is correct**
- **The Montreux Record is a register of wetland sites on the List of Wetlands of International Importance where changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference.**
- It is the principle tool under the Ramsar convention for highlighting wetlands sites in need of priority conservation status. It is maintained as part of the Ramsar Database and is subject to continuous review.
- It is maintained as part of the Ramsar List.
- At present, 46 sites are listed in Montreux Record in the world.
- At present 2 Indian sites are listed under it. (Loktak Lake, Manipur and Keoladeo National Park, Rajasthan)
- In 1993 Chilka lake was also listed in Montreux record due to problem of Siltation, But later in 2002, it was removed from the list as problem tackled by govt actions 2020.

Topic: Aquatic Ecosystem

Sub-topic: Lakes

27. Correct Option: (a)

Explanation:

- The vulnerability of a species to extinction depends on a wide variety of factors, some of which are:
  - Species with narrow geographical ranges. Such locally endemic species are highly susceptible to extinction.
  - Seasonal migratory species are depended on two or more distinct habitat types, and are unable to survive if either habitat is destroyed.
  - **Species low in genetic variability**: Adapting to new environments and changing conditions depend on the availability of genetic diversity.
  - **Species with small population sizes.**
  - **Species that need large home range**, like the Bengal Tiger. Usually, large-sized animals require larger ranges.

Topic: Adaptation of species & Interactions

Sub-topic: Types of species

28. Correct Option: (c)

Explanation:

- **Statement 2 is incorrect:** Both photosynthesis and respiration takes place in the photic zone.
- **Photic zone**
  - **It is the upper layer of the aquatic ecosystems**, up to which light penetrates and within which photosynthetic activity is confined.
  - The depth of this zone depends on the transparency of water. **Both photosynthesis and respiration activity takes place.**
  - Photic (or "euphotic") zone is the lighted and usually well-mixed portion that extends from the lake surface down to where the light level is 1% of that at the surface.
- **Aphotic zone**
  - The lower layers of the aquatic ecosystems**, where light penetration and plant growth are restricted form the aphotic zone. Only respiration activity takes place**.
  - **Aphotic zone is positioned below the littoral and photic zones** to bottom of the lake where light levels are too low for photosynthesis.
  - Respiration occurs at all depths so the aphotic zone is a region of oxygen consumption. This deep, unlit region is also known as the profundal zone.

Topic: Aquatic Ecosystem

Sub-topic: Phytoplankton

29. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect:** The Pneumatophores help in obtaining oxygen in an otherwise anaerobic substrate.

- Mangroves are a group of trees and shrubs that live in the coastal intertidal zone.
- **Mangroves grow in areas with low-oxygen soil, where slow-moving waters allow fine sediments to accumulate.**
- Mangrove forests only grow at tropical and subtropical latitudes near the equator because they cannot withstand freezing temperatures.
- **They grow luxuriantly in the places where freshwater mixes with seawater and where sediment is composed of accumulated deposits of mud.**
- The Sundarbans delta is the largest mangrove forest in the world and is intersected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests. It lies at the mouth of the Ganges.
- **Mangroves have breathing roots also called aerial roots which is defined as a root which, for part of the day, is exposed to the air.**
- The mangrove mud is rather anaerobic (oxygen poor) and unstable and different plants have root adaptations to cope with these conditions.
- Pneumatophores - Pneumatophores are erect roots that are some form of upward extension of the underground root system.
- Because these roots are exposed at least part of the day and not submerged underwater, the root system can obtain oxygen in an otherwise anaerobic substrate. Pneumatophores also accumulate sediments in protected sites and form mangrove peats.

Topic: Aquatic Ecosystem

Sub-topic: Marine Organism

30. Correct Option: (c)

Explanation:

- **<u>Statement 1 is correct:</u> Desert plants show phenomenon of Allelopathy** i,e. they secrete some chemical substance which inhibits the growth of plants growing in their near vicinity .
- **Succulent plants store water in fleshy leaves, stems or roots**. All cacti are succulents, as are such non-cactus desert dwellers as agave, aloe, elephant trees, and many euphorbias.
- Several other adaptations are essential for the water storing habit to be effective.
- Owl's clover, California poppy and other drought avoidance plants die after channelling all their energy into producing seeds
- A succulent must be able to absorb large quantities of water in short periods.
- **<u>Statement 2 is correct:</u>** Desert rains are often light and brief, and the soil dries rapidly under an intense sun. To cope with these conditions, nearly all succulents have extensive, shallow root systems.
- The roots of a saguaro extend horizontally about as far as the plant is tall but are rarely more than four inches (10 cm) deep. The water- absorbing roots are mostly within the upper half inch (1.3 cm). So that they can get water from atmosphere.

Topic: Terrestrial Ecosystem

Sub-topic: Deserts

31. Correct Option: (c)

Explanation:

- **<u>Statement 1 is incorrect:</u>** In the Tundra region, the diurnal range of temperature is **very low,** because of very little difference in the day and the night temperatures, but the annual range is quite large.
- **<u>Statement 2 is correct:</u>** The region is swept by speedy cold powdery storms, known as the blizzards.
- **<u>Statement 3 is incorrect:</u>** The mean annual precipitation is mostly in the form of snowfall. It is below 40 cm. The **absolute humidity is very low**, because of **very low rate of evaporation**, due to very low temperature throughout the year. The divergent system of air circulation and **anticyclonic conditions** do not favor much precipitation.
    - New settlements have sprung up because of the discovery of minerals.
    - Gold is mined in Alaska, petroleum in the Kenai Peninsula, Alaska; and copper at the Rankin Inlet, Canada.
    - With the declining reserves of iron ore around the Great Lakes, iron ore deposits in Labrador are gaining importance. New railway lines have been constructed to bring the ores to the St. Lawrence River.

Topic: Tundra

Sub-Topic: Terrestrial Ecosystem

32. Correct Option: (c)

Explanation:

- The State of Forest Reports, which are published biennially, provide a

comprehensive account of the Forest Cover Scenario of the Country to different user groups. India State of Forest Report (ISFR) is a biennial publication of Forest Survey of India (FSI) under the Ministry of Environment Forest & Climate Change

- **<u>Option (a) is incorrect:</u> India State of Forest Report (ISFR) is a biennial and not an annual publication) publication of Forest Survey of India (PSI), an organization under the Ministry of Environment, Forest & Climate Change, Government of India.**
    - It is a widely used primary information source across the Central Government, State Governments and forestry professionals of the State Forest Departments, academia. International organizations and other stakeholders.
- **<u>Option (b) is incorrect:</u> The total forest and tree cover of the country is 80.9 million hectare which is 24.62 percent of the geographical area of the country**.
    - As compared to the assessment of 2019, there is an increase of 2261 sq km in the total forest and tree cover of the country: Out of this, the increase in the forest cover has been observed as 1540 sq km and that in tree cover is 721 sq km.
- **<u>Option (c) is correct:</u> In the present ISFR 2021, FSI has included a new chapter related to the assessment of forest cover in the Tiger Reserves, Corridors and Lion conservation area of India. In this context, the decadal assessment of change in forest covers within Tiger Reserves.**
    - Corridors and Lion conservation area helps in assessing the impact of conservation measures and management interventions that have been implemented over the years
- **<u>Option (d) is incorrect:</u> According to the India state of forest report, in the Area-wise criteria Madhya Pradesh has the largest forest cover in the country followed by Arunachal Pradesh, Chhattisgarh, Odisha and Maharashtra.**
    - In terms of forest cover as percentage of total geographical area, the top five States are Mizoram (84.53 per cent), Arunachal Pradesh (79.33 per cent), Meghalaya (76.00 per cent). Manipur 4.34 per cent) and Nagaland (73.90 per cent).

Topic: ISFR 2021

33. Correct Option: (c)

Explanation:

- **<u>Statement 1 is incorrect:</u> The Tropical Forest Alliance is a global public-private partnership dedicated to collaborative action to realize sustainable rural development and better growth opportunities based on reduced deforestation and sustainable land use management in tropical forest countries**. The Alliance includes more than 170 partners representing the private sector, governments, civil society organizations, indigenous peoples' groups and multilateral organizations who are committed to reducing tropical deforestation associated with the production of palm oil, soy, beef, cocoa and pulp and paper.
- **<u>Statement 2 is incorrect:</u> TFA is funded by the Norwegian Ministry of Climate and Environment, the United Kingdom, the Netherlands, Germany, plus the Gordon and Betty Moore Foundation and Cargill.**
- **<u>Statement 3 is correct:</u> TFA is hosted by the World Economic forum.** The Tropical Forest Alliance was founded in 2012 at Rio+20 after the Consumer Goods Forum (CGF) committed to zero net deforestation by 2020 for palm oil, soy, beef, and paper and pulp supply chains in 2010. The CGF partnered with the US government to create the public-private alliance with the mission of mobilizing all actors to collaborate in reducing commodity-driven tropical deforestation. This project is a part of WEF's **Shaping the Future of Global Public Goods Platform.**

Topic: Tropical Forest

34. Correct Option: (b)

Explanation:

- **<u>Statements 1 and 3 are incorrect:</u> There is a small desert situated in the state of Tamil Nadu.** It consists of red sand dunes and is confined to Thoothukudi district. The red dunes are called theri in Tamil. **They consist of sediments dating back to the Quaternary Period and are made of marine deposits.**
- **<u>Statement 2 is correct:</u> They have very low water and nutrient retention capacity**. The dunes are susceptible to aerodynamic lift. This is the push that lets something move up. It is the force that is the opposite of weight.
- The petrographical study (petrography is the study of composition and properties

of rocks) and X-ray diffraction analysis (a method used to determine a material's crystallographic structure) of the red sand dunes reveal the presence of heavy and light minerals.

- These include Ilmenite, Magnetite, Rutile, Garnet, Zircon, Diopside, Tourmaline, Hematite, Goethite, Kyanite, Quartz, Feldspar, Biotite.
- The iron-rich heavy minerals like ilmenite, magnetite, garnet, hypersthene and rutile present in the soil had undergone leaching by surface water and were then oxidised because of the favourable semi-arid climatic conditions.
- It was due to these processes that the dunes near Tiruchendur, a coastal town of Thoothukudi district are red-coloured.
- The dunes are spread over Kuthiraimozhi theri (2,387.12 hectares) and Sathankulam (899.08 ha) reserve forest of Tiruchendur taluk, which is located on the shoreline overlooking the Bay of Bengal in the **south-eastern part of Tamil Nadu.**

Topic: Desert Ecosystem

35. Correct Option: (b)

Explanation:

- **Statement 1 is correct: Banni Grassland is situated near the Great Rann of Kutch in Gujarat. It is considered to be the largest Grassland in Asia.**
  - The grassland spreads over 2,618 kilometers and accounts for almost 45% of the pastures in Gujarat.
- **Statement 2 is incorrect:** The word 'Banni' comes from the Hindi word 'banai', meaning made. **The land here was formed from the sediments that were deposited by the Indus and other rivers over thousands of years.**
  - Two ecosystems, wetlands and grasslands are juxtaposed in Banni.
- **Statement 3 is incorrect:** The vegetation in Banni is sparse and highly dependent on rainfall. **It is dominated by low-growing forbs and graminoids, many of which are halophiles (salt-tolerant), as well as scattered tree cover and scrub.** The grasslands were traditionally managed by a system of rotational grazing. Graminoid refers to a herbaceous plant with a grass-like morphology, i.e. elongated culms with long, blade-like leaves. They are contrasted to forbs which are herbaceous plants without grass-like features.
  - In 1955, the court notified the grassland will be a reserve forest. In, 2019, the NGT ordered to demarcate the boundaries of the Banni grassland and restricted non-forest activities.
  - Wildlife Institute of India (WII) has identified this grassland reserve as one of the last remaining habitats of the cheetah in India. Also, a possible reintroduction site for the species.
- **Statement 4 is correct:** Maldharis are a tribal herdsmen community in Gujarat, India. The literal meaning of Maldhari is a keeper (dhari) of the animal stock (mal). **The Maldharis have lived in the Gir National Park, in the Banni Grasslands Reserve area, for the past thousand years**.
  - They have co-existed with the lions which the Gir National Park was created to preserve, for these thousand years.
  - Maldhari community breeds Banni Buffaloes, a species endemic to the region. The buffaloes are adaptive to Kutch's hot weather conditions.

Topic: Grassland

36. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect:** The rate of decomposition is controlled by the chemical composition of detritus and climatic factors. **In a particular climatic condition, the decomposition rate is slower if detritus is rich in lignin and chitin and quicker if detritus is rich in nitrogen and water-soluble substances like sugars**.
- **Statement 2 is correct: Bio-Digester Toilet is a decomposition mechanized toilet system by means of which the sludge (Human Waste), the fecal matter is decomposed to bits in the digester tank using a specific high graded bacteria further converting them into methane and water, discharged further to the desired surface.**
- The decomposition of vegetable matter into compost is considered an exothermic reaction because the decomposition process, which is carried out by microbes, requires energy to break down of bonds of vegetables. As a result of the reaction, energy is released in the form of light.

More about Decomposition:

- The decomposers break down complex organic matter into inorganic substances like carbon dioxide, water, and nutrients and the process is called decomposition.

- Dead plant remains such as leaves, bark, flowers, and dead remains of animals, including fecal matter, constitute detritus, which is the raw material for decomposition.
- The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification, and mineralization.
- Decomposition is largely an oxygen-requiring process.
- Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes. A warm and moist environment favours decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build-up of organic materials.

Topic:

Sub-topic:

37. Correct Option: (a)

Explanation:

<u>Statement 1 is incorrect:</u> Energy does not recycle in an ecosystem. It is unidirectional.

<u>Statement 2 is correct:</u> There is a loss of some energy in the form of unusable heat at each trophic level.

<u>Statement 3 is correct:</u> Ecosystems are "open systems."

Energy flow in ecosystem

- This energy always flows from lower (producer) to higher (herbivore, carnivore etc.) trophic levels. It never flows in the reverse direction. Furthermore there is a loss of some energy in the form of unusable heat at each trophic level so that the energy level decreases from the first trophic level upwards. As a result there are usually four or five trophic levels and seldom more than six as beyond that very little energy is left to support any organism.
- Sun is the ultimate source of all energy, which caters to the need of our ecosystems. Energy does not cycle in an ecosystem as the flow of solar energy is unidirectional. As a result the ecosystem needs a continuous inflow of high-quality energy in order to maintain their function and structure. This energy is provided by the solar energy of the sun.
- For this reason, ecosystems are "open systems" needing a net inflow of energy from the sun to continue over time. Without the sun, the biosphere of our Earth would shortly run out of energy and collapse. This is because producers which as we are aware are autotrophs use the solar energy of the sun along with nutrients and convert them into food materials which are stored within their bodies. All the food materials or nutrients that we or other animals consume are obtained directly or indirectly from such producers. As a result there is a continuous flow of energy from the sun through various organisms and then to outer space.

38. Correct Option: (c)

Explanation:

- Scientists use indicator species to determine a change in an ecosystem based on what they observe in the indicator species. Indicator species are used to show both good and bad environmental changes. These changes can include the presence of pollutants, changes in biodiversity and biotic interactions, and changes in the physical environment. Lichens, Mayflies, spotted owls, etc. are some of the indicator species.
- **<u>Statement 1 is correct:</u> A bio-indicator is an organism that is used to qualitatively assess an environmental change**. The presence or absence of an organism can be used to indicate the health of the environment. For example, if lichen is found in a certain area, scientists know that the air quality is poor. Bioindicators are used to monitor the environment, ecological processes, and biodiversity within an ecosystem.
- **<u>Statement 2 and 3 are correct:</u> A bio monitor, on the other hand, is used to quantitatively measure responses and changes in the environment that indicate pollution. For example, if the amount of chlorophyll in lichen decreases, scientists know that air pollution is present.**

Source:

39. Correct Option: (b)

Explanation:

- **<u>Statement 1 is incorrect:</u> Cyclic ecological succession happens within established communities and is merely a changing of the structure of the ecosystem on a cyclical basis. Some plants thrive at certain times of the year and lay dormant the rest.** Another organism, like cicadas, lay dormant for many years and emerge all at once, drastically changing the ecosystem.

- **<u>Statement 2 is correct:</u> Allogenic succession is succession driven by the abiotic components of an ecosystem.**
- An allogeneic succession can be brought about in a number of ways which can include:
  - Volcanic eruptions;
  - Meteor or comet strike;
  - Flooding;'
  - Drought;
  - Earthquakes;
  - Non-anthropogenic climate change; etc.
- **<u>Statement 3 is incorrect:</u>** In contrast, autogenic succession is driven by the biotic components of the ecosystem.
- Autogenic succession refers to ecological succession driven by biotic factors within an ecosystem. The plants themselves (biotic components) cause succession to occur.
  - Light captured by leaves
  - Production of detritus
  - Water and nutrient uptake
  - Nitrogen fixation
  - Anthropogenic climate change
- These aspects lead to a gradual ecological change in a particular spot of land, known as a progression of inhabiting species. Autogenic succession can be viewed as a secondary succession because of pre-existing plant life.

Topic: Ecological Succession

Sub-topic:

40. Correct Option: (b)

Explanation:

- When an ecosystem (or community) changes abruptly from one to another, that zone is called an ecotone. This is a fundamental characteristic of landscapes that are often studied by landscape ecologists.
- This zone can traverse long stretches along two ecosystems and is a place where characteristics of both ecosystems can be seen.
- Plenty of examples exist in nature. The classic example of an ecotone is the transition from a forest to a grassland ecosystem. The ecotones are not only a physical transition from one ecosystem to another; they also represent a transition in the living conditions: both in habitats and niches.
- **<u>Statement 1 is incorrect:</u> Greater number of landscape elements, vegetation complexity, and mixed ecosystem characteristics result in greater density and biodiversity along the ecotones.** This phenomenon is called the edge effect.
- For example, we will always find a greater number of bird species along the land-water ecotones. Similarly, the ecotones formed by seas and rivers (deltas or estuaries) have a greater number of fish species.
- The new arrays of species living along edges are unique and are called edge species. Amphibians are the classic edge species of floodplain ecotones. They are able to perform most of their daily activities along these edges.
- **<u>Statement 2 is correct:</u> Floodplain, a shift from terrestrial to the aquatic ecosystem, is an example of an ecotone** the stretch of the bank where these two ecosystems meet forms one of the most important ecotones in nature.
- **Another example is seen in elephant habitats**. When elephants move, they tend to break up the forest by trampling and create a grassland-type situation along their path. They use the same path over and over again (creating elephant corridors), eventually making sure there is no tree cover there.

Topic: Basics Concepts of Ecology

Sub-topic: Ecotone

41. Correct Option: (c)

Explanation:

- **<u>Statement 1 is correct:</u>** An ecological niche is defined as the role or position occupied by a particular species in its ecosystem**. A niche comprises of conditions created by the biotic (living) and abiotic (non-living) components of an ecosystem that influence how successfully the species can reproduce and obtain necessary resources - i.e., food, water and shelter.** A niche also involves the influence that the species, in turn, has on its ecosystem.
- Ecological niches allow species to exist in their environment. Under the right conditions, the species will thrive and **play a unique role**. Without the ecological niches, there would be less biodiversity and the ecosystem would not be in balance.
- **<u>Statement 2 is correct:</u> Ecological niches are important for species, as they allow them to function without high competition for shared, limited resources**.

- Often, we can observe the true importance of ecological niches for an ecosystem only when the species occupying it ceases to exist in it. For example, the **lack of bees** has been seen to **cause low fruit yields in greenhouses**, due to a lack of pollination. Similarly, we can understand that if bee populations severely decrease on our planet, we might have problems growing sufficient food in the future.

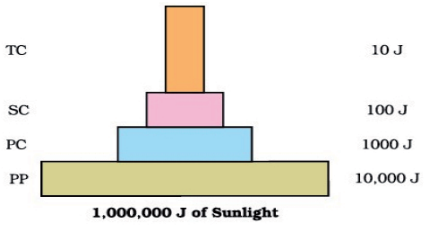
Topic: Environment

Sub-Topic: Habitat & Ecological Niche

42. Correct Option: (a)

Explanation:

- **Statement 1 is incorrect:** Solar radiation is the main driving force of all the ecosystems on earth and the solar energy is trapped by green plants through the process of photo-synthesis. **Solar energy is the primary source of energy for all ecosystem except the deep-sea hydrothermal ecosystem**.
- The deep-sea ecosystem is considered to be below a depth of 200 metres, where solar energy cannot support primary productivity through photosynthesis.
- These hydrothermal vents are the geysers and hot springs of the oceans. They occur in volcanically active areas such as the mid-ocean ridges where there is movement of tectonic plates. Here magma rises up close beneath the sea floor. The cracks in the porous rocks allow ocean water to percolate down and get heated by the underlying magma. A series of chemical reactions results as the heated fluids pouring out of the vent meet the cold ocean water. These reactions cause several materials such as sulphur, iron, zinc and copper to precipitate and form metal-rich towers, which is the classic image of a hydrothermal vent.
- The organisms thriving at deep sea vents and seeps are termed extremophiles because their living conditions are dark and freezing cold with high pressures and toxic chemicals.
- A unique gas-based ecosystem driven by chemosynthetic bacteria thrives around these vents. These are symbiotic bacteria that reside within or on the surfaces of the wide variety of living organisms—clams, mussels, shrimps and giant tubeworms—found around the vents. These bacteria use hydrogen sulphide to produce energy for the metabolic processes of these organisms.
- These chemosynthetic bacteria derive their energy from the methane hydrate present in the seeps.
- **Statement 2 is incorrect:** The flow of energy is **unidirectional and non-cyclic.**
- The green plants obtain energy from the sun and it is transformed into **chemical energy by the process of photosynthesis**.
- This energy is stored in plant tissues and transformed into heat energy during metabolic activities which then passes to next trophic level in the food chain.
- The solar energy captured by green plants (autotrophs) never revert back to sun, however, it passes to herbivores and that which passes to herbivores does not go back to autotrophs but passes to consumers.
- Thus, in biological systems, the energy flows from the sun to green plants and then to all heterotrophic organisms.
- **Thus, energy flows from lower trophic level- i.e., primary producers (autotrophs) to higher trophic levels (herbivores & carnivores).**
- **Statement 3 is correct:** As energy flows through the food chain, there occurs dissipation of energy at every trophic level.
- The loss of energy takes place through respiration, loss of energy in locomotion, running, hunting and other activities.
- **At every level there is about 90% loss of energy and the energy transferred from one trophic level to the other is only about 10%.**



An idcal pyramid of cncrgy. Obscrvc that primary producers convert only 1% of the energy in the sunlight available to them into NPP

Topic: Environment

Sub-Topic: Ecological Principles

43. Correct Option: (a)

Explanation:

- **Statement 1 is correct:** **Ecological succession** is defined as an orderly process of **changes in the community structure and function** with time mediated through **modifications in the physical environment** and ultimately culminating in a **stabilized ecosystem known as climax.** The whole sequences of communities which are transitory are known as **seral stages or seres** whereas the community establishing first of all in the area is called a **pioneer community.**

- The climax community is characterized by maximum biomass and symbiotic (mutually beneficial) linkages between organisms and is maintained quite efficiently per unit of available energy.
- **Statement 2 is incorrect: Hydrosere/ Hydrarch succession starts in a water body like pond**. A number of intermediate stages come and ultimately it culminates in a climax community which is a forest. **The pioneer community consists of phytoplanktons,** which are free floating algae, diatoms etc. Gradually these are replaced by rooted submerged plants followed by rooted-floating plants.
- **Statement 3 is incorrect: Xerosere/ Xerarch succession originates on a bare rock, which lacks water and organic matter. Here the climax community is a forest, although the intermediate stages are very different. The pioneer community here consists of crustose and foliose lichens**. These lichens produce some weak acids and help in disintegrating the rock, a process known as weathering. Their growth helps in building up gradually some organic matter, humus and soil. Then comes the community of mosses, followed by herbs, shrubs and finally the forest trees. Throughout this gradual process there is a slow build-up of organic matter and water in the substratum.

Topic: Environment

Sub-Topic: Ecological dominance

44. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect: Species richness of most taxa increases towards the equator.** The species richness generally decreases as we move away from equator towards the pole.
- The maximum biodiversity is found in tropical rain forests between 10^{o} south to 10^{o} north.
- The relative environmental stability of the tropics enables species to specialize to a greater extent, so that more can be packed into any given ecosystem. Further, the greater input of solar energy in the tropics increases available resources, resulting in greater biomass and population sizes compared to colder regions.
- **Statement 2 is correct: The diversity of plants and animals is not uniform throughout the world but shows a rather uneven distribution.** For many groups of animals or plants, there are interesting patterns in diversity, the most well- known being the latitudinal gradient in diversity. In general, species diversity decreases as we move away from the equator towards the poles. With very few exceptions, tropics (latitudinal range of 23.5° N to 23.5° S) harbour more species than temperate or polar areas.
- Colombia located near the equator has nearly 1,400 species of birds while New York at 41° N has 105 species and Greenland at 71° N only 56 species. India, with much of its land area in the tropical latitudes, has more than 1,200 species of birds. A forest in a tropical region like Equador has up to 10 times as many species of vascular plants as a forest of equal area in a temperate region like the Midwest of the USA. The largely tropical Amazonian rain forest in South America has the greatest biodiversity on earth- it is home to more than 40,000 species of plants, 3,000 of fishes, 1,300 of birds, 427 of mammals, 427 of amphibians, 378 of reptiles and of more than 1,25,000 invertebrates. Scientists estimate that in these rain forests there might be at least two million insect species waiting to be discovered and named.
- **Statement 3 is correct:** Ecologists and evolutionary biologists have proposed various hypotheses; some important ones are (a) Speciation is generally a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification, (b) **Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity** and (c) There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity.

Topic: Environment

Sub-Topic: Latitude vs altitude variation

45. Correct Option: (c)

Explanation:

- **Statement 1 is incorrect:** Desertification is the degradation of land in arid, semi-arid and dry sub-humid areas. It is caused primarily by human activities and climatic variations. Desertification does not refer to the expansion of existing deserts.

- The development of the fertile top-soil takes centuries. But it can be removed very easily due to human activities like over-cultivation, unrestricted grazing, deforestation and poor irrigation practices, resulting in arid patches of land. When large barren patches extend and meet over time, a desert is created. Internationally, it has been recognised that desertification is a major problem nowadays, particularly due to increased urbanisation.
- **Statement 2 is correct: As per the most recent UN estimates, up to 40 per cent of our planet's land is degraded.** This will directly affect half of humanity and is a threat to about 50 percent of global GDP or around $44 trillion. (UNCCD COP 15). If current practices continue through 2050, there could be an additional degradation of an area almost the size of South America, warns the UN Convention to Combat Desertification (UNCCD) report released in April 2022. The study was released ahead of the 15th session of the Conference of Parties to the UN Convention to Combat Desertification on May 9-20 in Abidjan, Cote d'Ivoire.
- The UNCCD described land degradation as the persistent or long-term loss of land-based natural capital. It gives rise to poverty, hunger, and environmental pollution while making communities more vulnerable to disease and disasters like drought, floods, or wildfires.
- **Statement 3 is incorrect: The United Nations Convention to Combat Desertification (UNCCD), adopted in 1994, is the sole legally binding international agreement linking environment and development to sustainable land management.** There are 197 Parties to the Convention, including 196 country Parties and the European Union. The Convention – based on the principles of participation, partnership and decentralization – is a multilateral commitment to mitigate the impact of land degradation, and protect our land so we can provide food, water, shelter and economic opportunity to all people.
- The Convention addresses specifically the arid, semi-arid, and dry sub-humid areas, known as the **drylands,** where some of the most vulnerable ecosystems and peoples can be found.

Topic: Environment

Sub-Topic: Desertification and control

46. Correct option: (a)

Explanation:

- **Option (a) is correct:** Characteristics of human modified ecosystems:
- **Highly simplified.**
- **Species diversity is very low.**
- **Food chains are simple and small.**
- Depend on human (anthropogenic) support for survival; need for fossil fuel energy, fertilizers, irrigation etc.
- Attract large number of weeds.
- More susceptible to epidemic diseases.
- Suffer from soil erosion.
- **Highly unstable.**

Topic: Basic Concepts of Ecology

Sub-topic: Environment and its Components

47. Correct Option: (d)

Explanation:

- **Option (d) is correct**
- It refers to the exertion of a major controlling influence of one or more species upon all other species by virtue of their number, size, productivity or related activities.
- To be considered as an ecologically dominant species:
  - The organism can compete more successfully than other organisms for essentials of life such as nutrition in the same habitat or the physical environment in which it live,
  - **It has greater adaptability to environmental variables**,
  - **It can exert a greater influence and compete on the habitat in which it lives,**
  - **The population or the size of the individual species constitutes a dominant proportion when compared with other species,** and
  - The organism is **mobile, aggressive and intelligent**, particularly in the case of human beings. Example: Caribou are a dominant species on the tundra.

Topic: Evolutionary Changes in Natural selection

Sub-topic: Adaptation of Species

48. Correct Option: (b)

Explanation:

- **Statement 1 is incorrect:** An organism with a narrow tolerance range is said to be "steno" whereas, that with a wide tolerance range is said to be "eury".
- Just as species have geographic ranges, they also have tolerance ranges for the abiotic environmental conditions. In other words, they can tolerate (or survive within) a certain range of a particular factor, but cannot survive if there is too much or too little of the factor.
- Each organism has an invariably defined range of conditions that it can tolerate, diversity in the resources it utilises and a distinct functional role in the ecological system, all these together comprise its niche.
- **An organism with a narrow tolerance range is said to be "steno" for that factor (e.g. stenothermal or stenohaline).**
- **An organism with a wide tolerance range is said to be "eury" (e.g. eurythermal).**
- Organisms can be steno with respect to one factor and eury with respect to a different one. Centrarchids (bass and sunfish) are eurythermal but stenohaline; salmonids are just the opposite. These tolerance ranges are not independent.
- An organism near the tolerance limits for one factor will probably be under stress, so its ability to tolerate other factors will be reduced.
- **The tolerance ranges against abiotic / environmental factors partly define the organism's niche**. If salinity tolerance is graphed against temperature tolerance, a niche area is defined.
- Ideally then, the organism should try to maintain the constancy of its internal environment (a process called homeostasis) despite varying external environmental conditions that tend to upset its homeostasis.
- This constancy, for example, could be in terms of optimal temperature and osmotic concentration of body fluids.

Responses to Abiotic Factors

- Some organisms are able to maintain homeostasis by physiological (sometimes behavioural also) means which ensures constant body temperature, constant osmotic concentration, etc. This is called regulation.
- **An overwhelming majority (99 per cent) of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature. This is called conformation.**
- The organism can move away temporarily from the stressful habitat to a more hospitable area and return when stressful period is over, called migration.
- **Another means is the suspension i.e. to suspend their physiological process until availability of suitable environment. For example, spores formation in bacteria, fungi and lower plants; 'seed dormancy' in higher plants; and hibernation & aestivation in animals.**

Topic: Adaptation of species

Sub-topic: Adaptation in Animals

49. Correct Option: (c)

Explanation:

- **Both statements are correct**
- The ecological communities are arranged in different layer or strata forms, a phenomenon called stratification.
- For example in a natural forest community, as per the height of the plants the community is arranged into number of strata or layers such as herbaceous layer consisting of herbaceous plants followed by shrubs, smaller trees and tall trees.
- This fractionation in the community is caused by the gradations in the external environmental factors like water levels, temperature and light.
- **The gradients in the physical environment of the community cause horizontal layering** or patterns among species.
- Differences in the amount of factors such as nutrients and water can significantly alter the distribution of plant and animal species over a region.
- Various growth form have different mode of arrangement classifying community into Horizontal Zonation and Vertical stratification, i.e. Populations assembled to form communities and these populations are dispersed into definite vertical or horizontal strata.

Horizontal Zonation

- The spatial arrangement of community species exhibit patterns and based on these

patterns the community is divided into sub-communities which are ecologically related.

- If the distribution pattern is horizontal it's called zonation layering in community.
- For example in lakes or deep ponds majorly three zones are recognised i.e. littoral, limnetic (Photic or openwater) and profondal zone (Aphotic or Deep-water). The organism varies in each zone of zonation pattern.
- Another example include mountain associated vegetation, altitudinal and latitudinal variations of vegetation in relation to climate of the existing region.

Vertical Stratification

- Vertical change in the pattern of community structure is called stratification.
- Vertical Stratification is as simple as the horizontal zonation community of pond, where each zone has different vertical storey, or complex stratification.
- For example in grassland communities distinct floor with different yet characteristics growth forms are exhibited.
- The lowest vertical sub-division is called Subterranean-beneath the soil.
- Subterranean, which includes roots of plants, debris and living organisms like soil bacterium, protozoas or fungi etc.
- Herbaceous substratum- Above the soil with roots of growth forms: The herbaceous substratum includes upper parts of growth forms.
- Forest animals' lives in different substrata and many of them may shift between substratums.
- The properties (requirement and adjustments) of one stratum can be similar to the same stratum of different community somewhere else in the world. For example forest floor of one community in country 1 share common requirements and adjustments to the community in country 2 although these countries are geographically separated.
- **The animals living in such geographically separated but similar substratum are called Ecological Equivalent.**

Topic: Basic Concepts of Ecology

Sub-topic: Functions of Ecosystem

50. Correct Option: (a)

Explanation:

- **Statement 2 is incorrect:** The process by which zooplankton species cope up with external environmental conditions is known as diapause.

Responses to Abiotic Factors

- There are various ways in which living things or an organism responds to the various abiotic components. They include the following:
- **Regulators:** It is the mechanism used by organisms to maintain a constant condition in the body. Homeostasis is the process by which organisms maintain their internal environment despite varying external environmental conditions. All birds and mammals are able to maintain homeostasis by physiological means which ensures constant body temperature, constant osmotic concentration via thermoregulation and osmoregulation.
- **Conformers:** Most of the organisms do not have the ability to regulate their body condition and they have a fluctuating bodily condition as per the environment.
- **Migrate:** Organisms travel to far off places during a particular weather condition and return when the weather condition is restored. For example, birds from Siberia migrate to south during winter to avoid the cold weather.
- **Suspension:** Many organisms, if unable to migrate, might avoid the stress by escaping in time. They do this by reducing their metabolic activity and going into a state of 'dormancy'. The familiar case of bears going into hibernation during winter is an example of an escape in time. Some snails and fish go into aestivation to avoid summer-related problems-heat and desiccation. Under unfavourable conditions, many zooplankton species in lakes and ponds are known to enter diapause, a stage of suspended development.

Topic: Adaptation of species

Sub-topic: Adaptation of animals