

Long Answer Questions (PYQ)

[5 Marks]

Q.1. Describe the process of decomposition of detritus under the following heads: Fragmentation; leaching; catabolism; humification and mineralisation.

Ans. The process of breaking down complex organic matter into inorganic substances like—, water and nutrient is called decomposition. The raw materials for decomposition is called detritus.

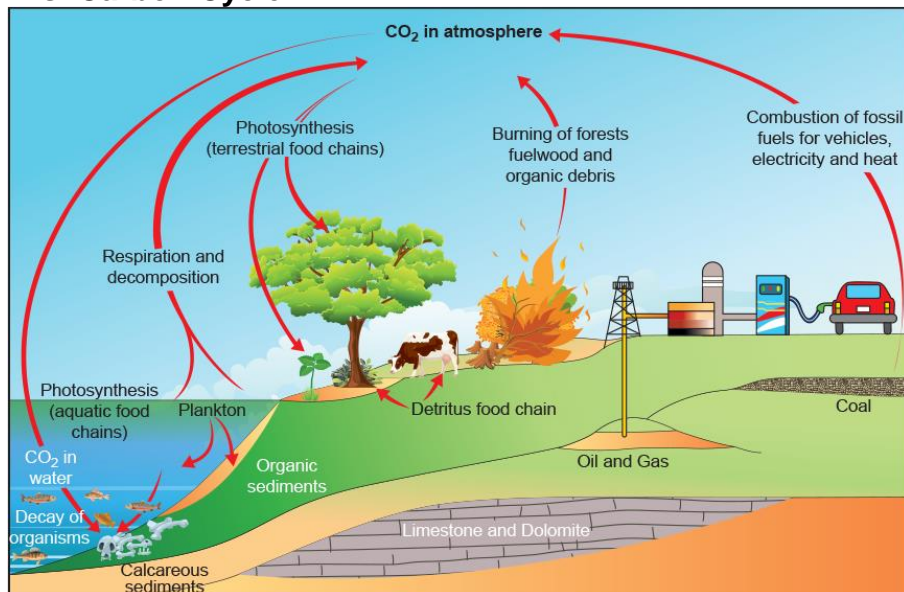
They are dead remains of plants and animals.

Steps in decomposition:

- Fragmentation:** The process of breaking down of detritus into smaller particles is called fragmentation, e.g., earthworm.
- Leaching:** The process by which water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
- Catabolism:** The enzymatic process by which degraded detritus is converted into simple inorganic substances is called catabolism.
- Humification:** The process of accumulation of a dark coloured amorphous substance called humus, that is, highly resistant to microbial action and undergoes decomposition at an extremely slow rate.
- Mineralisation:** The process by which humus is further degraded by some microbes and release inorganic nutrients is called mineralisation.

Q.2. Carbon cycle in nature is a biogeochemical event. Explain.

Ans. Carbon Cycle

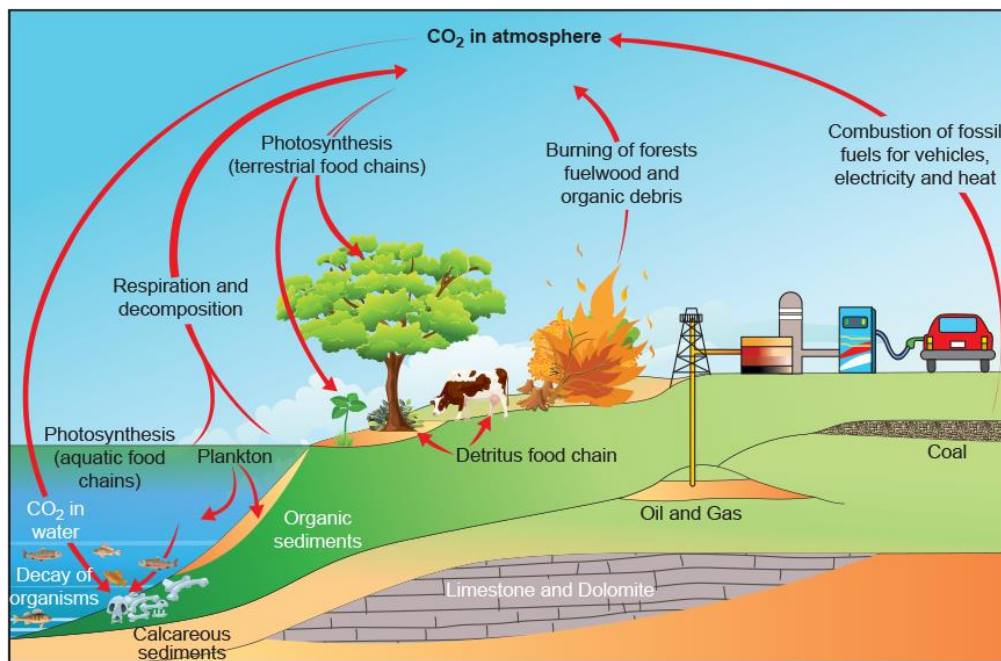


Simplified model of carbon cycle in the biosphere

- Carbon constitutes 49 per cent of dry weight of an organism.
- 71 per cent of the carbon is found dissolved in oceans which is responsible for its regulation in atmosphere.
- The carbon cycle occurs through atmosphere, oceans and through living and dead organisms.
- It is estimated that 4×10^{13} kg of carbon is fixed in the biosphere through photosynthesis annually.
- Carbon is returned to atmosphere as CO_2 by animals and plants through respiration and the activities of decomposers.
- Some amount of fixed carbon is lost as sediments and removed from circulation.
- Burning of wood, forest fire, volcanic activity and combustion of organic matter and fossil fuels are some essential sources for releasing CO_2 in the atmosphere.
- Human activities like deforestation and vehicular burning of fossil fuels has caused an increase in the amount of CO_2 in atmosphere.

Q.3. Explain the carbon cycle with the help of a simplified model.

Ans.



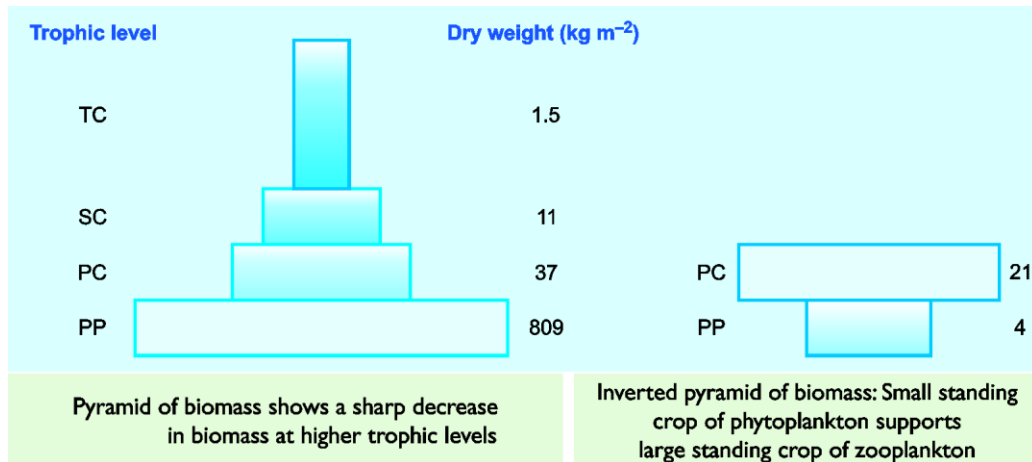
Simplified model of carbon cycle in the biosphere

Q.4.

- Draw the pyramids of biomass in a sea and in a forest. Explain giving reasons why the two pyramids are different.**
- “Pyramid of energy is always upright.” Explain.**

Ans.

a.



The pyramid of biomass in sea is inverted because the biomass of fish far exceeds that of phytoplankton. Whereas the pyramid of biomass in a forest ecosystem is upright, because the biomass decreases as the trophic level increases.

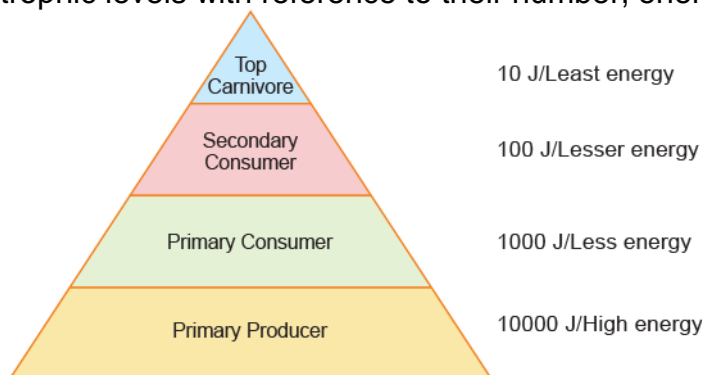
- b. Pyramid of energy is never inverted because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. Each bar in the energy pyramid indicates the amount of energy present at each trophic level at a given time.

Q.5.

- a. Explain the significance of ecological pyramids with the help of an example.
- b. Why are the pyramids referred to as 'upright' or 'inverted'?

Ans.

- a. Ecological pyramids express the relationship between the organisms at different trophic levels with reference to their number, energy and biomass.

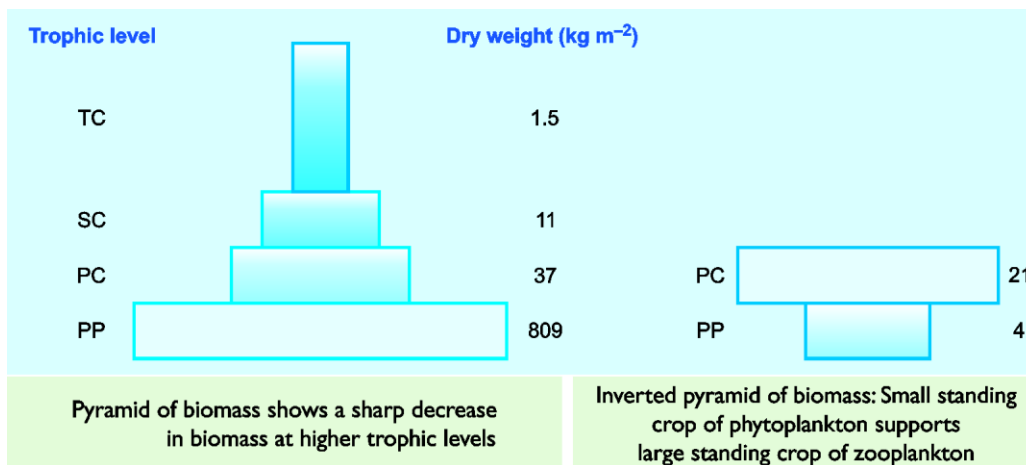


- b. Pyramid of energy is always upright as only 10% energy is transferred from one trophic level to the next.
Inverted pyramid shows less number/biomass of producers when compared to primary consumers.

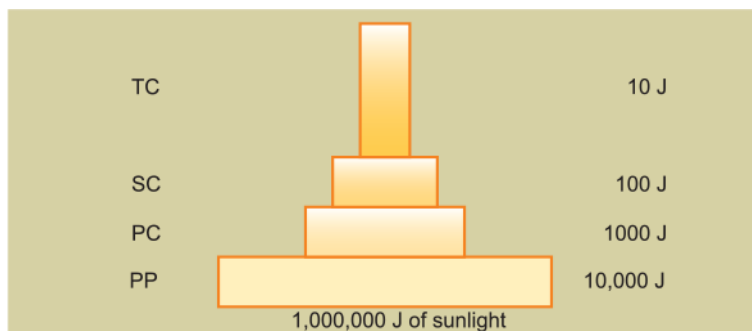
Q.6. “It is often said that the pyramid of energy is always upright. On the other hand, the pyramid of biomass can be both upright and inverted.” Explain with the help of examples and sketches.

Ans. Pyramid of biomass: The relationship between producers and consumers in an ecosystem can be represented in the form of a pyramid in terms of biomass called pyramid of biomass. It can be

- a. Upright, e.g., in case of grassland ecosystem; or
b. Inverted, e.g., in case of pond ecosystem.



Pyramid of energy: The relationship between producers and consumers in an ecosystem can be represented in the form of a pyramid, in terms of flow of energy called pyramid of energy. It is always upright because energy is always lost as heat at each step.

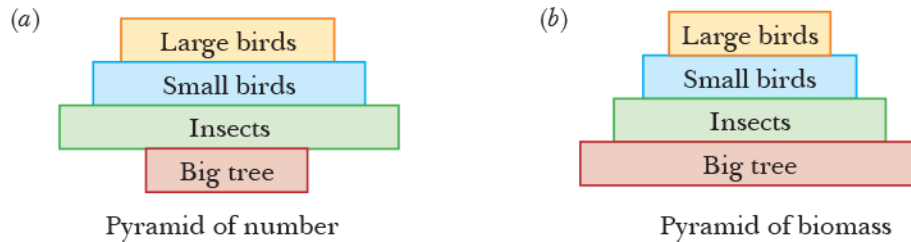


An ideal pyramid of energy

Q.7.

- a. Draw a 'pyramid of numbers' of a situation where a large population of insects feed upon a very big tree. The insects in turn, are eaten by small birds which in turn are fed upon by big birds.
- b. Differentiate giving reason, between the pyramid of biomass of the above situation and the pyramid of numbers that you have drawn.

Ans.



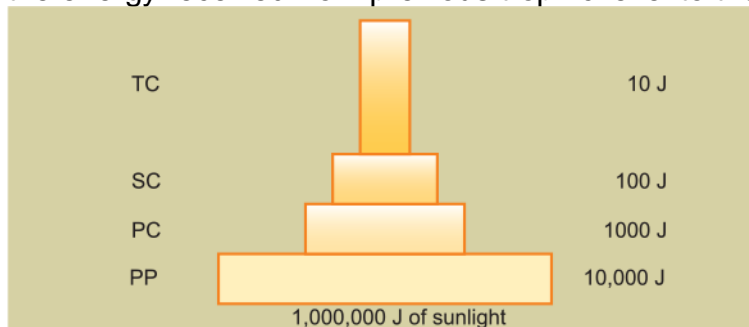
The pyramid of biomass is upright at the first two trophic levels because the biomass of a single tree is much more than total population of insects. Whereas, the pyramid of number is inverted at the first two trophic levels because the number of insects is much more than the number of trees.

Q.8.

- a. With suitable examples, explain the energy flow through different trophic levels. What does each bar in this pyramid represent?
- b. Write any two limitations of ecological pyramids.

Ans.

- a. In an ideal energy pyramid the primary producers convert only 1% of the energy in the sunlight available to them. The subsequent trophic levels pass on 10% of the energy received from previous trophic level to the next trophic level.



An ideal pyramid of energy

Each bar or level in the pyramid represents the amount of energy transferred to the next trophic level.

- b. **Limitations of ecological pyramids:**

- i. It does not take into account the same species belonging to two trophic levels.
- ii. It assumes simple food chain and not food web.
- iii. Saprophytes are not considered.

Q.9. Describe the advantages for keeping the ecosystems healthy.

Ans. By keeping the ecosystem healthy we can take advantage of the ecosystem services which are the products of ecosystems.

Following are the economic and environmental goods that we obtain from the ecosystem. They

- i. Purify air and water
- ii. Mitigate drought and floods
- iii. Cycle nutrients
- iv. Generate fertile soil
- v. Provide wildlife habitat
- vi. Maintain biodiversity
- vii. Pollinate crop
- viii. Provide storage site for carbon
- ix. Provide aesthetic cultural and spiritual value
- x. Provide stable food chain
- xi. Provide economically useful forest produces
- xii. Provide sustainable biological legacy to future generations.

Q.10. Answer the following questions:

Q. Explain primary productivity and the factors that influence it.

- **Ans.** The amount of biomass or organic matter produced per unit area over a time period in plants during photosynthesis is called **primary production**. It is expressed in terms of weight (g m^{-2}) or energy (kcal m^{-2}).
- Plant species inhabiting a particular area.
- Environmental factors.
 - a. **Sunlight:** The sunlight directly regulates the primary productivity because the plants perform photosynthesis with the help of sunlight. As tropical region receives maximum sunlight so it exhibits higher productivity.
 - b. **Temperature:** Temperature regulates the activity of enzyme. So, optimum temperature is required for proper functioning of enzyme.
 - c. **Moisture:** Rain (humidity) is required for higher primary productivity. Deserts have the lowest primary productivity as the soil is deficient in moisture.
- Availability of nutrients: Greater nutrients ensure greater primary productivity.
- Photosynthetic efficiency: Some plants have more efficiency to trap sunlight (sugarcane), so they accumulate more primary productivity.

Q. Describe how do oxygen and chemical composition of detritus control decomposition.

Ans. Decomposition of detritus is slow if it contains lignin, chitin, tannins and cellulose, whereas it is quicker if detritus is made up of nitrogenous compounds and water-soluble substances like sugars. This is because the latter are easy to degrade.

Oxygen is required for the activity of decomposers and detritivores. Therefore, a reduced oxygen amount will slow down the process of decomposition.

Q.11. Answer the following questions:

Q. Differentiate between primary and secondary ecological successions.

Ans. Primary succession: It begins in areas where no living organisms ever existed. Therefore, the establishment of a biotic community is very slow, e.g., newly cooled lava, bare rock, newly created pond or reservoir.

Secondary succession: It begins in areas where natural biotic communities have been destroyed, e.g., abandoned farm lands, buried or cut forests. Since soil is available, it is a faster process.

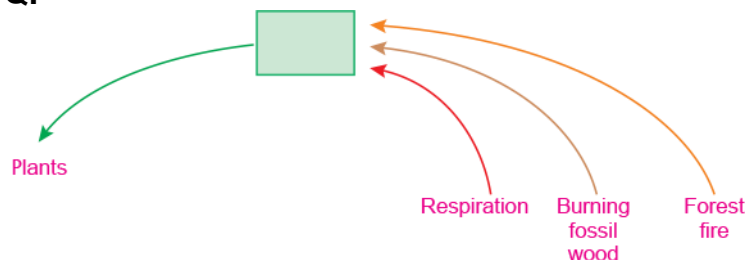
Q. Explain the different steps of xerarch succession occurring in nature.

Ans. Xerarch Succession in Nature:

- Lichens are the pioneer species on a bare area.
- The lichen secretes some acids to dissolve rock and help in weathering and soil formation.
- Later, some small bryophytes invade and hold the small amount of soil.
- The bryophytes are succeeded by herbs, shrubs and ultimately big trees.
- At last, a stable climax forest is formed.
- The xerophytic habitat gets converted into a mesophytic one.

Q.12.

Q.



- i. Name the biogeochemical (nutrient) cycle shown above.
- ii. Name an activity of the living organisms not depicted in the cycle by which this nutrient is returned to the atmosphere.

Ans.

- i. The biogeochemical cycle shown is carbon cycle.
- ii. Volcanic activity and mining/Microbial decomposition of organic matter.

Q. How would the flow of the nutrient in the cycle be affected due to large scale deforestation? Explain giving reasons.

Ans. Due to large scale deforestation, the flow of carbon in the environment will be disturbed because plants are the major consumers which utilise carbon for photosynthesis. This would lead to accumulation of carbon in the atmosphere.

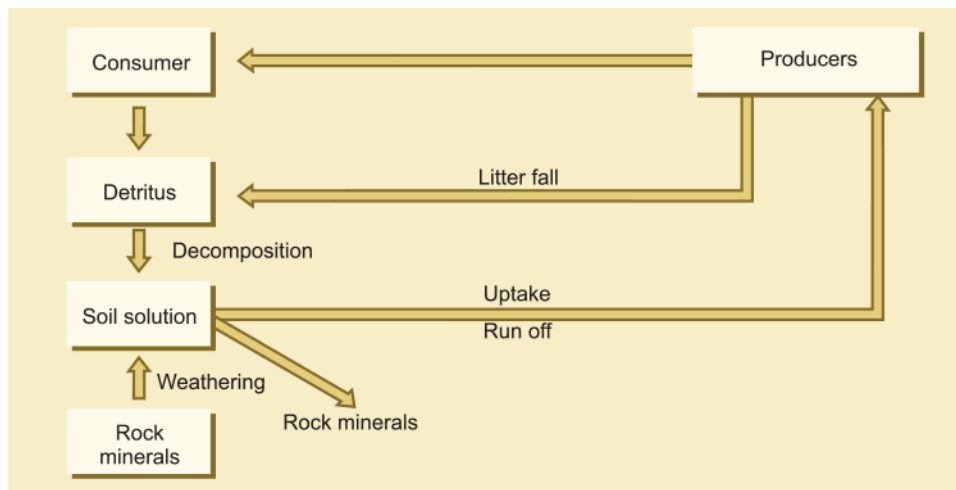
Q. Describe the effect of an increased level of this nutrient in the atmosphere on our environment.

Ans. Increase in level of carbon in atmosphere will result in greenhouse effect. This will lead to heating of earth's surface and finally to global warming. Rise in temperature result in odd climatic changes called El Nino effects which are harmful for the environment.

Q.13. Answer the following questions:

Q. Draw a simplified model of phosphorus cycling in a terrestrial ecosystem.

Ans.



A simplified model of phosphorus cycling in a terrestrial ecosystem

Q. Write the importance of such cycles in ecosystems.

Ans. Such cycles recycle nutrients again and again and maintain the balance in ecosystem.

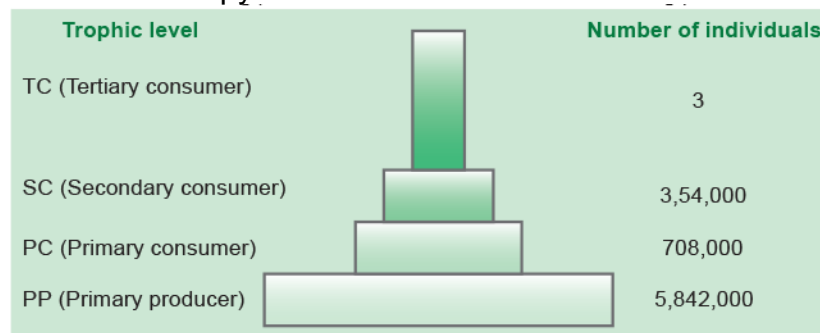
Long Answer Questions (OIQ)

[5 Marks]

Q.1. What is ecological pyramid? Describe the different types of pyramid.

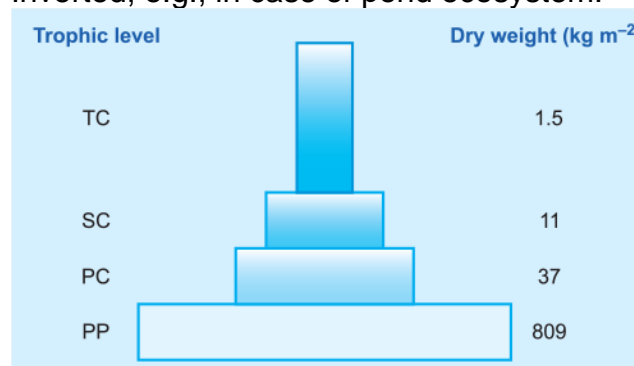
Ans.

- The relation between producers and consumers in an ecosystem can be graphically represented in the form of a pyramid called ecological pyramid.
- **Structure:** The base always represents the producers or the first trophic level and the apex represents top level consumer or the last trophic level.
- Ecological pyramids are of three types:
 - i. Pyramid of number
 - ii. Pyramid of biomass
 - iii. Pyramid of energy
- i. **Pyramid of number:** The relationship between producers and consumers in an ecosystem can be represented in the form of a pyramid in terms of number called pyramid of number.



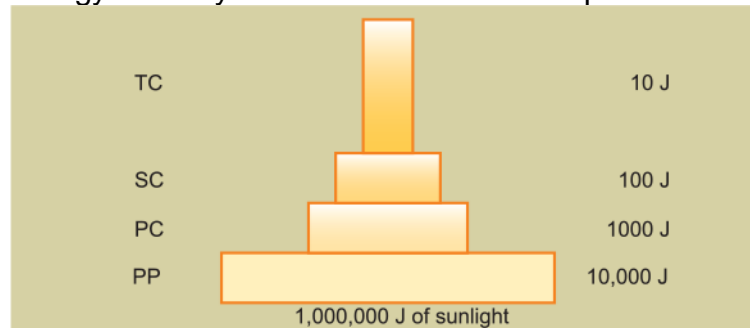
Pyramid of numbers in a grassland ecosystem

- ii. **Pyramid of biomass:** The relationship between producers and consumers in an ecosystem can be represented in the form of a pyramid in terms of biomass called pyramid of biomass. It can be
 - a. Upright, e.g., in case of grassland ecosystem; or
 - b. Inverted, e.g., in case of pond ecosystem.



Pyramid of biomass shows a sharp decrease in biomass at higher trophic levels

- iii. **Pyramid of energy:** The relationship between producers and consumers in an ecosystem can be represented in the form of a pyramid, in terms of flow of energy called pyramid of energy. It is always upright because energy is always lost as heat at each step.



An ideal pyramid of energy

Q.2. What is ecological succession? What is climax community? How is climax community established?

Ans. Ecological Succession

- The sequential, gradual and predictable changes in the species composition in an area are called succession or **ecological succession**.
- The entire sequence of communities that successively changes in a given area are called **sere(s)**.
- The individual transitional communities are termed as seral stages or **seral communities**.
- The community that is in near equilibrium with the environment is called a **climax community**.
- The species that invade a bare area are called **pioneer species**.
- The changes that occur in successive seral stages to reach a climax community are:
 - i. changes in the diversity of species of organisms.
 - ii. increase in the total biomass.
 - iii. increase in the number of species and organisms.
- Ecological succession is of two types:
 - i. **Primary succession:** It begins in areas where no living organisms ever existed. Therefore, the establishment of a biotic community is very slow, e.g., newly cooled lava, bare rock, newly created pond or reservoir.
 - ii. **Secondary succession:** It begins in areas where natural biotic communities have been destroyed, e.g., abandoned farm lands, buried or cut forests. Since soil is available, it is a faster process.

Q.3. Citing lake as an example of a simple aquatic ecosystem, interpret how various functions of this ecosystem are carried out. Make a food chain that is functional in this ecosystem.

Ans.

- i. **Productivity:** Conversion of inorganic into organic material with the help of solar energy by the autotrophs.
- ii. **Energy flow:** Unidirectional movement of energy towards higher trophic level (and its dissipation and loss as heat to the environment).
- iii. **Decomposition:** Fragmentation, leaching, catabolism, humification, mineralization by bacteria, fungi and flagellates (abundant at the bottom of lake).
- iv. **Nutrient cycling:** Decomposition of dead matter to release the nutrients back to be re-used by the autotrophs.

Food chain in aquatic ecosystem (lake):

Phytoplanktons → Zooplanktons → Small fish → Big fish (*Any other appropriate example*).

Q.4. Answer the following questions:

Q. Colonisation of a rocky terrain is a natural process. Mention the group of organisms which invade this area first. Give an example.

Ans. Pioneer species invade the area first. For example, lichen

Q. Over the years, it has been observed that some of the lakes are disappearing due to urbanisation. In absence of human interference, depict by making a flow chart, how do the successional series progress from hydric to mesic condition.

Ans. Phytoplankton – hydric → Submerged plant stage → Submerged free floating plant stage → Reed swamp stage → Marsh – meadow stage → Scrub stage → Forest stage – Mesic

Q. Identify the climax community of hydrarch and xerarch succession.

Ans. Forest is the climax community for both successions

Q.5. What will happen to an ecosystem if

- a. All producers are removed;
- b. All organisms of herbivore level are eliminated; and
- c. All top carnivore population is removed.

Ans.

- a. Reduction in primary productivity. No biomass available for consumption by higher trophic levels/heterotrophs and hence heterotrophs also die of starvation.
- b. Increase in primary productivity and biomass of producers. Carnivore population will subsequently dwindle due to food shortage.
- c. Increase in number of herbivores which leads to over-grazing by herbivores, finally resulting in desertification.