

Very Short Answer Questions (PYQ)

[1 Mark]

Q.1. All the primary productivity is not available to a herbivore. Give one reason.

Ans. All the primary productivity is not available to a herbivore because a considerable amount is utilised by the plant by respiration.

Q.2. Write the equation that helps in deriving the net primary productivity of an ecosystem.

Ans. $GPP - R = NPP$

Q.3. Write a difference between net primary productivity and gross productivity.

Ans. Gross productivity (GPP) is the rate of production of organic matter during photosynthesis. Net primary productivity (NPP) is the available biomass for the consumption by heterotrophs.

$GPP - R = NPP$

Q.4. What is secondary productivity?

Ans. Secondary productivity is defined as the rate of formation of new organic matter by consumers.

Q.5. State what does 'standing crop' of a trophic level represent.

Ans. Standing crop represents the mass of living material (biomass) at a particular time.

Q.6. List any two ways of measuring the standing crop of a trophic level.

Ans. Standing crop is measured as the biomass or the number in a unit area.

Q.7. Differentiate between standing state and standing crop in an ecosystem.

Ans. In an ecosystem, standing crop is the mass of living material in each trophic level at a particular time. Whereas standing state refers to the amount of nutrients in the soil at any given time.

Q.8. What is a detritus food chain made up of? How do they meet their energy and nutritional requirements?

Ans. Dead plant and animal remains and their faecal matter. They obtain energy by decomposing the dead materials.

Q.9. Mention the role of pioneer species in primary succession on rocks.

Ans. The pioneer species invade a bare area and pave way for other species.

Q.10. Why green plants are not found beyond a certain depth in the ocean?

Ans. Beyond a certain depth in the ocean, sunlight is not able to penetrate. Due to which green plants cannot photosynthesise and thus, do not survive.

Q.11. Why is an earthworm called a detritivore?

Ans. This is because earthworm breaks down detritus into smaller particles.

Q.12. “Man can be a primary as well as a secondary consumer.” Justify this statement.

Ans. Man has a varied diet. When on a vegetarian diet, they are primary consumers and when on a non-vegetarian diet, they are secondary consumers.

Q.13. How is ‘stratification’ represented in a forest ecosystem?

Ans. Stratification in the vertical distribution of species at different bonds. Trees occupy vertical strata, shrubs the second layer and herbs/ grasses occupy the bottom layers.

Q.14. Name the pioneer species:

- i. on a bare rock
- ii. in a water body

Ans.

- i. Lichens
- ii. Phytoplanktons.

Very Short Answer Questions (OIQ)

[1 Mark]

Q.1. Define primary production.

Ans. It is defined as the amount of biomass or organic matter produced per unit area over a certain time period by plants during photosynthesis.

Q.2. What is the approximate value of net primary productivity of the biosphere?

Ans. The approximate value of net primary productivity of the biosphere is 170 billion tonnes of (dry weight) organic matter.

Q.3. What percentage of productivity is contributed by oceans?

Ans. Oceans contribute about 55 billion tonnes, which is about 32.5%.

Q.4. Name the important steps in the process of decomposition.

Ans. Fragmentation, leaching, catabolism, humification and mineralisation.

Q.5. What is meant by humification?

Ans. The process of formation of humus from detritus or organic matter is called humification.

Q.6. Define mineralisation.

Ans. It is the process in which the humus is degraded by certain microbes and thus inorganic nutrients are released.

Q.7. List two factors that determine the vegetation and soil type of an ecosystem.

Ans. Two factors that determine the vegetation and soil type of an ecosystem are:

- i. Precipitation
- ii. Temperature.

Q.8. Define food chain.

Ans. It is referred to the transfer of energy (food) from the producers through a series of consumers.

Q.9. Name the basic requirement of any ecosystem to function and sustain properly.

Ans. A constant input of solar energy is the ultimate source of all energy and requirement of any ecosystem to function and sustain properly.

Q.10. Expand PAR.

Ans. Photosynthetic Active Radiation.

Q.11. What are primary carnivores?

Ans. The herbivores (primary consumers) which depend on plants for their food are called primary carnivores. They are also called secondary consumer.

Q.12. What is meant by 10% law?

Ans. It states that only 10% energy of a trophic level is transferred to the next higher trophic level.

Q.13. What is detritus?

Ans. Dead organic matter or remains of plant such as leaves, bark, flower and dead remain of animals, including faecal matter constitute detritus.

Q.14. Define trophic level.

Ans. Each energy step or level in a food chain is called a trophic level.

Q.15. Name the dominant producers in a deep aquatic ecosystem. What other name could you give to a primary consumer?

Ans. Phytoplanktons are the dominant producers in aquatic ecosystem. Primary consumers are also known as herbivores.

Q.16. What is net primary productivity?

Ans. The amount of energy or biomass remaining in a producer after meeting the cost of its respiration is called the net primary productivity.

Q.17. How much of carbon is dissolved in the oceans?

Ans. About 71% of carbon is dissolved in the oceans.

Q.18. Name the two forms of reservoirs of carbon that regulate the ecosystem carbon cycle.

Ans. Dissolved carbon in oceans and carbon in rocks, sediments and fossils are the two forms of carbon reservoirs.

Q.19. Why is the rate of assimilation of energy at the herbivore level called secondary productivity?

Ans. It is because the biomass available to the consumer for consumption is a resultant of the primary productivity from plants.

Q.20. What is the starting point of a grazing food chain and detritus food chain, respectively?

Ans. The grazing food chain starts with producers while the detritus food chain starts with decomposers.

Q.21. Why is a food web formed in nature?

Ans. Many organisms occupy positions in different food chains and several food chains become interconnected to form a food web.

Q.22. Name an omnivore which occurs in both grazing food chain and the decomposer food chain.

Ans. Sparrow/crow.

Q.23. Justify the pitcher plant as a producer.

Ans. Pitcher plant is chlorophyllous and is thus capable of photosynthesis and act as producer.

Q.24. Name any two organisms which occupy more than one trophic level in an ecosystem?

Ans. Man and sparrow.

Q.25. What is common to earthworm, mushroom, soil mites and dung beetle in an ecosystem.

Ans. They are all detritivores, *i.e.*, decomposing organisms which feed on dead remains of plants and animals.

Q.26. Standing crop and biomass are related to each other, how?

Ans. The standing crop is measured as the mass of living organisms or the number in a unit area. The biomass of a species is expressed in terms of fresh or dry weight.

Q.27. Why is the pyramid of biomass inverted in a pond ecosystem?

Ans. The pyramid of biomass is inverted in a pond ecosystem because the biomass of fish (top consumer) is far larger than the producers (phytoplanktons).

Q.28. Climax stage is achieved quickly in secondary succession as compared to primary succession. Why?

Ans. The rate of succession is much faster in secondary succession as the substratum (soil) is already present as compared to primary succession where the process starts from a bare area (rock).

Q.29. Under what conditions would a particular stage in the process of succession revert back to an earlier stage?

Ans. Natural or human induced disturbances like fire, deforestation, etc.

Q.30. Arrange the following as you observe in vertical stratification of a forest— Grass, Shrubby plants, Teak, *Amaranthus*.

Ans. Grass, *Amaranthus*, Shrubby plants, Teak.

Q.31. In terrestrial ecosystem DFC and GFC are interlinked at certain level. Justify the statement.

Ans. Some of the organisms of DFC are prey to the animal of GFC, hence they are interlinked.

Short Answer Questions-I (PYQ)

[2 Marks]

Q.1. How are productivity, gross productivity, net primary productivity and secondary productivity interrelated?

Ans. Productivity is the rate of biomass production.

$$GPP - R = NPP = 1$$

Where NPP is biomass available to consumers for secondary productivity.

Q.2. "It is possible that a species may occupy more than one trophic level in the same ecosystem at the same time." Explain with the help of one example.

Ans. For example, sparrow is an omnivore. When it eats seeds, fruits or any other plant product, it occupies the primary trophic level. Whereas, when it eats worms and any other insect, it occupies the secondary trophic level. Thus, it occupies more than one trophic level in the same ecosystem.

Q.3. Justify the importance of decomposers in an ecosystem.

Ans. Decomposers which are heterotrophic organisms, mainly fungi and bacteria break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients. They meet their energy and nutrient requirements by degrading dead organic matter or detritus. These are also known as saprotrophs. Decomposers secrete digestive enzymes that breakdown dead and waste materials into simple, inorganic materials, which are subsequently absorbed by them.

Q.4. Why is earthworm considered a farmer's friend? Explain humification and mineralisation occurring in a decomposition cycle.

Ans. Earthworms help in breakdown of complex organic matter as well as loosening of the soil. This helps in the proper growth of the crops. Therefore, they are considered farmer's friend.

- **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 is called humification.
- **Mineralisation:** The process by which humus is further degraded by some microbes to release inorganic nutrients is called mineralisation.

Q.5. Differentiate between two different types of pyramids of biomass with the help of one example of each.

Ans.

S. No.	Upright pyramid of biomass	Inverted pyramid of biomass
(i)	The biomass of producers is more than that of consumers.	The biomass of the producers (phytoplankton) is less than that of consumers (fish).
(ii)	For example, forest ecosystem.	For example, aquatic ecosystem.

Q.6. Construct a pyramid of biomass starting with phytoplanktons. Label three trophic levels. Is the pyramid upright or inverted? Why?

Ans.



The pyramid is inverted because the biomass of fishes is much more than that of the phytoplanktons.

Q.7. “In a food-chain, a trophic level represents a functional level, not a species.” Explain.

Ans. A given species may occupy more than one trophic level in the same ecosystem (in different food chains) at the given time. If the function of the mode of nutrition of species changes, its position shall change in the trophic levels. The same species can be at primary consumer level in one food chain and at secondary consumer level in another food chain in the same ecosystem at the given time.

Q.8.



Identify the type of the given ecological pyramid and give one example each of pyramid of number and pyramid of biomass in such cases.

Ans. The given ecological pyramid is the inverted pyramid.

Inverted pyramid of biomass in a lake: Phytoplankton → Zooplankton → fishes.

Inverted pyramid of number: Tree → insects → birds.

Q.9. State the difference between the first trophic levels of detritus food chain and grazing food chain.

Ans.

S. No.	First trophic level of detritus food chain	First trophic level of grazing food chain
(i)	Decomposers are the first trophic level.	Producers are the first trophic level.
(ii)	They break down the complex organic matter into simpler form by secreting enzymes.	They prepare complex organic molecules from simple inorganic material with the help of sunlight.

Q.10. Differentiate between a detritivore and a decomposer giving an example of each.

Ans.

Detritivore	Decomposer
They are organisms which feed on detritus and break them into smaller particles, e.g., earthworm.	They are organisms which by secreting enzymes break down complex organic matter into inorganic substances, e.g., some bacteria and fungi.

Q.11. Construct a grazing food chain and detritus food chain using the following, with 5 links each: Earthworm, bird, snake, vulture, grass, grasshopper, frog, decaying plant matter.

Ans. Grazing food chain:

Grass → Grasshopper → Frog → Snake → Vulture

OR

Grass → Grasshopper → Bird → Snake → Vulture

Detritus food chain:

Decaying plant matter → Earthworm → Bird → Snake → Vulture

Q.12. Apart from being part of the food chain, predators play other important roles. Mention any two such roles supported by examples.

Ans.

- Keeps prey population under control, for example the invasive prickly poor cactus in Australia was brought under control only after a cactus feeding predator (a moth) was introduced in the country.

- Maintains species diversity by reducing intensity of competition among prey species. For example, when the *Starfish Pisaster* was removed from its community of American Pacific coast, more than 10 species of invertebrates become extinct.

Q.13. Explain with the help of two examples, how the pyramid of number and the pyramid of biomass can look inverted.

Ans. The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton and the number of big fishes eating the small fishes is also greater than the small ones. Also in pyramid of number, the number of insects feeding on a big tree is far greater than the tree. Now the number of small birds depending on the insects and the number of larger birds eating the smaller ones also increases in the order.

Q.14. How does primary succession start in water and lead to the climax community? Explain.

Ans. Primary succession in water

- The pioneer species are phytoplanktons.
- The phytoplanktons are replaced by free-floating angiosperms.
- Then, rooted angiosperms invade sedges, grasses and finally the trees.
- At last, a stable climax forest is formed.
- An aquatic habitat is converted into mesic habitat.

Q.15. Name the pioneer and the climax species in a water body. Mention the changes observed in the biomass and the biodiversity of the successive seral communities developing in the water body.

Ans. Pioneer species — Phytoplanktons

Climax species — Forest or trees

Biomass will be gradually increased and phytoplanktons are replaced by free-floating angiosperms then by rooted hydrophytes followed by different seral communities thus, biodiversity also increases.

Q.16. Explain the function of 'reservoir' in a nutrient cycle. List the two types of nutrient cycles in nature.

Ans. The function of the reservoir is to meet the deficit which occurs due to imbalance in the rate of influx and efflux.

The two types of nutrient cycles are:

- i. Gaseous, and
- ii. Sedimentary

Short Answer Questions-I (OIQ)

[2 Mark]

Q.1. Name the four functional aspects of an ecosystem.

Ans. Functional aspects of an ecosystem are:

- i. Productivity
- ii. Decomposition
- iii. Energy flow
- iv. Nutrient cycle

Q.2. What is an incomplete ecosystem? Explain with the help of a suitable example.

Ans. An ecosystem is a functional unit with biotic and abiotic factors interacting with one another resulting in a physical structure. Absence of any component will make an ecosystem incomplete as it will hinder the functioning of the ecosystem. Examples of such an ecosystem can be a fish tank or deep aphotic zone of the oceans where producers are absent.

Q.3. What is stratification in an ecosystem? Explain with an example.

Ans. The vertical distribution of different species occupying different levels in an ecosystem is called stratification. Trees occupy the topmost vertical layer of a forest, shrubs occupy the second layer and herbs and grasses occupy the bottom most or base layers.

Q.4. Expand GPP and NPP. Differentiate between the two.

Ans. GPP stands for Gross Primary Productivity. It is the rate of production of organic matter during photosynthesis in an ecosystem.

NPP stands for Net Primary Productivity. It is defined as GPP - Respiratory loss.

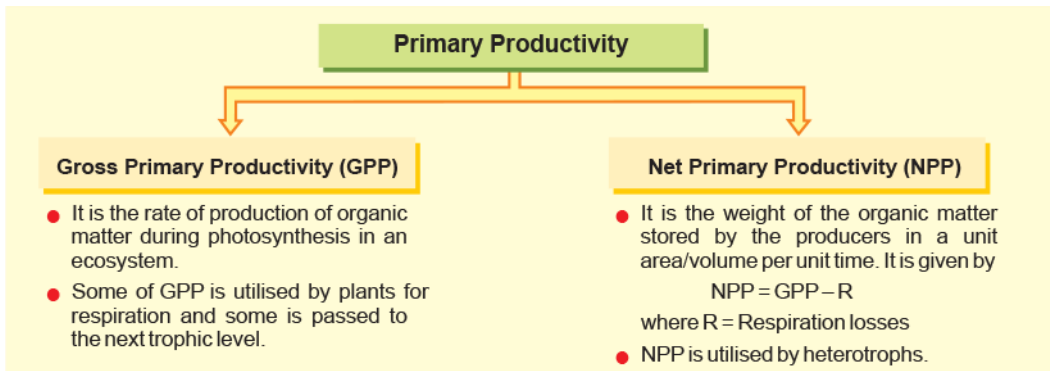
Q.5.

- i. **What is primary productivity? In what units could you express productivity?**
- ii. **Explain the differences between net primary productivity and gross primary productivity.**

Ans.

- i. The rate at which solar radiation is trapped by producers for the synthesis of organic compound through photosynthesis is called primary productivity. It is expressed as $\text{g m}^{-2} \text{y}^{-1}$ or $\text{kcal m}^{-2} \text{year}^{-1}$.

ii.



Q.6. What does secondary productivity in an ecosystem indicate? List any two factors by which productivity is limited in an aquatic ecosystem.

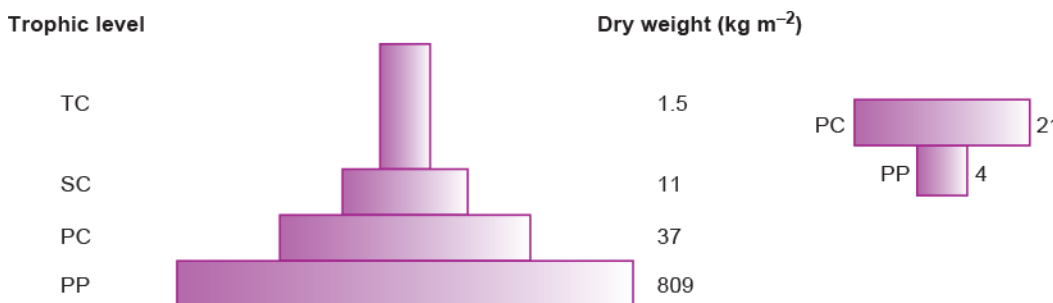
Ans. The rate of assimilation and formation of new organic matter by consumers is called secondary productivity. The factors which affect productivity in an aquatic ecosystem are:

- i. Nitrogen in marine ecosystem.
- ii. Light, which decreases with increasing depth of water.

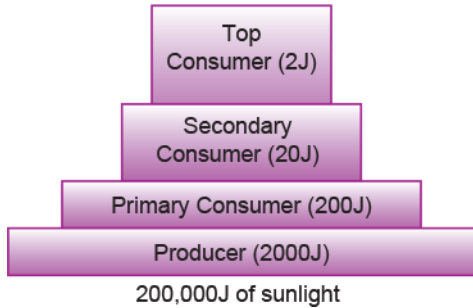
Q.7. Primary productivity varies from ecosystem to ecosystem. Explain.

Ans. Primary productivity varies from ecosystem to ecosystem because it depends on the plant species inhabiting the area and their photosynthetic activity. It also depends on various environmental factors, which vary in different ecosystems.

Q.8. Compare the two ecological pyramids of biomass given below and explain the situations in which this is possible. Also, construct an ideal pyramid of energy, if 200,000 joules of sunlight is available.



Ans. The first pyramid of biomass corresponds to a terrestrial ecosystem. Second pyramid refers to a small standing crop of phytoplankton supporting a large standing crop of zooplankton or an aquatic ecosystem.



Q.9. List the three parameters used for constructing ecological pyramids. Describe any one instance where the pyramid may look inverted.

Ans. The three parameters used are:

- i. Number of individuals in a trophic level.
- ii. Biomass of individuals in a trophic level.
- iii. Rate of flow of energy in a trophic level.

The pyramid may look inverted in a tree ecosystem where the number of consumers are numerous depending on a single producer.

Q.10. Due to uncontrolled excessive hunting, the population of tiger in a forest becomes zero. Discuss the long-term effects of this situation in the population of deer in that forest.

Ans. The reduction in population of tiger (predator) will result in an increase in deer (prey) population. The increased deer population will give more pressure on vegetation due to overgrazing. As a result, the plant population will decrease and lead to decreased deer population due to starvation, death and migration. As a result, the ecological balance will be disturbed, but in the long run these relationships stabilise the prey and predator population in a community.

Q.11. Apart from plants and animals, microbes form a permanent biotic component in an ecosystem. While plants have been referred to as autotrophs and animals as heterotrophs, what are microbes referred to as? How do these microbes fulfil their energy requirements?

Ans. Microbes are referred to as heterotrophs and saprotrophs. They fulfil their energy requirement by feeding on dead remains of plants and animals through the process of decomposition.

Q.12. Why is secondary succession faster than the primary succession?

Ans. Secondary succession is faster than the primary succession because of presence of

- i. soil for growth, which also results in quick attainment of climax.

- ii. water, the environment and the seeds or other propagules which are easily available.

Q.13. What could be the reason for the faster rate of decomposition in the tropics?

Ans. The rate of decomposition is regulated by climatic factors like temperature and soil moisture as they have an effect on the activities of soil microbes. The tropics with its hot and humid climatic condition provides an environment which is ideal for the microbes to speed up the process of decomposition.

Q.14. “Decomposition is an oxygen requiring process” Comment.

Ans. Detritus is rich in nitrogen and sugars. For oxidation of nitrogen and sugars oxygen is required by a class of aerobic microbes.

Q.15. What would happen to the successive trophic levels in the pyramid of energy, if the rate of reproduction of phytoplanktons was slowed down? Suggest two factors which could cause such a reduction in phytoplankton reproduction.

Ans. If the rate of reproduction of phytoplanktons slows down then the net primary productivity decrease. As a result, flow of energy will also decrease in the successive trophic level.

The following two factors cause reduction in phytoplankton reproduction:

- i. Less water availability
- ii. Less nutrient availability

Q.16. What are the shortcomings of ecological pyramids in the study of ecosystem?

Ans. The ecological pyramid assumes a simple food chain and does not accommodate food webs. Thereby, it does not take into account the fact that species may belong to two or more trophic levels at a time. Also saprophytes despite their vital role in ecosystem are given no place in the ecological pyramids.

Q.17. Sometimes due to biotic/abiotic factor the climax remain in a particular seral stage (preclimax) without reaching the climax. Do you agree with this statement. If yes, give a suitable example.

Ans. It is true that any change in the abiotic/biotic factor will arrest a particular seral stage leading to a pre-climax condition before the climax stage is achieved. This can happen in cases of forest fires, landslide, change in soil characteristics, increase in herbivore population leading to overgrazing.

Short Answer Questions-II (PYQ)

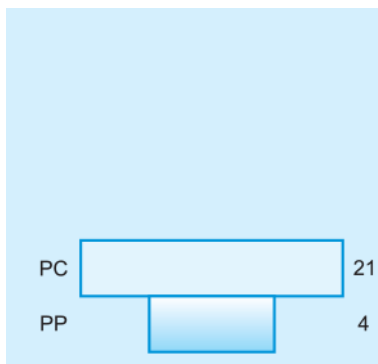
[3 Marks]

Q.1. Describe the inter-relationship between productivity, gross primary productivity and net productivity.

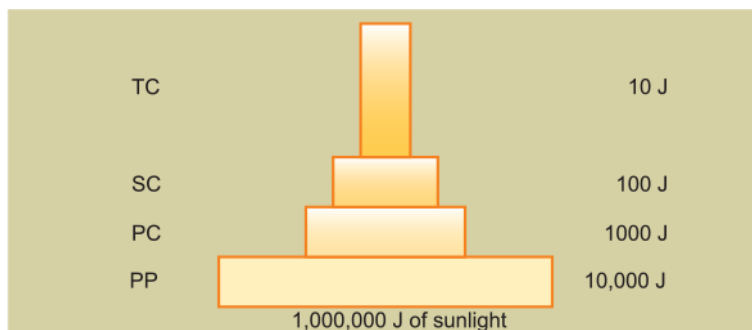
Ans. Productivity is the rate of biomass production per unit area over a period of time. Gross primary productivity is the rate of production of organic matter during photosynthesis in an ecosystem. Net productivity is the gross primary productivity minus respiration losses.

Q.2. Draw a pyramid of biomass and pyramid of energy in sea. Give your comments on the type of pyramids drawn.

Ans.



Inverted pyramid of biomass: Small standing crop of phytoplankton supports large standing crop of zooplankton



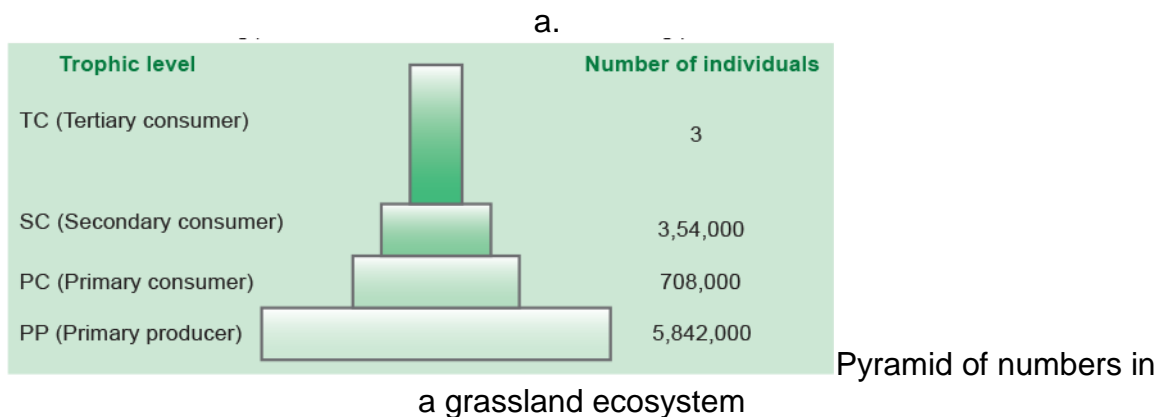
An ideal pyramid of energy

The pyramid of biomass in sea is inverted.
The pyramid of energy in sea is upright.

Q.3.

- a. Construct a pyramid of numbers by taking suitable examples for each trophic level in an ecosystem.**
- b. Explain why a progressive decline is seen in the population size from the first to the fourth trophic level in the above pyramid.**

Ans.



- b. Amount of energy decreases at successive trophic levels resulting into decreasing in number of organisms.**

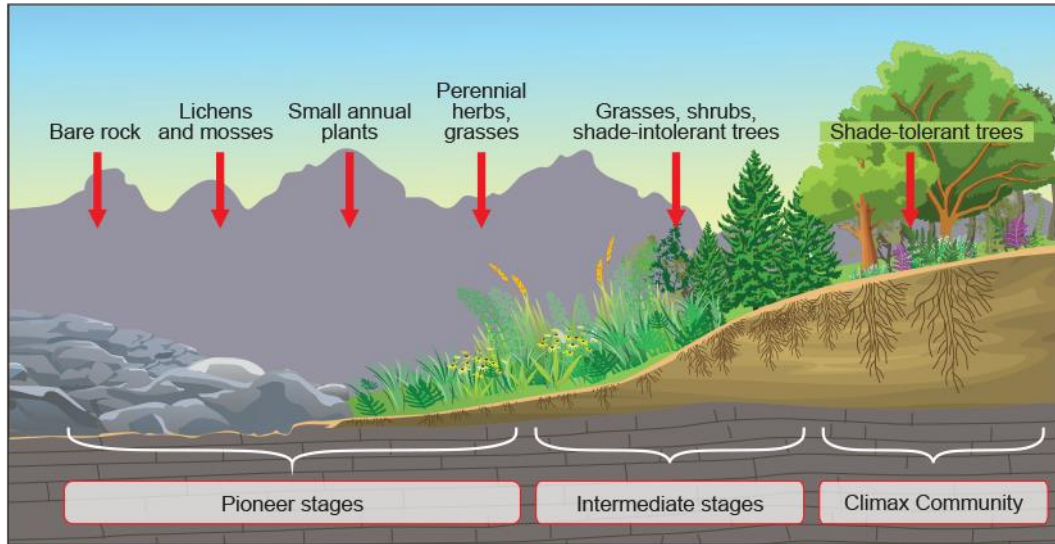
Q.4. Name the pioneer species on a bare rock. How do they help in establishing the next type of vegetation? Mention the type of climax community that will ultimately get established.

OR

Explain how does a primary succession start on a bare rock and reach a climax community.

Ans. Primary succession on rocks

- 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.



Biotic succession on a bare rock

Q.5.

- Describe primary succession that occurs on bare rock.
- Differentiate between xerarch and hydrarch successions.

Ans. (a) Primary succession on rocks

- 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.

(b) The plant succession is of two types:

- Hydrarch succession:** The plant succession which takes place in wet area or water, leading to a successional series progress from hydric to the mesic conditions.
- Xerarch succession:** The plant succession which takes place in dry area, leading to a successional series from xeric to mesic conditions.

Q.6. Differentiate between primary and secondary succession. Provide one example of each.

Ans.

Primary Succession	Secondary Succession
--------------------	----------------------

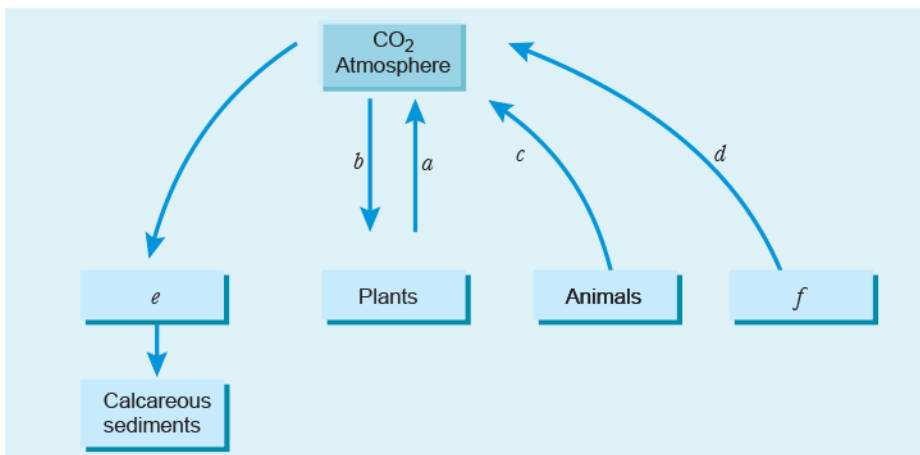
<ol style="list-style-type: none"> 1. It begins with areas where no living organisms ever existed. 2. Establishment of a biotic community is very slow. 3. Example: Newly cooled-lava/barerocks/newly created ponds or reservoir. 	<ol style="list-style-type: none"> 1. It begins in areas where natural biotic communities have been destroyed. 2. Establishment of a biotic community is faster. 3. Example: Abandoned farm lands/burnt or cut forests/ lands that have been flooded.
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Q.7. Name the type of food chains responsible for the flow of larger fraction of energy in an aquatic and a terrestrial ecosystem, respectively. Mention one difference between the two food chains.

Ans. In aquatic system, detritus food chain and in terrestrial ecosystem, grazing food chain are responsible for flow of larger fraction of energy.

S. No.	Grazing food chain (GFC)	Detritus food chain (DFC)
(i)	It starts with green plants called producers as first trophic level.	It begins with dead organic matter and decomposers called saprophytes as first trophic level.
(ii)	A much less fraction of energy flows through this type of food chain.	A much large fraction of energy flows through this type of food chain.
(iii)	Energy for food chain comes from sun.	Energy for the food chain comes from organic remain or detritus.

Q.8. Draw and complete the following model of carbon cycle filling a, b, c, d, e and f.



Ans.

- a. Photosynthesis
- b. Respiration
- c. Respiration
- d. Combustion of fossil fuels
- e. Aquatic food chain
- f. Coal, oil.

Q.9.

- a. **State any two differences between phosphorus and carbon cycles in nature.**
- b. **Write the importance of phosphorus in living organisms.**

Ans.

a.

	Phosphorus cycle	Carbon cycle
(i)	It is a sedimentary cycle.	It is a gaseous cycle.
(ii)	Atmospheric inputs through rainfall are much smaller.	Atmospheric inputs through rainfall are more.
(iii)	Gaseous exchange of phosphorus between organism and environment is nil.	Gaseous exchange of carbon between organism and environment is much more

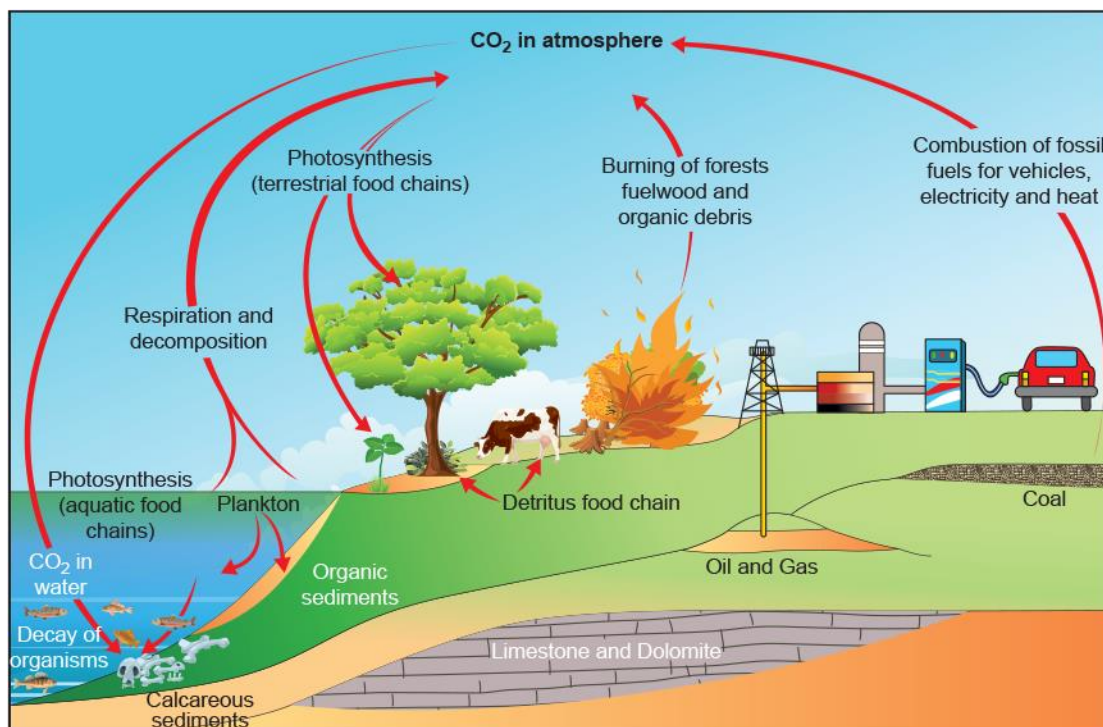
- b. Phosphorus is a major constituent of biological membranes, nucleic acids and cellular energy transfer

Q.10. Describe the effects of human activities in influencing natural ecosystem cycles with special reference to carbon cycle.

Ans. Human activities have significantly influenced the carbon cycle. Rapid deforestation and massive burning of fossil fuels for energy and transport have significantly increased the rate of release of carbon dioxide into the atmosphere. Carbon dioxide is a greenhouse gas which allows the solar radiations to enter but prevent the escape of heat radiations of longer wavelength. The absorbed radiations again come to earth's surface and heat it up. Thereby increasing the average temperature of surface of the earth, *i.e.*, global warming.

Q.11. State the function of a reservoir in a nutrient cycle. Explain the simplified model of carbon cycle in nature.

Ans. The function of a reservoir is to meet the deficit which occurs due to imbalance in the rate of influx and efflux.



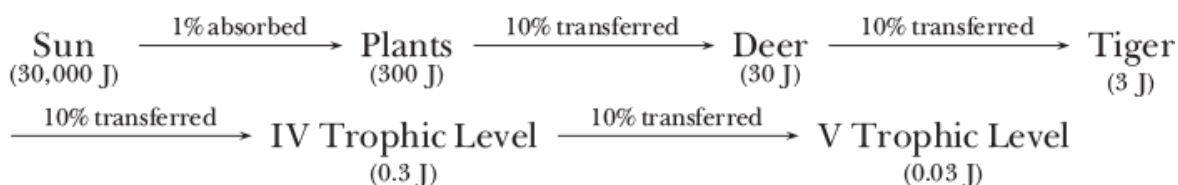
Simplified model of carbon cycle in the biosphere

Short Answer Questions-II (OIQ)

[3 Marks]

Q.1. Why is the length of a food chain in an ecosystem generally limited to 3–4 trophic levels? Explain with an example.

Ans. The amount of energy flow decreases with successive trophic levels as only 10% of energy is transferred from one trophic level to the next successive level. The energy is lost in the form of respiration and other vital activities to maintain life. If more trophic levels are present, the residual energy will be limited and decreased to such an extent that it cannot further support any trophic level by the flow of energy. So, the food chain is generally limited to 3–4 trophic levels only. For, e.g.,



Q.2. What are the limitations of ecological pyramids?

Ans. Limitations of ecological pyramids:

- i. It never takes into account the same species belonging to two or more trophic levels.
- ii. It assumes a simple food chain, which never exists in nature.
- iii. In spite of the vital role played by saprophytes/decomposers, they are not given any position in ecological pyramids.

Q.3. Explain xerarch succession highlighting the xeral communities.

Ans. The series of development stages of biotic succession in an arid area is termed as xerarch while biological succession on an arid area is called xerarch.

Primary succession on rocks

- 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.4. Name the kind of organisms which constitute the pioneer community of xerarch and hydrarch succession, respectively.

Ans.

Xerarch succession—Lichens.

Hydrarch succession—Phytoplanktons

Q.5.

- a. What is meant by ecological succession? Explain how it occurs.
- b. What properties distinguish a pioneer community from a climax community?

Ans.

- a. The sequential, gradual and predictable changes in the species composition in an area are called succession or ecological succession.

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.
- b.

S. No.	Pioneer community	Climax community
(i)	The species which invade a bare area or land to initiate succession is called pioneer community.	The last or final stage in a succession constitute the climax community.
(ii)	The pioneer species have high reproductive rate.	The climax species have low reproductive rate.
(iii)	The pioneer species have short life span.	The climax species have long life span.
(iv)	They are replaceable.	They are stable and not replaced.

Q.6. Fill in the missing stages in the given primary hydrarch succession.

Phytoplankton → (a) → (b) → (c) → **Submerged free-floating** → (d) → **Forest plant stage**

What is common between hydrarch and xerarch succession?

Ans.

- a. Reed-swamp stage
- b. Submerged plant stage
- c. Marsh-meadow stage
- d. Scrub stage

Both the hydrarch and xerarch lead to mesic conditions of forest.

Q.7. Where and how does the primary succession occur? Explain.

Ans. Primary succession occurs on newly cooled lava or bare rocks or newly created pond or reservoir.

[Any two]

i. Primary succession in water

- The pioneer species are phytoplanktons.
- The phytoplanktons are replaced by free-floating angiosperms.
- Then, rooted angiosperms invade sedges, grasses and finally the trees.
- At last, a stable climax forest is formed.
- An aquatic habitat is converted into mesic habitat.

ii. Primary succession on rocks

- 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.

[Any one]

Q.8. Define ecological succession. Give three differences between seral stages and climax community during succession.

Ans. The sequential, gradual and predictable changes in the species composition in an area are called succession or ecological succession.

S. No.	Seral stage	Climax community
(i)	It is the sequential replacement and establishment of species in the process of succession.	It is the community which gets established at the terminal stage of succession.
(ii)	The species composition changes from time to time.	The species are stable and species composition do not change.
(iii)	Simple food chains and food webs are found.	Complex food chains and food webs are found.

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.

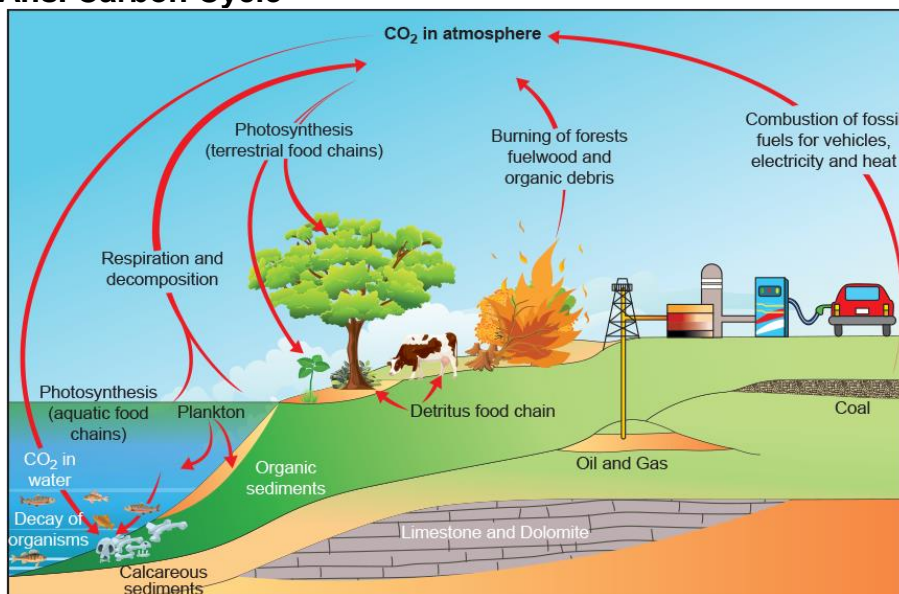
They are dead remains of plants and animals.

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

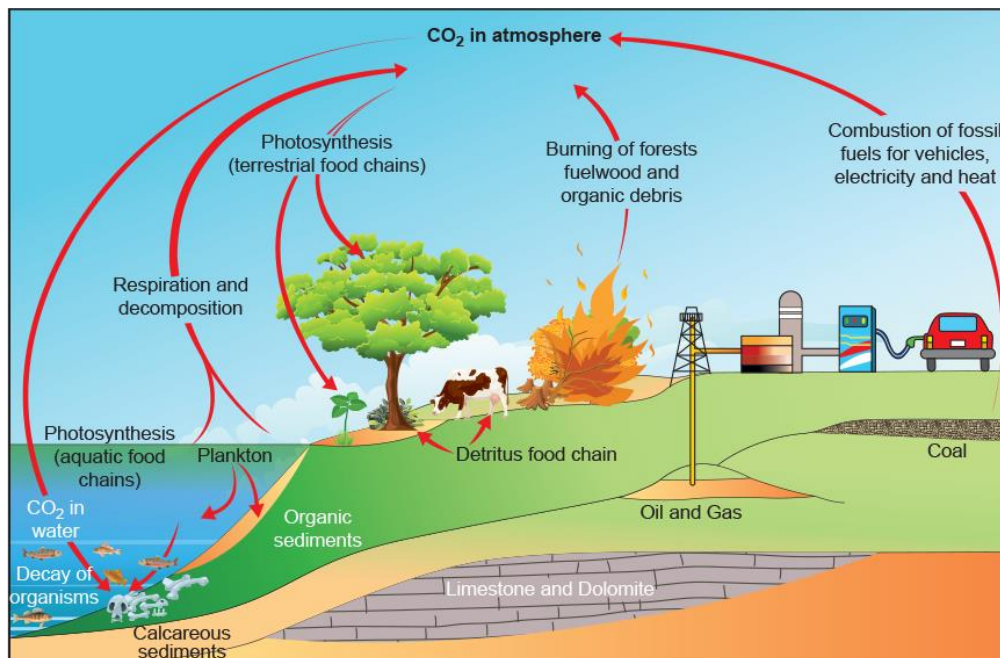


Simplified model of carbon cycle in the biosphere

- 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.



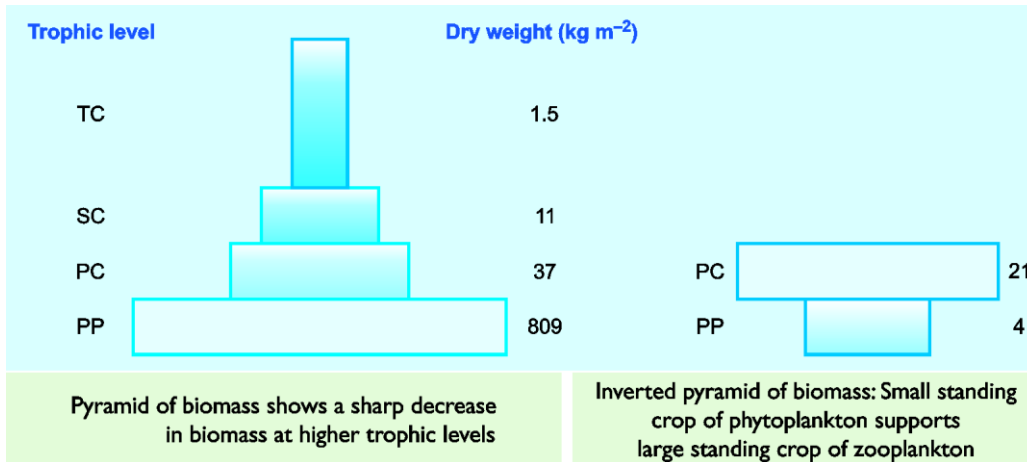
Simplified model of carbon cycle in the biosphere

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.

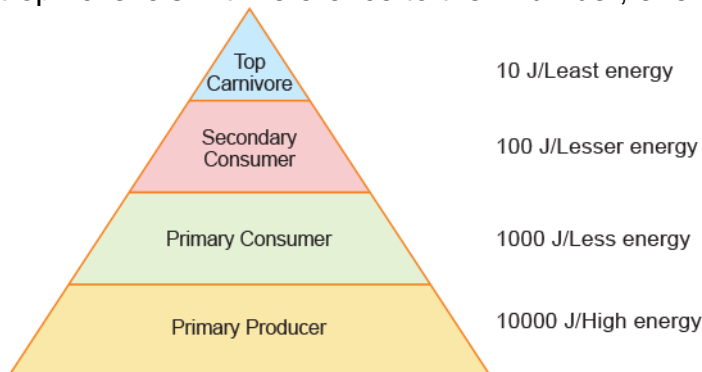
- b. Pyramid of energy is never inverted because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. Each bar in the energy pyramid indicates the amount of energy present at each trophic level at a given time.

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.

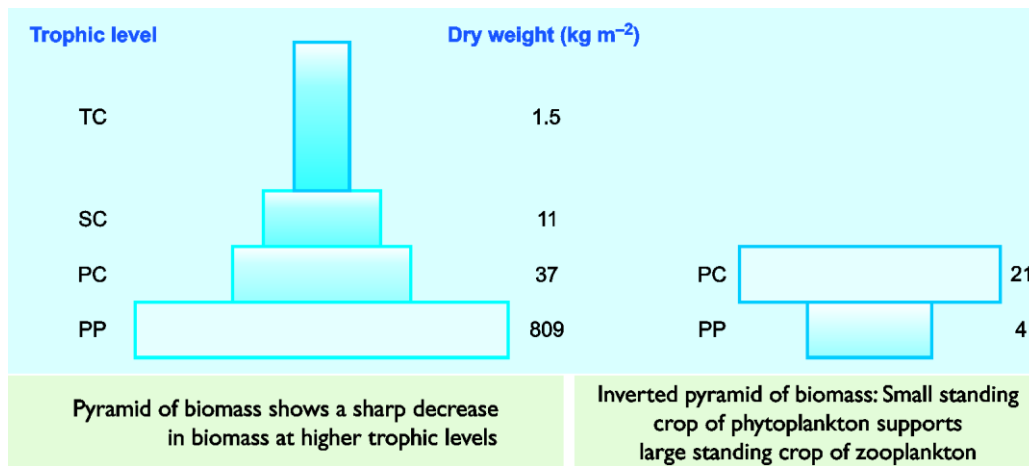


- b. Pyramid of energy is always upright as only 10% energy is transferred from one trophic level to the next.
 Inverted pyramid shows less number/biomass of producers when compared to primary consumers.

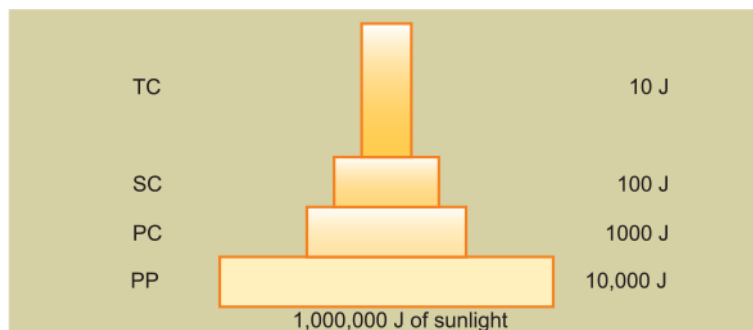
Q.6. “It is often said that the pyramid of energy is always upright. On the other hand, the pyramid of biomass can be both upright and inverted.” Explain with the help of examples and sketches.

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.

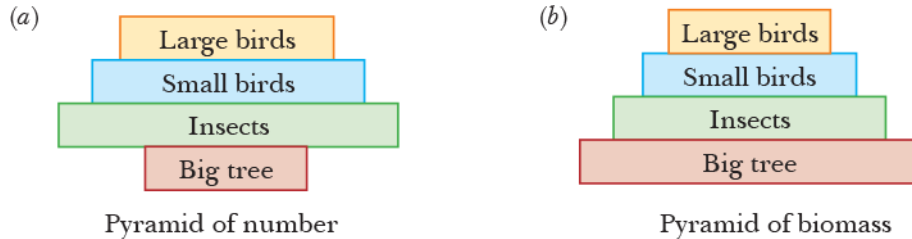


An ideal pyramid of energy

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.



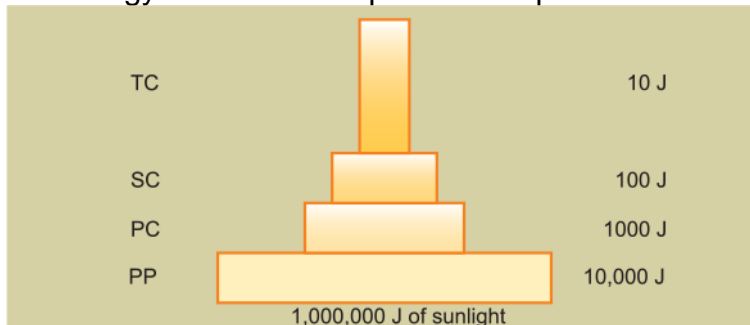
The pyramid of biomass is upright at the first two trophic levels because the biomass of a single tree is much more than total population of insects. Whereas, the pyramid of number is inverted at the first two trophic levels because the number of insects is much more than the number of trees.

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.

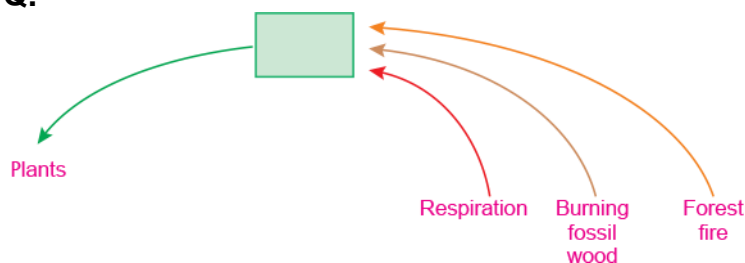
Q. Explain the different steps of xerarch succession occurring in nature.

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.

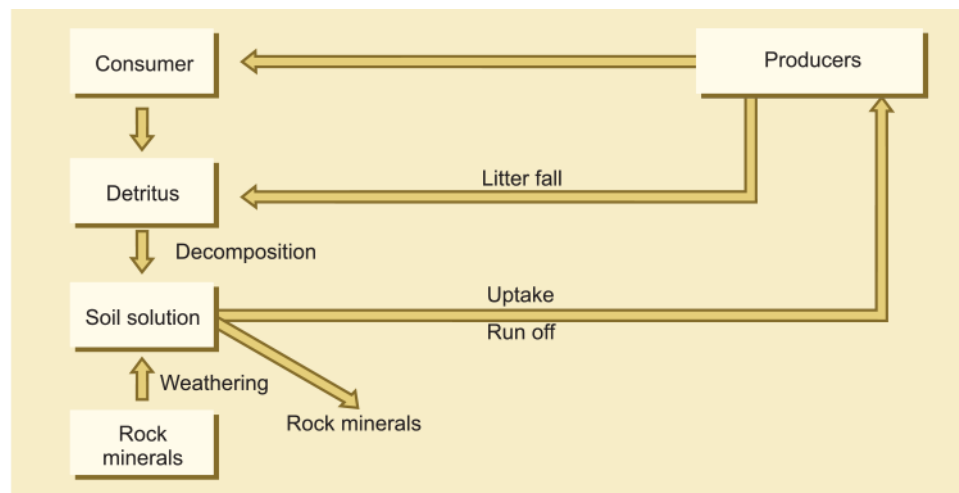
Q. Describe the effect of an increased level of this nutrient in the atmosphere on our environment.

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.

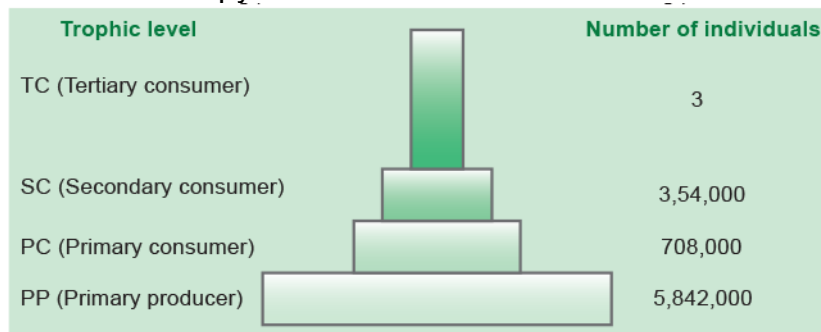
Long Answer Questions (OIQ)

[5 Marks]

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

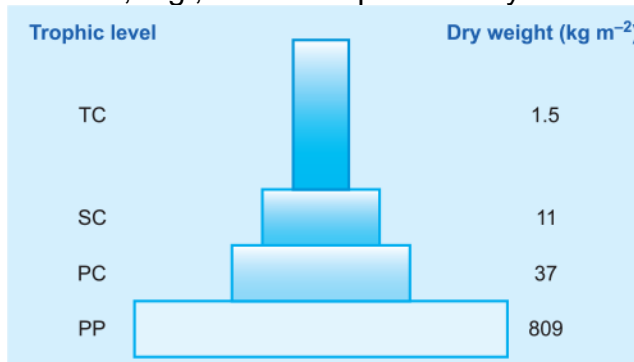
Ans.

- 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.



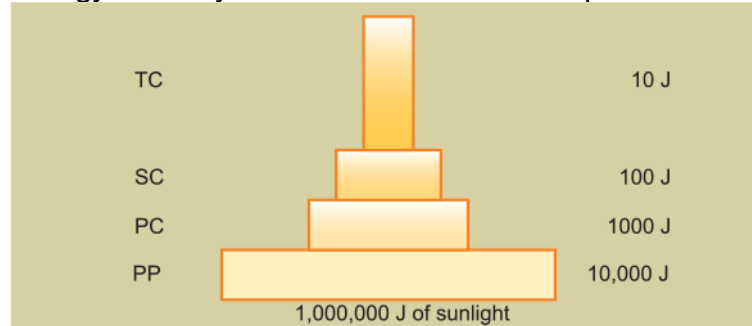
Pyramid of numbers in a grassland ecosystem

- 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.