

# Ecosystem

## Multiple Choice Questions (MCQs)

**Q. 1** Decomposers like fungi and bacteria are

- |                   |                       |
|-------------------|-----------------------|
| (i) autotrophs    | (ii) heterotrophs     |
| (iii) saprotrophs | (iv) chemo-autotrophs |

Choose the correct answer

- |                    |                  |
|--------------------|------------------|
| (a) (i) and (iii)  | (b) (i) and (iv) |
| (c) (ii) and (iii) | (d) (i) and (ii) |

### 💡 Thinking Process

*On the basis of mode of nutrition organism can be classified as autotrophs and heterotrophs.*

**Ans. (c)** **Autotrophs** (Chemoautotrophs and photoautotrophs) are those organisms which are able to synthesise their own food. e.g., plants while the organisms which derive their food, (from autotrophs or plants) are termed as **heterotrophs**. Heterotrophs may be herbivores, carnivores and omnivores.

**Saprotrophs** are the organisms which obtain their nourishment from dead organic matter or remains of both plant and animals. They are also known as decomposer as they play an important role in recycling of minerals by decomposing dead organic matter.

**Q. 2** The process of mineralisation by microorganisms helps in the release of

- (a) inorganic nutrients from humus
- (b) both organic and inorganic nutrients from detritus
- (c) organic nutrients from humus
- (d) inorganic nutrients from detritus and formation of humus.

**Ans. (a)** Five important steps occurred during the process of **decomposition** are **fragmentation, leaching, catabolism humification** and **mineralisation**. Humus and mineral (inorganic nutrients) are obtained by humification and mineralisation.

Mineralisation is also responsible for release of inorganic substances, both minerals ( $K^+$ ,  $Mg^{++}$ ,  $Ca^{++}$  and  $NH_4^+$ ) and non-minerals like  $H_2O$  and  $CO_2$  from dead organic matter of plant's and animal's remains.

**Q. 3** Productivity is the rate of production of biomass expressed in terms of

- (i)  $(\text{kcal m}^{-3}) \text{ yr}^{-1}$                       (ii)  $\text{g}^{-2} \text{ yr}^{-1}$   
(iii)  $\text{g}^{-1} \text{ yr}^{-1}$                               (iv)  $(\text{kcal m}^{-2}) \text{ yr}^{-1}$   
(a) (ii)                                      (b) (iii)                                      (c) (ii) and (iv)                              (d) (i) and (iii)

**Ans. (c)** Productivity is the rate of production of biomass or organic matter by any trophic level per unit area over a time period. It is expressed/measured in term of weight (e.g.,  $\text{gm/m}^2/\text{yr}^2$ ) or energy (e.g.,  $\text{kcal/m}^2/\text{yr}$ ).

**Q. 4** An inverted pyramid of biomass can be found in which ecosystem?

- (a) Forest                                      (b) Marine                                      (c) Grass land                                      (d) Tundra

**🔍 Thinking Process**

*Biomass is the amount of living organic matter in an ecosystem while its pyramid show relationship between producer and consumer in an ecosystem.*

**Ans. (b)** In case of aquatic ecosystem like pond ecosystem, marine ecosystem, pyramid of biomass is inverted because the biomass of fishes exceeds than that of phytoplanktons which make the small standing crop of aquatic ecosystems.

In aquatic ecosystem biomass of trophic level depends upon reproductive potential and longevity of its members.

**Q. 5** Which of the following is not a producer?

- (a) *Spirogyra*                                      (b) *Agaricus*                                      (c) *Volvox*                                      (d) *Nostoc*

**Ans. (b)** *Agaricus* belong to basidiomycetes fungi which is, heterotrophs (saprotrophs) class. It is popularly called as mushroom. Whereas *Spirogyra*, is a green algae and an autotrophs, i.e., producer *Nostoc* and *Volvox* are blue-green algae (cyanobacteria) and are also a producer (autotroph).

**Q. 6** Which of the following ecosystems is most productive in terms of net primary production?

- (a) Deserts                                      (b) Tropical rain forests  
(c) Oceans                                      (d) Estuaries

**Ans. (b)** In terms of net primary productivity tropical rain forest is at the top followed by coral reef, estuaries and desert and ocean. Thus option 'b' is correct while 'a', 'c' and 'd' are wrong.

**Q. 7** Pyramid of numbers is

- (a) Always upright                                      (b) Always inverted  
(c) Either upright or inverted                                      (d) Neither upright nor inverted

**🔍 Thinking Process**

*Ecological pyramids are generally prepared on the basis of 3 ecological parameters, number of individuals, organic matter or biomass and amount of energy.*

**Ans. (c)** Pyramid of number in ecosystems can be inverted or upright. In terrestrial ecosystem pyramids of number is upright. In case of successive decrease in members of trophic level like a big tree it is inverted whereas pyramid of energy is always upright.

Whereas pyramid of biomass may also be upright or inverted. In none of the case always inverted pyramid or neither any pyramid may be of obtained thus other options wrong.

**Q. 8** Approximately how much of the solar energy that falls on the leaves of a plant is converted to chemical energy by photosynthesis?

- (a) Less than 1% (b) 2-10%  
(c) 30% (d) 50%

**Ans. (b)** Sun is the ultimate source of energy in all ecosystems except deep hydrothermal ecosystem. Of the incident solar radiation (less than 50% is Photosynthetically Active Radiation (PAR)) and about 2-10% or 1-5% of solar incident energy is captured by the autotrophs and is converted to chemical energy by the process of photosynthesis.

**Q. 9** Among the following where do you think the process of decomposition would be the fastest?

- (a) Tropical rain forest (b) Antarctic  
(c) Dry arid region (d) Alpine region

**💡 Thinking Process**

*Tropical rain forest biome show well defined stratification, i.e., grouping of plants in well defined layer of trees according their heights. These layer of plant are called as **strata** or storeys. The biome may contain a minimum of five storeys, or vegetation or strata.*

**Ans. (a)** The lowest strata/storey/forest floor of the tropical rain forest receive little solar radiation and soil is rich in mineral and humus.

As the high temperature and moisture (humidity) are favourable for high microbial activity of decomposers to decompose the fallen leaves and dead organic matter, process of decomposition is fastest in this type of biome.

**Q. 10** How much of the net primary productivity of a terrestrial ecosystem is eaten and digested by herbivores?

- (a) 1% (b) 10% (c) 40% (d) 90%

**Ans. (d)** In a predator or grazing food chain predation occurs at every steps. Like herbivore are eaten up by carnivore. If they die naturally, then the energy trapped in the body of herbivore (or any trophic level) is transferred to decomposers.

Only 10% of herbivore productivity is utilised for raising productivity of next trophic level (primary carnivores), while the rest 90% is eaten and used up, in process like respiration, maintenance of body heat and other activities.

**Q. 11** During the process of ecological succession the changes that take place in communities are

- (a) orderly and sequential  
(b) random  
(c) very quick  
(d) not influenced by the physical environment

**Ans. (a)** The gradual and predictable changes in the species composition of a given area is called ecological succession. These changes are **orderly** and sequential. The entire sequences of communities that successively change in a given area are termed as sere.

The other options as random or quick change are not the features of ecological succession. Also the ecological succession is influenced by physical environment thus all the other options are wrong.

**Q. 12** Climax community is in a state of

- (a) non-equilibrium (b) equilibrium (c) disorder (d) constant change

**Ans. (b)** During ecological or biotic succession, climax community is stable, self-perpetuating and is the final biotic community. It is developed at the end of succession and is in state of perfect harmony and equilibrium with physical environment.

Climax community has maximum diversity and niche specialisation, thus all the other options are not related to climax community and are wrong.

**Q. 13** Among the following bio-geo-chemical cycles which one does not have losses due to respiration?

- (a) Phosphorus (b) Nitrogen (c) Sulphur (d) All of these

**Ans. (d)** Phosphorus, nitrogen and sulphur biogeochemical cycle does not have any losses due to the process of respiration. While cycles like carbon and oxygen are affected by the process of respiration.

**Q. 14** The sequence of communities of primary succession in water is

- (a) Phytoplankton, sedges, free-floating hydrophytes, rooted hydrophytes, grasses and trees.  
(b) Phytoplankton, free-floating hydrophytes, rooted hydrophytes, sedges, grasses and trees.  
(c) Free-floating hydrophytes, sedges, phytoplankton, rooted hydrophytes, grasses and trees.  
(d) Phytoplankton, rooted submerged hydrophytes, floating hydrophytes, reed swamp, sedges, meadow and trees.

**Ans. (d)** The sequences of communities of primary succession in hydrosere is phytoplankton (pioneer stage) → rooted submerged hydrophytes → floating hydrophyte (floating stage) → reed swamp → sedges → meadow and woodland (trees). The other options are wrong.

**Q. 15** The reservoir for the gaseous type of bio-geochemical cycle exists in

- (a) stratosphere (b) atmosphere (c) ionosphere (d) lithosphere

**🔍 Thinking Process**

*Nutrient cycles are of two types, gaseous and sedimentary.*

**Ans. (b)** There are two stores of nutrients reserve pool and cycling pool. The reservoir for gaseous type of nutrient and biogeochemical cycle (nitrogen and carbon cycle) exists in atmosphere while earth crust is the reservoir for sedimentary cycle. Whereas stratosphere ionosphere and lithosphere are the parts of atmosphere.

**Q. 16** If the carbon atoms fixed by producers already have passed through three species, the trophic level of the last species would be

- (a) scavenger (b) tertiary producer  
(c) tertiary consumer (d) secondary consumer

**Ans. (c)** Producer → I<sup>st</sup> Trophic level (Primary consumer) → II<sup>nd</sup> Trophic level (Secondary consumer) → III<sup>rd</sup> Trophic level (Tertiary consumer)

Scavengers are the detritivores which feed on the tissue of dead animals (e.g., vultures) and do not play a role in carbon fixation. Producers fix the carbon dioxide which is passed through the different trophic level.

**Q. 17** Which of the following type of ecosystem is expected in an area where evaporation exceeds precipitation, and mean annual rainfall is below 100mm

- (a) Grassland (b) Shrubby forest  
(c) Desert (d) Mangrove

**Ans. (c)** In true desert biome rainfall is less than 100mm/year, characterised by extremely hot days and cold nights. Evaporation from true desert always exceeds 7-50 times the precipitation (rainfall). Desert ecosystem of biomes are more in Northern hemisphere than Southern hemisphere.

**Whereas Grassland ecosystem** receives medium rainfall ranging from 25-75 cm/yr, but evaporation rate is not higher than precipitation rate.

**Shrubby forest** receives rainfall 90 – 150 cm/yr.

**Mangrove** forests receive annual rainfall ranging from 100 – 150 cm/yr. Thus, these options are wrong.

**Q. 18** The zone at the edge of a lake or ocean which is alternatively exposed to air and immersed in water is called

- (a) pelagic zone (b) benthic zone  
(c) lentic zone (d) littoral zone

**💡 Thinking Process**

*On the basis of light availability, an aquatic habitat can be categorised into littoral, limnetic profundal and benthic zone.*

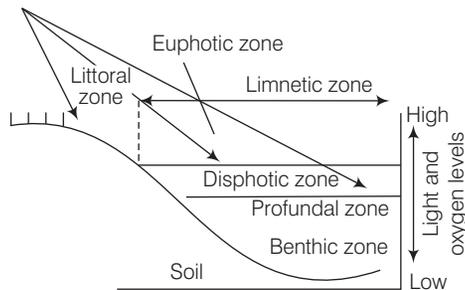
**Ans. (d)** The littoral zone is the zone at the edge of a lake or ocean or in aquatic habitat which is alternatively exposed to air, hence, light is also available and immersed in water.

This coastal zone is rich producers from surface to bottom, with a large number of brown and red algae attached at the zone. Different zones in an aquatic ecosystem.

**Pelagic zone** Any zone of water in a sea or lake that is neither close to bottom nor the shore is pelagic zone.

**Benthic zone** It is the bottom part of the water body (aphotic zone) light is not available here and it is dark. microorganisms and benthic organisms are found in this zone.

**Lentic zone** refers to standing or relatively still water in an aquatic ecosystem.



**Different zones in an aquatic ecosystem**

**Q. 19** Edaphic factor refers to

- (a) water
- (b) soil
- (c) relative humidity
- (d) altitude

**💡 Thinking Process**

*Edaphic factor is type of abiotic factors, the other are termed as climatic factors.*

**Ans. (b)** Edaphic factor refers to soil like soil texture, background, mineral, its topography and pH value etc.

Water, relative humidity and altitude another abiotic components of an ecosystem but affects the climatic conditions hence are climatic factors. The variations in these factors affects the ecosystem and these factors are also the deciding factor of the different types of ecosystem found on earth.

**Q. 20** Which of the following is an ecosystem service provided by a natural ecosystem?

- (a) Cycling of nutrients
- (b) Prevention of soil erosion
- (c) Pollutant absorption and reduction of the threat of global warming
- (d) All of the above

**Ans. (d)** A natural ecosystem maintain its biotic and abiotic factors naturally. The products of ecosystem processes are called the ecosystem services. A healthy ecosystem provides a wide range of economic, environmental and aesthetic goods and services.

*The various ecosystem services provided by a natural ecosystem includes*

- (i) Purify air and water
- (ii) Migration of droughts and floods
- (iii) Nutrient cycling
- (iv) Generation of fertile soil
- (v) Maintenance of biodiversity
- (vi) Provide storage site for carbon
- (vii) Pollinate crops
- (viii) Also provides aesthetic, cultural and spiritual values

Thus, all the above options are correct.

## Very Short Answer Type Questions

**Q. 1** Name an organism found as secondary carnivore in an aquatic ecosystem.

**Ans.** *In an aquatic ecosystem, food chain can be drawn as follows*

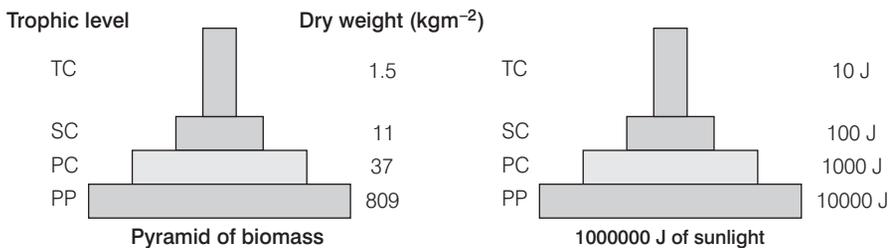
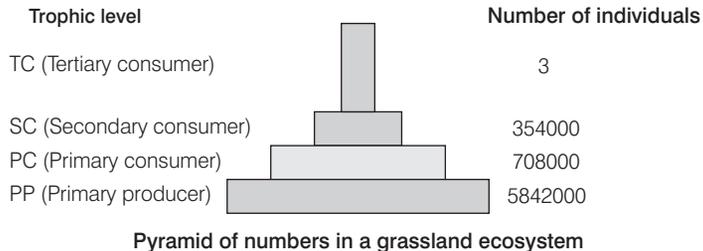
Producer (Phytoplankton) → Primary consumer (Zooplankton) → Secondary consumer (small fish and water beetle) (1st to carnivore) → Tertiary consumer (1Ind carnivore like large fish, water birds like fowl and duck).

So, the large fish and water birds like ducks and water fowls which are the tertiary consumers in an aquatic ecosystem occupy a position of secondary carnivore.

**Q. 2** What does the base tier of the ecological pyramid represent?

**Ans.** The base tier of the ecological pyramids represent the producers or first trophic level in case of three ecological pyramids

- (i) Pyramid of number
- (ii) Pyramid of biomass
- (iii) Pyramid of energy



**Q. 3** Under what conditions would a particular stage in the process of succession revert back to an earlier stage?

**Ans.** Natural disturbances like fire, flood or any other natural disaster and anthropogen activities can revert back to an earlier stage of succession.

**Q. 4** Arrange the following as observed in vertical stratification of a forest; Grass, Shrubby plants, Teak, *Amaranths*.

**Ans.** Vertical stratification (dispersion) of species in a forest ecosystem is arranged as grass (floor of forest) → *Amaranthus* → Shrubby plants → Teak (tree).

**Q. 5** Name an omnivore which occurs in both grazing food chain and the decomposer food chain.

**Ans.** Cockroaches and crow are two omnivore, that are present in both grazing or predator and detritus food chain.

**Q. 6** Justify the pitcher plant as a producer.

**Ans.** Pitcher plant (*Nepenthes*) is an insectivores plant, which is chlorophyllous and capable of trapping solar radiations for chemical energy for photosynthesis. It is insectivorous plant which are produced in the soil lacking nitrogen thus to make up their nitrogen deficiency they trap insects.

**Q. 7** Name any two organisms which can occupy more than one trophic level in an ecosystem.

**Ans.** Human being (man) and birds (sparrow) can be frequently seen in more than one trophic level, in an ecosystem.

**Q. 8** In the North East region of India, during the process of jhum cultivation, forests are cleared by burning and left for regrowth after a year of cultivation. How would you explain the regrowth of forest in ecological term?

**Ans.** Forests that are cleared by burning and left for regrowth will show secondary succession. Since, soil is already present, the buried seeds are to germinate. Due to wind dispersal and some other natural forces, new seeds will be brought into the area and new species will colonise the forest again.

**Q. 9** Climax stage is achieved quickly in secondary succession as compared to primary succession. Why?

**Ans.** The rate of ecological succession is quicker in secondary succession as compared to primary succession as the soil (substratum) is already available for further succession. While in primary succession, the succession starts from bare rocks. Which take time for first colonisation by plants as there is no nutrient holding mechanisms.

**Q. 10** Among bryophytes, lichens and fern which one is a pioneer species in a xeric succession?

**Ans.** The species that invade a bare area are called pioneer species. In a xeric succession, the pioneer species are usually lichens then bryophytes which are succeeded by ferns and some other bigger plants.

Lichen produces lichen acid and carbonic acid which corrodes rock surface and release minerals required for growth. The corroded rock accumulate soil particle by wind and provides substrate for Bryophytes and ferns.

**Q. 11** What is the ultimate source of energy for the ecosystems?

**Ans.** Solar radiation is the ultimate source of energy for the ecosystem except deep hydrothermal ecosystem.

**Q. 12** Is the common edible mushroom an autotroph or a heterotroph?

**Ans.** Common edible mushroom (*Agaricus*) is **achlorophyllous** (does not possess chlorophyll) and is a heterotroph.

**Q. 13** Why are oceans least productive?

**Ans.** *Oceans are least productive because*

- (i) There is insufficient radiation as sunlight decreases with the increasing depth of the ocean.
- (ii) Oceans are nitrogen deficient which is an important nutrient for plants.
- (iii) Conditions of high salinity which is not favourable for all plants.
- (iv) there is no substratum to support plants.

**Q. 14** Why is the rate of assimilation of energy at the herbivore level called secondary productivity?

**Ans.** The rate of assimilation of energy at herbivore level is called secondary productivity because the biomass available to the organisms of next trophic level (consumer) for further consumption is a resultant of the primary productivity which is formed by autotrophs (plants).

**Q. 15** Why are nutrient cycles in nature called biogeochemical cycles?

**Ans.** Nutrient cycles are called biogeochemical cycles because ions/molecules of a nutrient are transferred from the environment (rocks, air and water) to organisms (life) and then brought back to the environment in a cyclic pathway. The literal meaning of biogeochemical is bioliving organism and georocks, air and water.

**Q. 16** Give any two examples of xerarch succession.

**Ans.** Xerarch succession of ecological communities originates in extremely dry conditions such as sand deserts and rock deserts (as there is no water and the substratum does not absorb rain water).

**Q. 17** Define self sustainability

**Ans.** Self sustainability is the maintenance of an ecosystem itself or naturally. *i.e.*, A system that maintain itself by its own independent efforts is a self-sustainable ecosystem.

**Q. 18** Given below is a figure of an ecosystem. Answer the following questions?



(i) What type of ecosystem is shown in the figure?

(ii) Name any plant that is characteristic of such ecosystem.

**Ans. (i)** It is a tropical deciduous forest ecosystem.

**(ii)** In India this type of forest ecosystem is characterised by *Tectona*, *Dipterocarpus* Jamun, Amla, Palas, mahua and Semul plants.

**Q. 19** What is common to earthworm, mushroom, soil mites and dung beetle in an ecosystem.

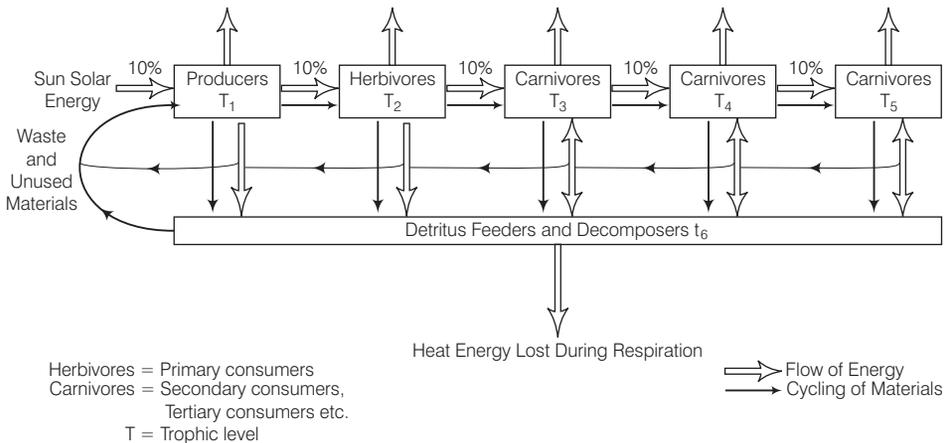
**Ans.** They all are designated as primary consumer in a detritus food chain and are termed as detritivores.

## Short Answer Type Questions

**Q. 1** Organisms at a higher trophic level have less energy available. Comment.

**Ans.** Energy flow in the ecosystem follows the 10% energy flow law, proposed by Lindman. According to this law only 10% of the energy available at each trophic level, gets transferred to the next trophic level, the rest is lost in the environment as heat.

As we move to higher trophic levels, the energy available to organisms keeps on decreasing. Thus, the top carnivore gains the least energy in a food chain. Heat energy is lost during Respiration.



**10% energy flow law showing transfer of energy from one trophic level to others**

**Q. 2** The number of trophic levels in an ecosystem are limited. Comment.

**Ans.** The number of trophic level in an ecosystem are each limited and are not more than 4-5. because the amount of energy flow decreases with successive trophic level as only 10% of energy is transferred from one trophic level to the next successive level.

So rest of 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 decreases 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.

e.g., Sun (30,000J)  $\xrightarrow{1\% \text{ absorbed}}$  Plants (300J)  $\xrightarrow{10\% \text{ transferred}}$  Deer (30J)  $\xrightarrow{10\% \text{ transferred}}$  Tiger (3J)

**Q. 3** Is an aquarium a complete ecosystem?

**Ans.** Aquarium is a man made ecosystem (artificial). If an ecosystem possess all physical and biological component, then it is said to be complete. Since aquarium has biotic (plants and fishes) and abiotic component (air, water) required for survival of fishes, so it is an complete ecosystem.

**Q. 4** What could be the reason for the faster rate of decomposition in the tropics?

**Ans.** Tropics are characterised by high temperature and moisture and soil is rich in humus and minerals. As the decomposition rate is regulated by climatic factors, thus optimum temperature and humidity enhance the activity of decomposers while the dead remain is also available in rich amount, which supports the faster rate of decomposition in the tropics.

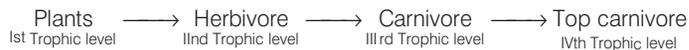
**Q. 5** Human activities interfere with carbon cycle. List any two such activities.

**Ans.** Two human activities that interfere with carbon cycles are

- (i) Rapid deforestation and
- (ii) Massive burning of fossil fuel for energy and transport.

**Q. 6** Flow of energy through various trophic levels in an ecosystem is unidirectional and non-cyclic. Explain.

**Ans.** Flow of energy in an ecosystem is always unidirectional, i.e., energy flow in one way and is noncyclic, like



As the energy content is decreasing from 1st trophic level to next trophic level and so on, thus the energy cannot pass in reverse direction.

**Q. 7** 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 the microbes fulfill their energy requirements?

**Ans.** On the basis of nutrition, organisms are classified as autotrophs and heterotrophs. Autotrophs are further categorised into photoautotrophs and chemoautotrophs, while heterotrophs may be parasite predator or a saprophyte etc.

Microbes are saprotrophs and derive nourishment or energy from dead organic matter or remain of plants and animals and this digestion is extracellular.

**Q. 8** Poaching of tiger is a burning issue in today's world. What implication would this activity have on the functioning of the ecosystem of which the tigers are an integral part?

**Ans.** Tiger represents an important part of the food web and helps in maintaining the ecological stability. As a carnivore, it keeps a check on the unlimited growth of herbivores and also removes sick or old animals from the population. It also acts as an indicator of the forest's health.

Saving the tiger means we save the forest. Since, tiger (top carnivore of the food chain) cannot live in places where trees or herbivores, that it hunts, have vanished and in turn secure food and water for all.

**Q. 9** In relation to energy transfer in ecosystem, explain the statement “10kg of deer’s meat is equivalent to 1 kg of lion’s flesh”.

**Ans.** In an ecosystem, flow (transfer) of energy is unidirectional. As energy trapped in 1st trophic level, only 10% of energy is transferred to next trophic level.



**Q. 10** Primary productivity varies from ecosystem to ecosystem. Explain?

**Ans.** Primary productivity is the rate at which primary producers (plants) capture and store solar radiation to form chemical energy. Primary production depends upon producer (green plant) which are variable in different ecosystem.

So, primary productivity varies from ecosystem to ecosystem.

**Q. 11** Sometimes due to biotic/abiotic factor the climax remain in a particular seral stage (pre climax) without reaching climax. Do you agree with this statement. If yes give a suitable example.

**Ans.** Sometimes climax remains in a particular seral stage without reaching to the climax because during ecological succession any change in abiotic and biotic component may affect the particular seral stage, leading to preclimax stage before the climax is achieved.

This type of condition occurs presence of seeds and other propagules. This secondarily based area may be invaded by moss or exotic weeds thus exhibiting succession seriously and the climax community is never regenerated. in the case of natural calamities like-fire landslide, floods, change in soil texture.

**Q. 12** What is an incomplete ecosystem? Explain with the help of suitable example.

**Ans.** An ecosystem comprises with biotic and a biotic component. A biotic component include light, air, water, temperature, humidity etc, while biotic factor comprises all living organism. Absence or limited availability of any component (either abiotic or biotic) makes an ecosystem incomplete like the profundal and benthic zone in an aquatic ecosystem.

**Q. 13** What are the shortcomings of ecological pyramids in the study of ecosystem?

**Ans.** Ecological pyramids are the graphical representation of ecological parameter. These are characterised by pyramid of number, pyramid of mass and pyramid of energy in an ecosystems. Assumption of a simple food chain is the major shortcoming of ecological pyramids.

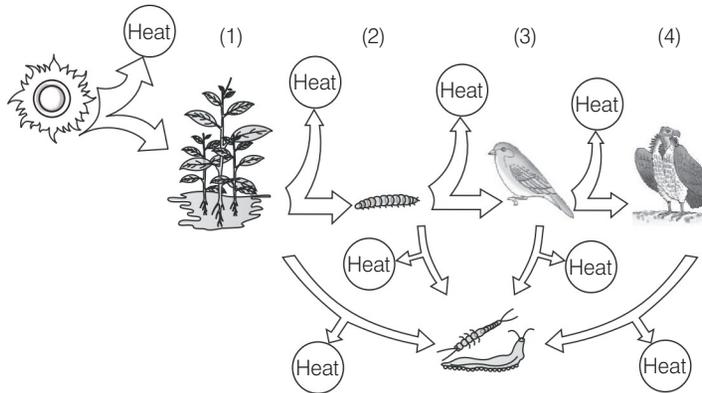
If we do not accomode food web, a clear position of or trophic levels of an organisms cannot be given. Saprophytic organism are not given any place in the ecological pyramid, though they are the important component in an ecosystem.

**Q. 14** How do you distinguish between humification and mineralisation?

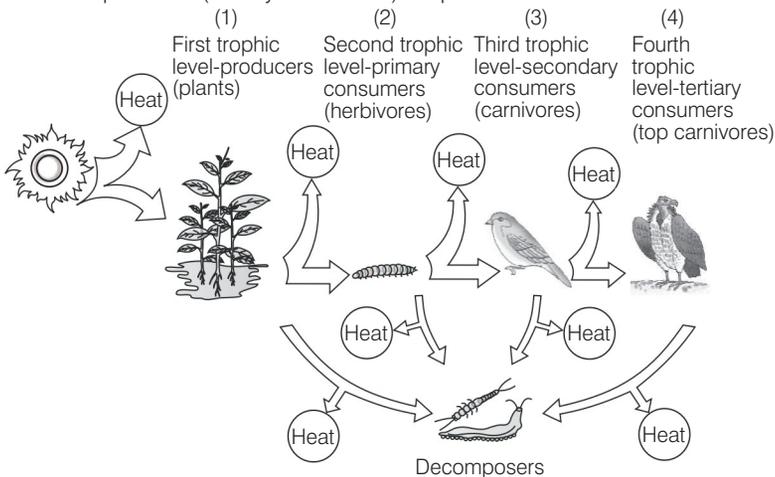
**Ans. Humification** is the process of decomposition of soil that leads to accumulation of a dark-coloured amorphous substance called humus. Humus are highly resistant to microbial action and under goes dicomposition at a very slow rate.

**Mineralisation** is the process by which the humus is further degraded by microbes and inorganic nutrients or minerals are released back into the substratum.

**Q. 15** Fill in the trophic levels (1, 2, 3 and 4) in the boxes provided in the figure.



- Ans.** (i) First trophic level (producers) - Plants  
 (ii) Second trophic level (primary consumers) - Herbivores  
 (iii) Third trophic level (secondary consumers) - Carnivores  
 (iv) Fourth trophic level (tertiary consumers) - Top carnivores



**Energy flow through different trophic levels**

**Q. 16** The rate of decomposition of detritus is affected by the abiotic factors like availability of oxygen, pH of the soil substratum, temperature etc. Discuss.

**Ans.** Decomposition of dead remain or matter of animal and plant is carried out by microorganisms like bacteria, fungi etc. The growth rate of these decomposers is affected by abiotic factors like temperature, humidity, pH of soil and light etc.

The soil pH affect the composition of acidophilic and basophilic microorganisms. In absence or presence of oxygen aerobic and anaerobic processes occurs.

In presence of oxygen, complete degradation of substance occurred while in absence of oxygen, there will be an incomplete degradation. Similarly, at high temperature microbes can not grow optimally but high or low temperature favours the growth of stress tolerant microorganisms.

## Long Answer Type Questions

**Q. 1** A farmer harvests his crop and expresses his harvest in three different ways.

- (a) I have harvested 10 quintals of wheat.
- (b) I have harvested 10 quintals of wheat today in one acre of land.
- (c) I have harvested 10 quintals of wheat in one acre of land, 6 months after sowing.

Do the above statements mean one and the same thing. If your answer is 'yes', give reasons. And if your answer is 'no' explain the meaning of each expression.

**Ans. (a)** Farmer's expression for his crop harvestation (a) he has harvested 10 quintal of wheat, (b); He has harvested 10 quintals of wheat in one acre of land (c), six, months after sowing mean one and the same thing. Because crop an artificial ecosystem can be prepared with inclusion of biotic and abiotic component in a given area.

Here abiotic components like water, is given by the farmer, while climatic factor like light, humidity, air is supplied naturally. The living component is wheat plant, which are obtained on harvestation by farmer.

**Q. 2** Justify the following statement in terms of ecosystem dynamics. "Nature tends to increase the gross primary productivity, while man tends to increase the net primary productivity".

**Ans.** In term of ecosystem dynamics, flow of energy takes place from one trophic level to the next trophic level and occurred in unidirectional way. About 50% of solar energy incident over earth is present in Photosynthetic Active Radiation (PAR) and only 2-10% of this PAR is utilised by green plants to form chemical energy (Gross Primary Productivity) (GPP).

Out of 90% of gross primary productivity is lost maximum during respiration and other vital activities. GPP utilised by plants in respiration minus respiration losses is the net primary productivity and is available to the organism of next trophic level (herbivore and decomposers) for consumption.

**Gross primary productivity** of an ecosystem is the rate of production of organic matter during photosynthesis.

So nature tend to increase gross primary productivity through supporting the large number of plant (producers) in an ecosystem.

**Net primary productivity** is the available biomass for the consumption to heterotrophs (human and animals) man tries to increase net primary productivity by cultivating food and other crops which the depend on to fulfill their needs.

Formula to generate NPP is

$$NPP \iff GPP - R$$

**Q. 3** Which of the following ecosystems will be more productive in terms of primary productivity? Justify your answer. A young forest, a natural old forest, a shallow polluted lake, alpine meadow.

**Ans.** Primary Productivity can be defined as the rate at which primary producers (Green plants) traps and store solar radiation in form of biomass. This is measured in term of weight ( $g^{-2}$ ) and in term of energy ( $Kcal\ m^{-2}$ ) per year in given time.

So, primary productivity varies from ecosystem to ecosystem and the ecosystem which possess more producer will be more productive in term of primary productivity. So young forest grow quicker than older, mature forest and are more productive in terms of productivity. The shallow polluted lake and alpins meadow will be less productive because of less number of producers and high amount of dead matter.

**Q. 4** What are the three types of ecological pyramids. What information is conveyed by each pyramid with regard to structure, function and energy in the ecosystem.

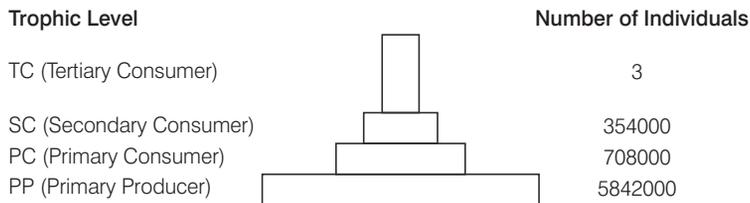
**Ans. Ecological Pyramids** An ecological pyramid is a graphical representation of an ecological parameter as number of individual present in various trophic level of food chain.

**Properties of ecological pyramid**

- (i) The trophic structure of an ecosystem is represented in the form of ecological pyramids.
- (ii) The base of each pyramid represents the producers or the first trophic level, while the apex represents tertiary or top level consumer.

*The three types of ecological pyramids are*

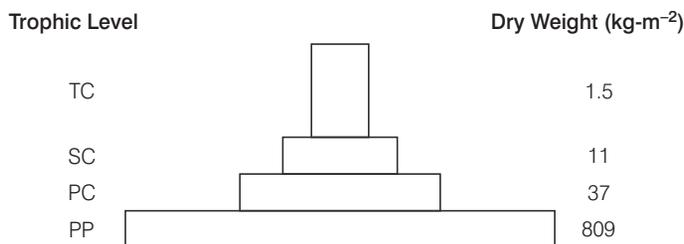
- (a) **Pyramid of number** shows relationship between producers and consumers in an ecosystem in terms of numbers. It may be inverted or upright pyramid.



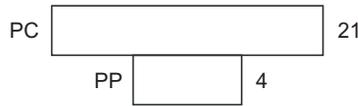
**Pyramid of numbers in a grassland ecosystem**

- (b) **Pyramid of biomass** shows relationship between producers and consumers in an ecosystem terms of biomass. It can be

- (a) Upright, e.g., in case of grass land ecosystem.
- (b) Inverted, e.g., in case of pond ecosystem.



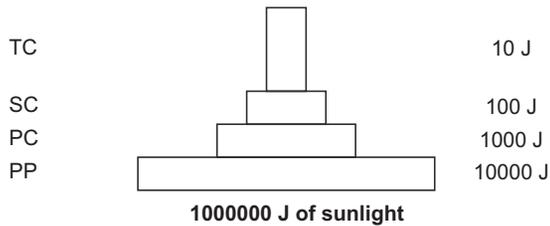
**Upright pyramid of biomass shows a sharp decrease in biomass at higher trophic levels**



**Inverted pyramid of biomass.**

Small standing crop of phytoplankton supports large standing crop of zooplankton

- (c) **Pyramid of energy** is the relationship between producers and consumers in an ecosystem in terms of flow of energy. It is always upright because energy is always lost as heat at each step.



An ideal pyramid of energy. Observe that primary producers convert only 1% of the energy of the sunlight available to them into Net Primary Productivity.

**Q. 5** Write a short note on pyramid of numbers and pyramid of biomass.

**Ans.** Ecological pyramids are graphical representations of the relationship between organisms of different trophic levels that can be expressed in terms of number, biomass or energy.

In most ecosystems, the pyramid of number is upright, *i.e.*, producers are more in number than the herbivores and herbivores are more in number than the carnivores. But, the pyramid of number may be inverted as in a forest ecosystem, where the number of insects (primary consumers) are greater than the number of trees (producers).

The pyramid of biomass is upright, generally, as the biomass of producers is more than biomass of herbivores and that of herbivores is more than biomass of carnivores. But, it is inverted in ecosystems like sea ecosystem, where the biomass of fishes (primary consumers) exceeds than phytoplankton (producers).

**Q. 6** Given below is a list of autotrophs and heterotrophs. With your knowledge about food chain, establish various linkages between the organisms on the principle of 'eating and being eaten'. What is this inter-linkage established known as?

Algae, hydrilla, grasshopper, rat, squirrel, crow, maize plant, deer, rabbit, lizard, wolf, snake, peacock, phytoplankton, crustaceans, whale, tiger, lion, sparrow, duck, crane, cockroach, spider, toad, fish, leopard, elephant, goat, *Nymphaea*, *Spirogyra*.

**Ans. Food Chain and Food Web** A straight line sequence of 'who eats whom' or eating and being eaten in an ecosystem is called a food chain. A network of cross connecting food chains involving producers, consumers and decomposers are termed as a food web.

Lion, Tiger — **Top carnivore** (Top trophic level)

Spider, cockroach, lizard, wolf, snake, toad, fish, crane — **Secondary Consumer** (IIIrd trophic level).

Crustaceans, grasshopper, deer, mouse, squirrel, rabbit, elephant, goat — **Primary Consumer** (IInd trophic level).

Phytoplankton, algae, *Hydrilla*, maize plant, *Nymphaea*, *Spirogyra* — **Producers** (Ist trophic level).

**Q. 7** "The energy flow in the ecosystem follows the second law of thermodynamics." Explain.

**Ans.** According to second law of thermodynamics every activity involving energy transformation (According to first law - energy can be transferred and transformed) is accompanied by dissipation of energy as heat and only a part of it is used in building up tissues in an organisms.

This trapped energy as biomass is transferred to next trophic level. According to Lindman law only 10% of the stored energy is passed from one trophic level to successive trophic level.

**Q. 8** 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)** Removal of all producer reduce primary production in the ecosystem. Hence, no biomass will be available to the successive/higher trophic level or heterotrophic organisms.

**(b)** Elimination of all organisms of herbivore level results into an increase in primary productivity and biomass of producer and carnivorous animal will not survive due to inavailability of food herbivores.

**(c)** Removal of top carnivores also disturb the ecosystem as it will result in huge increase in number of herbivores which will finish plants (producers) creating desertification.

**Q. 9** Give two examples of artificial or man made ecosystems. List the salient features by which they differ from natural ecosystems.

**Ans.** Aquarium and farm house, are artificial or man made ecosystem. In artificial ecosystem biotic and abiotic component are maintained artificially like cleaning, feeding and supply of oxygen to fishes in aquarium and irrigation in crop or farm house.

While abiotic and biotic component of natural ecosystem are maintained naturally like nutrient cycle, self sustainability, prevention of soil erosion, pollutant absorption and reduction of threat to global warming (ecological services), etc.

**Q. 10** The biodiversity increases when one moves from the pioneer to the climax stage. What could be the explanation?

**Ans.** During ecological succession biodiversity increase or changes from pioneer to climax stages.

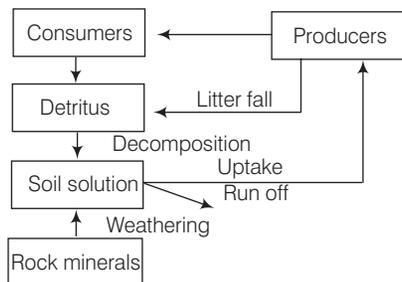
*Following are the effects of ecological succession*

(a) It leads to changes in vegetation that affects food and shelter for various types of animals.

(b) As succession proceeds, the numbers and types of plants, animals and decomposers also change.



The waste products and the dead organisms are decomposed by phosphate-solubilising bacteria thus releasing phosphorus.



**A simplified model of phosphorus cycling in a terrestrial ecosystem**

**Q. 12** What will be the P/R ratio of a climax community and a pioneer community? What explanation could you offer for the changes seen in P/R ratio of a pioneer community and the climax community?

**Ans. Production/Respiration ratio (P/R) ratio** It shows the relationship between gross production and total community respiration where  $P/R=1$  a steady state community result. This result may be instantaneously daily one or over a longer period. If P/R is persistantly greater or less than/then organic matter either accumulates or is depleted respectively.

<b>Pioneer Community</b>	<b>Climax Community</b>
The species that invade a base area are called pioneer species on base rocks these are generally lichens.	It is a final biotic community that develops in an area.
In aquatic ecosystem there are phytoplanktons.	It occurs over an area previously occupied by several communities.
In pioneer community the P/R ratio will be more than one.	In climax community the P/R ratio will be 1.