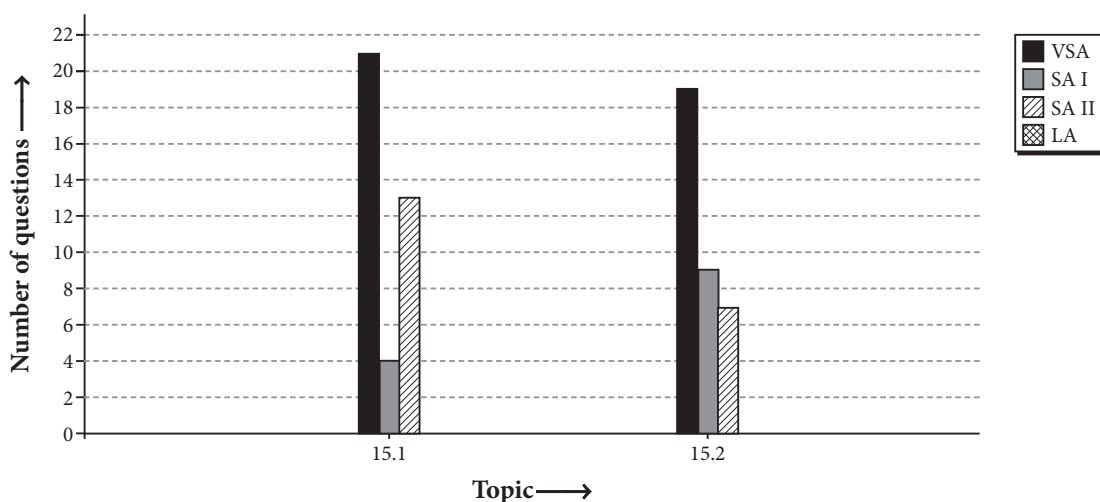


Our Environment

15.1 Ecosystem - What are Its Components?

15.2 How do Our Activities Affect the Environment?

Topicwise Analysis of Last 10 Years' CBSE Board Questions (2020-2011)



▶▶ Maximum weightage is of *Ecosystem - What are Its Components?*

▶▶ Maximum VSA and SA II type questions were asked from *Ecosystem - What are Its Components?*

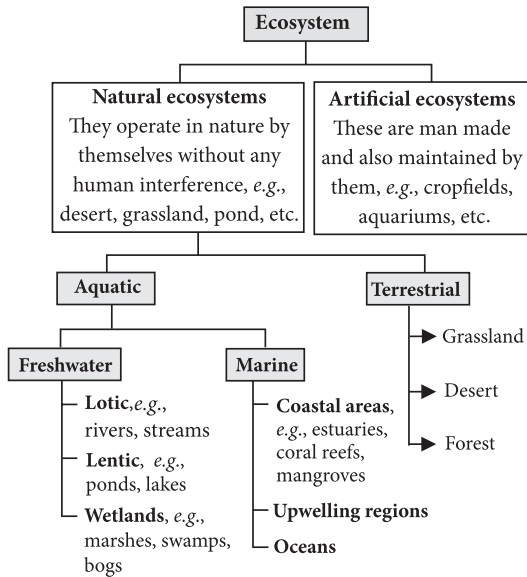
▶▶ Maximum SA I type questions were asked from *How do Our Activities Affect the Environment?*

QUICK RECAP

▶▶ **Environment** : It is the sum total of external factors and conditions that affect organisms without becoming an integral part of them. It includes everything surrounding the organism, *i.e.*, both non-living (abiotic) and living (biotic) components. The **abiotic components** are the physical factors such as climatic factors (*e.g.*, temperature, light, wind, humidity, precipitation, water, etc.) and

edaphic factors (*e.g.*, soil texture, substratum, topography, background, minerals, pH, etc.). The **biotic components**, on the other hand, include all kinds of living organisms.

▶▶ **Ecosystem and its components**: An ecosystem is self-supporting unit of living organisms (plants, animals and decomposers), and their non-living environment (soil, air and water).



Flow chart : Types of ecosystem

► **Abiotic components of ecosystem** : These include inorganic substances, organic compounds and climatic factors.

- **Inorganic substances**: These substances, e.g., carbon, nitrogen, oxygen, calcium, phosphorus, etc., and their compounds (water, carbon dioxide, etc.) constitute the main abiotic components. These occur either in the form of compounds dissolved in water, in the soil or in free state in the air.
- **Organic compounds**: These include carbohydrates, proteins, lipids, nucleic acids, etc. These are present in living organisms and dead organic matter. The dead organic matter is broken down by the action of decomposers (e.g., bacteria, fungi on decayed matter) into inorganic substances for their recycling.
- **Climatic factors**: These include light, temperature, humidity, wind, rainfall, water, etc., and also **edaphic factors** (e.g., soil and substrate, topography, mineral, pH, etc.)

► **Biotic components of ecosystem** : The biotic community (or living community) of an ecosystem includes three types of organisms:

- **Producers (or autotrophs)** are organisms which synthesise their own

food. All the green plants and some blue-green algae are producers.

- **Consumers (or heterotrophs)** are organisms which are dependent on others for food directly or indirectly. All the animals are consumers. Consumers can be further divided into three groups: herbivores, carnivores and omnivores. Those animals which eat only plants are called **herbivores**. Herbivores are **primary consumers**. E.g., cow, buffalo, goat, sheep, horse, deer, camel, etc.
- Those animals which eat only the flesh of other animals are called **carnivores**. The small carnivores which feed on herbivores are called **secondary consumers**. The large carnivores which feed upon the small carnivores are called **tertiary consumers**. E.g., lion, tiger, vulture, etc.
- Those animals which eat both, plants and animals, are called **omnivores**. E.g., dog, crow, sparrow, bear, mynah and ant.
- **Decomposers (or saprotrophs)** are those which consume the dead remains of other organisms. Certain bacteria and fungi are decomposers and they replenish the soil and increase its fertility.

► **Food chains** : The sequential interlinking of organisms involving transfer of food energy from the producers, through a series of organisms with repeated eating and being eaten is called the **food chain**. In ecosystem, different food chains may have two, three, four or maximum five trophic levels. A food chain may end at the:

- herbivore (primary consumer) level
- primary carnivore (secondary consumer) level
- secondary carnivore (tertiary consumer) level or
- tertiary carnivore (quaternary consumer) level.

► The distinct sequential steps in the food chain where transfer of energy occurs are referred to as different trophic levels. For example, green plants (producers) form the **first trophic level**. The plant eaters (herbivores), belong to the **second trophic level** and the

flesh eaters (carnivores), represent **the third trophic level**.

- ▶ A food chain is always straight and proceeds in a progressive straight line. In a food chain, there is unidirectional flow of energy from sun to producers and subsequently to series of consumers.
- ▶ The quantum of available energy in a food chain successively decreases at each trophic level as a result of energy which is wasted as heat in metabolic reactions such as respiration, excretion, etc.

▶ **Food web** : In nature, food chains do not operate in isolation. It is so because in natural environment, each organism is generally eaten by two or more kinds of organisms which, in turn, are eaten by several other organisms. Thus, instead of straight line food chain, the relationship between organisms forms a sort of interlocking pattern due to alternate pathways, called a **food web**.

- ▶ Food web is a network of food chains which become interlinked at various trophic levels forming a number of feeding connections amongst various organisms in a biotic community.
- ▶ Food webs provide stability to ecosystem, keep a check on the population of species of animals and plants having high reproductive rates and help in development of ecosystem.

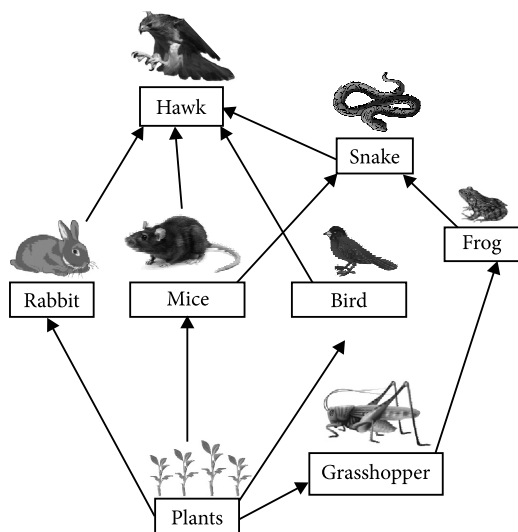


Fig.: Food web

▶ **Ecological pyramids** : An ecological pyramid is a graphic representation of an ecological parameter (numbers or biomass or amount of accumulated energy) at different trophic levels in a food chain in an ecosystem. Ecological pyramids can be of three types on the basis of ecological parameters.

- ▶ **Pyramid of numbers** : It is the graphic representation depicting the arrangement of number of individuals of different trophic levels in a food chain of an ecosystem. The shape of pyramid of numbers may be **upright** (e.g., in pond ecosystem and in grassland ecosystem) or **inverted** (e.g., in parasitic food chain) depending upon whether the number of organisms gradually decreases or increases at successive trophic levels from producers onwards to top consumers.

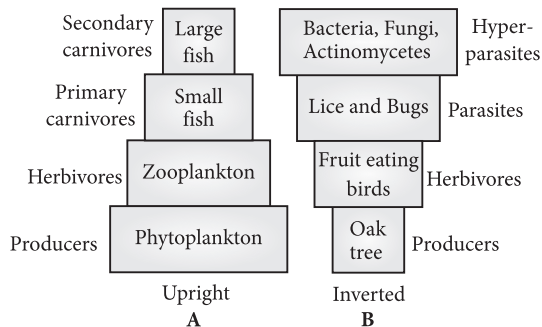


Fig.: Pyramid of numbers (A) in pond ecosystem; (B) in parasitic food chain

- ▶ **Pyramid of biomass**: A pyramid of biomass is the graphic representation of biomass (total amount of living organic matter in an ecosystem) per unit area at different trophic levels. Pyramid of biomass may also be **upright** (e.g., in a grassland ecosystem) or **inverted** (e.g., in a pond ecosystem) depending upon whether the biomass of organisms gradually decreases or increases at successive trophic levels from producers onwards to top carnivores.

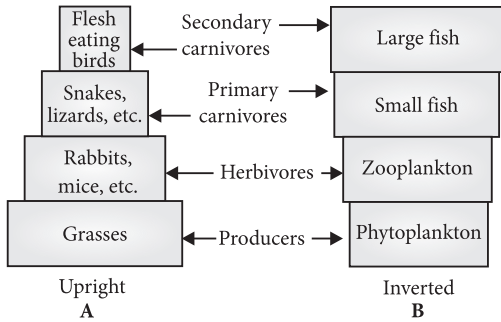


Fig.: Pyramid of biomass (A) in a grassland ecosystem; (B) in a pond ecosystem

- ▶ **Pyramid of energy:** A pyramid of energy is a graphic representation of amount of energy per unit area at different trophic levels of a food chain in an ecosystem. The pyramid of energy is **always upright** because the available energy is the highest at producer level. According to second law of thermodynamics, there is gradual decrease in available energy at successive trophic levels.

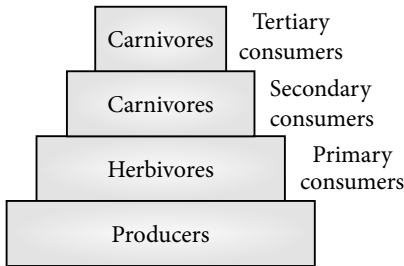


Fig.: Pyramid of energy

- ▶ **Flow of energy in an ecosystem :** In an ecosystem, energy comes from the sunlight which is further converted from one form to another. Energy gets continuously transferred from one trophic level to the other by repeated food consumption in a food chain. Loss of energy occurs as heat at each step of energy transfer (trophic level) in the environment. At each trophic level, organisms utilise energy in respiration, reproduction, growth, etc.)
- ▶ **Ten percent law** states that during transfer of energy from one trophic level to the next level, only about 10% energy is available to the higher trophic level and the remaining 90% is lost in respiration and heat. This limits

the trophic levels to 3 or maximum of 4 or 5 in food chain.

- ▶ **Types of waste :** In our daily lives, we generate a lot of useless materials and discard them. The useless left over or discarded materials are termed as **wastes**. The waste materials can be **gaseous** (e.g., automobile exhausts, smoke from chimneys of industries and house), **liquid** (e.g., effluents from industries, sewage water) or **solid** (e.g., kitchen waste, cow dung, human excreta, trash and rubbish, etc.)
- ▶ **Solid wastes :** These accumulate in the environment due to human activities and are the main sources of soil pollution. They can be categorised into two types: biodegradable and non-biodegradable wastes.
 - **Biodegradable wastes** can be easily degraded by natural means *i.e.*, by the action of microorganisms such as bacteria and fungi, complex organic matters can be converted into simpler, harmless substances in due course of time. However, biodegradable wastes can also act as pollutants when their quantity becomes large *i.e.*, they start accumulating as they are not broken down into simpler substances by the action of microorganisms at the pace at which they are generated. These affect the human life in various ways:
 - Flies breed on heaps of solid wastes containing biodegradable substances. These carry the germs and spread diseases such as diarrhoea, typhoid, tuberculosis, cholera, conjunctivitis, etc.
 - These biodegradable wastes may also block the drains, creating pools of water which become the breeding sites of mosquitoes. The latter are the carriers of diseases like malaria, chikungunya, etc.
 - **Non-biodegradable wastes** cannot be degraded by natural means, *i.e.*, by the action of microorganisms, into simpler, harmless substances in due course of time. Some harmful effects of non-biodegradable wastes are :

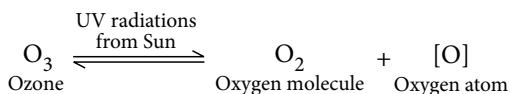
- (i) Some of the non-biodegradable substances, such as pesticides (e.g., D.D.T.), industrial chemicals, heavy metals and radioactive substances are very harmful. This is so because these enter the food chains and their concentration goes on increasing from one trophic level to the next. This phenomenon is known as **biomagnification** which results in many harmful effects in human beings and other animals.
- (ii) Excessive use of fertilisers and pesticides, and dumping of industrial chemical wastes affect the soil fertility and subsequently reduces the crop yield. The soil, thus, may become acidic or alkaline.
- **Modes of solid waste disposal :**
- (i) In urban areas, majority of the solid wastes are buried in low lying areas to level the uneven surface of land. This method of waste disposal is commonly called **land filling**.
- (ii) Number of solid wastes (e.g., paper, plastics, metals, etc.) can be recycled by sending them to respective recycling units. This is known as **recycling of wastes**.
- (iii) **Preparation of compost :** Household waste should be segregated and the biodegradable wastes such as fruit peel and vegetables, left-over food, fallen dead leaves of plants, etc., should be converted to **compost** and used as manure.
- (iv) **Incineration** is the process of burning of substances at high temperature (usually more than 1000°C) and ultimately converting them into ashes. It is carried out in an incinerator. Household wastes, chemical and hospital wastes are generally disposed off by incineration process.
- (v) Biodegradable wastes can be used in biogas plants to generate biogas (55% methane + 45% CO₂) and manure.

▶▶ **Greenhouse effect and global warming :** The atmospheric cover around the Earth acts as glass wall of a greenhouse. The clouds, dust particles, gases and water vapours, present in the atmosphere, filter and scatter large

quantity of solar radiation falling on Earth. Only about 48% of solar radiation actually reaches the surface of Earth and only 1% of it is absorbed by plants. Most of the remaining radiation is used up in warming the surface of Earth.

- ▶ The solar radiation absorbed by Earth's surface is emitted back as infrared radiations into the atmosphere. Part of infrared radiations pass through the atmosphere.
 - ▶ Most of the remaining infrared radiations are absorbed by greenhouse gases and re-emitted in all directions. It is called **greenhouse flux**. It is due to greenhouse flux that mean annual temperature of Earth is about 15°C.
 - ▶ The gases in the atmosphere, responsible for keeping Earth's surface warm, are carbon dioxide (CO₂), methane (CH₄), chlorofluorocarbons (CFCs) and nitrous oxide (N₂O). These gases are called **green - house gases**.
 - ▶ The phenomenon of rise of average atmospheric temperature due to continuous increase in concentration of greenhouse gases in the atmosphere is called **global warming**. The reasons for global warming are :
 - Man is adding large amounts of **carbon dioxide** (CO₂) to the atmosphere each year by burning fossil fuels in homes, industries and automobiles, biomass burning associated with agricultural practices, etc.
 - **Methane** is being added to the atmosphere by marshes, paddy fields, cattle sheds and biogas plants.
 - **Chlorofluorocarbons** (CFCs) are emitted into the atmosphere by refrigerators and air conditioners. Consequently, there is slow rise in the atmospheric temperature.
- ▶▶ **Ozone depletion :** Ozone is a triatomic molecule made up of three atoms of oxygen (O₃). Very little quantity of ozone is present in the lower part of atmosphere, called **troposphere**. However, good amount of ozone is present in the upper part of atmosphere, called **stratosphere**.

- ▶ Though ozone is present throughout the stratosphere, its concentration is maximum 23-25 km above equator and 11-18 km above poles. This rich zone of ozone in the stratosphere is called **ozone layer** or ozone shield because this region intercepts high energy ultraviolet (UV) radiations to reach the Earth's surface.
- ▶ In the stratosphere, ozone is being photodissociated and generated simultaneously by the absorption of harmful ultraviolet (UV) radiations coming from the Sun.



- ▶ The two reactions (photodissociation of O_3 and its generation) are in equilibrium thereby maintaining steady concentration of ozone in the stratosphere (18-50 km above sea level).
- ▶ The thinning of ozone layer is known as **ozone depletion**. Ozone shield is important for the survival and existence of life on Earth but it is being depleted by air pollutants like chlorofluorocarbons (CFCs), methane (CH_4) and oxides of nitrogen (NO_x).
- ▶ Chlorofluorocarbons (CFCs) are synthetic, harmful chemicals which are widely used in refrigerators and air conditioners as coolants,

in fire extinguishers, in aerosol sprayers and as propellants. Once released in the air, these harmful chemicals produce active chlorine (Cl and ClO radicals) in the presence of UV radiations.

- ▶ These radicals, through chain reactions, convert ozone into oxygen. Due to this, the ozone layer in the upper atmosphere (*i.e.*, stratosphere) becomes thinner.
- ▶ The thinning of ozone layer allows more UV radiations to pass through it which then strike the Earth. UV radiations reaching the Earth have following harmful effects on man, animals and plants:
 - In humans, UV radiations may cause sun burn, skin cancer, eye cataract, etc.
 - Damage to immune system in human beings and animals and hence lowering the body's resistance to diseases.
 - Increased mortality of developing embryos in the mother's uterus.
 - In plants, UV radiations may interfere with the process of photosynthesis. Decreased photosynthesis would increase the concentration of CO_2 in the atmosphere which will result in global warming.

Previous Years' CBSE Board Questions

15.1 Ecosystem - What are Its Components?

VSA (1 mark)

Human body is made up of five important components of which water is the main component. Food as well as potable water are essential for every human being. The food is obtained from plants through agriculture. Pesticides are being used extensively for a high yield in the fields. These pesticides are absorbed by the plants from the soil along with water and minerals and from the water bodies these pesticides are taken up by the aquatic animals and plants. As these chemicals are not biodegradable, they get accumulated progressively at each trophic level. The maximum concentration of these chemicals gets accumulated in our bodies and greatly affects the health of our mind and body.

1. Why is the maximum concentration of pesticides found in human beings?
2. Give one method which could be applied to reduce our intake of pesticides through food to some extent.
3. Various steps in a food chain represent:
 - (a) food web
 - (b) trophic level
 - (c) ecosystem
 - (d) biomagnification.
4. With regard to various food chains operating in an ecosystem, man is a:
 - (a) Consumer
 - (b) Producer
 - (c) Producer and consumer
 - (d) Producer and decomposer. (2020)
5. Food web is constituted by
 - (a) relationship between the organisms and the environment
 - (b) relationship between plants and animals
 - (c) various interlinked food chains in an ecosystem
 - (d) relationship between animals and environment. (2020)
6. What is an ecosystem? (Delhi 2017)
7. Why is a lake considered to be a natural ecosystem? (Delhi 2017)
8. In the following food chain, plants provide 500 J of energy to rats. How much energy will be available to hawks from snakes?
Plants → Rats → Snakes → Hawks (AI 2017)
9. In the following food chain, 100 J of energy is available to the lion. How much energy was available to the producers?
Plants → Deer → Lion (AI 2017)
10. List two biotic components of a biosphere. (Delhi 2016)
11. Why are green plants called producers? (Delhi 2016)
12. In a food chain of frog, grass, insect and snake, assign trophic level to frog. (AI 2016)
13. Why do producers always occupy the first trophic level in every food chain? (Foreign 2016)
14. We often use the word environment. What does it mean? (Foreign 2016)
15. Which of the following are always at the second trophic level of food chains?
Carnivores, Autotrophs, Herbivores (AI 2015)
16. The following organisms form a food chain. Which of these will have the highest concentration of non-biodegradable chemicals? Name the phenomenon associated with it.
Insects, Hawk, Grass, Snake, Frog (Foreign 2015)
17. List two examples of natural ecosystem. (Foreign 2015)
18. What is meant by the term 'Biomass'? (Board Term I, 2014)
19. Bacteria and fungi are called decomposers. Why? (Delhi 2012, Foreign 2011)
20. In a food chain, if 10,000 joules of energy is available to the producer, how much energy will be available to the secondary consumer to transfer it to the tertiary consumer? (AI 2012)

21. Consider the following food chain which occurs in a forest :

Grass → Deer → Lion

If 10000 J of solar energy is available to the grass, how much energy would be available to the deer to transfer it to the lion?

(Foreign 2012)

22. What is meant by biological magnification?
(AI 2011)
23. Give an example to illustrate that indiscriminate use of pesticides may result in the degradation of the environment.
(AI 2011)

SA I (2 marks)

24. What are decomposers? List two important roles they play in the environment.
(AI 2014)
25. List two reasons to show that the existence of decomposers is essential in an ecosystem.
(AI 2014)
26. State with reason any two possible consequences of elimination of decomposers from the earth.
(AI 2014)
27. What does a trophic level represent in a food chain? State the position of autotrophs and herbivores in a food chain. (Delhi 2013C)

SA II (3 marks)

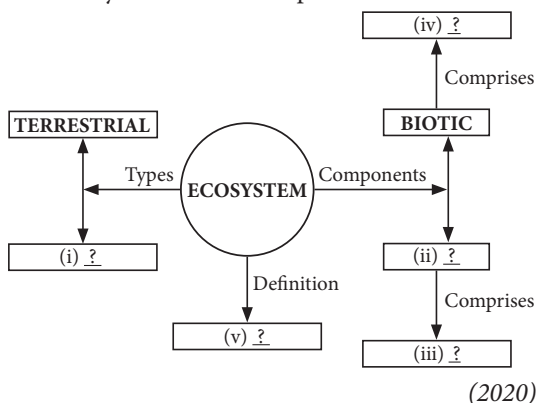
28. (a) From the following group of organisms create a food chain which is most advantageous for human beings in terms of energy.

Hawk, Rat, Cereal plant, Goat,
Snake, Human being

- (b) State the possible disadvantage if the cereal plant is growing in soil rich in pesticides.
(c) Construct a food web using the organisms mentioned above. (2020)
29. (a) Create a food chain of the following organisms.
Insect, Hawk, Grass, Snake, Frog
(b) Name the organism at the third trophic level of the created food chain.

- (c) Which organism of this food chain will have the highest concentration of non-biodegradable chemicals?
(d) Name the phenomenon associated with it.
(e) If 10,000 Joules of energy is available to frogs, how much energy will be available to snakes in this food chain? (2020)

30. (a) What is an ecosystem?
(b) List any two natural ecosystems.
(c) We do not clean ponds or lakes but an aquarium needs to be cleaned regularly. Why? (2020)
31. What is meant by trophic level in a food chain? Construct a terrestrial food chain with trophic levels. The energy flow in a food chain is always unidirectional. Why? (2020)
32. Complete the following flow chart based on ecosystem and its components.



- (2020)
33. (a) Construct a terrestrial food chain comprising four trophic levels.
(b) What will happen if we kill all organisms in one trophic level?
(c) Calculate the amount of energy available to the organisms at the fourth trophic level. If the energy available to the organisms at the second trophic level is 2000 J. (2020)
34. Define an ecosystem. Draw a block diagram to show the flow of energy in an ecosystem.
(Delhi 2019)
35. What is a food chain? Why is the flow of energy in an ecosystem unidirectional? Explain briefly. (AI 2019)
36. “Energy flow in food chains is always unidirectional.” Justify this statement. Explain how the pesticides enter a food chain and subsequently get into our body.
(Foreign 2015, AI 2014)

37. "Our food grains such as wheat and rice, the vegetables and fruits and even meat are found to contain varying amounts of pesticide residues." State the reason to explain how and why it happens. (Delhi 2014)
38. What is meant by food chain? "The number of trophic levels in a food chain is limited." Give reason to justify this statement. (Foreign 2014)
39. (a) What is an ecosystem? List its two main components.
(b) We do not clean ponds or lakes, but an aquarium needs to be cleaned regularly. Explain. (Delhi 2013)
41. State two methods of effective plastic waste collection in your school.
42. Name any two uses of 'single use plastic' in daily life.
43. If we discontinue the use of plastic, how can an environment-friendly substitute be provided?
44. Do you think microbes will work similarly in landfill sites as they work in the laboratory? Justify your answer. (2020)
45. The depletion of ozone layer is a cause of concern. Why? (AI 2016)
46. Write one negative effect on the environment, of affluent life style of few persons of a society. (AI 2016, 2014)
47. Why is excessive use of CFCs a cause of concern? (Foreign 2016)
48. What is the function of ozone in the upper atmosphere? (Delhi 2015, Foreign 2012)
49. Why should biodegradable and non-biodegradable wastes be discarded in two separate dustbins? (Delhi 2015, 2013)
50. Write the full name of the group of compounds mainly responsible for the depletion of ozone layer. (Foreign 2015, Delhi 2013C)
51. Which class of chemical is linked to the decrease in the amount of ozone in the upper atmosphere of the Earth? (Delhi 2012)
52. What happens when higher energy ultraviolet radiations act on the oxygen at the higher level of the atmosphere? (AI 2012)
53. Why did United Nations act to control the production of chlorofluorocarbons (CFCs) used in refrigerators? (Delhi 2011)
54. Why is decrease of ozone in our ozone layer a cause for our worry? (Foreign 2011)

15.2 How Do Our Activities Affect the Environment?

VSA (1 mark)

40. Choose the incorrect statement from the following:
- Ozone is a molecule formed by three atoms of oxygen.
 - Ozone shields the surface of the earth from ultraviolet radiations.
 - Ozone is deadly poisonous.
 - Ozone gets decomposed by UV radiations. (2020)

Answer questions numbers 41 to 44 on the basis of your understanding of the following paragraph and the related studied concepts:

India today is facing the problem of overuse of resources, contamination of water and soil and lack of methods of processing the waste. The time has come for the world to say goodbye to "single use plastics". Steps must be undertaken to develop environment-friendly substitutes, effective plastics waste collection and methods of its disposal.

Indore treated 15 lakhs metric tonnes of waste in just 3 years, through biomining and bioremediation techniques. Bioremediation involves introducing microbes into a landfill to naturally 'break' it down and biomining involves using trommel machines to sift through the waste to separate to 'soil' and the waste component. The city managed to chip away 15 lakh metric tonnes of waste at a cost of around ₹ 10 crore. A similar experiment was successfully carried out in Ahmedabad also.

SA I (2 marks)

55. "Industrialisation has adversely deteriorated the environment." Give four reasons in support of this statement. (Foreign 2016)

56. Why is Government of India imposing a ban on the use of polythene bags? Suggest two alternatives to these bags and explain how this ban is likely to improve the environment.

(Delhi 2014)

57. In some states of our country there is a ban on the use of polythene bags for shopping. Why? List three advantages of using jute or cloth bags over polythene bags.

(Delhi 2014)

58. "Affluent life style has a negative effect on the environment." Justify this statement with the help of an example.

(Delhi 2014)

59. Give one example each from your daily life where the domestic waste can be effectively reused and recycled.

(AI 2014)

60. "To discard the household waste we should have two separate dust-bins, one for the biodegradable waste and the other for the non-biodegradable waste." Justify this statement suggesting the proper way of disposal of these wastes.

(Foreign 2014)

61. We often observe domestic waste decomposing in the bylanes of residential colonies. Suggest ways to make the residents realise that the improper disposal of their waste is harmful to the environment.

(Foreign 2014, Delhi 2013)

62. Suppose you find a heap of domestic waste, in a nearby park, which is decomposing. What would you do to make the people of the surrounding area realise that such type of disposal of domestic waste is harmful to the environment?

(Foreign 2014)

SA II (3 marks)

63. (a) Write two harmful effects of using plastic bags on the environment. Suggest alternatives to the usage of plastic bags.

(b) List any two practices that can be followed to dispose off the waste produced in our homes.

(2020)

64. (a) Complete the following table :

	Oxygen	Ozone
Formula	(i) _____	(ii) _____
Benefits to biotic component	(iii) _____	(iv) _____

(b) How is ozone formed at the higher level of atmosphere?

(2020)

65. You have been selected to talk on "Ozone layer and its protection" in the school assembly on 'Environment Day'.

(a) Why should ozone layer be protected to save the environment?

(b) List any two ways that you would stress in your talk to bring in awareness amongst your fellow friends that would also help in protection of ozone layer as well as the environment.

(Delhi 2017)

66. After the examinations Rakesh with his friends went on a picnic to a nearby park. All friends carried cooked food packed in plastic bags or plastic cans. After eating the food some friends collected the leftover food and plastic bags etc., and planned to dispose them off by burning. Rakesh immediately checked them and suggested to segregate the leftover food and peels of fruits from the plastic materials and respectively dispose them off separately in the green and red dustbins placed in the corner of the park.

(a) In your opinion, is burning plastic an eco-friendly method of waste disposal? Why? State the advantage of method suggested by Rakesh.

(b) How can we contribute in maintaining the parks and roads neat and clean?

(Delhi 2015)

67. Differentiate between biodegradable and non-biodegradable substances with the help of one example each. List two changes in habit that people must adopt to dispose non-biodegradable waste, for saving the environment.

(AI 2015, Delhi 2013C)

68. What is ozone ? How and where is it formed in the atmosphere ? Explain how does it affect an ecosystem.

(Foreign 2015)

Detailed Solutions

1. The pesticides are not biodegradable, they get accumulated progressively at each trophic level. As human beings occupy the topmost level in food chain, their concentration becomes maximum in our bodies.

2. By using biological methods for controlling insects in fields and by washing fruits and vegetables before eating could help to reduce our intake of pesticides through food to some extent.

3. (b) trophic level

4. (a) consumer

5. (c)

6. An ecosystem is defined as a structural and functional unit of the biosphere. It comprises of living organisms and their non-living environment that interact by means of food chains and biogeochemical cycles resulting in energy-flow, biotic diversity and material cycling to form stable self-supporting system.

7. Lake is an ecosystem where living organisms grow, reproduce and interact among each other as well as with abiotic components and carry out other activities in nature by themselves without any human interference, therefore it is referred to as a natural ecosystem.

8. In an ecosystem, only 10% of energy is transferred from one trophic level to next, i.e., 10 percent law and rest is dissipated into the environment. Therefore, if plants (being producers-1st trophic level)-transfer 500 J of energy to rats (2nd trophic level) then rats would transfer 50 J of energy to snakes (3rd trophic level) which in turn will transfer only 5 J of energy to hawks (4th or last trophic level) in a food chain.

Plants → Rats → Snakes → Hawks

5000 J 500 J 50 J 5 J

9. As per 10% law of flow of energy in an ecosystem only 10% of energy is received by the next trophic level. Hence, in the given food chain : If 100 J of energy is available to lion, the plants or producers have 10,000 J of energy available to them.

Plants → Deer → Lion
10,000 J 1000 J 100 J

10. Two biotic components of a biosphere are:

(i) Producers – Include organisms which can produce their food using simple inorganic compounds, e.g., all green plants, blue green algae (cyanobacteria).

(ii) Consumers – Include organisms which are unable to synthesise their food, therefore, utilise materials and energy stored by the producers or eat other organisms, e.g., all the animals.

11. Green plants are called producers because they manufacture their own food with the help of CO₂ and H₂O in the presence of sunlight and chlorophyll.

12. In the given food chain, frog belongs to the third trophic level as shown here :

Grass → Insect → Frog → Snake

T₁ T₂ T₃ T₄

13. Producers are the green plants that can manufacture food using CO₂ and H₂O in the presence of sunlight, i.e., they are autotrophs. They serve as a source of food for all non-producers or consumers directly or indirectly. Hence, producers occupy the first trophic level in a food chain.

14. Environment can be defined as the physical or biological world where an organism lives. Literally speaking, an organism's immediate surrounding constitutes its environment which includes both biotic and abiotic components around him.

15. Herbivores always occupy the second trophic level of food chains.

16. Among the following organisms of the food chain, hawk being top consumer is present at topmost trophic level, hence will have the highest concentration of non-biodegradable chemicals due to a phenomenon known as biomagnification.

17. The two examples of natural ecosystem are :

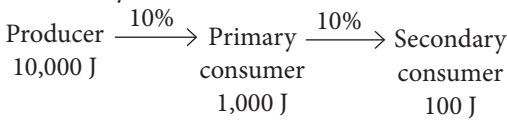
(i) Forest ecosystem

(ii) River ecosystem

18. Biomass is the total amount of living or organic matter in an ecosystem at any time.

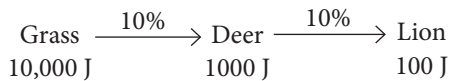
19. Bacteria and fungi are called decomposers because these microorganisms break down the complex organic matter present in dead plants and animals into simpler substances.

20. According to ten percent law, 10% of the energy of producer will be available to primary consumer, and 10% of this energy will be available to secondary consumer and so on.



Hence, 100 J of energy will be available to the secondary consumer to transfer it to tertiary consumer.

21. The energy available to the deer is 1000 J to transfer it to the lion. This can be depicted as follows:



22. Biological magnification or biomagnification refers to the process of accumulation of non-biodegradable chemicals (pesticides, etc.) into the body of organisms through the food chain which go on increasing in its concentration at each trophic level.

23. Pesticides are the chemicals used to kill plant and animal pests. They are non-biodegradable and toxicants. For example, excessive use of DDT resulted in reduced population of fish eating birds. DDT accumulated in such birds through the food chain. It interfered with the egg shell formation. The shell being thin broke due to weight of the bird during incubation. Hence, their population declined.

24. Decomposers are microorganisms including bacteria and fungi which decompose or break-down the complex organic compound present in dead plants and animals into simpler substances. Role of decomposers in environment are –

(i) They help in decomposing dead bodies of plants and animals and hence act as cleansing agents of environment.

(ii) They help in recycling of materials in the ecosystem to maintain its stability.

25. The existence of decomposers in an ecosystem is essential because:

(i) If there were no decomposers, then the dead bodies of plants and animals would keep lying as such and the elements constituting plant and animal bodies would never be returned to their original pools like soil, air and water. In such case the organic waste go on accumulating and the cyclic process of life and death would be disrupted.

(ii) Decomposers make the soil fertile by providing/replenishing nutrients to it, thus forming the integral part of ecosystem.

26. Consequences of elimination of decomposers are :

(i) There would be no recycling of nutrients and therefore, raw materials to produce food will not be available to producers. Hence, the food chains will get affected.

(ii) The dead bodies of plants and animals will go on accumulating in the absence of decomposition thereby polluting the environment.

27. Trophic level represents each of several hierarchical levels of a food chain operating in an ecosystem, consisting of organism sharing the same function in the food chain and the same nutritional relationship to the primary sources of energy.

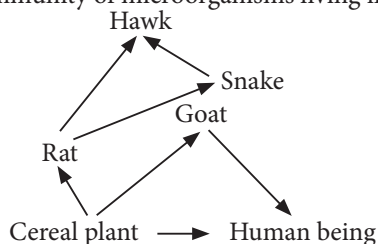
The position of producers (or autotrophs) in a food chain constitute the first trophic level. They fix up sun's energy and make it available for consumers. The herbivores or primary consumers (which feed upon plants) constitute the second trophic level in a food chain.

28. (a) A food chain which is most advantageous for human beings in terms of energy is:

Cereal plant → Human being

(b) If the cereal plant is growing in soil rich in pesticides, these pesticides are absorbed by growing plants along with water and minerals, when animals eat these cereal plants, these poisonous chemical pesticides go into their bodies through food. This increase in concentration of harmful pesticides in the body of living organisms at each trophic level of a food chain is called biological magnification. Pesticides are lethal to non-target species also. The extensive use of pesticides in agriculture can change the community of microorganisms living in soil.

(c)



29. (a) Grass → Insect → Frog → Snake → Hawk

(b) Frog is present in the above created food chain.

(c) Hawk is the top consumer of the food chain, so, it will have high concentration of non-biodegradable chemicals.

(d) Biological magnification

(e) As per 10% law of flow of energy in an ecosystem, only 10% of energy is received by the next trophic level. Hence, in the given food chain, if 10,000 Joules of energy is available to frog, then the energy available to snakes will be 1000 Joule.

Grass → Insect → Frog → Snake → Hawk
10,00,000 J 10,000 J 10,000 J 1000 J 100 J

30. (a) An ecosystem is defined as a structural and functional unit of the biosphere comprising of living organisms and their non-living environment.

(b) Two examples of natural ecosystem are : pond ecosystem and grassland ecosystem.

(c) Ponds or lakes being natural ecosystems are self sufficient and do not need to be maintained regularly. On the other hand, aquarium being an artificial ecosystem needs to be cleaned and maintained regularly as it contains mainly fishes as living organisms, as compared to natural ecosystems where presence of other organisms maintains a balance. Also, because the producers and decomposers are absent in aquarium the fish waste or excretory products, *i.e.*, ammonia may turn into toxic compounds and accumulate to dangerous levels causing the fishes to die. Hence, the artificial ecosystems like aquarium needs to be cleaned regularly.

31. The various steps representing organisms in a food chain at which the transfer of food and energy takes place are called trophic levels.

Four trophic levels in a terrestrial food chain:

Grass → Rabbit → Wild cat → Tiger

There is a unidirectional flow of energy from sun to producers and subsequently to series of different types of consumers, *i.e.*,

Solar radiations → Producers → Herbivores
Carnivores ←

It cannot pass in reverse direction. There is always a decrease in the flow of energy and content with rise in trophic level. Large quantity of energy is lost at each step in the form of heat and is also used up in various metabolic activities.

32. (i) Aquatic

(ii) Abiotic

(iii) Inorganic substances

(iv) Producers

(v) Structural and functional unit of biosphere

33. (a) A terrestrial food chain with four trophic levels is :

Grass → Insect → Frog → Eagle

(b) Removal of the organisms of any trophic level will always adversely affect the ecosystem, *e.g.*, the removal of lions and tigers (top carnivores) will cause rapid increase in deer population, which leads to rapid consumption of vegetation resulting in scarcity of vegetation and population crash of deer.

(c) According to ten percent law, only 10% of the energy is received by the next trophic level.

Producers → Primary → Secondary → Tertiary
consumer consumer consumer

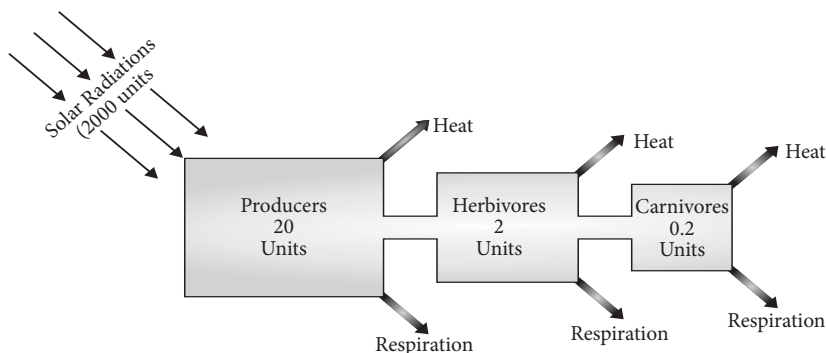
T₁ T₂ T₃ T₄
20,000 J 2000 J 200 J 20 J

If the energy available at second trophic level (T₂) is 2000 J, so the 20 J of energy will be at fourth trophic level (T₄).

34. An ecosystem is defined as a structural and functional unit of the biosphere. It comprises of living organisms and their non-living environment that interact by means of food chains and biogeochemical cycles resulting in energy-flow, biotic diversity and material cycling to form stable self-supporting system.

Green plants capture about 1% of the solar energy incident on the earth to carry out the process of photosynthesis. A part of this trapped energy is used by plants in performing their metabolic activities and some energy is released as heat into the atmosphere. The remaining energy is chemical energy stored in the plants as photosynthetic products. When these green plants are eaten up by herbivores, the chemical energy stored in the plants is transferred to these animals. These animals (herbivores) utilise some of this energy for metabolic activities and some energy is released as heat while the remaining energy is stored in their body. This process of energy transfer is repeated till top carnivores. In an ecosystem, transfer of energy follows 10 per cent law, *i.e.*, only 10 per cent of the energy is transferred to each trophic level from the lower trophic level. Nearly 90 per cent of energy is lost when it moves from one trophic level to the next.

The given block diagram shows unidirectional flow of energy at different trophic levels in a freshwater ecosystem :



35. The sequential interlinking of organisms involving transfer of food energy from the producers, through a series of organisms with repeated eating and being eaten is called the food chain. A food chain involves a nutritive interaction between the living organisms of an ecosystem. There is a unidirectional flow of energy from sun to producers and subsequently to series of different types of consumers, i.e.,

Solar radiations → Producers → Herbivores
Carnivores ←

It cannot pass in reverse direction. There is always a decrease in the flow of energy and content with rise in trophic level. Large quantity of energy is lost at each step in the form of heat and is also used up in various metabolic activities.

36. Refer to answer 35.

Some harmful non-biodegradable chemicals (pesticides, e.g., D.D.T.) enter the bodies of organisms through the food chains and get concentrated at each trophic level. This phenomenon is called biomagnification or biological magnification. For example, in a food chain operating in a pond, river or lake, the water contains a small amount — 0.02 ppb (parts per billion) of harmful pesticides, i.e., D.D.T. When this water is consumed by phytoplanktons and zooplanktons, the concentration of these chemicals increases to 5 ppm. Fishes feeding on these, accumulate 240 ppm. Birds and humans feeding on these fishes were found to contain 1600 ppm of these chemicals. Thus, there is an increase in the concentration of the chemicals at each trophic level.

37. Pesticides are poisonous chemical substances which are sprayed over crop plants to protect them from pests and diseases. These chemical pesticides mix up with soil and water. From soil and water, these pesticides are absorbed by the growing plants along with water and other minerals. When herbivorous animals feed on these plants the poisonous pesticides enter their bodies through the food chain. Similarly, when the carnivorous animals eat these herbivores, the pesticides get transferred to their bodies. Therefore, the plant products such as food grains, vegetables and fruits as well as meat of animals contain varying amounts of pesticide residues in them depending upon the trophic level they occupy in a food chain.

38. The sequence of living organisms in a community in which one organism consumes or feeds upon another organism to transfer food energy, is called a food chain. The various steps in a food chain at which the transfer of food (or energy) takes place are called trophic levels. In fact, in a food chain, each step representing an organism forms a trophic level.

The number of trophic levels in a food chain are limited because at each trophic level only 10% of energy is utilised for the maintenance of organism which occur at that trophic level and the remaining large portion is lost as heat. As a result organisms at each trophic level pass on lesser energy to the next trophic level, than they receive. The longer the food chain, the lesser is the energy available to the final member of food chain. Food chains generally consist of three or four trophic levels because beyond that the energy available to the next organism will be too small and insufficient to sustain the life of that organism.

39. (a) Refer to answer 34.

The two main components of ecosystem are :

(i) Abiotic components – Non-living components of ecosystem, e.g., soil, water, air, light, etc.

(ii) Biotic components – Living components of ecosystem, e.g., plants, animals and microbes.

(b) Refer to answer 30 (c).

40. (d)

41. Two methods of effective plastic waste collection : (i) Use of separate dustbins for plastic collection (ii) Use of reusable for the canteen and school events (iii) Encourage less plastic in packed lunches.

42. Single use plastic, often also referred to as disposable plastics are commonly used for plastic packaging and include items intended to be use only once before they are thrown away or recycled. These include grocery bags, food packaging, bottles, straws, containers, cups and cutlery.

43. Best alternatives can be use of stainless steel, glass and platinum. Silicone storage containers. Cloth bags can be used in place of plastic bags. Use of wooden cleaning brushes, kitchen utensils and cutting board, pottery and other ceramics products, etc.

44. Microbes may not work exactly the same way in landfill sites as they work in laboratories because it is difficult to replicate the exact ambient conditions required for the microbes to thrive in these two conditions. But due to same downstream processing and other mechanism, they will work similarly in landfill sites.

45. Ozone layer is the ozone rich area in the stratospheric layer of atmosphere which acts as a protective shield by preventing harmful UV radiations from entering the Earth surface. Hence, the depletion of ozone layer is a cause of concern.

46. Affluent lifestyle of few persons leads to exploitation and over consumption of resources leading to their scarcity and generation of greater amount of waste materials which causes imbalance in environment.

47. CFCs or Chlorofluorocarbons are potent compounds that release active chlorine in the atmosphere which reacts with ozone molecules present there to convert them to oxygen. This results in thinning of ozone layer. Hence, excessive use of CFCs is a cause of concern.

48. Ozone (O_3) gas forms a protective shield in the upper atmosphere that absorbs most of the harmful ultraviolet radiations coming from Sun that can harm human beings, animals and plants. It protects us from various health hazards.

49. Biodegradable wastes are decomposed naturally by the action of microbes which degrade them to their simple constituents enabling their nutrients to recycle among the biotic and abiotic components of ecosystem. However, non-biodegradable wastes cannot be disposed off naturally since they cannot be decomposed by microbes. Such wastes are either recycled, incinerated or put in landfills, etc. As the disposal methods of the two types of waste is different, it is advisable to discard the two types of waste in two separate dustbins.

50. Chlorofluorocarbons (CFCs) are the group of compounds mainly responsible for ozone depletion.

51. The decrease in the amount of ozone in the atmosphere has been linked to synthetic chemicals like chlorofluorocarbons (CFCs) which are used as coolant and in fire extinguishers, etc.

52. When high energy ultraviolet radiations react with oxygen present in stratosphere (the higher level of atmosphere) it splits into its constituent atoms. Since these atoms produced are very reactive they react with molecular oxygen (O_2) to form ozone (O_3).

53. United Nations act to control the production of CFCs as they are the main chemicals responsible for ozone depletion.

54. Refer to answer 45.

55. Industrialisation has deteriorated our environment in the following ways :

(i) Rapid industrialisation has increased the demand of more land area for setting up of new factories. This demand is being fulfilled by clearing up of forest area. Deforestation is one of the major causes of ecological imbalance, biodiversity loss and ecosystem instability.

(ii) Industries release various harmful gases in the environment which pollute the air. These gases when inhaled by people around, cause various respiratory diseases in them.

(iii) A lot of effluent and liquid waste is discharged from various industries which is mostly dumped into nearby water bodies. This causes water pollution. Polluted water causes death of various aquatic organisms and consumption of this polluted water causes various diseases in humans.

(iv) The solid waste released from factories is dumped on open land and not treated properly to ensure their proper decomposition. This leads to land pollution that degrades quality of soil and also causes various kinds of diseases in humans and animals.

56. Government of India is imposing a ban on the use of polythene bags because these are non-biodegradable substances which are not acted upon by the microbes. So, they cannot be decomposed and therefore persist in the environment for a long time thereby causing harm to the ecosystem. Polybags choke drains which results in water logging, that allows breeding of mosquitoes and hence leads to various diseases like malaria, dengue, etc. Jute bags and cloth bags are the alternatives to the polythene bags.

57. Refer to answer 56.

The three advantages of using jute or cloth bags over polythene bags are :

- (i) They are made of biodegradable material.
- (ii) They can be reused.
- (iii) They do not pollute our environment.

58. With the advancement in technology over time, there has been improvement in lifestyle of people. Such changes in people's lives have also changed their attitudes. When people have more resources at their end they tend to overuse and misuse it thereby generating huge amounts of waste material. For example, the affluent life style has forced people to start using more of disposable articles, e.g., plastic cups, bags, etc., which keep on accumulating in the environment and lie undecomposed, thereby negatively affecting the environment.

Similarly, excessive use of refrigerators and air conditioners, plastic foams, etc., also releases high quantities of CFCs which are responsible for ozone depletion.

59. We can reuse plastic and glass jars of jams and pickles, etc, for the purpose of storage of things like salt, sugar, tea, etc., whereas we can recycle

newspapers, plastic of some types, broken glass and metal wares for making fresh paper, plastic, glass and metal objects.

60. "To discard the household waste we should have two separate dust-bins, one for the biodegradable waste and the other for the non-biodegradable waste." Segregation of biodegradable and non-biodegradable waste is utmost important for their proper disposal, as different methods are adopted for their disposal. Biodegradable wastes can be composted whereas non-biodegradable wastes can be recycled, incinerated or landfilled.

61. Some of the ways to make people realise that the improper disposal of waste is harmful to the environment includes making people aware of negative impacts of waste disposal. They can be made aware by :

(i) Conducting seminars about the negative effects of the wastes on environment.

(ii) Usage of pamphlets and posters for providing information.

(iii) Forming an eco-club in the society for spreading awareness about the ill effects of waste on the surroundings such as :

- Improper disposal of waste will release harmful gases in the environment that make it unclean and unhygienic for the living organisms.
- The waste will flow to water bodies along with rain water and become a threat to aquatic life and pollute the water bodies.
- It provides space for breeding of the mosquitoes and which results in spread of malaria, filariasis, dengue, etc.
- Hazardous chemicals from wastes get into the soil and can harm the plants when they take up the contamination through their roots. This will affect the health of other animals and humans and will have negative impact on environment.

62. Refer to answer 61.

63. (a) Two harmful effects of using plastic bags on the environment:

- (i) Plastic bags are non-biodegradable substances which are not acted upon by microbes. So, they cannot be decomposed and therefore persist in the environment for a long time causing harm to the soil fertility and quality.

(ii) Plastic bags choke drains which result in waterlogging, that allows breeding of mosquitoes and hence leads to various diseases.

Jute bags and cloth bags are the alternatives to the polyethylene bags.

(b) Practices that can be followed to dispose off the waste produced in our homes:

(i) Separation of biodegradable and non-biodegradable wastes.

(ii) The biodegradable waste can be converted to manure.

(iii) Non-biodegradable waste should be disposed off at suitable places from where municipal authorities can pick them up and dispose properly and scientifically.

(iv) Use discarded bottles and jars to store food items.

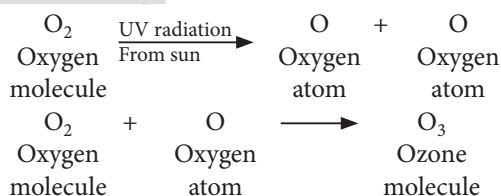
64. (a) (i) O_2

(ii) O_3

(iii) Respiration

(iv) Absorbs harmful ultraviolet radiations coming from the sun.

(b) When high energy ultraviolet radiations react with oxygen present in stratosphere (the higher level of atmosphere) it splits into its constituent atoms. Since these atoms produced are very reactive they react with molecular oxygen (O_2) to form ozone (O_3).



65. (a) The ozone layer is very important for the existence of life on Earth because it forms a protective shield around Earth by absorbing most of the harmful ultraviolet (UV) radiations coming from the Sun and prevents them from reaching the Earth.

The UV radiations have extremely harmful effects on human beings, animals and plants as well, *i.e.*, cause mutations, skin cancer, cataract, damage immune system, etc. So, ozone layer must be protected to save the environment.

(b) The two ways which can help in protection of ozone layer and environment are :

(i) The use of chemicals like chlorofluorocarbons (CFCs) which are widely used in refrigerators and air conditioners (as a coolant), in fire extinguishers and in aerosol sprayers destroy the ozone layer gradually. We can protect our ozone layer by avoiding the use of such objects which are releasing CFCs.

(ii) Nitrous oxide is the largest ozone depleting substance as well as greenhouse gas released by human activities, such as from motor vehicles, fertilisers. People should be encouraged to use more public transport, car pooling, using hybrid or electric cars and use of fertiliser formulations to reduce emission of nitrous oxide.

66. (a) No, burning plastic is not an eco-friendly method of waste disposal. Burning plastics can produce toxic fumes and cause air pollution. Plastic, being non-biodegradable cannot be dumped (land filled), so the best way to dispose plastic items is to recycle them. Recycling is a less polluting and more sustainable option.

Rakesh segregated left over food items, fruit peels, *i.e.*, biodegradable waste and plastic material, *i.e.*, non-biodegradable waste. The biodegradable waste can be converted to manure whereas non-biodegradable waste can be recycled. This contributes in decreasing the level of pollution and easy disposal and treatment of waste.

(b) We can contribute to keep our roads and parks clean by adopting following habits:

(i) We should recycle non-biodegradable waste products instead of dumping it in garbage.

(ii) We should use carry bags made of natural fibre as jute, cloth, instead of plastic bags.

(iii) We should make compost of biomass collected from park such as food waste, leaf litters, etc.,

(iv) We should stop littering, throwing garbage and spitting on road sides, parks, etc.

67. Differences between biodegradable and non-biodegradable wastes are as follows:

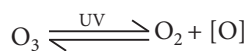
S. No.	Biodegradable Wastes	Non-biodegradable Wastes
(i)	These are biological in origin.	These are mostly man-made.
(ii)	These are degraded by microorganisms such as bacteria and fungi.	These are not degraded by microorganisms.

(iii)	These do not get biologically magnified in food chains.	These enter into the food chains and get biologically magnified.
(iv)	These can be converted into resource. Examples-sewage, cattle dung, household garbage, etc.	Some of these can be recycled. Examples-plastic objects, synthetic fibres, glass objects, etc.

People should adopt the following changes in their habit to dispose off non-biodegradable waste, so as to save the environment.

- (i) Non-biodegradable household waste should be disposed in separate dustbins and should not be mixed with biodegradable waste.
- (ii) Recyclable non-biodegradable wastes like glass, paper, metal, various types of plastics etc., can be sent to local recycling units.
- (iii) People should try to reuse items as much as possible instead of disposing them as this reduces need of new materials and keeps ecological impact down.
- (iv) Use of cloth bags/gunny bags/paper bags instead of polythene /plastic bags.
- (v) Use of compost, vermicompost instead of fertilisers.

68. Ozone is a form of oxygen. It is a made up of three atoms of oxygen. It is highly poisonous. However, good amount of ozone is present in upper part of the atmosphere called stratosphere. In the stratosphere ozone is being photo-dissociated and generated simultaneously by absorption of harmful ultraviolet (UV) radiations coming from sun.



The two reactions are in equilibrium thereby maintaining a steady concentration of ozone in the stratosphere. Ozone layer is commonly called ozone blanket. It acts as a protective shield to protect all types of life from the harmful effect of UV radiation. Therefore, any thinning or depletion of ozone layer allows entry of high energy UV radiations into the earth's surface, thereby causing harmful effects on plants, animals and human beings.

The harmful effects of ozone depletion on man, animals and plants includes :

- (i) Incidences of skin cancer and herps.
- (ii) Damage to eye sight, photoburning as well as increased incidences of cataract in eyes.
- (iii) Damage to immune system and hence lowering the body's resistance to disease.
- (iv) Increased embryonic mortality.
- (v) 10-25% decline of photosynthesis in plants.
- (vi) Global warming.

