

Question Bank on **Environment and Ecology**

For UPSC and State Civil Services Examinations

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Preface

The civil services examination conducted by UPSC (Union Public Service Commission) has become more dynamic and challenging in recent years. Every year UPSC surprises candidates by bringing an element of uncertainty and unpredictability in the way question papers are set—both for Preliminary and Mains examinations. This dynamic and evolving nature of the exam is intended to select the best minds who can quickly adapt to changeability and solve questions to arrive at the right and the most relevant solutions without losing their nerves. This ability to think on the spot when faced with uncertainty can only be cultivated and strengthened by applying one's knowledge repeatedly to solve a variety of new and challenging questions as part of one's day-to-day preparation.

In this regard, InsightsIAS (www.insightsonindia.com) a pioneer in making UPSC civil services examination preparation test based, has come up with the book—*Question Bank on Environment and Ecology*. This question bank has the added advantage of dividing and reorganizing all the questions into micro-topics, giving solutions at the end of the chapter rather than just below each question, and inserting separate answer key for self-evaluation.

The MCQs in this book are thoroughly vetted and chosen in order to eliminate any typo mistakes and repetition. This book will act as your ultimate guide to apply your knowledge in the right direction so as to be ready to face any uncertainty on the day of the actual exam. Moreover, the detailed solutions given for every question help you with the Mains syllabus as well. With every challenging question, this book tests not only the conceptual clarity but also ascertains your command over the subject, thus helping you to be on a higher pedestal than the rest.

In a nut shell, this book is a must read for all Civil Services aspirants as it tests your bounds and maximizes your frontiers of knowledge and skills. Once an aspirant has read the basic reference books for UPSC CSE Examination, he/she can take up this question bank for practice.

About the Book

With syllabus of the UPSC Civil Services Preliminary examination being sophisticatedly divided into numerous chapters, this question bank provides a

perfect roadmap for holistic preparation from prelims perspective. It comprises more than 900 questions framed on various aspects of environment and ecology. The book covers around 27 main topics such as functions of an ecosystem, terrestrial ecosystem, environmental pollution and measures, and environmental impact assessment. These main topics have been divided into 27 chapters with each chapter containing several sub-topics related to the main topic.

Key Features

- Contains questions that have been framed after referring to NCERT and Standard books of reference for UPSC Civil Services Examination
- Encompasses questions that have a logical flow to help an individual to maximize retention in an implicit manner
- Provides a separate answer key at the end of each chapter for better practice
- Provides the most qualitative explanations for the answer keys, which give an in-depth understanding of the concepts and analysis of the question
- Provides the 2019 solved question paper
- Provides previous years' questions from 2011 to 2018 with answer key
- Includes appendices on biosphere reserves in India, conventions, important days related to the environment, Indian organizations and NGOs, international organizations, IUCN Red List, tiger reserves in India, Ramsar sites in India, and State animals of India

Acknowledgments

This work has been possible only because of the exceptional talent of InsightsIAS. Our team members, especially Aditya Jha, Shruthi Gayakwad, Kailash, and Sugnyan are instrumental in shaping this book. They along with others have curated and helped me edit the content to make the book useful for civil services exam aspirants. We thank Oxford University Press, India sincerely for giving us an opportunity to partner with them and provide quality content to students preparing for various competitive examinations across India.

Today, InsightsIAS (www.insightsonindia.com) is synonymous with UPSC civil services exam

preparation. The quality guidance and content given to IAS aspirants has resulted in exceptional results over the years. With books like this, more number of aspirants will be benefited and their preparation will be simplified. As this book is purely driven to give competitive edge to its readers, their chances

of clearing the prelims exam will be very high. I hope this book will be your constant companion during your exam preparation. We sincerely wish to see you crack this exam and serve our great nation.

Vinay G.B.

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Functions of an Ecosystem

MULTIPLE CHOICE QUESTIONS

Food Chain and Food Web

- 12.** Consider the following statements with reference to food chains.
- The grazing food chain is found only in terrestrial ecosystem.
 - The initial energy source for detritus food chain is dead organic matter.
 - The grazing and detritus food chains are interlinked.
- Select the correct statements.
- (a) All statements are correct
(b) 1 and 2 only
(c) 2 and 3 only
(d) 2 only
- 13.** Arrange the following marine organisms in the order of increasing hierarchies in the food chain.
- (a) Dinoflagellates = Diatoms < Copepods < Ocean Sunfish
(b) Dinoflagellates < Copepods = Diatoms < Ocean Sunfish
(c) Diatoms < Dinoflagellates < Copepods = Ocean Sunfish
(d) Diatoms < Dinoflagellates < Ocean Sunfish < Copepods

Ecological Pyramid

- 14.** With reference to ecological pyramids, consider the following statements.
- The food producer represents the base of the pyramid and the top carnivore forms the tip in the upright pyramid.
 - The pyramid of energy will always be upright.
- Select the correct answer using the codes given below.
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None
- 15.** The pyramid of energy in an ecosystem is always upright because
- The continuous loss of energy due to metabolic activity puts limits on how much energy is available to higher trophic levels.
 - There is loss of energy at each trophic level in being transferred to the higher trophic level.
- Which of the above is/are correct?
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

Pollutants and Trophical Level

- 16.** Which of the following is/are the characteristics that the pollutant should possess for biomagnification to occur?
- A pollutant should be long lived.
 - A pollutant should be biologically active.
 - A pollutant should be soluble in fats.
- Select the correct answer using the codes given as follows.
- (a) 1 only (b) 2 only
(c) 2 and 3 only (d) 1, 2, and 3
- 17.** Why chemical oxygen demand (COD) is a better mode to measure pollution load in water than biochemical oxygen demand (BOD)?
- COD can measure pollution load in flowing water which BOD cannot.

2. COD measures pollution load due to non-biodegradable sources which BOD does not.

Which of the above is/are correct?

- (a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) None

18. Mosses is a bioindicator. What do you understand by this statement?

- It reflects changes such as pollution in the ecosystems.
- It cannot be cloned or genetically engineered.
- It does not contain mRNA.

Select the correct answer using the codes below.

- (a) 1 only (b) 2 and 3 only
(c) 3 only (d) 1 and 2 only

19. In which of the following trophic levels are you likely to find the highest concentration of an organic toxin that has been found in ocean water?

- (a) Phytoplankton
(b) Aquatic plants

- (c) Small fishes at lower trophic levels
(d) Human being who consumes seafood

20. An indicator species is the one whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem. Consider the following species and the indications they show in an ecosystem.

1.	Mosses	A.	Help indicate acidic soil
2.	Lichens	B.	Help indicate air pollution
3.	Fungi	C.	Help indicate old-growth forests where an abundance of coarse woody debris exists

Select the correct match using the codes given below.

- (a) 1-A, 2-B, 3-C (b) 1-C, 2-B, 3-A
(c) 1-B, 2-C, 3-A (d) 1-A, 2-C, 3-B

21. BOD can be a measure of

- Nutrient enrichment of water.
- Level of pollution.

Which of the above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

Biotic Interaction

22. A large tree shades a small plant, retarding the growth of the small plant. The small plant has no effect on the large tree. This example is related to which type of biotic interaction?

- (a) Commensalism (b) Amensalism
(c) Competition (d) Neutralism

23. Match the following.

Biotic Interaction	Characteristic
A. Commensalism	1. One species benefits, other is harmed
B. Mutualism	2. One species is harmed, other is unaffected
C. Amensalism	3. Both species benefit
D. Parasitism	4. One species benefits, other is unaffected

Choose the correct answer from the codes below.

- (a) A-1, B-4, C-3, D-2
(b) A-2, B-3, C-1, D-4
(c) A-4, B-3, C-2, D-1
(d) A-2, B-4, C-3, D-1

24. Consider the following.

- Water
- Decomposers
- Soil
- Non-green plants

Which among the above components is/are biotic components of environment?

- (a) 1 and 2 only (b) 2 and 3 only
(c) 2 and 4 only (d) 3 and 4 only

25. Which of the following is/are example(s) of mutualistic interaction between the species?

- Leech and Cattle
- Rhizobium and Leguminous plants
- Coral Polyps and Zooxanthellae

Select the correct answer using the codes given below.

- (a) 1 only (b) 2 and 3 only
(c) 3 only (d) 1, 2, and 3

26. Which of the following exemplifies the biological relationship of mutualism?

- (a) Humans and the bacteria that lives in intestinal gut of humans
(b) Cows and tapeworms attached to the intestines of cows
(c) Relationship between barnacles and whales
(d) All of the above

27. Lichens are a symbiotic relationship between

1. Fungi
2. Bacteria
3. Algae
4. Virus

Select the correct answer using the codes given below.

- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 4 only (d) 3 and 4 only

28. The speed of decomposition of organic matter is determined by which of these major factors?

1. Soil organisms
2. Temperature conditions
3. Moisture conditions
4. Quality of the organic matter

Select the correct answer using the codes given below.

- (a) 1 and 2 only (b) 2, 3, and 4 only
(c) 3 and 4 only (d) 1, 2, 3, and 4

29. What symbiotic relationship is exemplified by lichens?

- (a) Algae provides shelter, water, and minerals; fungus provides food
(b) Fungus provides shelter, water, and minerals; algae provides food
(c) Fungus provides minerals and bacteria provides decayed matter to fungi
(d) Bacteria provides protection against parasites; algae provides food

Bio-geochemical Cycle

30. Which of the following clearly shows the importance of carbon dioxide in earth's atmosphere?

1. It is essential for the growth of plants.
2. It is the most abundant gas in the atmosphere after nitrogen and oxygen.
3. It absorbs the heat directly incoming from the sun thus warming the planet.
4. Ocean absorbs carbon dioxide from the atmosphere to form carbonate rocks.

Select the correct answer using the codes given below.

- (a) 1 and 4 only (b) 2 and 3 only
(c) 1, 3, and 4 only (d) 1, 2, 3, and 4

31. Consider the following statements.

Assertion (A): Most living organisms can only make use of reactive nitrogen and not the diatomic nitrogen present in the atmosphere.

Reason (R): Breaking the triple bond holding the two nitrogen atoms together requires a large amount of energy which can be mustered only by select microorganisms or processes.

In the context of the above, which of these is correct?

- (a) A is correct, and R is an appropriate explanation of A.
(b) A is correct, but R is not an appropriate explanation of A.
(c) A is correct, but R is incorrect.
(d) Both A and R are incorrect.

32. With reference to bio-geochemical cycles, which of the following are gaseous cycles?

- (a) Carbon cycle (b) Phosphorus cycle
(c) Water cycle (d) Both (a) and (c)

33. Which of the following add(s) carbon dioxide to the carbon cycle on the planet Earth?

1. Volcanic eruptions
2. Respiration
3. Photosynthesis
4. Decay of organic matter

Select the correct answer using the codes given below.

- (a) 1 and 3 only (b) 2 only
(c) 1, 2, and 4 only (d) 1, 2, 3, and 4

- 34.** Phosphorus plays a central role in aquatic ecosystems and water quality. This is because

1. Phosphorus cycle is largely atmospheric and easily dissolves in water from air.
2. Phosphorus is responsible for excessive growth of rooted and free-floating microscopic plants in water bodies.

Which of the above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 35.** What are the sources that add nitrogen oxides (NO_x) into the atmosphere?

1. Bacteria living in soil
2. Reaction of ultraviolet radiation with ozone
3. Lightning stroke

Select the correct answer using the codes given below.

- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2, and 3

- 36.** Consider the following with reference to the sulphur cycle.

1. Most of the sulphur in the cycle comes from the atmosphere.
2. Mineralization of organic sulphur into inorganic forms is an important part of the cycle.
3. Microbial process converts some forms of sulphur into another indicating that sulphur is accessible by microorganisms.

Select the correct answer using the codes given below.

- (a) 1 only (b) 1, 2, and 3
(c) 2 and 3 only (d) 1 and 3 only

- 37.** Consider the following.

1. Evaporation

2. Transpiration
3. Condensation

Which of the above processes is/are part of the water cycle on earth?

- (a) 1 and 2 only
(b) 2 only
(c) 2 and 3 only
(d) 1, 2, and 3

- 38.** Which of the following play a role in the nitrogen cycle on earth?

1. Blue-green algae
2. Lightning
3. Uptake of soil nutrients by plants
4. Terrestrial food chain

Select the correct answer using the codes given below.

- (a) 1, 2, and 3 only (b) 1, 2, 3, and 4
(c) 1, 2, and 4 only (d) 3 and 4 only

- 39.** The nitrogen cycle is of particular interest to ecologists because

1. Nitrogen availability can affect the rate of key ecosystem processes such as primary production.
2. Nitrogen is an important component of complex molecules such as amino acids that form the building blocks of life.

Which of the above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 40.** Which of the following is not a gaseous type of cycle?

- (a) Nitrogen cycle
(b) Carbon cycle
(c) Phosphorous cycle
(d) None of the above

Ecological Succession

- 41.** Consider the following statements with reference to ecological succession.

1. Autogenic succession refers to succession brought about by living inhabitants of that community itself.
2. Allogenic succession refers to succession brought about by outside forces.

Select the correct statements using the codes given below.

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 42.** With reference to ecological succession, consider the following statements.

1. The first plants to colonize an area are known as the pioneer community.
2. The final stage of succession is called the climax community.
3. Allogenic succession is driven by the biotic components of the ecosystem.

Which of the statements given above is/are correct?

- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 only (d) 1, 2, and 3

- 43.** Lichen is a pioneer species. What do you understand by this statement?
- (a) It has the ability to form symbiotic relation with a large number of species.
 - (b) It can live in inhospitable climatic conditions.
 - (c) It contributes substantially to nutrient recycling in the ecosystem.
 - (d) It is, generally, one of the first species to colonize an ecosystem.

- 44.** Consider the following statements with reference to ecological succession.

1. It can occur in lifeless areas.
2. A climax community results when the web of biotic interactions becomes so intricate that no other species can be admitted.

Which of the statements given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 45.** Primary ecological succession is likely to occur in a region in which

1. Lava flows have occurred.
2. Rocks are left from a retreating glacier.
3. Fires have occurred.

Select the correct answer using the codes given below.

- (a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2, and 3

Ecological Terms and Concepts

- 46.** Ecosystem is formed, most appropriately, by the interaction of
- (a) Both biotic and abiotic factors of the environment.
 - (b) All living organisms present in the system.
 - (c) Diverse landforms found within a large zone.
 - (d) Communities found near the edge of a biome.
- 47.** A biomarker is generally used as an indicator of
- (a) Increase in the size of a biome.
 - (b) Biodiversity of an ecosystem.
 - (c) Diseases in an organism.
 - (d) Phenotype and genotype of a microbe.

- 48.** Consider the following statements regarding productivity of organisms.
1. Primary productivity is defined as the rate of formation of new organic matter by the major 'consumers' of the ecosystem.
 2. Primary productivity depends on the plant species inhabiting a particular area, environmental factors, and availability of nutrients and photosynthetic capacity of plants.

Which of the above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 49.** The terms 'absorptive capacity' and 'carrying capacity' are used in the discourse of
- (a) Evolutionary biology.
 - (b) Geographical determinism.
 - (c) Employment elasticity.
 - (d) Sustainable development.

- 50.** Consider the following statements.

1. An ecological niche is the unique functional role or place of a species in an ecosystem.
2. No two species have exact identical niches.

Which of the above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 51.** Which of these is the most productive ecosystem in terms of primary productivity per unit area?

- (a) Algal bed and coral reefs
- (b) Cultivated land
- (c) Temperate forests
- (d) Savannah

- 52.** pH determines the proliferation of any microbial species in a particular environment and the rate at which it can reproduce. Consider the following statements with reference to this.

1. Most blue-green bacteria prefer an acidic environment.
2. Fungi generally prefer an alkaline environment.
3. The optimum pH of most bacteria and protozoa is near neutrality.

Select the correct answer using the codes given below.

- (a) 1 and 2 only (b) 3 only
(c) 1 and 3 only (d) 1, 2, and 3

- 53.** With reference to the keystone species, consider the following statements.

1. It has a disproportionately large effect on its natural environment relative to its abundance.
2. Sea otter is considered an example of keystone species.

Which of the statements given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 54.** With reference to the ecological niche, consider the following statements.

1. It is the role and position a species has in its environment.
2. Each species have a distinct niche.

Which of the statements given above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 55.** What do you understand by an indicator species?

- (a) Its status provides information on the overall health of the ecosystem.
- (b) It is a keystone species of an ecosystem without which the local food chain may collapse.
- (c) It is an endemic species that is at the lowest level of the food chain.
- (d) It is a representative species of all species that are threatened or endangered in the ecosystem.

- 56.** What is a biotope?

- (a) It is a well-defined geographical area, characterized by specific ecological conditions.
- (b) It is an ecosystem that supports the genetic mutation of a contiguous ecosystem.
- (c) It is a biome that harbours all species of the same phenotype.
- (d) It is a community of species that reproduces entirely by asexual reproduction.

- 57.** How is landscape connectivity between different protected areas crucial?

1. It helps to ensure natural seasonal migration pattern of species.
2. It increases the quality and diversity of available habitat that is crucial for species survival.

Which of the above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

- 58.** Ecozones are a method of dividing up the earth's surface based on

- (a) Common evolutionary history.
- (b) Niche habitats of exotic species.
- (c) Endemism and variety.
- (d) Geographic landscapes.

- 59.** Which of these is/are crucial in the transition of an economy to 'green economy'?

1. Conservation of biodiversity
2. Reducing carbon emissions and pollution
3. Promoting consumption with sole focus on economic growth

Select the correct answer using the codes given below.

- (a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1 and 3 only

- 60.** What do you understand by the term 'social forestry'?

1. Reducing pressure on the traditional forest area by encouraging plantations on community land
2. Promoting commercial harvesting of timber and non-timber products from traditional forests by community to meet local demands

Which of the above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

61. An ecotype is a population that
1. Plays a specific functional 'keystone' role in an ecosystem.
 2. Has remained endemic to a particular ecological niche for a long period of time on evolutionary scales.
 3. Carries genes to successfully adapt to local environmental conditions.

Select the correct answer using the codes given below.

- (a) 1 only (b) 1 and 2 only
(c) 3 only (d) 2 and 3 only

62. As an ecological phenomenon, a trophic cascade is definitely caused when
- (a) Secondary succession immediately follows primary succession.
 - (b) Top predators are removed from an ecosystem.
 - (c) Human demand on resources exceeds what earth can regenerate each year.
 - (d) Energy flowing through the food chain is a constant.

63. If patches of green are seen amidst huge bodies of water, that signals presence of phytoplankton. A large such patch would signify that
- (a) The primary productivity of that water region is high.
 - (b) The region is oxygen deprived.
 - (c) The prevailing water is unusually hot.
 - (d) No waves or currents are found in its vicinity.

64. The philosophy of environmentalism advocates that

1. One should learn to live in harmony with the rhythms of the ecosystem.
2. Humans should not manipulate the natural environment to serve their immediate interests.
3. There is no way humans can preserve or restore the nature to its undisturbed form.

Select the correct answer using the codes given below.

- (a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1 only

65. What is land footprint in ecology?
- (a) Area of land that is used to grow feed for animals within a country
 - (b) The proportion of built-up land as against the unused land

- (c) The percentage of land to grow crops to the non-crop land
- (d) Amount of land that is needed to produce a product by an organization or a nation

66. With reference to ecological value, consider the following statements.

1. It is a monetary assessment of minimum requirements for ecosystem service provision.
2. It includes assessment of ecosystem integrity, health, and resilience.
3. It accrues to both humans and non-humans.

Select the correct answer using the codes given below.

- (a) 1 only (b) 1 and 2 only
(c) 1, 2, and 3 (d) 2 and 3 only

67. What do you understand by ecological footprint?

- (a) The way in which ecological agents reveal their preferences through ecological activity
- (b) A degree of impairment to an ecosystem, which when surpassed is too severe to allow recovery of that ecosystem
- (c) An index of the area of a productive ecosystem required to produce the resources used and to assimilate the wastes produced by a defined population
- (d) Non-monetary assessment of ecosystem integrity, health, or resilience

68. Humus is the dark organic matter that forms in the soil when plant and animal matter decays. Consider the following about it.

1. It contains nitrogen that is essential for plant growth and helps in nutrient retention.
2. It contributes to moisture retention in the soil by increasing microporosity.

Which of the above is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None

69. A phenotype usually results from the interaction of

- (a) Genotype and environment.
- (b) Ecosystem and biome.
- (c) Species and genotype.
- (d) Alleles and species.

Answers

12. (c)	13. (a)	14. (c)	15. (c)	16. (d)	17. (b)	18. (a)	19. (d)	20. (a)
21. (c)	22. (b)	23. (c)	24. (c)	25. (b)	26. (a)	27. (b)	28. (d)	29. (b)
30. (a)	31. (a)	32. (d)	33. (c)	34. (b)	35. (b)	36. (c)	37. (d)	38. (b)
39. (c)	40. (c)	41. (c)	42. (a)	43. (d)	44. (c)	45. (a)	46. (a)	47. (c)
48. (b)	49. (d)	50. (c)	51. (a)	52. (b)	53. (c)	54. (c)	55. (a)	56. (a)
57. (c)	58. (a)	59. (b)	60. (a)	61. (c)	62. (b)	63. (a)	64. (a)	65. (d)
66. (d)	67. (c)	68. (c)	69. (a)					

Explanation

12. The answer is (c).

Justification: A sequence of organisms that feeds on one another forms a food chain. The two main types of food chains found in nature are 'grazing food chain' and 'detritus food chain'.

The grazing food chain starts with producers or autotrophs as base, which is consumed by heterotrophs. It is found in both terrestrial and aquatic ecosystems.

The detritus food chain starts from dead organic matters of decaying plants and animals and then to detritus feeding organism called detritivores or decomposer and to other predators.

The waste and dead organic matter from the grazing food chain is the initial energy source for detritus food chain and these two food chains are interlinked with each other.

13. The answer is (a).

Justification: In a food chain, dinoflagellates and diatoms are producers. Copepods are primary consumers, ocean sunfish are secondary consumers and sharks are tertiary consumers.

14. The answer is (c).

Justification: Statement 1: Ecological pyramid is a 'graphical representation of relationship' between the organisms from different trophic levels of food chains. It is represented based on energy, number, and biomass productivity. The base of the upright pyramid is represented by the 'lowest trophic level, i.e., producers'. The next level is occupied by the primary consumer and so on. The tip is occupied by top carnivore of a food chain.

Statement 2: Pyramid of energy in an ecosystem is always upright as the energy flow in a food chain is always unidirectional and with increasing trophic level, some energy is lost as heat and respiration.

15. The answer is (c).

Justification and Learning: Pyramid of energy is a graphical representation of the amount of energy trapped per unit time and area in different trophic levels of a food chain. Pyramid of energy in an ecosystem is always upright as the energy flow in a food chain is always unidirectional and with increasing trophic level, some energy is lost as heat and respiration.

It follows 10% rule, that is, during each transfer about 90% of the energy available at lower trophic level is used up to overcome its entropy and to perform metabolic activities and only about 10% of the energy is available to the next trophic level.

16. The answer is (d).

Justification: Biological magnification or in general biomagnification means the 'increase of contaminated substances or toxic chemicals' that takes place in the food chains as the pollutants pass from lower trophic to higher trophic.

The pollutants are heavy metals such as mercury, arsenic, pesticides such as DDT, and polychlorinated biphenyls (PCBs). These compounds are taken up by organisms because of the food they consume from an intoxicated environment.

Pollutants need to satisfy characteristics such as having a long life and being biologically active and soluble in fat to make biomagnification possible.

17. The answer is (b).

Concept: The level of dissolved oxygen is an important indicator of water pollution.

Justification: Water pollution by biodegradable organic wastes is measured in terms of BOD. Whereas water pollution by both biodegradable and non-biodegradable organic wastes is measured in terms of COD. Hence COD is a better measure of water pollution than BOD.

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18. The answer is (a).

Justification: Mosses can be used as a low-cost bio indicator to monitor urban pollution and to measure the impact of atmospheric change. As a bio indicator, mosses respond to any change in environment in terms of pollution or drought-stress, by changing its shape, density, or even disappearing from the environment.

19. The answer is (d).

Learning: Generally, organic toxins are water insoluble and non-biodegradable. They are transferred from lower trophic level to higher trophic level through food chain and lead to biomagnification. Over time, the concentration of these toxins is highest in higher animals and reaches a level which causes serious metabolic and physiological disorders.

20. The answer is (a).

Learning: They reflect the quality and changes in environmental conditions as well as aspects of community composition. Following are some examples of indicator species.

- **Stoneflies:** Indicator of high oxygen water
- **Mosses:** Some mosses species indicate acidic soil and some monitor urban pollution
- **Lichens:** Some species of lichens indicate low air pollution
- **Fungi:** Some species of fungi can indicate old-growth forests where an abundance of coarse woody debris exists
- **Mollusca:** Can indicate water pollution status

21. The answer is (c).

Justification: Water pollution by biodegradable organic wastes is measured in terms of BOD. The quality of water can be measured by BOD as

- It provides an index to assess the discharged wastewater (nutrient discharge).
- A higher BOD value means greater amount of organic matter available for oxygen consuming bacteria.

Thus, both 1 and 2 are correct.

22. The answer is (b).

Justification: Amensalism is a type of biotic interaction where one species is harmed and the other is unaffected. For example, a large tree shades a small plant, retarding the growth of the small plant, whereas the small plant has no effect on the large tree.

23. The answer is (c).

Justification: Organisms living on this earth are interlinked to each other in one way or another, this interlinking between organisms is known as biotic

interaction. There are six major types of biotic interaction, which are:

- **Mutualism:** Both species benefit
- **Commensalism:** One species benefits, the other is unaffected
- **Competition:** Both species are harmed by the interaction
- **Predation and parasitism:** One species benefits, the other is harmed
- **Amensalism:** One species is harmed, the other is unaffected
- **Neutralism:** No net benefit or harm to either species

24. The answer is (c).

Justification: Everything that surrounds or affects an organism during its lifetime is collectively known as its environment, which comprises both living (biotic) and non-living (abiotic) components. The abiotic components are energy, fire, water, and soil, while the biotic components are green and non-green plants, animals, and parasites.

25. The answer is (b).

Justification: The interaction between leech and cattle is parasitic in nature. Hence statement 1 is wrong.

26. The answer is (a).

Justification and Learning: Mutualism means both species benefit from association with each other.

Option (a): It is a mutual relationship. The bacteria that live inside our gut get food from our intake and in turn help us digest the food.

Option (b): It is a parasitic relationship.

Option (c): It is an example of commensalism.

27. The answer is (b).

Justification: A lichen is not a single organism, rather a symbiosis between a fungus and an alga or cyanobacterium. Fungus and alga are in a symbiotic relationship.

28. The answer is (d).

Justification: The factors that affect the decomposition of organic matter are

- Soil organisms or other decomposers
- Temperature
- Moisture
- Quality of organic matter

Hence, all the given options are correct.

29. The answer is (b).

Justification: Lichens is a symbiosis of fungus and alga. Fungus is incapable of making its own food and

depends on alga for food. In turn fungus provides shelter, water, and minerals to alga.

30. The answer is (a).

Justification: Statement 1: Green plants use CO_2 gas to prepare their food through photosynthesis.

Statement 2: Argon is the next abundant gas after nitrogen and oxygen. Hence statement 2 is wrong.

Statement 3: Carbon dioxide in the atmosphere absorbs outgoing infrared radiations radiated by earth. Hence statement 3 is wrong.

Statement 4: Carbon dioxide (CO_2) is absorbed from atmosphere by oceans. After this absorption, chemical reactions occur in the oceans and reduce seawater pH, carbonate ion concentration, and saturation states of biologically important calcium carbonate minerals.

31. The answer is (a).

Justification and Learning: Nitrogen is the most abundant gas in atmosphere and more than 99% of it occurs as molecular nitrogen (N_2). This molecular nitrogen cannot be used by most organisms because breaking the triple bond holding the two nitrogen atoms together requires a large amount of energy, which can be mustered only through high-temperature processes or by a small number of nitrogen-fixing microbes. Hence most of the living organisms make use of reactive nitrogen.

32. The answer is (d).

Justification: Bio-geochemical cycle is the circulation of elements or mineral nutrients from non-living to living and then back to non-living in the form of a cycle. There are two types of cycles based on the nature of reservoir, namely gaseous and sedimentary.

Examples of gaseous cycle are carbon cycle, water cycle, nitrogen cycle, etc. Here the reservoir is atmosphere or hydrosphere.

Examples of sedimentary cycle are phosphorus cycle, sulphur cycle, etc. Here the reservoir is earth's crust.

33. The answer is (c).

Justification: Volcanic eruptions, respiration, and decay of organic matter adds carbon dioxide to the carbon cycle. Whereas photosynthesis, removes carbon dioxide from the carbon cycle.

34. The answer is (b).

Justification: Statement 1: If you understand the phosphorous cycle, you can easily mark statement 1 as incorrect. Phosphorous cycle is an example of sedimentary cycle. Its cycle is mainly terrestrial.

Statement 2: Being an important nutrient, phosphorous promotes eutrophication in lakes. Along with nitrogen related compounds it leads to undesirable situations like algal bloom.

35. The answer is (b).

Justification: Statement 1: Nitrous oxide emissions occur naturally through many sources such as plants, animals, and microorganisms that live in soil and water. So, statement 1 is correct. But there are certain bacteria which can remove NO_x from atmosphere. So in general, bacteria can both add or remove nitrogen from the atmosphere.

Statement 2: Nitrous oxide is actually removed from the atmosphere when it is destroyed by ultraviolet radiation or chemical reactions. So, 2 is wrong.

Statement 3: A natural source of nitrogen oxides occurs from a lightning stroke.

36. The answer is (c).

Justification: Statement 1: Sulphur cycle is sedimentary cycle. Hence statement 1 is wrong.

Statement 2: The process of sulphur cycle is

- Mineralization of organic sulphur into inorganic forms
- Oxidation of hydrogen sulphide, sulphide, and elemental sulphur (S) to sulphate
- Reduction of sulphate to sulphide
- Incorporation of sulphide into organic compounds

Statement 3: Uptake and release of sulphate by microorganisms, to convert it into various sulphur intermediates, and ultimately to sulphide which is released from the cell.

37. The answer is (d).

Justification: Water is a hydrological cycle. The important processes that are involved in the water cycle are evaporation, transpiration, condensation, precipitation, and runoff.

38. The answer is (b).

Justification: Nitrogen is one of the essential constituents of all living organisms as part of proteins, chlorophyll, nucleic acids, and vitamins.

Statements 1 and 3: There are certain nitrogen fixing bacteria and blue green algae present in the soil that fix nitrogen in the atmosphere. These fixed nitrogens are utilized by plants from the soil through their root system.

Statement 2: Lightning also fixes atmospheric nitrogen.

Statement 4: One of the essential constituents of all living organisms is nitrogen as it forms a part of proteins, chlorophyll, nucleic acids, and vitamins. Hence it is an important component in the formation of biomass and the terrestrial food chain.

39. The answer is (c).

Justification: Statement 1: Nitrogen is a major nutrient required for the survival of plants and phytoplankton, and the nutrient later gets recycled via their decomposition.

Statement 2: One of the essential constituents of all living organisms is nitrogen as it forms a part of proteins, chlorophyll, nucleic acids, amino acids, and vitamins.

40. The answer is (c).

Justification: Nutrient cycle is the description of use, movement, and recycling of nutrients in the environment. It plays a major role in making nutrients available to organisms by way of recycling. The major nutrient cycles are carbon cycle, nitrogen cycle, oxygen cycle, and phosphorous cycle. All these cycles except phosphorous circulate mainly through atmosphere and hence are gaseous cycles. Whereas phosphorus is circulated mainly through soil, rocks, water, and living organisms. Phosphorus is added to soil and water by runoff resulting from the weathering of rocks that contain phosphates. Hence, it is a sedimentary cycle.

41. The answer is (c).

Justification: There are two types of succession on the basis of factors causing succession.

'Autogenic succession' is a succession brought about by the living inhabitants of that community itself.

'Allogenic succession' is a succession brought about by outside forces. The forces can be

- Flooding
- Volcanic eruptions and earthquakes
- Meteor or comet strikes
- Drought

42. The answer is (a).

Justification: The gradual process by which ecosystems change and develop over time is known as ecological succession.

Statement 1: Pioneer community are the plants which colonise the area for the first time.

Statement 2: The successive stages are known as seral community and the final stage is known as the climax community.

Statement 3: Allogenic succession is a succession brought about by outside forces. The forces can be

- Flooding
- Volcanic eruptions and earthquakes
- Meteor or comet strikes
- Drought

43. The answer is (d).

Justification: In any ecosystem, there are a series of steps which lead to its enrichment, i.e., ecological succession takes place in a series of stages. Most ecosystems will start from purely inorganic material such as rocks. Only a few organisms such as lichens are capable of surviving in such an inhospitable area. The plants which colonise the area for the first time are known as pioneer community or pioneer species.

Lichens is therefore a pioneer species since growth in its population will give rise to the entire ecosystem biodiversity in a series of steps. As a symbiotic relationship between an alga and a fungus, a lichen can survive considerable drying out.

44. The answer is (c).

Justification: There are two types of ecological succession.

- **Primary succession:** This type of succession essentially occurs in a lifeless area. These are the regions which are incapable of sustaining life. These regions are formed by volcanic eruptions, sand dunes, etc. Hence statement 1 is correct.
- **Secondary succession:** This type of succession occurs in areas where a community that previously existed has been removed by disturbances but all life and nutrients have not yet been eliminated from the environment.

Statement 2: Climax community forms the part of climax stage of succession. When the web of biotic interactions becomes so intricate that no other species can be admitted, then the existing ecological community is known as the climax community.

45. The answer is (a).

Justification: Primary succession essentially occurs in a lifeless area. These are the regions which are incapable of sustaining life. These regions are formed by volcanic eruptions, sand dunes, etc. Hence statements 1 and 2 are correct.

Secondary succession occurs in regions which are affected by disturbances such as a fire or a flood.

46. The answer is (a).

Justification: The system formed by the interaction of all living organisms (biotic) with each other and with the physical and chemical factors (abiotic) of the environment in which they live is known as ecosystem.

47. The answer is (c).

Learning: A biomarker is a biological molecule found in blood, other body fluids, or tissues that is a sign of a normal or abnormal process, or of a condition or disease. It can also be a substance whose detection indicates a particular disease state.

48. The answer is (b).

Justification: Statement 1: The rate of formation of new organic matter by consumers is known as secondary productivity. Hence statement 1 is wrong. Whereas the rate of formation of new organic matter by plants (producers) is known as primary productivity.

Statement 2: The factors that affect primary productivity are

- Plant species inhabiting a particular area
- Availability of nutrients
- Photosynthetic capacity of plants

49. The answer is (d).

Learning: The environment is able to perform ecological functions without any interruption as long as these functions are within the carrying capacity of that environment. This means that resource extraction is not above the rate of regeneration of the resource and the wastes generated are within the assimilating capacity of the environment.

50. The answer is (c).

Justification: An ecological niche is the unique functional role or place of a species in an ecosystem. The ecological niche is the description of all the biological, physical, and chemical factors that a species needs to survive, stay healthy, and reproduce in an environment. The ecological niche is unique for each species and no two species can have identical and exact niches.

51. The answer is (a).

Learning: The following table shows the most productive ecosystem in terms of primary productivity per unit area.

Ecosystem Type	Primary Productivity (Per Unit Area)
Algal bed and reef	2500
Cultivated land	650
Temperate forest	1200
Savannah	900

52. The answer is (b).

Justification: Different microorganisms require different environments such as varied temperature,

light, levels of oxygen, and pH level. Some microbes grow faster in environments with extremely low pH values. The optimum pH for most bacteria and protozoa is near neutrality. Hence statement 3 is correct.

Fungi generally prefer an acidic environment whereas blue-green bacteria generally prefer an alkaline environment. Hence statements 1 and 2 are wrong.

53. The answer is (c).

Justification: A keystone is that stone in an arch's crown that secures the other stones in place. In many ecological communities, keystone species also act like a keystone by maintaining the structure and integrity of the community.

If the population of the keystone species in an ecosystem changes or diminishes, then the ecosystem would be dramatically different or it may even cease to exist altogether. No other species will be able to replace the ecological niche of a keystone species. They are not always the largest or most abundant species in an ecosystem. Sea otter is considered as an example of keystone species.

54. The answer is (c).

Justification: An ecological niche is the unique functional role or place of a species in an ecosystem. The ecological niche is the description of all the biological, physical and chemical factors that a species needs to survive, stay healthy and reproduce in an environment. The ecological niche is unique for each species and no two species can have identical and exact niches.

55. The answer is (a).

Learning: Indicator species provide information on the overall conditions of an ecosystem and reflect the quality and changes in environmental conditions as well as aspects of community composition. River otters (*Lontra canadensis*) can be an indicator species of clean rivers or presence of too much algae can be the indication of toxicity in a marine ecosystem.

56. The answer is (a).

Justification and Learning: Biotope is a well-defined geographical area, characterized by specific ecological conditions. The whole area has uniformity in environmental conditions and distribution of animal and plant life.

57. The answer is (c).

Justification: One of the most commonly cited threats to species extinction and an ensuing loss of biological diversity is habitat fragmentation, making it perhaps the most important contemporary conservation issue. Loss of connectivity between contiguous

ous protected areas can reduce the size and quality of available habitat, impede and disrupt movement of organisms to new habitats, and also affect their seasonal migration patterns. These changes can decrease carrying capacity of the ecosystem, lead to loss of genetic variation and ultimately species extinction.

58. The answer is (a).

Learning: A large area that contains a number of habitats, which are linked by the evolutionary history of the animals and plants within them is known as ecozone. An example of ecozone is Australasia, because the marsupials in this area evolved in isolation to mammals in the rest of the world.

59. The answer is (b).

Justification: A green economy is an economy whose growth in income and employment is driven by public and private investments that promote sustainable development and help in overcoming the deeply rooted causes of unsustainable economic development.

Three priorities in transition of economy to green economy are

- decarbonizing the economy;
- committing the environmental community to justice and equity; and
- conserving the biosphere.

60. The answer is (a).

Justification: The term 'social forestry' was first used by the National Commission on Agriculture, Government of India in 1976. Social forestry means managing and protecting forests and afforesting on barren lands to help in environmental, social, and rural development. The main aim of social forestry is to raise plantations by the common man so as to meet the growing demand for 5Fs: food, fuel, fodder, fibre, and fertilizer and reduce pressure on the traditional forest area.

Statement 2: It does not aim at displacement or exploitation of traditional forests, but at supplementing them with community grown forests. So, statement 2 is wrong.

61. The answer is (c).

Justification: Species that suit the description in Statement 1 are known as keystone species. Those suiting Statement 2 description are more similar to those living in ecological niches.

Statement 3: An ecotype is a population that has successfully adapted to local environmental conditions. The individuals in these ecotypes carry genes that are partly responsible for their success in that en-

vironment and the adaptation is based on the interactions of their own special sets of genes with their own environment.

62. The answer is (b).

Justification and Learning: Trophic cascade is an ecological phenomenon triggered by the addition or removal of top predators. With the change in population of top predator, there are reciprocal changes in the relative populations of predator and prey through a food chain. These changes often result in dramatic changes in the ecosystem structure and the nutrient cycle.

63. The answer is (a).

Justification and Learning: Phytoplankton, also known as microalgae, are similar to terrestrial plants in that they contain chlorophyll and require sunlight in order to live and grow. Phytoplankton are producers and form the base of several aquatic food webs. They are buoyant and float in the upper part of the ocean, where sunlight penetrates the water.

64. The answer is (a).

Justification: Statements 1 and 2: Environmentalists maintain that human beings should learn to live in harmony with the rhythms of the ecosystem and not manipulate the natural environment to serve their immediate interests. Environmentalism is an attempt to balance the relations between humans and the natural ecosystems on which they depend.

Statement 3: It does not say that we cannot restore the environment.

65. The answer is (d).

Learning: Land footprint is a consumption-based indicator, which looks at the resources needed to create a final product by an organization or a country.

66. The answer is (d).

Justification: The 'non-monetary' assessment of ecosystem integrity, health, or resilience is known as 'ecological value'. All of these indicators are crucial to determine critical thresholds and minimum requirements for ecosystem service provision. It is non-monetary because the value of ecology is evaluated in terms of its intrinsic value as a part of the earth, and not because it provides secondary benefits that can be capitalized by humans. For example, the value of pollination by bees can hardly be measured monetarily, and is beneficial to both humans and non-humans.

67. The answer is (c).

Justification: According to Millennium Eco Assessment, ecological footprint is an index of the area of productive ecosystems required to produce the re-

sources used and to assimilate the wastes produced by a defined population. Ecological footprint analysis is used in support of sustainability assessments and to measure and manage the use of resources throughout the economy. It is also used to explore the sustainability of individual lifestyles, industry sectors, neighbourhoods, cities, and nations.

68. The answer is (c).

Learning: Humus has a uniformly dark, spongy, and jelly-like appearance. It is organic due to accumulation of organic carbon. The process of humification occurs naturally in soil but it can also be induced artificially in the production of compost. Humus is a source of nutrients to microbes. It provides a readily available supply of nutrients, and also acts as a

longer-term storage reservoir of nutrients. It contributes to moisture retention in the soil by increasing micro porosity.

69. The answer is (a).

Concept and Learning: The phenotype of an organism is a result of the expression of an organism's genetic code, its genotype, as well as the influence of environmental factors on the organism and the interactions between the environment and the genotype. Phenotypic variation is a fundamental prerequisite for evolution by natural selection. The interaction between genotype and phenotype has often been conceptualized by the following relationship.

Genotype (G) Environment (E) → Phenotype (P)