Organisms and Populations

OBJECTIVE TYPE QUESTIONS

Multiple Choice Questions (MCQs)

1. Niche is

(a) all the biological factors in the organism's environment
(b) the physical space where an organism lives
(c) the range of temperature that the organism needs to live
(d) the functional role played by the organism where it lives.

2. Presence of plants arranged into well defined vertical layers depending on their height can be seen best in

(a) tropical rainforest (b) grassland
(c) temperate forest (d) tropical savannah.

3. Match mean annual precipitation in column I with the biome in column II and choose the right option.

Column I	Column II
(i) 0-50 cm	A. Tropical forest
(ii) 50-100 cm	B. Coniferous forest
(iii) 150-400 cm	C. Grassland
(iv) 50-250 cm	D. Desert

(a) (i)-D (ii)-C (iii)-A (iv)-B
(b) (i)-C (ii)-A (iii)-B (iv)-D
(c) (i)-C (ii)-D (iii)-A (iv)-B
(d) (i)-B (ii)-D (iii)-A (iv)-C

4. Plants requiring low light intensity for optimum photosynthesis are called

(a) heliophytes (b) pteridophytes
(c) sciophytes (d) bryophytes.

5. –1°C to 13°C annual variations in the intensity and duration of temperature and 50 to 250 cm annual variation in precipitation, account for the formation of a major biome as

(a) temperate forest (b) coniferous forest
(c) tropical forest (d) grassland.

6. Pneumatophores occur in

(a) halophytes
(b) free-floating hydrophytes
(c) carnivorous plants
(d) submerged hydrophytes.

7. Organisms possessing strong and stout forelimbs with clawed digits show _____ adaptations.

(a) arboreal (b) cursorial
(c) fossorial (d) volant

8. Some desert beetles can survive on "metabolic water", without ever drinking liquid water which

(a) is a breakdown product of pyruvate inside the mitochondria, along with carbon dioxide
(b) was produced as water in the organisms they eat
(c) is a breakdown product from glycolysis in the cytoplasm
(d) is absorbed from the air along with respiratory oxygen.

9. Which one of the following is the specific xerophytic adaptation?

(a) Presence of spines
(b) Absence of stomata
(c) Presence of long tap root system
(d) Presence of stipular leaves

10. Which of the following statements regarding responses of organisms to abiotic factors is false?

(a) All birds and mammals are capable of thermoregulation.
(b) Majority of animals and nearly all plants cannot maintain a constant internal environment.
(c) Shivering is a kind of exercise which produces heat and raises body temperature.

(d) Very small animals are commonly found in polar regions as they have to spend less energy to generate body heat.

11. The success of mammals on earth is largely because

(a) they have the ability to maintain constant body temperature
(b) they can conform to the changes in the environment
(c) they can take care of their young ones as they have mammary glands to suckle them
(d) they can reduce metabolic activity and go into a state of dormancy during unfavourable conditions in the environment.

12. Which one of the following refers to Allen's rule?

(a) An organism can move from a stressful habitat to a more hospitable area and return when the stressful period is over.
(b) If the stressful conditions are localised or remain only for a short duration, an organism either migrates or suspends itself.
(c) Low atmospheric pressure in higher altitudes results in altitude sickness.
(d) Mammals from colder climates have shorter ears and limbs to minimize heat loss.

13. Which one of the following is not a parasitic adaptation?

(a) Development of adhesive organs
(b) Loss of digestive organs
(c) Loss of reproductive capacity
(d) Loss of unnecessary sense organs

14. The stage of suspended development shown by zooplanktons is called

(a) desiccation (b) diapause
(c) hibernation (d) homeostasis

15. Consider the following statements (A-D) each with one or two blanks.

(A) Bears go into __(1)__ during winter to __(2)__ cold weather.
(B) A conical age pyramid with a broad base represents ____(3)__ human population.
(C) A wasp pollinating a fig flower is an example of __(4)__.
(D) An area with high levels of species richness is known as __(5)__.

Which one of the following options, gives the correct fill ups for the respective blank numbers from (1) to (5) in the statements?

(a) (3)-stable, (4)-commensalism, (5) marsh
(b) (1)-aestivation, (2)-escape, (3)-stable, (4)-mutualism
(c) (3)-expanding, (4)-commensalism, (5)-biodiversity park
(d) (1)-hibernation, (2)-escape, (3)-expanding (5)-hot spot

16. Select the incorrect statement.

(a) An overwhelming majority of animals and nearly all plants maintain a constant internal temperature.
(b) An orchid growing as an epiphyte on a mango branch is an example of commensalism.
(c) In brood parasitism, the parasitic bird lays its eggs in the nest of its host and lets the host to incubate them.
(d) Very small animals are rarely found in polar regions.

17. Match the following and select the correct option.

Column I	**Column II**
A. Bears	1. Diapause
B. Snail	2. Hibernation
C. Zooplanktons	3. Dormancy
D. Seeds	4. Aestivation

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

18. In a growing population of a country,

(a) pre-reproductive individuals are more than the reproductive individuals
(b) reproductive individuals are less than the post-reproductive individuals
(c) reproductive and pre-reproductive individuals are equal in number
(d) pre-reproductive individuals are less than the reproductive individuals.

19. Asymptote in a logistic growth curve is obtained when

(a) K = N
(b) K > N
(c) K < N
(d) the value of '*r*' approaches zero.

20. Select the correct statement.

(a) In a population, number of births is different from birth rate
(b) A sigmoid growth curve is depiction of exponential growth

(c) In a logistic growth curve the asymptote is beyond the carrying capacity

(d) '*r*' is equal to the difference between number of births and number of deaths in a population.

21. A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is

(a) 05 (b) zero

(c) 10 (d) 15.

22. Which of the following is correct?

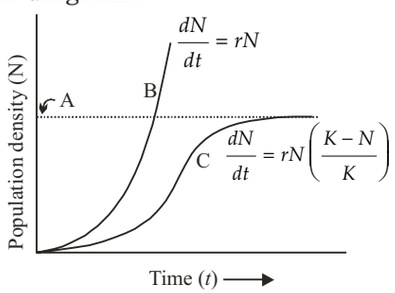
(a) Population change = (Birth + immigration) – (death + emigration)

(b) Population change = (Birth + immigration) + (death + emigration)

(c) Population change = (Birth + emigration) + (death – immigration)

(d) Population change = (Birth – immigration) – (death + emigration)

23. Which is correctly labelled with respect to the given diagram?



(a) B : Logistic curve

(b) C : Carrying capacity

(c) C : Exponential curve

(d) A : Carrying capacity

24. Match list I with list II and choose the correct option.

	List I		**List II**
A.	Pacific salmon fish	1.	Verhulst-Pearl Logistic growth
B.	$N_t = N_0 e^{rt}$	2.	Breeds only once in lifetime
C.	Oyster	3.	Exponential growth
D.	$dN/dt = rN\left(\frac{K-N}{K}\right)$	4.	A large number of small sized offsprings.

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

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

25. The formula of growth rate for population in given time is

(a) $dt/dN = rN$ (b) $dt/rN = dN$

(c) $rN/dN = dt$ (d) $dN/dt = rN$.

26. Between which among the following, the relationship is not an example of commensalism?

(a) Orchid and the tree on which it grows

(b) Cattle Egret and grazing cattle

(c) Sea Anemone and Clown fish

(d) Female wasp and fig species

27. If '+' sign is assigned to beneficial interaction, '–' sign to detrimental and 'O' sign to neutral interaction, then the population interaction represented by '+' '–' refers to

(a) mutualism (b) amensalism

(c) commensalism (d) parasitism.

28. Match the following.

	Population Interaction		**Example**
1.	Predation	A.	*Cuscuta* and hedge plants
2.	Commensalism	B.	*Balanus* and *Chthamalus*
3.	Parasitism	C.	Cactus and moth
4.	Competition	D.	Orchid and mango

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

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

29. Connel's field experiment on the rocky sea coast of Scotland, where larger barnacle *Balanus* dominates the intertidal area and removes the smaller barnacle *Chthamalus*. This happened due to

(a) parasitism (b) predation

(c) mutualism (d) competition.

30. All the following interactions are mutualism, except

(a) plant and animal relation for pollination

(b) association of algae and fungi in lichens

(c) association of cattle egret and grazing cattle

(d) association of fungi and roots of higher plants in mycorrhiza.

31. Gause's principle of competitive exclusion states that

(a) no two species can occupy the same niche indefinitely for the same limiting resources

(b) larger organisms exclude smaller ones through competition
(c) more abundant species will exclude the less abundant species through competition
(d) competition for the same resources exclude species having different food preferences.

32. Match column I with column II and select the correct option from the codes given below.

	Column I		**Column II**
A.	Commensalism	(i)	One inhibited, other unaffected
B.	Parasitism	(ii)	One benefitted, other unaffected
C.	Mutualism	(iii)	Both are benefitted
D.	Amensalism	(iv)	One benefitted, other harmed

(a) A-(iv), B-(ii), C-(iii), D-(i)
(b) A-(iii), B-(iv), C-(ii), D-(i)
(c) A-(ii), B-(iv), C-(iii), D-(i)
(d) A-(ii), B-(iv), C-(i), D-(iii)

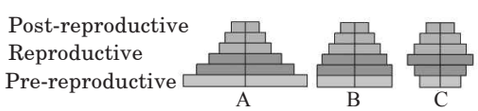
33. Carnivorous animals lions and leopards, occupy the same niche but lions predate mostly larger animals and leopards take smaller ones. This mechanism of competition is referred to as

(a) character displacement
(b) altruism
(c) resource partitioning
(d) competitive exclusion.

34. A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is

(a) 05 (b) zero
(c) 10 (d) 15.

35. Select the correct option *w.r.t.* age pyramids.



(a) A-Expanding, B-Stable, C-Declining
(b) A-Stable, B-Expanding, C-Declining
(c) A-Stable, B-Declining, C-Expanding
(d) A-Declining, B-Stable, C-Expanding

36. Which one of the following population interactions is widely used in medical science for the production of antibiotics?

(a) Commensalism
(b) Mutualism
(c) Parasitism
(d) Amensalism

37. Which of the following statements is false regarding predators?

(a) Predators keep prey populations under control.
(b) Predators help in maintaining species diversity in a community.
(c) If a predator is not efficient, then the prey population would become extinct.
(d) Herbivores (predators) have a greater advantage since the plants cannot run away to avoid predation.

38. Which one of the following causes population explosion?

(a) Decrease in infant mortality rate and increase in death rate
(b) Decrease in death rate, maternal mortality rate and infant mortality rate
(c) Decrease in infant mortality rate and decrease in the number of people in reproductive age
(d) Decrease in death rate and increase in maternal mortality rate

39. Which one of the following is most appropriately defined?

(a) Host is an organism which provides food to another organism.
(b) Amensalism is a relationship in which one species is benefitted whereas the other is unaffected.
(c) Predator is an organism that catches and kills other organism for food.
(d) Parasite is an organism which always lives inside the body of other organism and may kill it.

40. Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition?

(a) *Azotobacter* (b) *Aspergillus*
(c) *Glomus* (d) *Trichoderma*

Case Based MCQs

Case I : Read the following passage and answer the questions from 41 to 45 given below.

Organism P has thick lips and tongue so that it can easily feed on the commonly available spiny plants. Organism Q has thick layer of insulating fat under the skin. It was strong hooves to walk steadily on steep surfaces and lives in burrows during winters. Organism R has bright colours and sticky pads on its fingers and toes. It lives on trees.

41. Which of the following is correct habitat for organisms P regarding its adaptation?

(a) Grassland biome (b) Desert biome
(c) Tropical rainforest
(d) Tropical deciduous forest

42. Which of the following is correct match regarding organism Q and its habitat?

(a) Tundra - Polar bear
(b) Tropical rain forest - Deer
(c) Grassland - Bighorn sheep
(d) Desert - Camel

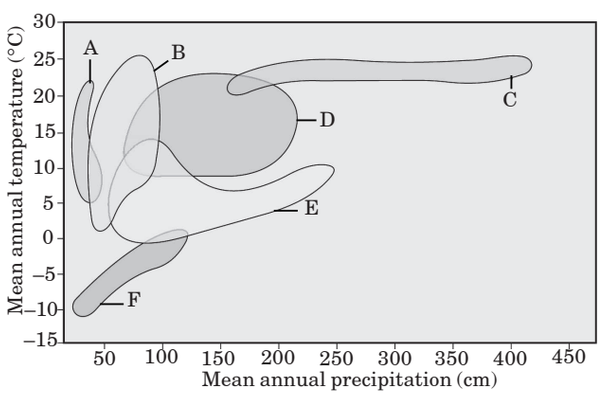
43. Which of the following is incorrect regarding organisms R's habitat?

(a) The vegetation shows stratification
(b) Epiphytic growth is rich
(c) Standing crop is highest
(d) Deep rooted shrubs are common due to abundant sunlight

44. The dominant plants in habitat where P lives could be

(a) *Opuntia* (b) *Nymphaea*
(c) *Deodar* (d) both (a) and (c).

45. Organisms P, Q and R respectively most likely occur in



(a) F, B and A (b) C, A, E
(c) A, F and C (d) B, D and A.

Case II : Read the following passage and answer the questions from 46 to 50 given below.

Growth of a population with time shows specific and predictable patterns. Two types of growth patterns of population are exponential and logistic growth. When resources in the habitat are unlimited each species has the ability to realise fully its innate potential to grow in number. Then the population grows in exponential fashion. When the resources are limited growth curve shows an initial slow rate and then it accelerates and finally slows giving the growth curve which is sigmoid.

46. Which of the following statement is incorrect?

(a) Exponential growth occurs in organism such as lemmings.
(b) Logistic growth is more realistic.
(c) Exponential growth has two phases lag and log.
(d) In logistic growth, population passes well beyond the carrying capacity of ecosystem.

47. Which of the following equations correctly represents the exponential population growth curve?

(a) $dN/dt = rN$ (b) $dN/dt = rN\left(\frac{K-N}{K}\right)$
(c) $N_t = N_0 e^{rt}$ (d) Both (a) and (c)

48. Which of the following equations correctly represents Verhulst-Pearl logistic growth?

(a) $dN/dt = rN\left(\frac{K-N}{K}\right)$ (b) $dN/dt = \frac{rN}{K}$
(c) $dN/dt = \frac{N(K-N)}{K}$ (d) $dN/dt = \frac{r(K-N)}{K}$

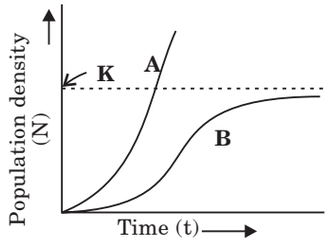
49. The population growth is generally described by the following equation:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

What does 'r' represent in the given equation?

(a) Population density at time 't'
(b) Intrinsic rate of natural increase
(c) Carrying capacity
(d) The base of natural logarithm

50. Study the population growth curves (A and B) in the given graph and select the incorrect option.



(a) Curve 'A' shows exponential growth, represented by equation $\frac{dN}{dt} = rN.$.

(b) Curve 'B' shows logistic growth, represented by equation $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$.

(c) Exponential growth curve is considered as more realistic than the logistic growth curve.

(d) Curve 'A' can also be represented by equation $N_t = N_0 e^{rt}$.

Assertion & Reasoning Based MCQs

For question numbers 51-60, two statements are given-one labelled Assertion and the other labelled Reason. Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

(b) Both assertion and reason are true but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false.

(d) Assertion is false but reason is true.

51. Assertion : Microclimate generally differs from the prevailing regional climatic conditions.

Reason : Microclimate represents the climatic conditions that prevail at local scale or in areas of limited size.

52. Assertion : Aerenchyma is present in the leaves and petioles of hydrophytes.

Reason : Aerenchyma imparts buoyancy to the hydrophytes.

53. Assertion : Ectotherms are able to remain active under cold conditions.

Reason : Ectotherms are unable to maintain a constant internal temperature.

54. Assertion : Many mangrove plants possess high levels of organic solutes.

Reason : This is an adaptation to cope with the conditions of high salt concentration and osmotic potential.

55. Assertion : With increase in population size, environmental resistance tends to increase.

Reason : This is a nature's way to check the expression of biotic potential.

56. Assertion : The soil profiles of grassland, forest and desert biomes differ from each other.

Reason : Soil profile develops due to weathering process, accumulation of organic matter and leaching of mineral matter.

57. Assertion : Heliophytes, generally have low photosynthetic, respiratory and metabolic activities.

Reason : Heliophytes are the sun adapted plants which are adapted to high intensity of light.

58. Assertion : Mycorrhizal relation exists between *Boletus* and *Pinus*.

Reason : Mycorrhizal association is a symbiotic interaction.

59. Assertion : Mimicry is the resemblance of one organism to another.

Reason : Mimicry may be protective or aggressive.

60. Assertion : Phytoplanktons grow in abundance in the profundal zone of lake.

Reason : Profundal zone is the dark zone where light does not reach.

SUBJECTIVE TYPE QUESTIONS

Very Short Answer Type Questions (VSA)

1. Soil horizons A and B represent solum. Why?

2. Plants like *Calotropis* have evolved adaptations for defence against grazers. Explain.

3. Name the type of interaction that exists between barnacles and whale.

4. When and why do some animals like frogs hibernate?

5. In a population, per capita birth rate is 0.025 and per capita death rate is 0.008 during a unit time period. What is the value of intrinsic rate of natural increase, 'r' for the population?

6. When and why do some animals like snails go into aestivation?

7. Give one example where population estimation of an organism is done indirectly without actually counting the organism.

8. What is an interaction called when an orchid grows on a mango plant?

9. Give example of an organism that enters 'diapause' and why.

10. Give an example of drought escapers xerophytic plant.

Short Answer Type Questions (SA-I)

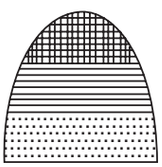
11. What type of interaction is seen when koel lays eggs in crow's nest?

12. If 8 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during that period.

13. Draw and explain expanding age pyramids of human population. Why is it so called?

14. Differentiate between the mutualism and competition.

15. What does the given age pyramid signify about the status of a population? (The bar at the base represents pre-reproductive individuals.)



16. Shark is eurythermal while polar bear is stenothermal. What is the advantage the former has and what is the constraint the later has?

17. Explain why very small animals are rarely found in polar region.

18. Explain parasitism and coevolution with the help of one example of each.

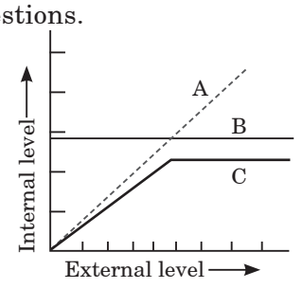
19. Why do clown fish and sea anemone pair up? What is this relationship called?

20. A species is introduced into a new habitat with favourable environment. What kind of population growth does it undergo on a long term basis? Describe briefly.

21. Why the plants that inhabit a desert are not found in a mangrove? Give reasons.

Short Answer Type Questions (SA-II)

22. Refer to the given graph and answer the following questions.



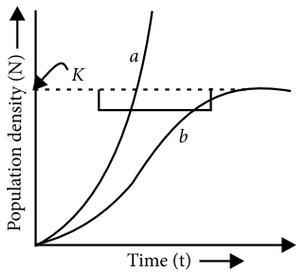
(a) What does the graph represent? Identify A, B and C.
(b) Differentiate between A and B.
(c) How organism C regulates their body functions?

23. Define the following:
(a) Ecological niche
(b) Gause's competitive exclusion principle
(c) Mimicry

24. **(a)** How are herbs able to grow on forest floors?
(b) What are osmoconformers?

25. Predation is usually referred to as detrimental association. State any three positive roles that a predator plays in an ecosystem.

26. Study the graph given below and answer the questions that follow :



(i) The curve '*b*' is described by the following equation:

$$\frac{dN}{dt} = rN\left\{\frac{K-N}{K}\right\}$$

What does '*K*' stand for in this equation? Mention its significance.
(ii) Which one of the two curves is considered a more realistic one for most of the animal populations?
(iii) Which curve would depict the population of a species of deer if there are no predators in the habitat? Why is it so?

27. Name and explain the type of interaction that exists in mycorrhizae and between cattle egret and cattle.

28. Explain Verhulst-Pearl Logistic Growth of a population.

29. When you go for a trek/trip to any high altitude places, you are advised to take it easy and rest for the first two days. Comment, giving reasons.

30. During a school trip to 'Rohtang Pass', one of your classmates suddenly developed 'altitude sickness'. But, she recovered after sometime.
(a) Mention one symptom to diagnose the sickness.
(b) What caused the sickness?
(c) How could she recover by herself after sometime?

31. Water is very essential for life. Write any three features both for plants and animals which enable them to survive in water scarce environment.

32. Differentiate between hibernation and aestivation. Give one example of each.

33. Some organisms suspend their metabolic activities to survive in unfavourable conditions. Explain with the help of any four examples.

34. **(a)** List any three ways of measuring population density of a habitat.
(b) Mention the essential information that can be obtained by studying the population of an organism.

35. Name and explain the kind of interaction in the following:
(i) Algae and fungi in lichens
(ii) Hermit crab and sea anemone
(iii) Head louse and humans

Long Answer Type Questions (LA)

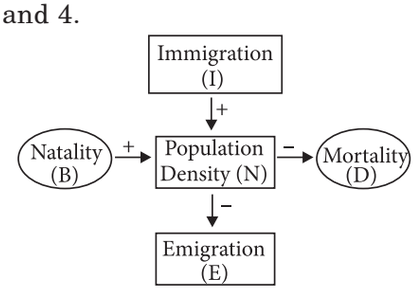
36. List the different ways by which organisms cope or manage with abiotic stresses in nature. Explain any three ways listed.

37. Study the table given below in regard to population interactions and answer the questions that follow :

Species A	Species B	Name of interaction
–	0	(a)
+	–	(b)
–	–	(c)
+	+	(d)
+	0	(e)

[Note: (+) plus = beneficial interaction; (–) minus = detrimental interaction; (0) zero = neutral interaction]
(i) Identify the interactions.
(ii) Explain each one of them.

38. **(a)** Study the flow chart given below and complete the equation that follows by identifying 1, 2, 3 and 4.



$$N_{t+1} = N_t + \{(1 + 2) - (3 + 4)\}$$

(b) Mention the different ways by which the population density of different species can be measured.

39. (a) Compare, giving reasons, the J-shaped and S-shaped models of population growth of a species.

(b) Explain "fitness of a species" as mentioned by Darwin.

40. (a) What is "population" according to you as a biology student?

(b) "The size of a population for any species is not a static parameter". Justify the statement with specific reference to fluctuations in the population density of a region in a given period of time.

ANSWERS

OBJECTIVE TYPE QUESTIONS

1. (d) : Niche is specific part of habitat occupied by individuals of a species which is circumscribed by its range of tolerance, range of movement, microclimate, etc. Hence, niche refers to the functional role played by the organism where it lives.

2. (a) **3. (a)**

4. (c) : Plants growing in partial shade or low intensity light are called shade plants or sciophytes. In shade plants, the stems are soft, slender with large internodes. Leaves are thin and large sized. They have bright green colour. Cuticle is thin. Stomata are present on both the surfaces. Palisade parenchyma is less developed. There is more vegetative growth as compared to flowering and fruiting. In low light intensity they acquire optimum photosynthesis.

5. (b)

6. (a) : Pneumatophores are breathing or respiratory roots which are found in plants growing in mangroves or water logged soil or saline swamps. Such plants are called halophytes.

7. (c) : The fossorial adaptation is adaptation for digging. Organisms showing this type of adaptation have strong and stout forelimbs. They are provided with claws which are useful in digging. They may have a pointed, elongated snout which is also used in digging.

8. (a)

9. (c) : Xerophytes are the plants living in xeric (dry) habitats. Deserts are the typical xerophytic habitat. Plants growing in xerophytic habitats develop various morphological and physiological adaptations. Roots of these plants are deep tap roots penetrating the soil to great depths so as to absorb water to the maximum. Roots can also be shallow but extensive and spreading so as to collect and hold rain water. In many xerophytes, leaves are reduced to form spines to reduce the transpiration losses as in cacti.

10. (d) : Heat loss or heat gain is a function of surface area. Since small animals have a larger surface area relative to their volume they tend to lose body heat very fast, when it is cold outside and they have to expend much more energy to generate body heat through metabolism. Hence, very small animals are rarely found in polar areas.

11. (a) : Mammals are endothermic. Endothermy (maintenance of internal temperature) enable these animals to live at temperatures that other land vertebrates cannot bear.

12. (d)

13. (c) : Parasitism is a relationship between two living organisms of different species in which one organism called parasite obtains its food directly from another living organism called host. The parasite spends a part or whole of its life either on or inside the body of the host. The general parasitic adaptations are (i) anaerobic respiration in internal parasites, (ii) loss of certain organs, (iii) presence of adhesive organs, (iv) excessive multiplication, (v) resistant cysts and eggs for safe transfer of their progeny to new hosts and (vi) well developed and complicated reproductive organs.

14. (b) : Environment keeps changing with time and these changes may be unfavourable for an organism *e.g.*, extreme heat or extreme cold. Some organisms migrate from the unfavourable place to the place with favourable conditions *e.g.*, birds. Some organisms, unable to migrate, might avoid the stress by escaping in time. They do so by reducing their metabolic activity and going into a state of 'dormancy'. Under unfavourable conditions many zooplankton species in lakes and ponds are known to enter diapause, a stage of suspended development.

15. (d) : A wasp pollinating a fig flower is an example of mutualism.

16. (a) **17. (d)**

18. (a) : In a population where the number of pre-reproductive individuals or the younger individuals is higher than the reproductive individuals, the population will increase.

19. (a) : Asymptote in a logistic growth curve is obtained when population density (N) reaches the carrying capacity (K), *i.e.*, N = K.

20. (a) : Birth, *i.e.*, production of new offspring is an attribute of an individual whereas birth rate *i.e.*, production of new individuals per unit population per unit time is an attribute of population. A sigmoid growth curve is depiction of logistic growth, a more realistic growth model where individuals compete for limited resources and the fittest individual survives and reproduces. In an exponential growth curve

(J-shape curve) the asymptote, is beyond carrying capacity as resources are unlimited. '*r*' is intrinsic rate of natural increase.

21. (b) : Natality and immigration positively contribute to the population growth while mortality and emigration are negative factors. In the given question,
The net increase in population is
natality + immigration = 250 + 20 = 270
The net decrease in population is
mortality + emigration = 240 + 30 = 270
Thus, net increase in population = 270 – 270 = 0

22. (a)

23. (d) : The given figure shows population growth curve, in which *A* is carrying capacity, *B* is exponential growth curve and *C* is logistic growth curve.

24. (d) : Pacific salmon fish – Breeds only once in lifetime
$N_t = N_0 e^{rt}$ – Exponential growth
Oyster – A large number of small sized offsprings

$\frac{dN}{dt} = rN\left(\frac{K - N}{K}\right)$ – Verhulst-Pearl Logistic growth

25. (d) : The population grows in an exponential or geometric ratio. If in a population of size *N*, the birth rates (not total number but per capita births) are represented as *b* and death rates (per capita death rates) as *d*, the increase or decrease in N (growth rate) during a unit time period *t* (*dN*/*dt*) will be
$dN/dt = (b - d) \times N$
Let $(b - d) = r$, then
$dN/dt = rN$.
The *r* in this equation is called intrinsic rate of natural increase.

26. (d) : Female wasp and fig species show mutualism.

27. (d) : Parasitism is an association in which one organism (the parasite) lives on (ectoparasitism) or in (endoparasitism) the body of another organism (host), from which it obtains its nutrients. This association is beneficial for the parasites as they get continuous supply of nutrients from their host and are able to rapidly multiply their numbers. But it is detrimental for the host organism as parasitic infection leads to various complications and diseases in the host body may also be fatal to him under certain circumstances.

28. (a)

29. (d) : Competition is a rivalry between two or more organisms for obtaining the same resources.

30. (c)

31. (a) : Gause's 'competitive exclusion principle' states that if resources are limited, then two closely related species competing for the same resource cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually.

32. (c) **33. (c)**

34. (b) : Natality and immigration positively contribute to the population growth while mortality and emigration are negative factors. In the given question,
The net increase in population is
natality + immigration = 250 + 20 = 270
The net decrease in population is
mortality + emigration = 240 + 30 = 270
Thus, net increase in population = 270 – 270 = 0

35. (a) : In a growing or expanding population, the number of pre-reproductive individuals is very large, number of reproductive individuals is moderate while post reproductive individuals are fewer. In a stable population, the number of pre-reproductive and reproductive individuals is almost equal whereas post reproductive individuals are fewer. In declining population, proportion of reproductive age group is higher than pre-reproductive age group. Number of post reproductive individual is also sizeable.

36. (d) : Amensalism is a relationship between organisms of different species in which an organism does not allow other organism to grow or live near it. Inhibition is achieved through the secretion of chemicals called allochemics. Antibiotics are a kind of allochemics produced by some microbes which in small concentration can kill or retard growth of harmful microbes without adversely affecting the host.

37. (c) : Predators are those organisms that devour other organisms to obtain energy. They may be carnivores (eating other animals) or herbivores (eating plants). Besides acting as 'conduits' for energy transfer across trophic levels, predators play other important roles. They keep prey populations under control. Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species. But if a predator is too efficient and overexploits its prey, then the prey might become extinct and following it, the predator will also become extinct for lack of food.

38. (b) : Death rate is defined as the number of deaths per 1,000 individuals in a population per year. It decreases population size and population density.
Maternal mortality rate is the rate of maternal deaths. Maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration of pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.

$\text{MMR} = \frac{\text{Maternal deaths}}{\text{Live births}}$ Infant mortality rate is the number of deaths per 1,000 infants who die between birth and 1 year of age.
A decrease in all three of these factors can result in population explosion.

39. (c) : Predation is an interaction between members of two species in which members of one species capture, kill and eat up members of other species 'Host' is a term which is specifically related to parasitism. Amensalism is an interspecies interaction in which one species is harmed whereas the other one is unaffected. Parasitic organism can live both over the surface of their host or inside their body.

40. (c) : *Azotobacter*, *Aspergillus* and *Trichoderma* all are free living microbes that help plants in their nutrition. *Glomus* is a fungus that symbiotically forms endomycorrhiza that helps in absorption of nutrition specially phosphorus from soil.

41. (b) : P is a camel adapted to desert conditions as it has thick lips and tongue so that it can easily feed on the commonly available spiny plants.

42. (a) : Q is polar bear as it has thick insulating fat layer under the skin.

43. (d) : R could be poison dart frog as it has bright colours and sticky pads on its fingers and toes and its habitat is tropical rainforest. Deep rooted shrubs are not found in tropical rainforest. These are found in deserts.

44. (a) : Habitat of P is desert, so, the dominant plant is *Opuntia*.

45. (c)

46. (d) : In logistic growth population seldom grows beyond the carrying capacity of ecosystem.

47. (d) : If any species is flourishing under unlimited resources, it would reach exponential growth which can be depicted by equation:

$$\frac{dN}{dt} = rN$$

Where, N = population density at time t; r = intrinsic rate of natural increase. If we derive the integral form of the exponential growth equation, it can be written as

$$N_t = N_0 e^{rt}$$

Where N_t = population density after time t; N_0 = population density at time zero; r = intrinsic rate of natural increase; e is the base of natural logarithm.

48. (a)

49. (b)

50. (c) : Since resources of growth for most animal populations are finite and become limiting sooner or later, so the logistic growth model is considered as more realistic.

51. (a) : Microclimate generally differs from the prevailing regional climatic conditions, because the microclimate represents the climatic conditions that prevail at local scale or in areas of limited size, such as the immediate surroundings of plants and animals.

52. (a) : Plants which remain permanently immersed in water are called hydrophytes. They may be submerged or partly submerged and show the presence of aerenchyma (large air space) in the leaves and petioles. Aerenchyma helps to transport oxygen produced during photosynthesis and permits its free diffusion to other parts, including roots located in anaerobic soils. These tissues also impart buoyancy to the plants.

53. (d) : Endotherms (warm - blooded animals) can regulate their body temperature by physiological means and are able to maintain a more or less constant internal temperature, even when the temperature outside fluctuates (for example - birds and mammals). They have physiological mechanisms for keeping body temperature constant or within tolerance limits. Ectotherms, (cold-blooded animals) cannot regulate their body temperature and are unable to maintain a constant internal temperature. Their body temperature tends to match with the environmental temperature in which they live, (for example-frogs and snakes).

54. (a) : Mangroves are found in marshy conditions of tropical deltas and along ocean edges. For coping with conditions of high salt concentration and osmotic potential, many mangrove plants have high levels of organic solutes, such as proline and sorbitol. *Dunaliella* species (green and halophytic algae found in hyper saline lakes) can tolerate saline conditions by accumulating glycerol in the cells, which helps in osmoregulation. Some species of mangroves can excrete salts through the salt glands on the leaves. Some mangroves can exclude salts from the roots by pumping excess salts back into soil.

55. (a) : The inherent maximum capacity of an organism to reproduce or increase in number is termed as biotic potential (designated by the symbol 'r). Biotic potential is realised only when the environmental conditions are non-limiting, so that natality rate (birth-rate) is maximum and mortality rate (death - rate) is minimum. Under these conditions, population size increases at the maximum rate. However, nature keeps a check on the expression of biotic potential. For example, if a pair of flies is allowed to reproduce unchecked, the fly population may outweigh the earth in a few years. The environmental check on population size, or its biotic potential is called environmental resistance. With increase in population size, the environmental resistance (against the population) tends to increase. The environmental resistance represents the limiting effect of abiotic (*e.g.*, water, space) and biotic factors (*e.g.*, food, competition) that do not allow organisms to attain their biotic potential and keep the population size at a much lower level.

56. (b)

57. (d) : Plants have special traits that help them to enlarge their tolerance limits to light regimes. Individual plants, as well as plant communities, adapt to different light intensities by becoming shade tolerant or sun adapted. Heliophytes are the sun adapted plants which are adapted to high intensity of light, and have higher temperature optima for photosynthesis,as well as have high rate of respiration. On the

other hand, shade adapted plants also called as sciophytes generally have low photosynthetic, respiratory and metabolic activities. Plants such as ferns and several herbaceous plants growing on the ground under the dense canopy of trees, are shade tolerant plants.

58. (b) : Mycorrhiza is a mutualistic or symbiotic interaction in which a fungus (*e.g. Boletus*) and a root of plant (*e.g. Pinus*) are involved. The root provides food and shelter to the fungus. The fungus helps the plant in solubilisation and absorption of minerals, water uptake and protection against pathogenic fungi.

59. (b) : Mimicry is defined as the resemblance of one organism to another or to any natural object for the purpose of concealment, protection or for some other advantage. Mimicry employed by a prey is known as protective mimicry while the other used by a predator is termed as aggressive mimicry.

60. (d) : Life activity under water is often controlled by the availability of light. In aquatic systems the presence of light determines where producers and consumers are to live in water. For example, the phytoplanktons (phyto : plants; plankton : small) live in the illuminated surface layer of water, whereas benthic organisms live in, or at, the segments of a lake. Profundal zone is the dark zone where light does not reach.

SUBJECTIVE TYPE QUESTIONS

1. Only A and B horizons of soil represents solum or true soil because they have weathered products of the parent rock.

2. In order to keep predators or herbivores away from grazing, certain plants like *Calotropis* produce highly poisonous cardiac glycosides that can make herbivores sick when eaten. Hence, grazers like cattle, goats and sheep do not graze it.

3. Commensalism

4. When animals are exposed to low temperatures, hibernation is necessary for cold-blooded animals like frogs to prevent their metabolic rate from getting slow down.

5. Intrinsic rate of natural increase,
r = Per capita birth rate – Per capita death rate
= 0.025 – 0.008 = 0.017.

6. When animals like snails are exposed to lethal high temperatures, they go into aestivation to avoid the heat of summer.

7. Sometimes population size is indirectly estimated without actually counting them, for example, tiger census in our National parks and tiger reserves is often based on pug (animal's foot print) marks and faecal pellets.

8. Commensalism

9. *Bombyx mori* (silk moth) is an insect that enters diapause due to some adverse environmental conditions such as drought, extreme temperature, reduced food availability which, in turn, delays the overall development. The physiological and metabolic activities diminish at this particular time.

10. Emphemerals are drought escapers xerophytic plants, for example: *Tribulus terrestris*.

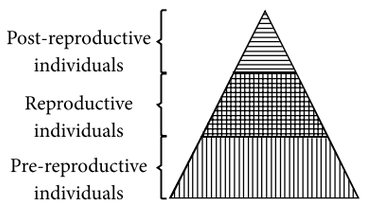
11. Koel or cuckoo laying its eggs in crow's nest is an example of brood parasitism. In brood parasitism, the parasitic bird lays its eggs in the nest of its host, and the host incubates them. Here, the eggs of the parasitic bird have evolved to resemble the host's egg (in size and colour) so as to avoid being detected.

12. Death rate is defined as the number of deaths per 1000 individuals of a population. Since, total number of butterflies = 80,

Number of butterflies that died = 8

Death rate $= \frac{8}{80} = 0.1$ butterflies per week.

13. An age pyramid for expanding human population is as follows:



Pyramid with broad base or triangular shape indicates a rapidly expanding population with a high percentage of pre-reproductive individuals followed by reproductive then post-reproductive individuals. Thus, in rapidly growing population, birth rate is high and population keeps growing.

14.

	Mutualism	Competition
(i)	In mutualism both interacting species benefit from each other.	It is a rivalry between two or more organisms for resources.
(ii)	Contact between the two organisms is obligatory to time and space.	Competition is of two types. Competition between individuals of the same species is called intraspecific competition while that between individuals of different species is termed as interspecific competition.

15. Given is a bell-shaped age pyramid which signifies that the population is stable. Such age pyramid is formed when the number of pre-reproductive and reproductive individuals is almost equal and the post-reproductive individuals are comparatively fewer. It implies that the population is neither decreasing nor increasing, instead is maintained at a stable level.

16. Sharks being eurythermal can tolerate wide range of temperature variations and thus have wider distribution on

earth, on the other hand, polar bear being stenothermal can tolerate only narrow range of temperature and is restricted to specific regions only.

17. Very small animals have large surface area to body volume ratio. It results in excessive heat loss from exposed body surface. Such a great extent of heat loss makes it impossible for very small animals to survive in cold polar regions. Large animals have small surface area to body volume ratio, reducing heat loss and making temperature maintenance easier for them. This effect of temperature on the absolute size of an animal and the relative proportions of various body parts is also known as Bergmann's rule.

18. Parasitism is the interspecific interaction where one of species (called parasite) depends on the other species (host) for food and shelter and damages the host. *E.g.*, malarial parasite in blood cells of humans. Coevolution in parasitism refers to the process in which parasite evolves mechanism to interact and neutralise the mechanism evolved by the host to reject or resist parasite.

19. Mutualism is the interaction between clown fish and sea anemone. The clownfish lives among the stinging tentacles of sea anemone and gets protection from its predators. Clownfish has a slimy mucus covering that protects it from the poisonous tentacles of sea anemone. Also clown fish makes its meals from the anemone's leftover. In return clown fish helps anemone in catching its prey by luring other fish towards it. It also eats the dead tentacles keeping the anemone and the area around it clean.

20. When a species is introduced into a new habitat with favourable environment (unlimited resources) it undergoes exponential growth. It has two phases-lag and log phase. In lag phase, species shows poor growth as trying to establish in the new environment. After its establishment, species shows maximum growth in the log or exponential phase, resulting in J-shape curve.

21. Plants inhabiting desert (xerophytes) are not found in mangroves, because xerophytic plants are adapted to dry and hot environment. They possess various physical modifications to tolerate extreme water scarcity and heat, like extensive root system, succulent organs, leaf reduced to spine, etc. Mangrove swamp is a region of vegetation where soil is highly saline and water logged. Only halophytes can survive in such regions as they possess aerial roots called pneumatophores through which gaseous exchange occurs. Roots of xerophytes are positively geotropic and will suffocate and die in such badly aerated soil ultimately leading the whole plant to death.

22. (a) The given graph represents various ways of organismic response *i.e.*, possibilities of living organisms to cope with stressful conditions. A represents the conformers, B represents regulators and C represents partial regulators.

(b) Differences between A (conformers) and B (regulators) are as follows:

S.No.	Conformers	Regulators
(i)	Homeostasis is little.	They possess a constant internal environment or homeostasis.
(ii)	Their body temperature changes according to that of environment.	They maintain constant body temperature.
(iii)	They have a narrow range of distribution.	They have a wide range of distribution.
(iv)	They consume lesser amount of energy and are less active	They consume large amount of energy and are more active.

(c) C *i.e.*, partials regulators have the ability to regulate body functions to a limited extent. Beyond that limit they become conformers.

23. (a) Ecological niche (Grinnel, 1917) is a specific part of habitat occupied by individuals of a species which is circumscribed by its range of tolerance, range of movement, microclimate, type of food and its availability, shelter, type of predator and timing of activity.

(b) Gause's competitive exclusion principle states that two or more species with similar niche requirements cannot coexist indefinitely in the same area and one of the two gets eliminated.

(c) Animals develop strategies to live better in their environment. Mimicry is the resemblance of one species with another in order to obtain advantage, especially against predation.

24. (a) Sciophytes or shade plants like herbs and shrubs survive under the shadow of big canopied trees or sun plants or heliophytes in forests as they are perfect shade tolerant plants which show better growth in lower level of light intensity. They grow in a manner, that they are arranged in different strata according to their shade tolerance.

(b) Osmoconformers are those organisms which cannot maintain constant osmolarity of their body fluids and it varies according to their surrounding medium.

25. Predators play important role in ecosystem. These are discussed as follows:

(i) Maintaining prey population : In nature, the population of predator is quite small as compared to that of the prey. The prey has high reproductive potential. If, for some time, the prey population is allowed to grow without predation, then it would grow beyond the carrying capacity of the environment. The predator keeps the population of the prey under check so that an equilibrium is maintained. Example, the prickly pear cactus introduced in Australia in the early 1920's caused havoc by spreading rapidly into millions of hectares of rangeland. Finally, the invasive cactus was brought under control only after a cactus-feeding predator (a moth) from its natural habitat was introduced into the country.

(ii) Maintaining species diversity : Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species. Example, in the rocky intertidal communities of the American Pacific Coast, the starfish *Pisaster* is an important predator. When all the starfish were removed from an enclosed intertidal area, more than 10 species of invertebrates became extinct within a year because of interspecific competition.

(iii) Vegetation : Predation helps in growth of vegetation all over the globe by restricting population of herbivores.

26. (i) In the given graph, 'a' represents exponential or J-shaped growth and 'b' represents logistic or sigmoid growth. The equation $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$, represents logistic growth form and '*K*' represents carrying capacity for a particular species in the given habitat. In nature, a given habitat has resources to support a certain number of individuals of a population, beyond which no further growth is possible. This limit is called nature's carrying capacity (*K*) for that species in that habitat.

(ii) The curve 'b' is considered to be more realistic growth model for most of the animal population because resources are limited in this type of growth curve. Whereas, in case of curve 'a', the resources (such as food, space, etc.) are unlimited.

(iii) The curve 'a' would depict the population of a species of deer in absence of predators in the habitat as the population increases exponentially. In absence of predators, the resources will be unlimited for the deer population and it can reach high population densities in a short time. This type of growth pattern of a population results in J-shaped curve.

27. Mycorrhiza is a mutualistic interaction between fungus and roots of higher plants. The root provides food and shelter to the fungus. The fungus helps the plant in solublisation and absorption of minerals, water uptake and protection against pathogenic fungi.

The egret and grazing cattle in close association is an example of commensalism. Commensalism is the interaction in which one organism is benefitted and other organism is neither harmed nor benefitted. The egrets always forage close to where the cattle are grazing because the cattle, as they move, stir up and flush out from the vegetation insects that otherwise might be difficult for the egrets to find and catch.

28. According to Verhulst-Pearl logistic growth, population increases in size in sigmoid fashion. S-shaped growth form is found in stable population. It shows population growth in a habitat with limited resources. Population shows initially a lag phase, followed by phases of increase and decrease and finally the population density reaches the carrying capacity.

A plot of *N* in relation to time (*t*) results in a sigmoid curve. This type of population growth is called Verhulst-Pearl logistic growth as explained by the following equation :

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

Where *N* = population density at a time *t*; *r* = intrinsic rate of natural increase and; *K* = carrying capacity.

29. Atmospheric pressure is low at higher altitudes as compared to plains. When we go for a trek/trip on high altitude, then due to low atmospheric pressure our body does not get enough oxygen, as a result of which we experience nausea, fatigue and heart palpitation (altitude sickness). But by taking rest for first two days, body gets acclimatised to high altitude conditions. The body compensates low oxygen availability by increasing red blood cell production, decreasing binding capacity of haemoglobin and increasing breathing rate. Hence, we automatically stop experiencing altitude sickness.

30. (a) Heart palpitation

(b) Sickness is due to low atmospheric pressure of high altitudes, as body does not get enough oxygen.

(c) After sometimes, body compensates for low oxygen availability by increasing red blood cell production, decreasing binding capacity of haemoglobin and by increasing breathing rate.

31. Water is very essential for life. Plants and animals show modifications according to availability of water in the area. Some of the adaptations seen in plants which enable them to survive water scarce environment are as follows:

- Plants of hot deserts are adapted to survive in dry conditions of soil and high temperatures. The plant which evade dry conditions are known as ephemerals. Some plants have deep tap root which are capable of absorbing water from deep soil *e.g.*, *Prosopis*, *Acacia*, etc.
- In case of cacti and succulents, the presence of fleshy leaves and stems to store water (succulence) is an adaptation to dry environment. In cacti, leaves are reduced to spines, where stems are modified to fleshy structures.
- Many tropical plants, particularly grasses which grow in hot and arid climates possess C_4 pathway of photosynthesis. So, these plants perform better in low soil water environments. Such plants, use less water to achieve higher rates of photosynthesis.

Some of the adaptations seen in animals which enable them to survive water scarce environment are as follows:

- Desert lizards lack the physiological ability that mammals have to deal with the high temperature. They keep their body temperature fairly constant by behavioural means. They enjoy in the sun and absorb heat when their body temperature drops below the comfort zone but move into shade when the surrounding temperature starts increasing.
- The Kangaroo rats conserves water by excreting solid urine and can live from birth to death without even drinking water. Loss of water is minimised by producing nearly solid urine and faeces.

– The camels show tolerance to wide fluctuations in body temperature and are able to maintain blood stream moisture even during extreme heat stress.

32. The differences between hibernation and aestivation are as follows:

	Hibernation	Aestivation
(i)	It is winter sleep in which animal passes the winter period in dormant conditions.	It is summer sleep.
(ii)	It is of longer duration.	It is of shorter duration.
(iii)	Northern ground squirrels undergo hibernation during winter and rest in warm place.	Squirrels of South-Western deserts undergo aestivation and lie in torpid state inside the burrows.

33. To tide over unfavourable conditions, some organisms suspend their metabolic activities. These are discussed as follows :

(i) Bacteria, fungi and lower plants develop thick walled spores, which germinate during suitable conditions.

(ii) Polar bears go into hibernation during winter season to escape cold.

(iii) Some snails and fish undergo aestivation to avoid summer related problems like heat and dessication.

(iv) During unfavourable conditions, zooplanktons in lakes and ponds are known to enter diapause, *i.e.*, stage of suspended development.

34. (a) The different methods to study population size are as follows:

– Quadrat method : It is a method which involves the use of square of particular dimension to measure number of organisms. For example the number of *Parthenium* plants in a given area can be measured using the quadrat method.
– Direct observation: It involves counting of organisms. For example, in order to determine the number of bacteria growing in a petri dish, their colonies are counted.
– Indirect method : The number of fishes caught per trap gives the measure of their total density in a given water body.

(b) Whether competition of survival exists or not, whether the population is increasing or decreasing, natality, mortality, emigration and immigration.

35. (i) Mutualism is found between algae and fungi in lichen. Lichen is a composite entity which is formed jointly by an alga and a fungus. The fungus provides water, minerals and shelter to the alga. In return alga provides food to the fungus.

(ii) Interaction between sea anemone and hermit crab is considered as an example of mutualism (or as protocooperation by some). Sea anemone uses hermit crab as a portable home and is able to find more food. Hermit crab in turn gets protection from its enemies. Thus it is a mutually beneficial association. Recent studies reveal that it is obligate mutualism not proto-cooperation.

(iii) Parasitism is found between head louse and humans. Head louse is an ectoparasite that sucks the blood of man or feed on living tissues of head's skin.

36. Living organisms cope with stressful conditions by various methods :

(i) Hibernation and aestivation : Hibernation is winter sleep in which animal passes the winter period in dormant condition in a warm place. Polar bears hibernate during winters. Aestivation is summer sleep in which animal rests in a cool/ shady and moist place during extreme heat period. Ground squirrels of South-Western deserts undergo aestivation and lie in torpid state inside burrows during hot dry periods.

(ii) Camouflage : It is the ability to blend with the surroundings or background. It is protective to animals which are preyed upon by others and it is also advantageous to predators as it eases predation, *e.g.*, it is difficult to distinguish leaf like grasshopper from the surrounding foliage.

(iii) Mimicry : It is resemblance of one species with another in order to obtain advantage specially against predation. The species which is imitated is called model while the species which imitates is known as mimic. *E.g.*, Viceroy butterfly mimics unpalatable, toxic Monarch butterfly.

(iv) Migration : The organisms can migrate temporarily from the unfavourable habitat to more favourable area and return when unfavourable period is over. Many animals, particularly birds, during winter undergo long-distance migrations to more favourable areas.

(v) Perennating structures : Various kinds of thick walled spores are formed in bacteria, fungi and lower plants which help them survive under unfavourable conditions. These germinate on return of suitable conditions.

(vi) Diapause : Under unfavourable conditions many zooplanktons in lakes and ponds are known to enter diapause *i.e.*, a stage of suspended development.

37. (i) (a) = Amensalism
(b) = Parasitism/Predation
(c) = Competition
(d) = Mutualism
(e) = Commensalism

(ii) (a) Amensalism is an association between two species that is detrimental to one of the species but has no effect on the other. A common example of amensalism is the release of chemical toxins by plants that can inhibit the growth of the other plant species (allelopathy).

(b) Parasitism is an association in which one organism (the parasite) lives on or in the body of another organism (host), from which it obtains its nutrients. It is an one sided relationship in which parasite is benefitted and host is harmed.

(c) Competition is a rivalry between two or more organisms for obtaining the same resources. It may be between individuals of same species (intraspecific) or different species (interspecific).

(d) Mutualism is an interaction between two organisms of different species where both the partners are benefitted and are obligatory to each other.

(e) Commensalism is the interaction between two individuals of different species in which one is benefitted while other remains unaffected.

38. (a) In the given equation, 1, 2, 3 and 4 respectively are B, I, D and E. Therefore, the equation will be

$$N_{t+1} = N_t + [(B + I) - (D + E)]$$

(b) Population density is defined as number of individuals of a species per unit area or per unit volume of environment. Population density may be measured by :

(i) Numerical density calculated by number of individuals per unit area or volume. For example, if in a pond there were 20 lotus plants last year and through reproduction 8 new plants are added, taking the current population to 28, the birth rate will be calculated as 8/20 = 0.4 offspring per lotus per year.

(ii) Biomass density calculated as biomass per unit area or volume. For example if in an area, there are 200 *Parthenium* plants but only a single huge banyan tree, then the percent cover or biomass is more meaningful measure of the population size.

(iii) Abundance or absolute number of population. For ecological investigations, population density is measured as absolute population densities or relative densities. For example the tiger census in our National parks and tiger reserves is often based on pug marks and fecal pellets.

39. (a) The comparison between J-shaped or exponential growth and S-shaped or logistic growth is as follows :

	Exponential or J-shaped growth	Logistic or S-shaped growth
(i)	It occurs when the resources are abundant.	It occurs when the resources are limited.
(ii)	Population passes well beyond the carrying capacity of the ecosystem.	Population seldom grows beyond the carrying capacity of ecosystem.
(iii)	A stationary or steady phase is seldom achieved.	A stationary or steady phase is reached.
(iv)	Population crashed ultimately due to mass mortality.	Population seldom crashes.
(v)	It has two phases, lag and log.	It has four phases-lag, log, deceleration and steady.
(vi)	It occurs in fewer organisms, *e.g.*, lemmings, algal bloom.	It is more common, *e.g.*, members of wildlife.

(b) The fitness, according to Darwin, refers ultimately and only to reproductive fitness. Hence, those who are better fit in an environment, leave more progeny than others. These, therefore, will survive more and hence are selected by nature. He called it natural selection and implied it as a mechanism of evolution.

40. (a) According to me as a biology student, population is defined as the total number of interbreeding individuals of a species found in a geographical area who share and compete for similar resources.

(b) The population density is the number of individuals of a species per unit area/space at a given time. The size of a population (population density) is not a static parameter. It keeps changing with time, depending upon a number of factors : abiotic and biotic, food availability, predation pressure, etc. The density of a population changes due to four basic processes:

(i) Natality : Number of births during a given period per unit population.

(ii) Mortality : Number of deaths in the population during a given period.

(iii) Immigration : Number of individuals of the same species moving inside a population during the time period.

(iv) Emigration : Number of individuals moving outside from a habitat during the time period.

Therefore, if N is the population density at time t, then its density at time t + 1 can be explained by the given equation :

$$N_{t+1} = N_t + [(B + I) - (D + E)]$$

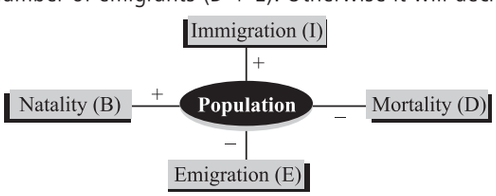
Where, B represents natality or number of births;

I represents number of immigrants;

D represents mortality or number of deaths;

E represents number of emigrants.

From the above equation it is clear that population density increases if the number of births plus the number of immigrants (B + I) is more than the number of deaths plus the number of emigrants (D + E). Otherwise it will decrease.



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