Chapter–13

Organisms and Populations

basic concepts

1. Ecology

- It is a branch of science which deals with the interactions among organisms and between the organism and its physical (abiotic) environment.

2. Organisational Levels of Ecology

- **Organism:** Living component of the environment at individual level is called organism.
- Ecology at the organismic level is **physiological ecology** which reveals how different organisms are adapted to their environments. The organism is the smallest level of ecological hierarchy.
- **Population:** Population is defined as the sum total of all individuals of a species in a specific geographical area.
- **Species:** The species are the group of individuals of one or more populations which resemble each other and can interbreed among themselves.
- **Biotic community:** The assemblage of all the populations of different species present in an area that interact among themselves are called biotic community. It is of three types:
  - (*i*) Plant community
  - (*ii*) Animal community
  - (*iii*) Microbial community
- **Ecosystem:** The sum total of the biotic (living) and abiotic (non-living) components of a particular geographical area, being integrated through exchange of energy and recycling of nutrients are collectively called ecosystem.
- **Biome:** The large unit of environment consisting of a major vegetation type and its associated fauna in a specific climatic zone is called a biome.
- **Biosphere:** All the ecosystems of the world are collectively called biosphere.
- **Niche:** The ecological niche of an organism represents the range of conditions that it can tolerate, the resources it utilises and its functional role in the ecological system. Each species occupies a distinct niche and no two species occupy the same niche.

3. Environment

- Environment is referred to as the sum total of all the physical and biotic conditions which influence the organism in terms of survival and reproduction.
- Different seasons result due to
  - (*i*) rotation of earth around the sun.
  - (*ii*) tilting of the earth on its axis.

- The major biomes of the world include desert, grassland, rainforest and tundra.
- Formation of different biomes is due to
  (*i*) annual variations in intensity and duration of temperature.
  (*ii*) annual variations in precipitation.
- The above annual variations together with annual variation in precipitation (remember precipitation include both rain and snow) thus form major biomes.
- The biomes may be desert, rainforest and tundra.
- Regional and local variations within each biome lead to the formation of different habitats.

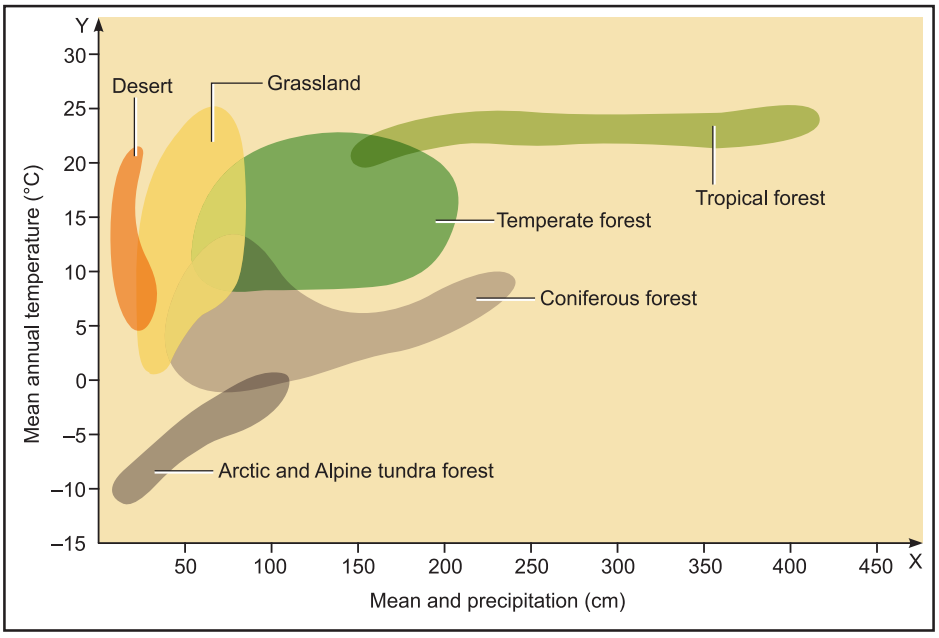
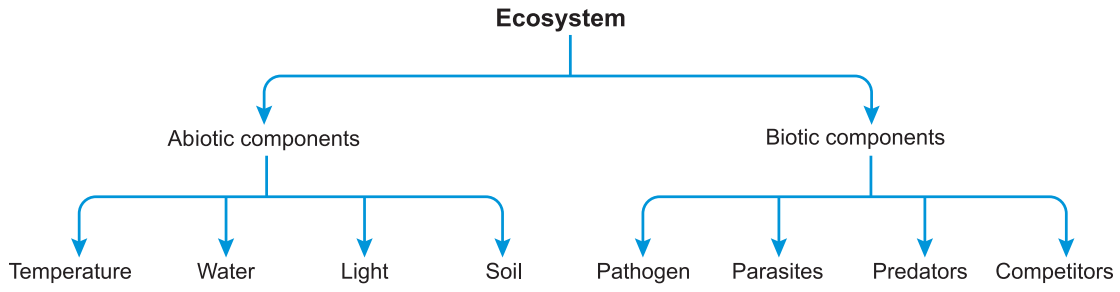


Fig. 13.1 Biome distribution with respect to annual temperature and precipitation

4. Components of Ecosystem



5. Major Abiotic Factors

(i) Temperature

- It is the most ecologically relevant environmental factor.
- It is observed that seasonally, the average temperature on land varies.
- The temperature decreases progressively from the equator to the poles and from plains to the mountain top.

- The range of temperature varies from subzero levels in polar areas to >50°C at high altitude in tropical deserts in summer.
- The temperature can affect the kinetics of enzymes and through it the basal metabolism and other physiological functions of the organisms.
- The organism tolerating the high range of temperature is called **eurythermal** *e.g.*, cyclops, Artemisia, Toad lizard and the organism which can tolerate narrow range of temperature is called **stenothermal** *e.g.*, palms, corals, snakes, some fishes.
- Level of thermal tolerance of different species determine their geographical distribution.

(ii) Water

- It is the next important factor as life is unsustainable without water.
- The amount of water in an environment determines the productivity and distribution of plants.
- For aquatic habitat, the quality of water becomes important like pH value, salinity and temperature of water.
- The organisms tolerating wide range of salinities are called **euryhaline** *e.g.*, migratory fish like Hilsa, Salmon and the organisms that tolerate only narrow range of salinities are called **stenohaline** *e.g.*, number of organism.
- Fresh water forms cannot live in sea water for long because of osmotic problems.

(iii) Light

- Light is important because autotrophs make food with the help of light (photosynthesis) and O_2 is evolved during this process.
- The small plants like herbs and shrubs can perform photosynthesis under very low light conditions as they are overshadowed by tall trees.
- The plants depend on sunlight to meet their photoperiodic requirement for flowering.
- For many animals, light is important in that they use the diurnal and seasonal variations in light intensity and duration (photoperiod) as cues for timing their foraging, reproductive and migratory activities.
- In deep sea, animals have special devices for life as many are luminescent like Angler fish.

(iv) Soil

- The nature and properties of soil varies with different places.
- The nature and properties of soil depend on the climate and weathering process.
- The characteristics of soil: soil-composition, grain size and aggregation, determine the percolation and water holding capacity of the soil.
- The vegetation in an area is determined by some soil parameters like pH, mineral composition and topography.

6. Responses to Abiotic Factors

- During the course of million years of existence, many species would have evolved a relatively constant internal (within the body) environment that permits all biochemical reactions and physiological functions to proceed with maximum efficiency and thus, enhances the overall fitness of the species.
- The organisms try to maintain the constancy of its internal environment (a process called **homeostasis**) despite varying external environmental conditions that tend to upset its homeostasis.

7. How do Living Organisms Cope with Environment?

(i) Regulate

- Some organisms maintain homeostasis by physiological and behavioural means, such organisms are called regulators. All birds and mammals and few lower vertebrate and invertebrate species maintain homeostasis by thermoregulation and osmoregulation.
- The success of mammals is largely due to their ability to maintain a constant body temperature.
- In summers, when outside temperature is more than our body temperature, we sweat profusely and the resulting evaporative cooling brings down the body temperature.

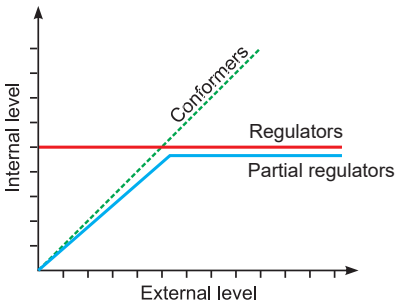


Fig. 13.2 Diagrammatic representation of organismic response

- In winters, when temperature is lower we shiver, a kind of exercise that produces heat and raises the body temperature.
- Plants do not have such mechanism to maintain internal temperatures.

(ii) Conform

- Majority (99%) of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature is determined by ambient temperature.
- The osmotic concentration of the body fluids change with that of the ambient water osmotic concentration, such animals and plants are simply called conformers.
- Loss or gain of heat is a function of surface area. The small animals have larger surface area relative to their volume. They lose body heat very fast in low temperature. So, they expend energy to generate body heat through metabolism for adjusting. Therefore, very small animals like shrews and humming birds are rarely found in polar regions.
- During evolution, some species have evolved the ability to regulate but only over a limited range of environment conditions and beyond that limit they conform.

(iii) Migration

- The temporary movement of organisms from the stressful habitat to a more hospitable area and return when favourable conditions reappear, is called **migration**.
- The long distance migration is very common in birds. In winter, famous Keoladeo National Park (Bharatpur) in Rajasthan hosts thousands of migratory birds coming from Siberia and other extremely cold northern regions.
- Examples of migratory animals, are Siberian crane, Whale, Caribou, Lamprey, Eel, Salmon.

(iv) Suspend

- Some bacteria, fungi and lower plants, under unfavourable conditions slow down metabolic rate and form a thick-walled spore to overcome stressful conditions. These spores germinate under onset of suitable environment.
- The animals that fail to migrate, might avoid the stress by escaping in time, *e.g.*, bear frog goes into **hibernation** during winter.
- Snail and fish go into **aestivation** to avoid summer.
- Zooplanktons under unfavourable conditions enter **diapause**, a stage of suspended development.
- Cyst formation in *Amoeba*.

8. Adaptations

- Any morphological, physiological and behavioural attribute of the organism that enables it to survive and reproduce in its habitat is called **adaptation**.
- Over a long period of time, many adaptations have evolved and are incorporated in the gene, thus becoming heritable.

(i) Adaptation in Kangaroo rat (*Dipodomys merriami*)

- The Kangaroo rat in North American deserts is capable to meet its internal water requirement by oxidation of fat where water is a by-product.
- It has the ability to concentrate its urine for minimum loss of water through excretory products.
- Prevents water loss by living in burrows during day.
- Solidification of faeces.
- Nasal counter current mechanism to retrieve moisture from air being exhaled.

(ii) Adaptation in desert plants

- Desert plants have thick waxy coating on leaves called cuticle, for minimum loss of water through transpiration.
- They have special photosynthetic pathway (CAM) that enables minimum loss of water during daytime because stomata remain closed.
- Some desert plants, *e.g.*, *Opuntia* develop spines instead of leaves and photosynthetic function is carried out by the flattened stem.
- Stomata are arranged in deep pits to minimise loss through transpiration.

(iii) Adaptation in mammals in cold climate

- Mammals have shorter ears and limbs to minimise heat loss. This is called **Allen's rule**.
- Seals (aquatic mammals) have a thick layer of fat (blubber) below their skin that acts as an insulator and reduces excessive loss of body heat.

(iv) Adaptation in desert lizards

- They absorb heat from the sun when the body temperature drops below the comfort zone.
- They move into shade when ambient temperature rises above the comfort levels.
- Some burrow into soil to escape above ground heat.

(v) Adaptation at high altitude in humans

- People at high altitudes (> 3,500 m like in Rohtang Pass, near Manali, Mansarovar in China occupied Tibet) experience **altitude sickness**.
- **Symptoms:** Nausea, fatigue, heart palpitations.
- **Cause:** The people living in high altitudes compensate low oxygen by increasing production of red blood cells (RBCs).
- The binding capacity of haemoglobin decreases and breathing rate increases.
- People travelling to high altitude get slowly **acclimatized** (adjust) and **stop experiencing altitude sickness** by:
  - (*a*) Increasing RBC production
  - (*b*) Decreasing Binding capacity of hemoglobin.
  - (*c*) Increasing breathing rate.
- People living at high altitudes of Himalayas have higher RBC count or total Hb than people living in plains.

(vi) Biochemical Adaptations

- Biochemical Adaptations in marine invertebrates and fish living at great depths in oceans where pressure is more than 100 times the normal atmospheric pressure.

(vii) Adaptations in fish found in Antarctic Waters (temperature below zero)

- These fishes show **cold hardening** *i.e.*, physiological adaptation allowing animals to live comfortably in cold conditions. It is of two types:
  - **(*a*) Freeze tolerance:** Extracellular spaces contain ice nucleating proteins that form ice. Small amount of water is withdrawn from cells and thus cells have high solute concentration that protects them from freezing.
  - **(*b*) Freeze avoiding animals:** Body fluids of these animals contain antifreeze solutes like glycerol, antifreeze proteins which lower the freezing point of body fluids below 0°C and thus ice formation is prevented and animals remain active, *e.g.*, Ice fish (*Chaenocephalus*).

(viii) Adaptations in Archaebacteria

- **Most animals** have metabolism and physiology functioning optimally in narrow temperature range (37°C for human beings) but **Archaebacteria** flourish in hot springs and deep sea hydrothermal vents where temperature exceeds 100°C because they have special enzymes and plasma membrane constituents that help them to metabolise comfortably at high temperature.

9. Population Attributes

- **Population** is defined as the total number of individuals of a species in a specific geographical area, sharing/ competing for similar resources which can interbreed under natural conditions to produce fertile offsprings and function as a unit of biotic community.
- Population ecology links ecology to population genetics and evolution.
- **Characteristics of a population:**
  - **(*i*) Population size or density** of a species is the number of individuals of a species per unit area or volume

$$\text{Population Density (PD)} = \frac{\text{Number of individuals in a region (N)}}{\text{Number of unit area in a region (S)}}$$

$$\text{PD} = \frac{\text{N}}{\text{S}}$$

  - **(*ii*) Birth or natality rate:** It is expressed as the number of births per 1,000 individuals of a population per year.
  - **(*iii*) Death or mortality rate:** It is expressed as the number of deaths per 1,000 individuals of a population per year.
  - **(*iv*) Sex ratio:** It is expressed as the number of females per 1,000 males of a population in given time.
- A population at any given time is composed of individuals of different ages. When the age distribution (per cent individuals of a given age or age group) is plotted for the population, the resulting structure is called **age pyramid**.
- For human population, the age pyramids generally show age distribution of males and females in a combined diagram.
- The shape of the pyramids reflects the growth status of the population and is of three types:
  - **(*a*) Expanding (Triangular shaped pyramid):** Number of prereproductive individuals is very large, reproductive individuals moderate in no. and postreproductive are fewer. Population is growing and show rapid increases.
  - **(*b*) Stable (Bell shaped pyramid):** Population size remains stable, neither growing nor diminishing *i.e.*, all the age group are evenly balanced.
  - **(*c*) Declining (Urn shaped pyramid):** Population is declining or diminishing population showing negative growth.

- The pyramids also indicate the ratio of pre-reproductive, reproductive and post-reproductive individuals in a population.

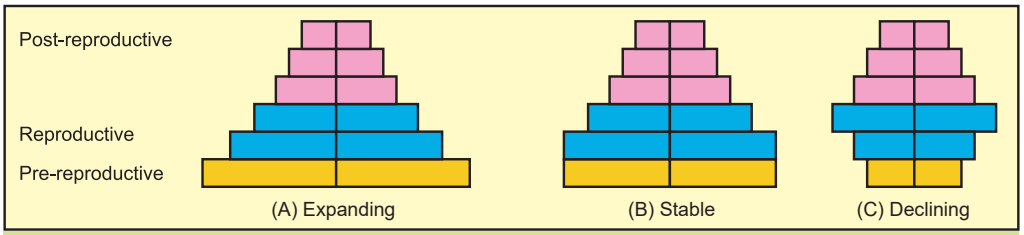


Fig. 13.3 Representation of age pyramids for human population

10. Population Growth

- The size of a population depends on food availability, predation pressure and weather. Therefore, size of the population is not a static parameter.

  Population Density (N) = Number of individuals or % **cover** or biomass.

- The population density depends on few basic processes:

  (*i*) Natality: It is the number of births during a given period of time. It increases the population density.

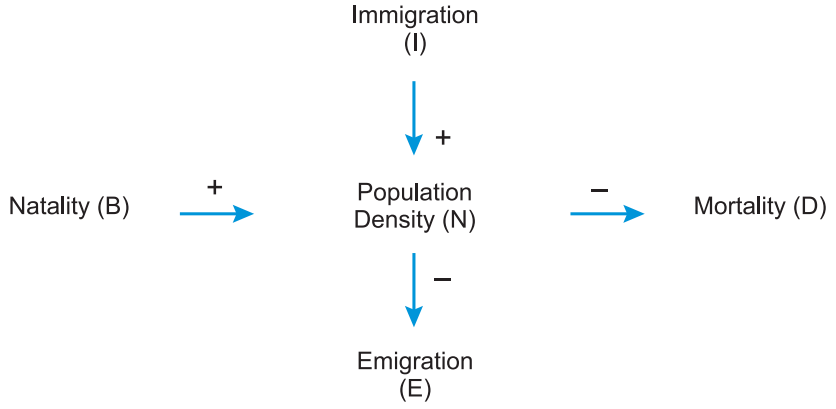
  So birth rate = $\frac{28}{20}$ = 0.4 per second

  (*ii*) Mortality: It is the number of deaths in a given time period. It decreases the population density. *e.g.*, if 4 individuals out of 40 fruit flies died during specified time interval.

  $$\text{Death rate} = \frac{4}{40} = 0.1 \text{ Individuals per fruitfly per week}$$

  (*iii*) Immigration: It is the number of individuals of same species added to a habitat in a given time period. It increases the population density.

  (*iv*) Emigration: It is the number of individuals of same species that move to a different habitat in a given time period. It decreases the population density.



- The population density is given by the following equation:

  $$N_t = N_0 + [(B + I) - (D + E)]$$

  where N_t = population density at time t, B = birth rate, I = immigration, D = death rate, E = emigration, and N_0 = population in the beginning.

- This equation shows that the population density will increase, if the number of births plus the number of immigrants (B+I) is more than the number of deaths plus the number of emigrants, *i.e.*, (D+E), otherwise it will decrease.

11. Population Growth Models

- There are two models of population growth:
  (*i*) The exponential growth
  (*ii*) Logistic growth

(i) Exponential Growth

- The exponential or geometric growth is common where the resources (food + space) are unlimited.
- Each species has the ability to realise fully its innate potential to grow in number.
- The equation for exponential growth can be derived as follows:

$$\frac{dN}{dt} = (b - d) \times N,$$

Let $(b - d) = r$, then

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

Integral form of exponential growth equation is

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

where, N = population size,
N_t = population density after time t,
N_0 = population density at time zero,
r = intrinsic rate of natural increase,
e = the base of natural logarithms (2.71828),
b = birth rate (per capita births)
d = death rate (per capita death rates).

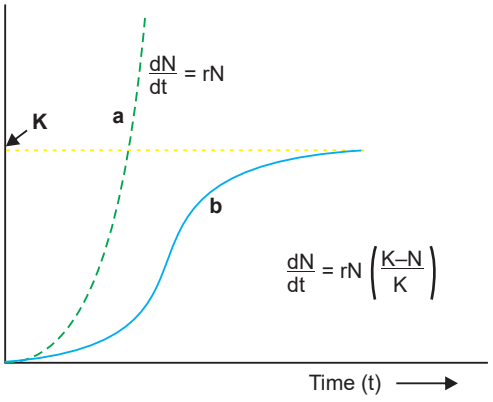


Fig. 13.4 Population growth curve:
(a) When resources are not limiting the growth, plot is exponential.
(b) When resources are limiting the growth, plot is logistic, K is carrying capacity.

- 'r' is an important parameter assessing impacts of biotic and abiotic factors on population growth. 'r' for flour beetle was 0.12, for Norway rat was 0.015 and for human population in India was 0.0205 in 1981.
- In exponential growth, when N in relation to time is plotted on graph, the curve becomes J shaped.

(ii) Logistic growth

- The resources become limited at certain point of time, so no population can grow exponentially.
- This growth model is more realistic.
- Every ecosystem or environment or habitat has limited resources to support a particular maximum number of individuals called its **carrying capacity (K)**.
- When N is plotted in relation to time t, the logistic growth show sigmoid curve and is also called **Verhulst–Pearl logistic growth**. It is given by the following equation:

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

where N = population density at time t
r = intrinsic rate of natural increase
K = carrying capacity.

- Graph shows lag phase, followed by phases of acceleration and deceleration and finally an asymptote when population density reaches the carrying capacity.

12. Life History Variation

- **Darwinian fitness** refers to the populations where they evolve to maximise their reproductive fitness, *i.e.*, high 'r' value.
- Under selection pressures, organisms evolve towards the most efficient reproductive strategy.
- The rate of breeding varies from species to species, as some organisms breed once in their lifetime (Pacific salmon fish, bamboo), while others breed many times during their lifetime (most birds and mammals).
- Some organisms produce a large number of small-sized offsprings (oysters, pelagic fishes), while others produce a small number of large-sized offsprings (birds, mammals).
- Ecologists suggest that life history traits of organisms have evolved in relation to the constraints, imposed by the abiotic and biotic components of the habitat, in which they live.

13. Population Interaction

- **Interspecific interactions** are interactions of populations of two different species.
- The interactions may be
  - beneficial/positive effect indicated by +.
  - harmful/detrimental/negative effect indicated by –.
  - neutral interaction/no effect on the species indicated by 0.

Table 13.1 Population Interactions

Species A	Species B	Name of Interaction
+	+	Mutualism
–	–	Competition
+	–	Predation
+	–	Parasitism
+	0	Commensalism
–	0	Amensalism

(i) Predation

- It is an interspecific interaction, where an animal, called **predator**, kills and consumes the other weaker animal called **prey**.
- Predation is nature's way of transferring energy to higher trophic levels, *e.g.*, a tiger (predator) eating a deer (prey), a sparrow (predator) eating fruit or seed (prey), etc.
- **The role of predators:**
  (*a*) Predators keep prey population under control. This is called biological control.
  (*b*) Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among prey species.
  (*c*) Besides acting as 'conduits' for energy transfer across trophic levels, predators play other important roles. In absence of predator species, prey species could achieve very high population densities and lead to ecosystem instability.
- When certain exotic species are introduced into a geographical area, they become invasive and start spreading fast because the invaded land does not have its natural predators, *e.g.* Prickly pear cactus introduced in 1920's into Australia created **havoc** by spreading to millions of hectares and thus was brought under control only after a cactus feeding predator (a moth) was introduced into the **country** from its natural habitat.
- If a predator is too efficient and over-exploits its prey, then the prey might become extinct and following it, the predator will also become extinct due to the lack of food.

- They also help in maintaining species diversity in a community by reducing intensity of competition among **competing** prey species, *e.g.*, In rocky **intertidal** communities of American Pacific Coast, star fish Pisaster is important predator. In the beginning when all starfishes were removed from an intertidal area more than 10 species of invertebrates became extinct in a year because of interspecific competition.
- **The prey defence mechanisms**
  (*a*) To avoid being detected easily by the predators, some species of insects and frogs are cryptically coloured (camouflaged).
  (*b*) The Monarch butterfly is highly distasteful to its predator (birds) because of a special chemical present in its body which is acquired by the butterfly by feeding on a poisonous weed in its caterpillar stage.
  (*c*) 25% of insects are phytophagous, *i.e.*, feed on plant sap and other parts of plants. So, some plants have thorns or spines for defence mechanism, *e.g.*, *Acacia*, cactus.
  (*d*) Some plants produce highly poisonous chemicals like cardiac glycosides, nicotine, caffeine, quinine, strychnine, opium, etc., are produced by plants actually as defences against grazers and browsers e.g. , *Calotropis* grows in abandoned fields.

(ii) Competition

- Competition is a type of interaction where both the species suffer. It may exist between some species (**interspecific competition**) or between individuals of same species (**intraspecific competition**).
- The competition occurs due to limited resources between closely related species.
- Some totally unrelated species could also compete for the same resource, *e.g.*, in some shallow South American lakes, visiting flamingoes and resident fishes compete for their common food, zooplanktons.
- In interspecific competition, the feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species, although the resources are abundant.
- For example, after the introduction of goats in Galapagos Islands, the Abingdon tortoise became extinct within a decade due to greater browsing efficiency of the goats.
- A species whose distribution is restricted to small geographical area because of presence of competitively superior species is found to expend its distributional range when competing species is removed. **Connell's Elegant field experiment** showed on rocky sea coasts of Scotland, larger and competitively superior barnacle *Balanus* dominates intertidal area and excludes smaller barnacle *Chathamalus* from that zone.
- **Competitive release** refers to the phenomenon of a species whose distribution is restricted to a small geographical area because of the presence of a competitively superior species, is found to expand its distributional range dramatically when the competing species is experimentally removed.
- Gause's competitive exclusion principle states that two closely related species competing for the same resource cannot coexist indefinitely and the competitively inferior one will be eliminated eventually by the superior one.
- **Resource partitioning:** It refers to the phenomenon in which species facing competition might evolve mechanisms that promote coexistence rather than exclusion. MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition and coexist due to behavioural differences in their foraging activities.
- Herbivores are more adversely affected by competition than carnivores.

(iii) Parasitism

- It is the mode of interaction between two species in which one species (parasite) depends on the other species (host) for food and shelter, and in this process damages the host. In this process one organism is benefited (parasite) while the other is being harmed (host).
- **Adaptation of parasite:**
  (*a*) The parasite have evolved to be host-specific in such a manner that both host and parasite tend to co-evolve.

(*b*) Loss of unnecessary sense organs as they do not interact with external environment [For example, eyes as they are found in an environment that lacks light.)

(*c*) Presence of adhesive organs or suckers to cling to host

(*d*) Loss of digestive system to absorb digested food from increase chances of survival.

(*e*) High reproductive capacity.

(*f*) Presence of adhesive.

(*g*) Loss of chlorophyll and leaves (*e.g.* cuscuta), to derive its nutrition from the host plant which it parasitises.

(*h*) Presence of more than one host to facilitate parasitisation of its primary host.

(*i*) Eggs resemble the host egg (*e.g.*, crow) in size and colour to reduce the chances of host bird (*i.e.*, *Koel*) detecting them.

- The life cycles of some parasites are complex, where one or more intermediate host or vectors to facilitate parasitisation are present.
  (*a*) The human liver fluke depends on two intermediate hosts, a snail and a fish, to complete its life cycle.
  (*b*) Malarial parasite (*Plasmodium*) needs a vector (mosquito) to complete its life cycle.
- Majority of parasites harm the host by reducing the survival, growth and reproduction of the host. They reduce its population density by making it physically weak.
- Parasites may be of two types: ectoparasites and endoparasites.

Table 13.2 Differences between endoparasite and ectoparasite

S. No.	Endoparasite	Ectoparasite
(*i*)	These are the parasites which live inside the host's body at different sites like liver, kidney, lungs, etc., for food and shelter.	These are the parasites which feed on the external surface of the host organism for food and shelter.
(*ii*)	Example, tapeworm, liver fluke, *Plasmodium*.	Example, lice on humans, ticks on dogs, copepods, *Cuscuta*.

- The phenomenon in which one organism (parasite) lays its eggs in the nest of another organism is called **brood parasitism**. Eggs of parasitic birds have evolved to resemble host's eggs in size and colour to reduce the chance of host bird detecting foreign eggs and remove them from nest. *e.g.*, Cuckoo lays eggs in Crow's nest.

(iv) Commensalism

- Commensalism is referred to as the interaction between two species where one species is benefited and the other is neither harmed nor benefited.
- **Few examples of commensalism:**
  (*a*) An orchid growing as an epiphyte on a mango tree. The orchid gets shelter and nutrition from mango tree while the mango tree is neither benefited nor harmed.
  (*b*) Barnacles growing on the back of whale. Barnacles are benefited to move to location for food as well as shelter while the whales are neither benefited nor harmed.
  (*c*) The egrets are in close association of grazing cattle. The cattle egrets are benefited by the cattle to detect insects because cattle stir up the bushes and insects are flushed out from the vegetation, to be detected by cattle egrets.
  (*d*) Commensalism is also found between sea anemones (that has stinging tentacles) and the clown fish. The fish is protected from predators and sea anemones are neither benefited nor harmed.

(v) Amensalism

- Amensalism is referred to as the interaction between two different species, in which one species is harmed and the other is neither benefited nor harmed.
- For example, the mould *Penicillium* secretes penicillin which kills bacteria but the mould is unaffected.

(vi) Mutualism

- Mutualism is referred to as the interspecific interaction in which both the interacting species are benefited.
- **Some examples of mutualism**
  - (*a*) Lichens represent close association between fungus and photosynthetic algae or cyanobacteria, where the fungus helps in the absorption of nutrients and provides protection while algae or cyanobacterium prepares the food.
  - (*b*) Mycorrhizae are close mutual association between fungi and the roots of higher plants, where fungi helps the plant for absorption of nutrients while the plant provides food, & protection for the fungus.
  - (*c*) Mutualism are found in plant–animal relationships. Plants take the help of animals for pollination and dispersal of their seeds and animals are rewarded in the form of nectar or edible pollen or oviposition (site for laying egg).
  - (*d*) Orchids have evolved to attract right pollinator insect (bees and bumble bees). Mediterranean orchid. *Ophrys muscifera* employs sexual deceit to get pollinated by bee species. One petal of flower resembles female bee in size, color and markings and male bee is attracted and pseudocopulates with it. During this process of pseudocopulation, the pollen grains are dusted on the body of male bees. With such pollen dusts, male bee pseudocopulates to another flower of the same species and pollination takes place. Here we see co-evolution, *i.e.*, if female bee's colour patterns change during evolution, orchid flower also co-evolves to maintain resemblance of petal to female bee.
  - (*e*) Co-evolution is also seen in many species of fig trees which are pollinated by specific species of wasp. Female wasp uses fruit for oviposition and also uses developing seeds within fruit for nourishing its larvae. Wasp pollinates the fig inflorescence while searching for suitable egg laying sites. In return, the fig offers the wasp some of its developing seeds as food for the developing wasp larvae.

NCERT Textbook Questions

Q. 1. How is diapause different from hibernation?

Ans. **Table 13.3 Differences between hibernation and diapause**

S. No.	Hibernation	Diapause
(*i*)	Under unfavourable conditions, the animals that fail to migrate, avoid the stress by escaping in time and showing winter sleep is called hibernation.	Under unfavourable conditions, many species in lakes and ponds are known to enter a stage of suspended development called diapause.
(*ii*)	It occurs usually in winters.	It occurs both in summers and winters.
(*iii*)	*Example*, bear goes into hibernation during winter.	*Example*, zooplanktons undergo diapause in lakes and ponds under unfavourable conditions.

Q. 2. If a marine fish is placed in a freshwater aquarium, will the fish be able to survive? Why or why not? ***[HOTS]***

Ans. A marine fish if kept in freshwater aquarium will not be able to survive because:

(*a*) water will enter the body of fish through endosmosis.

(*b*) it does not have mechanism of salt absorption as in freshwater fishes.

(*c*) its drinking water habit will cause excess of water to enter the body.

So, the marine fish will fail to maintain the osmolarity and hence will die.

Q. 3. Most living organisms cannot survive at temperature above 45°C. How are some microbes able to live in habitats with temperatures exceeding 100°C? ***[HOTS]***

Ans. Most living organisms cannot survive above 45°C because

(*a*) Above 45°C enzymes get denatured.

(*b*) Protoplasm precipitates at high temperature.

However, some microbes (Archaebacteria) are found at 100°C because of

(*a*) reduced fluidity of cell membrane due to presence of branched chain lipids in their cell membrane.

(*b*) presence of heat-tolerant enzymes.

Q. 4. List the attributes that populations, but not individuals possess.

Ans. The attributes that populations but not individuals possess are:

(*i*) Population density (*ii*) Population growth

(*iii*) Mortality or death rate (*iv*) Natality or birth rate

(*v*) Sex ratio (*vi*) Age distribution

Q. 5. If a population growing exponentially doubles in size in 3 years, what is the intrinsic rate of increase (r) of the population?

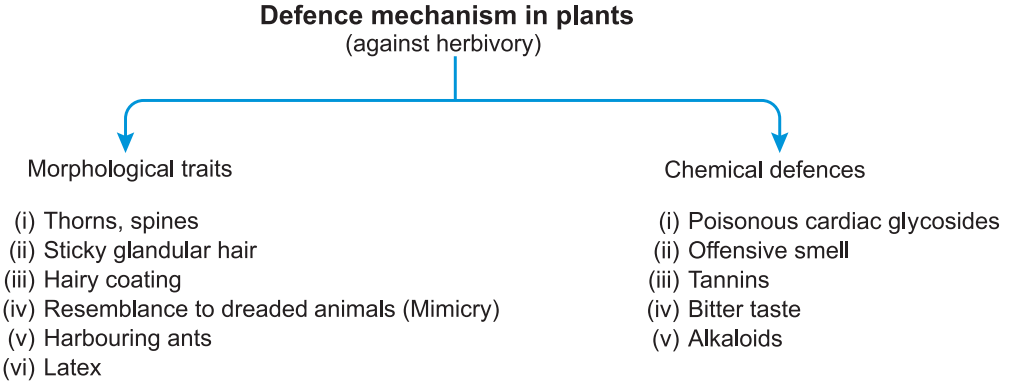
Ans. $$t = \frac{\log_2 N}{r}$$

or $$r = \frac{\log_2 N}{t} = \frac{0.7931}{3} = 0.2643$$

Intrinsic rate of increase = 0.2643 × 100 = 26.43%

Q. 6. Name important defence mechanisms in plants against herbivory.

Ans.



Q. 7. An orchid plant is growing on the branch of mango tree. How do you describe this interaction between the orchid and the mango tree?

Ans. The interaction between an orchid and the mango tree is commensalism, because orchid is benefited by getting shelter from mango tree whereas the mango tree is neither harmed nor benefited.

Q. 8. What is the ecological principle behind the biological control method of managing with pest insects?

Ans. The ecological principle operating in the biological control method of managing with pest insect is through their natural enemies, *i.e.*, predators and parasites.

Q. 9. Distinguish between the following:

(*a*) Hibernation and aestivation

(*b*) Ectotherms and endotherms

Ans. (*a*)

Table 13.4 Differences between hibernation and aestivation

S. No.	Hibernation	Aestivation
(*i*)	It is the condition of passing the winter in a resting or dormant condition.	It is the state of inactivity during hot dry summer.
(*ii*)	Animals rest in a warm place.	Animals rest in a cool and shady place.
(*iii*)	It lasts usually for the whole winter season.	It generally last for hot dry day-time because nights are often cooler.
(*iv*)	It is also called winter sleep.	It is also called summer sleep.

(*b*) **Table 13.5 Differences between ectotherms and endotherms**

S. No.	Ectotherms	Endotherms
(*i*)	They are also called cold-blooded animals.	They are also called warm-blooded animals.
(*ii*)	They are unable to regulate their body temperature, body temperature changes with temperature of environment.	They can regulate their body temperature.
(*iii*)	They exhibit both hibernation and aestivation.	Their activities are uncommon.
(*iv*)	They are less active animals.	They are more active animals.

Q. 10. Write a short note on:

(*a*) Adaptations of desert plants and animals

(*b*) Adaptations of plants to water scarcity

(*c*) Behavioural adaptations in animals

(*d*) Importance of light to plants

(*e*) Effect of temperature or water scarcity and the adaptations of animals.

Ans. (*a*) Adaptations of desert plants are as follows:

(*i*) Desert plants have cuticles to minimise transpiration.

(*ii*) In some desert plants, leaves are modified into spines to minimise loss of water.

(*iii*) They have long roots and adaptations to reduce transpiration, *e.g.*, *Acacia.*

(*iv*) Stomata are present in deeppits.

Adaptations of desert animals are as follows:

(*i*) Desert animals have concentrated their urine for minimum loss of water, *e.g.*, Kangaroo rat.

(*ii*) Desert animals absorb heat from the sun, when the body temperature drops below the comfort zone.

(*iii*) They live in burrows during hot season and have little water requirement, *e.g.*, camel.

(*iv*) Meet water requirement by interval fat oxidation.

(*b*) Adaptations of plants to water scarcity

(*i*) Some desert plants develop special photosynthetic pathway (CAM) to minimise the loss of water and close stomata during day.

(*ii*) Some desert plants have sunken stomata to minimise the loss of water.

(*iii*) Epidermis is thick walled with thick cuticles and often possess wax, thus, reducing the surface transpiration.

(*iv*) Roots are deep-seated, almost reaching the water table, *e.g.*, *Prosopis*.

(*v*) These xerophytes possess hard and pointed spines (modified leaves) to reduce transpiration.

(*c*) Behavioural adaptations in animals

(*i*) Desert lizards bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing.

(*ii*) Some species are capable of burrowing into the soil to hide and escape from ground heat.

(*iii*) Hibernation and aestivation are quite common in ectothermal animals.

(*d*) Importance of light to plants

(*i*) Light is important for manufacturing food by the process of photosynthesis.

(*ii*) Duration of light determines flowering and fruit formation.

(*iii*) Light also determines the temperature which is associated with functioning of enzymes.

(*iv*) Light is essential for growth and development of plant because it provides organic materials.

(*e*) Effect of temperature or water scarcity and the adaptations of animals.

(*i*) Animals living in arid areas reduce water loss to minimum. For example, Kangaroo Rat feeds on dry seeds and seldom drink water.

(*ii*) The requirement of water is often compensated by food and metabolic water. Water loss is prevented by burrowing into the soil to hide and escape from the above ground heat, concentration of urine and solid faeces. Camel stops producing urine when water is not available and can remain without water for many days.

(*iii*) Animals protect themselves from excessive cold by deposition of fat, fur, etc. Bears undergo hibernation during winters.

Q. 11. List the various abiotic environmental factors.

Ans. **(*i*) Atmospheric factors:** Light, temperature, wind and water.

(*ii*) Lithosphere: Rock, soil.

(*iii*) Hydrosphere: Pond, river, lake and ocean.

(*iv*) Edaphic factors: Soil texture, soil water, soil air, soil micro-organisms, soil pH, minerals.

(*v*) Topographic factors: Slope, altitude, valley.

Q. 12. Give an example for:

(*a*) An endothermic animal **(*b*) Ectothermal animal**

(*c*) An organism of benthic zone.

Ans. (*a*) Monkey (*b*) Snake (*c*) Angler fish.

Q. 13. Define population and community.

Ans. **Population:** Population is a group of individuals of same species, which can reproduce among themselves and occupy a particular area in a given time.

Community: It is an assemblage of several populations in a particular area and time and exhibit interaction and interdependence through trophic relationships.

Q. 14. Define the following terms and give one example for each:

(*a*) Commensalism **(*b*) Parasitism** **(*c*) Camouflage**

(*d*) Mutualism **(*e*) Interspecific competition.**

Ans. **(*a*) Commensalism:** It is an interaction between two different species where one is benefited and other remains unaffected, *e.g.*, clown fish and sea anemone. Here, the clown fish gets protection from predators which stay away from stinging tentacles of anemone but anemone does not derive any benefit from fish.

(*b*) Parasitism: It is an interaction between two organisms in which one is benefited and the other is harmed, *i.e.*, one organism lives at the cost of other organism. *e.g.*, *Cuscuta*, a parasitic plant that is found growing on hedge plants, do not have chlorophyll and thus derives its nutrition from the host.

(*c*) Camouflage: It is a phenomenon of blending of an organism with the surrounding due to similar colour, marking and shape so as to avoid the predators, *e.g.*, leaf-like insect such as grasshopper.

(*d*) Mutualism: It is the interaction between two species in which both organisms are benefited to maintain the life process, *e.g.*, lichen (association between algae and fungi). Here, fungi helps in absorption of nutrients and water while the algal partner manufactures food.

(*e*) Interspecific competition: It is the competition among the members of different species for limited natural resources. The Abingdon tortoise in Galapagos Islands became extinct within a decade after goats were introduced on the Island, apparently due to the greater browsing efficiency of the goats.

Q. 15. With the help of suitable diagram describe the logistic population growth curve.

Ans. Refer to Basic Concepts Point 11(*ii*) and Fig. 13.4.

Q. 16. Select the statement which explains parasitism best.

(*a*) One organism is benefited.

(*b*) Both the organisms are benefited.

(*c*) One organism is benefited, other is not affected.

(*d*) One organism is benefited, other is affected.

Ans. (*d*).

Q. 17. List any three important characteristics of a population and explain them.

Ans. The three important characteristics of a population are as follows:

(*i*) Population density: Population density of a species is the number of individuals of a species per unit area or volume.

$$PD = \frac{N}{S}$$

where, PD = Population density

N = Number of individuals in a region

S = Number of unit area in a region.

(*ii*) Birth rate: It is expressed as the number of births per 1,000 individuals of a population per year.

(*iii*) Death rate: It is expressed as the number of deaths per 1,000 individuals of a population per year.

Multiple Choice Questions [1mark]

Choose and write the correct option in the following questions.

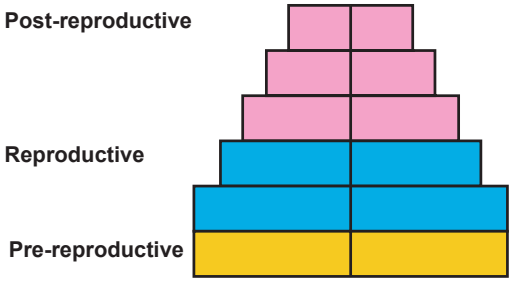
1. Reduction in vascular tissue, mechanical tissue and cuticle are characteristics of

(*a*) mesophytes (*b*) epiphytes (*c*) hydrophytes (*d*) xerophytes

2. Which of the following is a characteristic of biological community?

(*a*) Startification (*b*) Natality (*c*) Morality (*d*) Sex-ratio

3. What type of human population is represented by the following age pyramid?



(*a*) Vanishing population (*b*) Stable population

(*c*) Declining population (*d*) Expanding population

4. The logistics population growth is expressed by the equation

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

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

5. *Cuscuta* is an example of

(*a*) ectoparasitism (*b*) brood parasitims (*c*) predation (*d*) endoparasitims

6. A sedentary sea anemone gets attached to the shell lining of hermit crab. The association is

(*a*) commensalism (*b*) amensalism (*c*) ectoparasitism (*d*) symbiosis

7. Which of the following is the most accurate comment on Earth's carrying capacity (K)?

(*a*) K is smaller now than it was a thousand years ago.

(*b*) The human population is still a long way from K.

(*c*) Our technology has allowed us to keep increasing K.

(*d*) When it comes to humans, the concept of K is irrelevant.

8. Which of the following would be true of a species with an opportunistic life history?

(*a*) Members of the species take a relatively long time to reach reproductive age.

(*b*) They are regulated mostly by density-dependent factors.

(*c*) They produce large numbers of offspring.

(*d*) The population usually stabilizes near carrying capacity.

9. A particular species of tropical fish has only a few offspring and takes care of them for an extended period. We might also expect the fish population to

(*a*) be controlled mostly by density independent factors.

(*b*) show exponential growth.

(*c*) live in a harsh environment.

(*d*) be relatively stable near carrying capacity.

10. Ecological niche is **[*NCERT Exemplar*]**

(*a*) the surface area of the ocean

(*b*) an ecologically adapted zone

(*c*) the physical position and functional role of a species within the community

(*d*) formed of all plants and animals living at the bottom of a lake

11. When birth rate equals death rate,

(*a*) a population grows rapidly.

(*b*) the size of a population remains constant.

(*c*) density-dependent limiting factors do not affect the population.

(*d*) a population is in danger of extinction.

12. According to Allen's Rule, the mammals from colder climates have **[*NCERT Exemplar*]**

(*a*) shorter ears and longer limbs (*b*) longer ears and shorter limbs

(*c*) longer ears and longer limbs (*d*) shorter ears and shorter limbs

13. Salt concentration (Salinity) of the sea measured in parts per thousand is **[*NCERT Exemplar*]**

(*a*) 10 – 15 (*b*) 30 – 70 (*c*) 0 – 5 (*d*) 30 – 35

14. Formation of tropical forests needs mean annual temperature and mean annual precipitation as **[*NCERT Exemplar*]**

(*a*) 18–25°C and 150–400 cm (*b*) 5–15°C and 50–100 cm

(*c*) 30–50°C and 100–150 cm (*d*) 5–15°C and 100–200 cm

15. Which of the following forest plants controls the light conditions at the ground? **[*NCERT Exemplar*]**

(*a*) Lianas and climbers (*b*) Shrubs (*c*) Tall trees (*d*) Herbs

16. What will happen to a well growing herbaceous plant in the forest if it is transplanted outside the forest in a park? **[*NCERT Exemplar*]**

(*a*) It will grow normally

(*b*) It will grow well because it is planted in the same locality

(*c*) It may not survive because of change in its micro climate

(*d*) It grows very well because the plant gets more sunlight

17. If a population of 50 *Paramecium* present in a pool increases to 150 after an hour, what would be the growth rate of population? **[*NCERT Exemplar*]**

(*a*) 50 per hour (*b*) 200 per hour (*c*) 5 per hour (*d*) 100 per hour

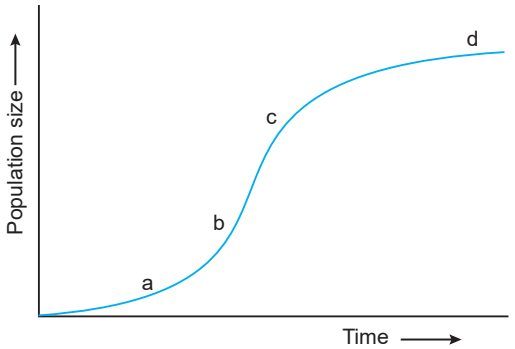
18. What would be the per cent growth or birth rate per individual per hour for the same population mentioned in the previous question (Question 17)? **[*NCERT Exemplar*]**

(*a*) 100 (*b*) 200 (*c*) 50 (*d*) 150

19. A population has more young individuals compared to the older individuals. What would be the status of the population after some years? *[NCERT Exemplar]*

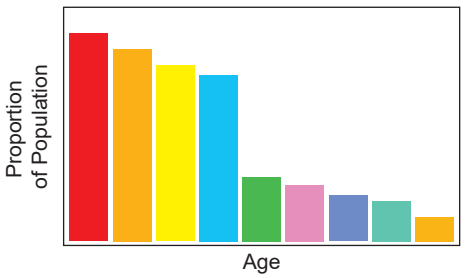
(*a*) It will decline
(*b*) It will stabilise
(*c*) It will increase
(*d*) It will first decline and then stabilise

20. At which point in the graph shown below would there be zero population growth (DN/Dt = 0)?



(*a*) a (*b*) b (*c*) c (*d*) d

21. For a population that is stable in size, the following age distribution indicates that



(*a*) The population's birth and death rates are both high.
(*b*) The population's birth and death rates are both low.
(*c*) The population's birth rate is low but its death rate is high.
(*d*) The population's birth rate is high but its death rate is low.

22. Amensalism is an association between two species where *[NCERT Exemplar]*

(*a*) one species is harmed and other is benefitted
(*b*) one species is harmed and other is unaffected
(*c*) one species is benefitted and other is unaffected
(*d*) both the species are harmed.

23. Lichens are association of *[NCERT Exemplar]*

(*a*) bacteria and fungus
(*b*) alga and bacterium
(*c*) fungus and alga
(*d*) fungus and virus

24. Which of the following is a partial root parasite? *[NCERT Exemplar]*

(*a*) Sandalwood
(*b*) Mistletoe
(*c*) Orobanche
(*d*) Ganoderma

25. The birth and death rates of four countries are given below. Which one will have the least population growth rate?

Country	Birth rate/1000	Death rate/1000
M	15	5
N	25	10
O	35	18
P	48	41

(*a*) M (*b*) N (*c*) O (*d*) P

26. According to population scientists, one of the factors responsible for limiting population is the

(*a*) availability of food. (*b*) daily variation of environmental temperature.

(*c*) time required for ecological succession. (*d*) life span of members of the population.

Answers

1. (*d*)	**2.** (*a*)	**3.** (*b*)	**4.** (*b*)	**5.** (*a*)	**6.** (*d*)	**7.** (*c*)	**8.** (*c*)	**9.** (*d*)	**10.** (*c*)
11. (*b*)	**12.** (*d*)	**13.** (*d*)	**14.** (*a*)	**15.** (*c*)	**16.** (*c*)	**17.** (*d*)	**18.** (*b*)	**19.** (*c*)	**20.** (*d*)
21. (*a*)	**22.** (*b*)	**23.** (*c*)	**24.** (*a*)	**25.** (*d*)	**26.** (*a*)				

Assertion-Reason Questions

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

1. Assertion : Species are groups of potentially interbreeding natural populations which are isolated from other such groups.
Reason : Distinctive morphological features are displayed due to reproductive isolation.

2. Assertion : Leaf butterfly and stick insect show mimicry to dodge their enemies.
Reason : Mimicry is a method to acquire body colour blending with the surroundings.

3. Assertion : Small sized animals are rarely found in polar regions.
Reason : Small sized animal have larger surface area relative to their volume and have to spend energy to generate body heat.

4. Assertion : A stable population is depicted by bell-shaped age pyramid.
Reason : The proportion of individuals in reproductive age group is higher than those in pre reproductive age group.

5. Assertion : Plant-animal interactions do not generally involve co-evolution of the mutualist organisms.
Reason : Evolution of plants and animals go side by side.

6. Assertion : Predators are organisms which feed on other individuals.
Reason : Prey species have evolved various defences to lessen the impact of predation.

7. Assertion : Population pyramid (graphically) depicts the rate at which population will grow in future.
Reason : A triangular population pyramid depicts population size is stable.

8. Assertion : Epiphytes growing on branches of the tree exhibit commensalism.
Reason : In commensalism on organism benefits from the association while the other has no effect.

9. Assertion : Coral reefs are found in regions of West Bengal and Andhra Pradesh.
Reason : Coral reef require low fresh water inflow, high salinity and optimal temperature to propagate.

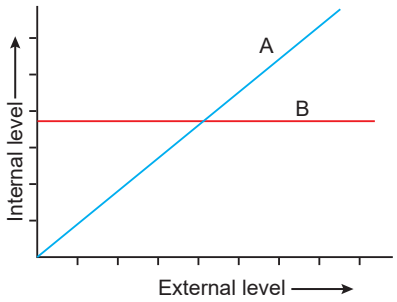
10. Assertion : Verhulst-Pearl Logistic growth curve is sigmoid in nature.
Reason : A population growing in habitat with limited resources shows an initial lag phase, followed by acceleration and deceleration and finally an asymptote.

Answers

1. (*b*)	**2.** (*a*)	**3.** (*a*)	**4.** (*c*)	**5.** (*d*)	**6.** (*b*)	**7.** (*c*)	**8.** (*a*)	**9.** (*d*)	**10.** (*b*)

Case-based/Source-based Question

1. The graph shown alongside represents the organismic response to a certain environmental condition (*e.g.*, temperature):



(*i*) Which one of these, 'A' or 'B', depicts conformers?

(*ii*) What does the other line graph depict?

(*iii*) How do these organisms differ from each other with reference to homeostasis?

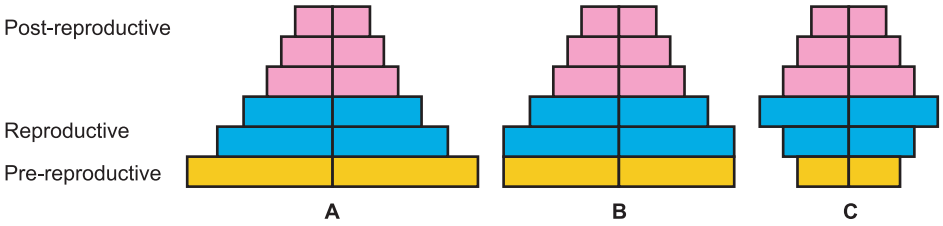
Ans. (*i*) 'A' depicts conformers.

(*ii*) The other line depicts response of the regulators.

(*iii*)

Conformers	Regulators
Aquatic animals and plants in which the osmotic concentration or body temperature of body fluids changes according to the ambient conditions or environment of water are called conformers.	Some organisms are able to maintain homeostasis by physiological means which ensures constant body temperature, constant osmotic concentration, etc.

2. Study the three different age pyramids for human population given below and answer the questions that follow:



(*i*) Write the names given to each of these age pyramids.

(*ii*) Mention the one which is ideal for human population and why.

(*iii*) What would be the growth rate pattern when the resources are unlimited?

Ans. (*i*) A — Expanding pyramid B — Stable pyramid
C — Declining pyramid

(*ii*) Stable pyramid is ideal for human population because it maintains the stability in all population phases.

(*iii*) Exponential.

Very Short Answer Questions [1 mark]

Q. 1. Write the basis on which an organism occupies a space in its community/natural surroundings. ***[CBSE (AI) 2013]***

Ans. Feeding relationships with other organisms.

Q. 2. Name a 'photoperiod' dependent process, one each in plants and in animals. ***[CBSE (F) 2013]***

Ans. In plants, flowering and in animals, migration/foraging are photoperiod dependent processes.

Q. 3. Between amphibians and birds, which will be able to cope with global warming? Give reasons. [*HOTS*]

Ans. Birds being eurythermals can tolerate a wide range of temperature and thus will be able to cope with global warming more efficiently.

Q. 4. Why are green algae not likely to be found in the deepest strata of the ocean? [*CBSE (AI) 2013*] [*HOTS*]

Ans. The wavelength of light at the deepest strata is unsuitable for growth of green algae.

Q. 5. Why are some organisms called as eurythermals and some others as stenohaline? [*CBSE (F) 2011*] [*HOTS*]

Ans. Eurythermals are organisms that can tolerate and thrive in a wide range of temperature, whereas stenohalines can tolerate a narrow range of salinities.

Q. 6. Which one of the two, stenothermals or eurythermals, shows wide range of distribution on earth and why?

Ans. Eurythermals show a wide range of distribution on earth, as they show tolerance for wide range of temperatures.

Q. 7. What are ectotherms?

Ans. Ectotherms are those animals whose body temperature changes and matches with that of the environment in which they are living. They are also called cold-blooded animals.

Q. 8. Species that tolerate wide range of salinity are called _____. [*NCERT Exemplar*]

Ans. Euryhaline.

Q. 9. Mention the effect of global warming on the geographical distribution of stenothermals like amphibians. [*CBSE (F) 2012*]

Ans. Due to global warming, stenothermals would either migrate or die due to change in the temperature.

Q. 10. When and why do some animals go into hibernation?

Ans. When the animals are not able to tolerate the stressful conditions like low temperature, they hibernate to avoid the stress by escaping in time since they can not migrate.

Q. 11. When and why do some animals like snails go into aestivation?

Ans. Snails undergo aestivation if they are unable to migrate in order to avoid stressful condition of high temperature.

Q. 12. Why are mammals the most successful animals on earth? [*HOTS*]

Ans. The mammals are most successful animals on earth because they can maintain a constant body temperature with high range of tolerance whether in Antarctica or in Sahara desert.

Q. 13. Why do people living in high altitude have more haemoglobin/high RBC count? [*HOTS*]

Ans. To acclimatise at high altitude, the people have more haemoglobin/high RBC count to compensate for the low oxygen availability.

Q. 14. What is a tree line? [*NCERT Exemplar*] [*HOTS*]

Ans. When we go up the altitude, beyond a particular height no tree are found and the vegetation comprise only of shrubs and herbs. The altitude beyond which no tree is seen is known as tree line.

Q. 15. Why has life history of variation evolved? [*HOTS*]

Ans. (*a*) Life history of variation has evolved.

(*b*) In order to maximise reproductive fitness of individual.

Q. 16. State Gause's Competitive Exclusion principle. [*CBSE (AI) 2014*]

Ans. Gause's Competitive Exclusion Principle states that two closely related species competing for same resources, cannot coexist indefinitely, (the inferior will be eliminated) by the superior one.

Q. 17. What does nature's carrying capacity for a species indicate? [*CBSE (F) 2016*]

Ans. In nature, a given habitat has enough or limited resources to support a maximum possible number of population and nature's carrying capacity indicates that how much growth is possible in a population.

Q. 18. Name two organisms (one plant and one animal) which breed only once in their life time.

Ans. Pacific salmon fish and bamboo.

Q. 19. What is Allen's rule?

Ans. According to Allen's rule, mammals in colder climate have shorter ears and shorter limbs to minimise heat loss.

Q. 20. Why do predators avoid eating Monarch butterfly? How does the butterfly develop this protective feature? **[*CBSE (F) 2010*]**

Ans. The Monarch butterfly is highly distasteful to its predator (birds) because of a special chemical present in its body. It acquires this chemical during its caterpillar stage by feeding on a poisonous weed.

Q. 21. Give two reasons as to why a weed such a *Calotropis* flourishes in abandoned fields. **[*CBSE 2019 (57/2/1)*]**

Ans. *Calotropis* flourishes in abandoned fields because of:
(*i*) It has dry hairy seeds which help in dissemination (*ii*) Its have xerophytic adaptations like thick hair on leaves and stems. (*iii*) It is not grazed by animals as it produces poisonous substances like cardiac glycosides. (*Any two*)

Q. 22. Why are cattle and goats not seen browsing on *Calotropis* growing in the fields? **[*CBSE (F) 2011*] [*HOTS*]**

Ans. *Calotropis* produces highly poisonous cardiac glycosides. Therefore, cattle and goats do not browse on them.

Q. 23. If 8 individuals in a laboratory population of 80 fruit flies died in a week, then what would be the death rate of population for the said period? **[*CBSE Delhi 2010*] [*HOTS*]**

Ans. $$\text{Death rate} = \frac{\text{Number of individuals dead}}{\text{Total number of individual}} = \frac{8}{80} = 0.1$$

The death rate will be 0.1 individuals per week.

Q. 24. In a pond there were 20 *Hydrilla* plants. Through reproduction 10 new *Hydrilla* plants were added in a year. Calculate the birth rate of the population. **[*CBSE Delhi 2010*] [*HOTS*]**

Ans. $$\text{Birth rate} = \frac{\text{Number of individuals born}}{\text{Total number of individuals}} = \frac{10}{20} = 0.5$$

Birth rate is 0.5 plants per year.

Q. 25. What does J-shaped growth curve of a population indicate?

Ans. The J-shaped growth curve indicates the minimum or absence of environmental resistance.

Q. 26. What does sigmoid growth curve of a population indicate?

Ans. Sigmoid growth curve of a population indicates following characteristics:

(*i*) Initially the growth is slow.

(*ii*) The growth becomes rapid and the curve becomes steady due to environmental resistance.

Q. 27. Pollinating species of wasps show mutualism with specific fig plants. Mention the benefits the female wasps derive from the fig trees from such an interaction. **[*CBSE (AI) 2011*] [*HOTS*]**

Ans. The wasp uses the fruit as oviposition, *i.e.*, egg laying and the developing seeds for nourishing its larvae.

Q. 28. Give an example of an organism that enters 'diapause' and why. **[*CBSE Delhi 2014*] [*HOTS*]**

Ans. Many species of Zooplankton under unfavourable conditions enters diapause which delay overall development and hence they can pass unfavourable conditions.

Q. 29. Name the type of association that the genus *Glomus* exhibits with higher plants. **[*CBSE (AI) 2014*] [*HOTS*]**

Ans. Symbiosis/Mycorrhizae/Mutualism.

Q. 30. Name the interaction between a whale and the barnacles growing on its back. **[*CBSE (F) 2012*]**

Ans. Commensalism

Q. 31. Name the interaction between sea anemone and the hermit crab that grows on it. [*CBSE (F) 2012*]

Ans. Commensalism

Q. 32. What is the interaction called between *Cuscuta* and shoe flower bush? [*CBSE Delhi 2012*]

Ans. Parasitism

Q. 33. What is an interaction called when an orchid grows on a mango plant? [*CBSE Delhi 2012*]

Ans. Commensalism

Q. 34. What do phytophagous insects feed on? [*CBSE Delhi 2012*]

Ans. Phytophagous insects feed on plant sap and other parts of plant.

Q. 35. What is mycorrhiza? [*NCERT Exemplar*]

Ans. Mycorrhiza is a symbiotic association between a fungus and the roots of higher plants.

Q. 36. Give one function of aerenchyma in aquatic plants. [*HOTS*]

Ans. Aerenchyma gives buoyancy to the aquatic plants due to presence of air chambers.

Short Answer Questions [2 marks]

Q. 1. Explain the response of all communities to environment over time. [*CBSE (AI) 2011*] [*HOTS*]

Ans. Environmental factors like temperature, water, light, soil, etc., may influence the members of communities in varying degrees. Organisms in response to these factors try to adapt according to their capacities, by maintaining a constant internal environment through homeostasis or migration to a less stressful environment or suspending activities till favourable conditions return.

Q. 2. Categorise the following plants into hydrophytes, xerophytes, halophytes and mesophytes. Write the type of plant against the following examples.

(*a*) *Salvinia* (*b*) *Opuntia

(*c*) *Rhizophora* (*d*) *Mangifera* [*NCERT Exemplar*]

Ans. (*a*) Hydrophyte (*b*) Xerophyte

(*c*) Halophyte (*d*) Mesophyte

Q. 3. In a pond, we see plants which are free-floating, rooted-submerged, rooted emergent, rooted with floating leaves. Write the type of plants against each of them.

(*a*) *Hydrilla*, (*b*) *Typha*, (*c*) *Nymphaea*, (*d*) *Lemna*, (*e*) *Vallisnaria* [*NCERT Exemplar*]

Ans. (*a*) Submerged (*b*) Rooted emergent

(*c*) Rooted with floating leave (*d*) free-floating

(*e*) Rooted Submerged

Q. 4. The density of a population in a habitat per unit area is measured in different units. Write the unit of measurement against the following:

(*a*) Bacteria, (*b*) Grass, (*c*) Banyan, (*d*) Deer, (*e*) Fish [*NCERT Exemplar*]

Ans. (*a*) Numbers/volume (*b*) Coverage/area

(*c*) Biomass/area (*d*) Numbers/area

(*e*) Weight/area or Number/area

Q. 5. Explain relationship between biotic potential and environmental resistance.

Ans. Biotic potential is defined as the maximum inherent capacity of an organism to reproduce or increase the number of individuals. Whereas the environmental resistance is the biotic and abiotic factors of the environment, that do not allow the population of organisms to grow unlimited and keeps the population size in control.

Q. 6. "Snow leopards are not found in Kerala forests and tuna fish are rarely found beyond tropical latitude in the ocean". Study the above two cases and state the possible reasons for the same. [*HOTS*]

Ans. Change in temperature from their established habitats affects the kinetics of the enzymes and through it, the basal metabolism, activity and other physiological functions of the organism.

Q. 7. Why are coral reefs not found from West Bengal to Andhra Pradesh but found in Tamil Nadu on the east coast of India? **[*NCERT Exemplar*] [*HOTS*]**

Ans. High salinity, optimal temperature and less siltation are essential to colonise corals. If siltation and fresh water inflow are very high, the corals don't colonise. In contrast when the siltation and fresh water in flow by the rivers are very less, the corals do colonise.

Q. 8. In a sea shore, the benthic animals live in sandy, muddy and rocky substrata and accordingly developed the following adaptations. Find the suitable substratum against each adaptation.

(*a*) Burrowing _____

(*b*) Building cubes _____

(*c*) Holdfasts/peduncle _____ **[*NCERT Exemplar*] [*HOTS*]**

Ans. (*a*) Sandy, (*b*) Muddy, (*c*) Rocky.

Q. 9. Name two basic types of competition found amongst organisms. Which one of them is more intense and why?

Ans. The two basic types of competitions are:

(*i*) Interspecific competition

(*ii*) Intraspecific competition

The intraspecific competition is more intense because the requirement of the individual of the species are similar.

Q. 10. Mention four adaptive features that help cacti survive in xeric environment. ***[CBSE (F) 2010]***

Ans. Adaptation in desert plants:

(*i*) Desert plants have thick waxy coating on leaf called cuticle for minimum loss of water, through transpiration.

(*ii*) They have special photosynthetic pathway (CAM) that enables minimum loss of water during day time because stomata remain closed.

(*iii*) Some desert plants develop spines instead of leaf and photosynthetic function is carried out by the flattened stem.

(*iv*) Stomata are arranged in deep pits to minimise loss, through transpiration.

Q. 11. In certain seasons we sweat profusely while in some other season we shiver. Explain. **[*CBSE Delhi 2016*]**

Ans. Human beings maintain a constant body temperature of 37°C.

- **In summers:** The outside temperature is much higher than our body temperature. Therefore, we sweat profusely. This results in evaporative cooling and our body temperature is brought down to normal (37°C).
- **In winters:** The outside temperature is much lower than our body temperature. Therefore, we start to shiver; this action (of shivering) is a kind of exercise (work) that produces heat and raises the body temperature.

Q. 12. Why are small animals rarely found in the polar regions? Explain.

OR **[*CBSE Delhi 2013; (F) 2010*]**

Why are small birds like humming birds not found in polar regions? Explain. **[*CBSE (F) 2012*]**

Ans. Small animals like humming birds have a large surface area relative to their volume. So they tend to lose body heat very fast when it is cold outside. Then, these animals have to use their energy (generated by metabolic reactions) to generate body heat. That is the reason why small sized animals are rarely found in the polar regions.

Q. 13. Why the plants that inhabit a desert are not found in a mangrove? Give reasons. **[*CBSE Delhi 2016*]**

Ans. In mangroves the soil is oxygen deficit because of excess water present. Plants in mangroves develop special roots called breathing roots or pneumatophores for respiration. This adaptation

is not present in desert plants because of which they cannot survive in mangroves.

Q. 14. Bear hibernates whereas some species of zooplanktons enter diapause to avoid stressful external conditions. How are these two ways different from each other? ***[CBSE (F) 2011]***

Ans. Hibernation is the winter sleep, seen in cold-blooded animals in polar regions, in which they suspend their metabolic activities when external temperature becomes unfavourable. Whereas, diapause is the phenomenon seen in insects during their developmental stages, in which metabolic activities are suspended due to unfavourable conditions.

Q. 15. Many fresh water animals cannot survive in marine environment. Explain. ***[CBSE Delhi 2015]*** ***[HOTS]***

Ans. Marine environment has high salt concentration. These fresh water animals in such hypertonic surroundings suffer from osmotic problems. Their bodies start losing water by exosmosis.

Q. 16. How do seals adapt to their natural habitat? Explain. ***[CBSE (F) 2010]***

Ans. Seals adapt to the cold climate by developing a thick layer of fat (blubber) below their skin that acts as an insulator and reduce excess loss of body heat.

Q. 17. Some organisms suspend their metabolic activities to survive in unfavourable conditions. Explain with the help of any four examples. ***[CBSE Delhi 2012]***

Ans. **(*i*) Polar bear:** They hibernate during winter to escape the cold weather.

(*ii*) Snails/fishes: They go into aestivation during summer to avoid heat related problems and desiccation.

(*iii*) Seeds of higher plants/spores of bacteria/fungi: They become dormant in unfavourable conditions and in case of *Amoeba* cyst formation takes place.

(*iv*) Some species of zooplankton: They undergo diapause.

Q. 18. Plants that inhabit a rain-forest are not found in a wetland. Explain. ***[CBSE Delhi 2016]***

Ans. Plants in wetland are adapted differently. The soil in wetland lacks oxygen. So, for respiration the roots have to grow above the soil. These roots are called breathing roots or pneumatophores. This feature is not present in roots of plants growing in rainforest.

Q. 19. How does our body adapt to low oxygen availability at high altitudes? ***[CBSE (F) 2011]***

Ans. Our body adapts to low oxygen availability by increasing red blood cell production, decreasing the binding capacity of haemoglobin and by increasing breathing rate.

Q. 20. How does a desert plant adapt to the dry, warmer environmental conditions? ***[CBSE (F) 2015]***

Ans. Adaptations of a desert plant:

(*i*) Leaf surface has a thick cuticle.

(*ii*) Stomata are situated in deep pits.

(*iii*) Stem is flattened and performs photosynthesis.

(*iv*) Leaves are modified into spines as in *Opuntia*. (*Any two*)

Q. 21. (*a*) Explain "birth rate" in a population by taking a suitable example.

(*b*) Write the other two characteristics which only a population shows but an individual cannot. ***[CBSE (AI) 2013]***

Ans. (*a*) Birth rate is expressed as the number of births per 1,000 individuals of a population per year. For example, in a pond there were 200 frogs and 40 more were born in a year. Then, the birth rate of the population will be 40/200 = 0.5 frogs per year.

(*b*) Sex ratio, age distribution, population density, population growth. (*Any two*)

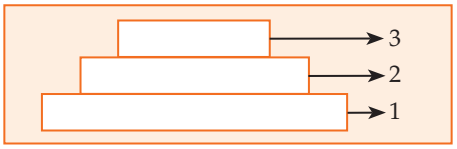
Q. 22. Construct an age pyramid which reflects an expanding growth status of human population. ***[CBSE (AI) 2014]*** ***[HOTS]***

Ans. Refer to Fig. 13.3.

Q. 23. Construct an age pyramid which reflects a stable growth status of human population. ***[CBSE Delhi 2014]*** ***[HOTS]***

Ans. Refer to Fig. 13.3.

Q. 24.



(*a*) Label the three tiers 1, 2, 3 given in the above age pyramid.

(*b*) What type of population growth is represented by the above age pyramid?

[*NCERT Exemplar*] [*HOTS*]

Ans. (*a*) 1 represents Pre-reproductive age group
2 represents Reproductive age group
3 represents Post-reproductive age group

(*b*) Expanding population.

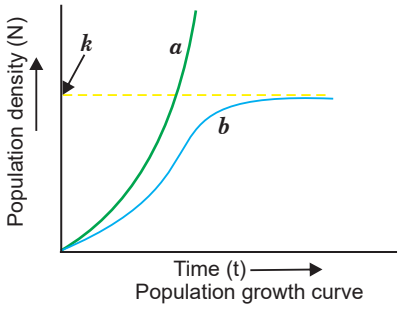
Q. 25. (*a*) What is "r" in the population equation given: dN/dt = rN?

(*b*) How does the increase and the decrease in the value of 'r' affect the population size?

Ans. (*a*) 'r' is called intrinsic rate of natural increase.

(*b*) Population size increases with increase in 'r' and it decreases with decrease in 'r'.

Q. 26. Identify the curves '*a*' and '*b*' shown in the graph given below. List the conditions responsible for growth patterns '*a*' and '*b*'. [*HOTS*]



Ans. Curve '*a*' is exponential growth curve. When the resources (food + space) are unlimited, this type of growth curve appears.

Curve '*b*' is logistic growth curve. When the resources become limited at certain point of time, this type of growth curve appears.

Q. 27. Explain Verhulst-Pearl Logistic Growth of a population. [*CBSE (F) 2014*]

Ans. According to Verhulst–Pearl Logistic growth, a population growing in a habitat with limited resources initially shows a lag phase, followed by phases of acceleration and deceleration and finally an asymptote when the population density reaches the carrying capacity. It is given by the following equation:

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

where, N = population density at time t, r = intrinsic rate of natural increase, K = carrying capacity.

Q. 28. Co-evolution is a spectacular example of mutualism between an animal and a plant. Describe co-evolution with the help of an example. [*CBSE (F) 2016*]

OR

Describe the mutual relationship between fig tree and wasp and comment on the phenomenon that operates in their relationship. [*CBSE (AI) 2014*]

Ans. Co-evolution can be observed in Fig (plant) and wasp (animal). The female wasp uses the fruit for oviposition or egg laying. It also uses developing seeds within the fruit for nourishing its larvae. The wasp in turn pollinates the fig inflorescence. The given Fig species can be pollinated by its 'partner' wasp species and no other species.

Q. 29. Egrets are often seen along with grazing cattle. How do you refer to this interaction? Give a reason for this association.

Ans. The interaction between them can be referred to as commensalism. Egrets always forage close to where the cattle are grazing because the cattle, as they move stir up and flush out insects from the vegetation which otherwise might be difficult for the egrets to find and catch.

Q. 30. Explain brood parasitism with the help of an example. ***[CBSE (AI) 2012]***

Ans. *Koel* is a parasitic bird (which has lost the instinct to make its own nest to lay eggs), has evolved the technique of laying eggs in the nest of a crow.

Its eggs bear resemblances to those of crow.

Q. 31. Explain parasitism and co-evolution with the help of one example of each. ***[CBSE (AI) 2016]***

Ans. Mode of interaction between two species in which one species (parasite) depends on the other species (host) for food and shelter is called parasitism. In this one organism is benefitted and the other is harmed.

For example, Human liver fluke or Malarial parasite or *Cuscuta.*

Co-evolution is the relationship between two interacting organisms where an organisms fails to survive in the absence of the other.

For example, Fig and fig wasp or *Ophrys* and bumble bee.

Q. 32. What is mutualism? Mention any two examples where the organisms involved are commercially exploited in agriculture. ***[CBSE (AI) 2015]***

Ans. Interaction between two species in which both are benefited is called mutualism.

(*i*) Rhizobium in the roots (nodules) of legumes.

(*ii*) Mycorrhiza → Glomus living with the roots of higher plants.

Q. 33. How does the Mediterranean orchid *Ophrys* ensure its pollination by bees?

Ans. The petals of the *Ophrys* resembles the female of a bee species in size, colour and odour, etc. Male bee mistakes the *Ophrys* for female bee and tries to copulate. Few pollen grains adhered with the body of the male bee fall over stigma of the flower thereby leading to pollination.

Q. 34. How do plants benefit from having mycorrhizal symbiotic association? ***[CBSE (F) 2010]***

Ans. Mycorrhizal association is found between fungi and the roots of higher plants. The fungi help the plant in the absorption of essential nutrients from the soil while plant in turn provides energy-yielding carbohydrates to fungi.

Q. 35. (*a*) How is *Cuscuta* adapted to be a parasitic plant?

(*b*) Why do cattle avoid browsing on *Calotropis* plants? Explain.

Ans. (*a*) *Cuscuta* has lost its chlorophyll and leaves during evolution and thus it derives its nutrition from host plant, thus, it is a parasitic plant.

(*b*) Cattle avoid browsing on *Calotropis* plants because it produces poisonous cardiac glycosides.

Q. 36. Why do clown fish and sea anemone pair up? What is this relationship called? ***[CBSE Delhi 2012]***

Ans. The clown fish gets protection from predators which stay away from stinging tentacles of anemone but anemone does not derive any benefit from the fish. This relationship is called commensalism.

Q. 37. Besides acting as 'conduits' for energy transfer across trophic levels, predators play other important roles. Justify. ***[CBSE Sample Paper 2016]***

Ans. Besides acting as 'conduits' of energy transfer across trophic levels, predators play other important roles like

(*i*) They keep prey population under control.

(*ii*) Predators also help in maintaining species diversity in a community by reducing the intensity of competition among competing prey species.

Q. 38. An organic farmer relies on natural predation for controlling plant pests and diseases. Justify giving reasons why this is considered to be a holistic approach. ***[CBSE (F) 2010] [HOTS]***

Ans. Besides acting as 'conduits' for energy transfer across trophic levels, predators are used in biological control of plant pests. This ability of the predator is based on its regulating the prey population. The natural predators reduce interspecific competition and do not harm the crop

plants. For example, in an area the invasive cactus can be brought under control by cactus-feeding predator (a moth). Using natural predation, the ecosystem is kept stable without harming any of the trophic levels.

Q. 39. Apart from being part of the food chain, predators play other important roles. Mention any two such roles supported by examples. ***[CBSE Delhi 2014] [HOTS]***

Ans. (*i*) Keeps prey population under control. For example, the invasive prickly. Pear cactus in Australia was brought under control only after a cactus feeding predator (a moth) was introduced in the country.

(*ii*) Maintains species diversity by reducing intensity of competition among prey species. For example, when the starfish *Pisaster* was removed from its community of American Pacific Coast, more than 10 species of invertebrates became extinct.

Long Answer Questions–I [3 marks]

Q. 1. (*a*) Write the importance of measuring the size of a population in a habitat or an ecosystem.

(*b*) Explain with the help of an example how the percentage cover is a more meaningful measure of population size than mere numbers. ***[CBSE (AI) 2013]***

Ans. (*a*) By measuring the size of a population, following can be predicted:

(*i*) Status of the population in a habitat.

(*ii*) Outcome of competition with other species.

(*iii*) Impact of predator or pesticides.

(*iv*) Increase or decrease of population size.

(*iv*) Effect of pesticide application (*Any two*)

(*b*) **Example:** Banyan tree and *Parthenium* plants.

When 1 banyan tree is compared with 100 *Parthenium* plants, the population of banyan in terms of number is very much low as compared to *Parthenium*. But in terms of percentage cover or biomass, the banyan tree provides a much larger cover in comparison to 100 *Parthenium* plants. Thus, the percentage cover or biomass is a more meaningful measure of population size.

Q. 2. (*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 density of an organism. ***[CBSE (AI) 2012]***

Ans. (*a*) By physical counting, percent cover or total biomass, from relative density, counting pugmarks, counting faecal pellets. (*Any three*)

(*b*) Status of habitat, whether competition for survival exists or not, whether population is increasing or declining, natality, mortality, emigration, immigration.

Q. 3. (*a*) List the biotic components an organism interacts with in its natural habitat.

(*b*) Mention how have organisms optimised their survival and reproduction in a habitat. ***[CBSE (F) 2013]***

Ans. (*a*) Plants, animals and microorganisms.

(*b*) (*i*) Some organisms regulate to maintain homeostasis by physiological and behavioural means.

(*ii*) In some animals and plants the osmotic concentration of the body fluids change with that of the ambient water osmotic concentration (Conform).

(*iii*) Some animals migrate to avoid unfavourable conditions.

(*iv*) Some bacteria, fungi and lower plants, under unfavourable conditions slow down metabolic rate and form thick-walled spores to overcome stressful conditions (Suspend).

Q. 4. How do organisms which cannot migrate, tend to overcome adverse environmental conditions? Explain taking one example each from vertebrates and angiosperms respectively.

Ans. Organisms which cannot migrate tend to overcome adverse environmental conditions by developing several methods/features. For example, some vertebrates escape the stress caused by

unfavourable environmental conditions by escaping in time like bears go into hibernation during the winter months. In angiosperms, seeds and some other vegetative reproductive structures serve as means to tide over periods of stress. They reduce their metabolic activity and go into an inactive, *i.e.*, 'dormant' state. They germinate to form new plant when the favourable conditions return.

Q. 5. Explain with the help of suitable examples the three different ways by which organisms overcome their stressful conditions lasting for short duration. ***[CBSE Delhi 2016]***

Ans. If the stressful conditions remain for short duration, the organism has following alternatives, *i.e.*, either conform, migration, suspension.

(*i*) Conform: In some animals called conformers, osmotic concentration of body fluids change with that of the ambient water osmotic concentration. For example, small animals have larger surface area relative to their volume. They lose body heat very fast in low temperature. So, they expand energy to generate body heat through metabolism.

(*ii*) Migration: The temporary movement of organism from the stressful habitat to a more hospitable area and return when stressful period is over is called migration. For example, migratory birds from Siberia come to Keoladeo National Park (Bharatpur) in every winter.

(*iii*) Suspend: Those animals who fail to migrate, might avoid the stress by escaping in time. Hibernation of bears during winter or aestivation of snails and fish to avoid summer are examples of this phenomenon.

Q. 6. Explain with the help of an example each, any two ways by which the animals cope with the stressful conditions lasting for a short period in their habitat. ***[CBSE 2019 (57/3/3)]***

Ans. Refer to Basic Concepts Point 7.

Q. 7. How do organisms like fungi, zooplanktons and bears overcome the temporary short-lived climatic stressful conditions? Explain. ***[CBSE (AI) 2010]***

Ans. **Fungi** form thick-walled spores which help them survive in unfavourable conditions. On availability of suitable environment, these germinate.

Zooplanktons in lakes and ponds under unfavourable conditions, enter diapause, a stage of suspended development.

Bears in extreme low temperatures, escape winter time by hibernating.

Q. 8. How do organisms cope with stressful external environmental conditions which are localised or of short duration? ***[CBSE (AI) 2011]***

Ans. The following methods are employed by organisms to cope with stressful conditions:

(*i*) Migrate temporarily from the stressful habitat to a hospitable area,
(*ii*) suspend activities,
(*iii*) form thick walled spores,
(*iv*) form dormant seeds,
(*v*) hibernate during winter,
(*vi*) aestivate during summer,
(*vii*) planktons undergo diapause. (*Any six*)

Q. 9. (*a*) State how the constant internal/environment is beneficial to organisms.

(*b*) Explain any two alternatives by which organisms can overcome stressful external conditions. ***[CBSE (AI) 2014]***

Ans. (*a*) Constant internal environment permits all biochemical reaction and physiological functions to proceed with maximal efficiency and thus enhance the overall fitness of the species.

(*b*) Organisms can overcome stressful external conditions with the following ways:

(*i*) Regulation: Maintaining internal environment by maintaining constant body temperature or osmotic concentration.

(*ii*) Suspend (conform): By suspending metabolic activities through hibernation or aestivation or diapause.

(*iii*) Migration: Organisms migrate temporarily to more hospitable areas.

Q. 10. Different animals respond to changes in their surroundings in different ways. Taking one example each, explain "some animals undergo aestivation while some others hibernate". How do fungi respond to adverse climatic conditions? ***[CBSE (AI) 2017]***

Ans. Some animals go into aestivation to avoid summer problems like, heat and dessication. For example, snails and fish.

Some animals go into hibernation to avoid winter related problem like, extreme cold. For example, bear.

Fungi form thick walled spores and suspend their activities to respond to adverse climatic conditions.

Q. 11. Water is very essential for life. Write any three features both for plants and animals which enable them to survive in water scarce environment.

[CBSE (AI) 2011, CBSE Sample Paper 2014]

Ans. **Plants:** Ephemeral mode (complete life cycle in short period); deep tap roots; deciduous leaves; waxy cuticle; sunken stomata; succulence to store water; C_4 or CAM pathway of photosynthesis. (*Any three*)

Animals: No sweating; uricotelic; deposition of fat in sub-epidermal layer; burrowing nature; thick skin; body covered with scales. (*Any three*)

Q. 12. How do kangaroo rats and desert plants adapt themselves to survive in their extreme habitat? Explain. ***[CBSE (AI) 2017]***

Ans. Kangaroo rats are capable of meeting its water requirements through its internal fat oxidation in which water is a by product. It also has the ability to concentrate its urine so that minimal volume of water is used to remove excretory products.

Desert plants have a thick cuticle on their leaf surface and have their stomata arranged in deep pits to minimise water loss. They also have leaves reduced to spines and deep roots to absorb more water. They have a special photosynthetic pathway (CAM).

Q. 13. Describe the specific adaptation of xerophytes with respect to root system, stem and leaves.

Ans. (*i*) The root system is deep-rooted, that help to reach up to the level of water table.

(*ii*) Stem become modified into fleshy, spongy flat and green structure called phylloclade. Stem can perform photosynthesis and store water.

(*iii*) Leaves have waxy layer called cuticle, contain sunken stomata and leaves are modified into hard pointed spines to reduce transpiration. Leaves become fleshy in succulents.

Q. 14. (*a*) "Organisms may be conformers or regulators." Explain this statement and give one example of each.

(*b*) Why are there more conformers than regulators in the animal world? ***[CBSE (AI) 2017]***

Ans. (*a*) Conformers are organisms which cannot maintain a constant internal environment under varying external environmental conditions. They change body temperature and osmotic concentration with change in external environment. For example, all plants, fishes, amphibians etc.

Regulators are organisms which can maintain homoeostasis (by physiological means or behavioural means) *i.e.*, they maintain constant body temperature and osmotic concentration. For example, birds and mammals.

(*b*) Thermoregulation is energetically expensive for animals. Therefore, more conformers are found.

Q. 15. Explain mutualism with the help of any two examples. How is it different from commensalism? ***[CBSE Delhi 2013]***

Ans. Refer to Basic Concepts Point 13 (*vi*).

In commensalism, one species benefits and the other is neither benefitted nor harmed whereas in mutualism both the species are benefitted.

Q. 16. Study the graph given alongside and answer the questions which follow:

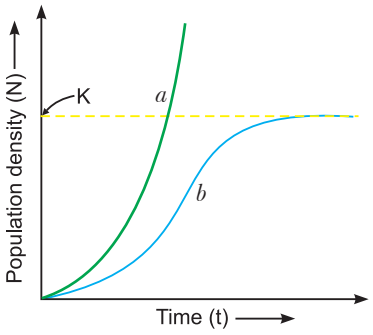
(*i*) The curve '*b*' is described by the following equation:

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

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?



Ans. (*i*) 'K' stands for carrying capacity. Carrying capacity is defined as the maximum number of individuals of a population that can be sustained by the given habitat/environment.

(*ii*) Curve '*b*' is more realistic.

(*iii*) Curve '*a*'. When the predators are absent, the prey population grows exponentially.

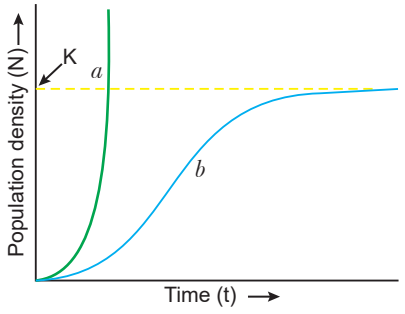
Q. 17. Study the population growth curves in the graph given below and answer the questions that follow:

(*i*) Identify the growth curves '*a*' and '*b*'.

(*ii*) Which one of them is considered a more realistic one and why?

(*iii*) If $\frac{dN}{dt} = rN\left\{\frac{K - N}{K}\right\}$ is the equation of the logistic growth curve, what does K stand for?

(*iv*) What is symbolised by N?



Ans. (*i*) *a* is exponential growth curve or J-shaped curve.

b is logistic growth curve or S-shaped curve.

(*ii*) Logistic growth curve (*b*) is considered more realistic because unlimited resources are never available in an ecosystem or in a habitat.

(*iii*) K stands for carrying capacity.

(*iv*) N indicates population density, which is the number of species of a population per unit area.

Q. 18. When do you describe the relationship between two organisms as mutualistic, competitive and parasitic? Given one example of each type. ***[CBSE (F) 2017]***

Ans. Mutualism is referred to as the interspecific interaction in which both the interacting species are benefited from each other. For example, lichens represent close association between fungus and Algae.

Competition is a type of interaction due to limited resources between closely related species where they compete for the same resource and both species suffer. For example, In South American lakes, visiting flamingos and resident fishes compete for zooplanktons.

Parasitism is the mode of interaction between two species, in which one species (parasite) depends on the other species (host) for food and shelter, and in the process damages the host. For example, human liver fluke depends on two hosts, a snail and a fish, to complete its life cycle.

Q. 19. Name the type of interaction seen in each of the following examples:

(*i*) *Ascaris* worms living in the intestine of humans

(*ii*) Wasp pollinating fig inflorescence

(*iii*) Clown fish living among the tentacles of sea-anemone

(*iv*) Mycorrhizae living on the roots of higher plants

(*v*) Orchid growing on a branch of a mango tree

(*vi*) Disappearance of smaller barnacles when *Balanus* dominated in the coast of Scotlan(d) **[*CBSE Delhi 2011*]**

Ans. (*i*) Parasitism (*ii*) Mutualism
(*iii*) Commensalism (*iv*) Mutualism
(*v*) Commensalism (*vi*) Competition

Q. 20. Predation is usually referred to as a detrimental association. State any three positive roles that a predator plays in an ecosystem. **[*CBSE (AI) 2016*]**

Ans. (*i*) They predators act as conduits for energy transfer across trophic levels.
(*ii*) They keep prey populations under control.
(*iii*) They help in maintaining species diversity in a community by reducing the intensity of competition among prey species.

Q. 21. Explain co-evolution with reference to parasites and their hosts. Mention any four special adaptive features evolved in parasites for their parasitic mode of life. **[*CBSE (AI) 2015*]**

Ans. If the host evolves special mechanism for rejecting or resisting the parasite. The parasite has to (simultaneously) evolve/co-evolve the mechanism to counter act and neutralise them & *i.e.* called co-evolution.

(*a*) Parasitic adaptation in Animals

Refer to Basic concept 13 (*iii*) (Adaptation of parasite)

(*b*) Parasitic adaptation in plants

(*i*) Haustoria in *Cuscuta*
(*ii*) Loss of chlorophyll
(*iii*) Loss of leaves/foliage

Q. 22. Differentiate between mutualism, parasitism and commensalism. Provide one example for each of them. **[*CBSE (F) 2015*]**

Ans. Refer to Basic Concepts Point 13 (*iii*), (i*v*) & (*vi*).

Q. 23. Differentiate between commensalism and mutualism by taking one example each from plants only. **[*CBSE (F) 2014*]**

Ans.

Table 13.7 Differences between commensalism and mutualism

S. No.	Commensalism	Mutualism
(*i*)	It is an interspecific interaction in which one species is benefited and other is neither harmed nor benefited.	It is an interspecific interaction in which both the species (individuals) are mutually benefited.
(*ii*)	The two individuals may be physically associated.	The two individuals may be physically or physiologically associated.
(*iii*)	*E.g.*, Sucker fish and shark.	*E.g., Rhizobium* and the legume plants.

Q. 24. (*a*) Explain any two defence mechanisms plants have evolved against their predators.
(*b*) How does predation differ from parasitism? **[*CBSE (F) 2016*]**

Ans. (*a*) Plants have developed the following defence mechanisms:
(*i*) Thorns as means of defence.
(*ii*) Plants may produce chemicals such as nicotine, caffeine, quinine, strychnine, opium for defence.

(*b*)

Table 13.8 Differences between predation and parasitism

S. No.	Predation	Parasitism
(*i*)	The predator only feeds on prey.	The parasite lives and feeds on the host.
(*ii*)	The predator is not prey specific.	The parasite is host specific.
(*iii*)	The predator keeps a check on prey population.	The parasite coevolves with the host.

Q. 25. Highlight the differences and a similarity between the following population interactions: Competition, predation and commensalism. ***[CBSE (F) 2017]***

Ans. **Table 13.9 Differences between competition, predation and commensalism**

S. No.	Competition	Predation	Commensalism
(*i*)	In this type of interaction both the species suffer.	In this type of interaction the predator kills and consumes the prey.	In this type of interaction one species is benefited and the other is neither harmed nor benefited.
(*ii*)	It occurs due to limited resources between closely related species.	It is the nature's way of transferring energy to higher trophic level.	It is not particularly for any gain of energy or resources.
(*iii*)	For example, In American lakes visiting flamingos and resident fish.	For example, tiger (predator) and deer (prey).	For example, sucker fish and shark.

Similarity: All these interactions leads to evolution as the fittest organism survives.

Q. 26. Highlight the differences between the population interactions given below. Given an example of each.

(*a*) Parasitism (*b*) Amensalism (*c*) Mutualism ***[CBSE (F) 2017]***

Ans. **Table 13.10 Differences between parasitism, amensalism and mutualism**

S. No.	Parasitism	Amensalism	Mutualism
(*i*)	In this interaction one species (parasite) depends on the other species (host) for food and shelter.	In this interaction one species is harmed and the other is neither benefited nor harmed.	In this interaction both the interacting species are benefited.
(*ii*)	The interacting species co-evolve.	No evolution is observed.	The interacting species co-evolve.
(*iii*)	For example, Cuscuta is commonly found growing on hedge plants.	For example, the mould Penicillium secretes penicillin which kills bacteria but the mould is unaffected.	For example, *Rhizobium* and the legume plants.

Q. 27. Interspecific interactions of two species of any population may be beneficial, detrimental or neutral. Explain each of them with the help of suitable examples. ***[CBSE Sample Paper 2014]***

Ans. **Population interactions:**

Species A	Species B	Name of interaction
+	+	Mutualism
–	–	Competition
+	–	Predation
+	–	Parasitism
+	0	Commensalism

(*i*) + = Beneficial; – Detrimental; 0 Neutral. Both species benefit in mutualism, *e.g.* lichens

(*ii*) Both species lose in competition, *e.g.* (detrimental)

(*iii*) In predation and parasitism the predator and the parasite gets benefit but it is detrimental to the other species (host and prey respectively)

(*iv*) In commensalism one species is benefitted but the other is neither harmed nor benefitted.

Long Answer Questions–II [5 marks]

Q. 1. (*a*) List the different attributes that a population has and not an individual organism.

(*b*) What is population density? Explain any three different ways the population density can be measured, with the help of an example each. ***[CBSE (AI) 2015]***

Ans. (*a*) **Attributes of population**

Birth rate, death rate, sex ratio, age pyramids/age distribution. (*Any two*)

(*b*) **Population density:** Number of individuals per unit area at a given time/period

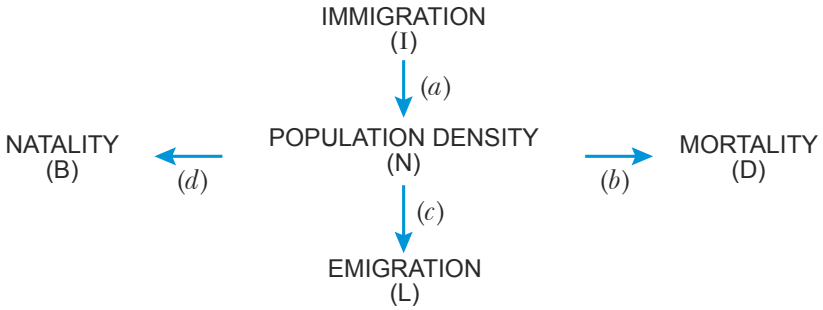
(*i*) **Biomass/%Cover,** *e.g.*, Hundred Parthenium plants and 1 huge banayan tree

(*ii*) **Relative Density,** *e.g.*, Number of fish caught per trap from a lake

(*iii*) **Numbers,** *e.g.*, Human population

(*iv*) **Indirect estimation,** *e.g.*, without actually counting/seeing them, *e.g.*, tiger census based on pug marks and faecal pellets. (*Any three*)

Q. 2.



(*a*) Which of the above represents the increase or decrease of population?

(*b*) If N is the population density at time t, then what would be its density at time (t+1)? Give the formula.

(*c*) In a barn there were 30 rats. 5 more rats enter the barn and 6 out of the total rats were eaten by the cats. If 8 rats were born during the time period under consideration and 7 rats left the barn, find out the resultant population at time (t+1).

(*d*) If a new habitat is just being colonized, out of the four factors affecting the population growth, which factor contributes the most? ***[CBSE Sample Paper 2016]***

Ans. (*a*) *a* and *d* represents increase of population and *b* and *c* represent decrease of population.

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

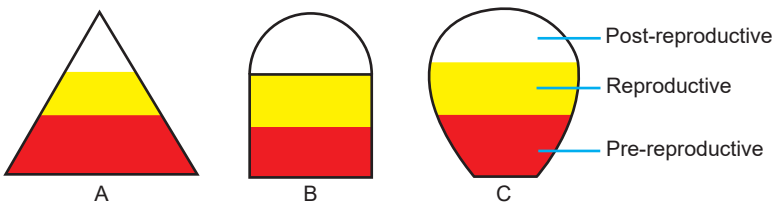
(*c*) Here, $N_t = 30$; I = 5; E = 7 ; D = 6; B = 8

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

$$N_{t+1} = 30 + [(8 + 5) - (6 + 7)]$$
$$= 30 + [13 - 13]$$
$$= 30 + 0$$
$$= 30 \text{ rats}$$

(*d*) Immigration contributes the most.

Q. 3. The following diagrams are the age pyramids of different populations. Comment on the status of these populations. ***[NCERT Exemplar]*** ***[HOTS]***

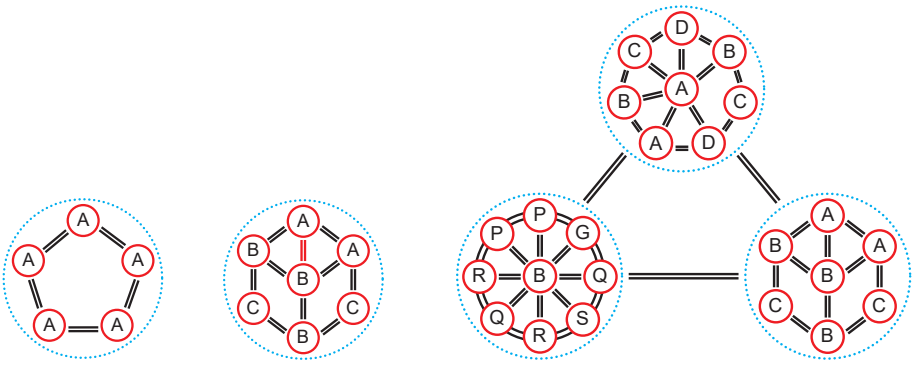


Ans. **Fig. A:** It is a 'pyramid' shaped age pyramid. In this figure, the base, *i.e.*, pre-reproductive stage is very large as compared with the reproductive and post-reproductive stages of the population. This type of age structure indicate that the population would increase rapidly.

Fig. B: It is an 'inverted bell' shaped pyramid. In this figure, the pre-reproductive and reproductive stages are same. This type of age structure indicates that the population is stable.

Fig. C: It is 'urn' shaped pyramid. In this figure, the pre-reproductive and reproductive stages are less than the post-reproductive stage of this population. In this population more older people are present. This type of age structure indicates that the population definitely is declining.

Q. 4. Comment on the following diagrams:
A, B, C, D, G, P, Q, R, S are species. **[*NCERT Exemplar*] [*HOTS*]**



I **II** **III**

Ans. **Fig. I:** It is a single population and all individuals are of the same species, *i.e.*, A individuals interact among themselves and their environment.

Fig. II: It is a community and it contains three populations of species A, B and C. They interact with each other and their environment.

Fig. III: It is a biome. It contains three communities of which one is in climax and other two are in different stage of development. All three communities are in the same environment and they interact with each other and their environment.

Q. 5. (*a*) Following are the responses of different animals to various abiotic factors. Describe each one with the help of an example.
(*i*) Regulate **(*ii*) Conform**
(*iii*) Migrate **(*iv*) Suspend**
(*b*) If 8 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during that period.

Ans. (*a*) Refer to Basic Concepts Point 7.

(*b*) $\text{Death rate} = \frac{\text{Number of individuals dead}}{\text{Total population}}$

$= \frac{8}{80} = 0.1$ individuals per butterfly per week

Q. 6. (*a*) Explain giving reasons why the tourists visiting Rohtang Pass or Mansarovar are advised to resume normal 'active life' only after a few days of reaching there.
(*b*) It is impossible to find small animals in the polar regions. Give reasons. **[*CBSE (AI) 2012*]**

Ans. (*a*) Initially the person suffers from altitude sickness/nausea, fatigue and heart palpitation because of low oxygen availability and low atmospheric pressure. Gradually the body increases RBC production, decreasing binding capacity of Hb and increases the breathing rate to get acclimatised.

(*b*) Small animals have larger surface area relative to their volume, so they lose heat much faster, & have to spend more energy to generate body heat.

Q. 7. (*a*) List any three parameters used by ecologists under different situations to measure the population size in a habitat.

(*b*) Mention what do the following stand for in the equation given below:

(*i*) N_{t+1}, (*ii*) B and (*iii*) E.

$$N_{t+1} = N_0 + [(B + I) - (D + E)]$$

Give an explanation for the above equation.

Ans. Refer to Basic Concepts Point 10.

Q. 8. Draw and explain a logistic curve for a population of density (N) at time (t) whose intrinsic rate of natural increase is (r) and carrying capacity is (K).

Ans. Refer to Basic Concepts Point 11(*ii*)

For diagram refer to Fig. 13.4.

Q. 9. (*a*) Explain with the help of a graph the population growth curve when resources are

(*i*) limiting and (*ii*) not limiting.

(*b*) "Nature has a carrying capacity for a species." Explain. **[*CBSE (F) 2010*]**

Ans. (*a*) Refer to Basic Concepts Point 11, for graph refer to Fig. 13.4.

(*b*) (*i*) The resources become limited at certain point of time, so no population can grow exponentially.

(*ii*) Every ecosystem or environment or habitat has limited resources to support a particular maximum number of individuals called its carrying capacity (K).

Q. 10. (*a*) Name the two growth models that represent population growth and draw the respective growth curves they represent.

(*b*) State the basis for the difference in the shape of these curves.

(*c*) Which one of the curves represent the human population growth at present? Do you think such a curve is sustainable? Give reason in support of your answer. **[*CBSE (AI) 2016*]**

Ans. (*a*) Exponential growth curve and logistics growth curve

For graph refer to Fig. 13.4.

(*b*) The difference in the shape of the curve is due to the amount of resources available for the given population. When resources are unlimited, each species realises its innate potential to grow in number and result in a J-shaped curve in exponential growth while in logistics growth no population has unlimited resources leading to competition for resources and show S-shaped curve.

(*c*) Logistic growth represents human population growth at present. Such a curve is not sustainable because with growing population natural resources are getting depleted and its availability is not increasing enough.

Q. 11. (*a*) Represent diagrammatically three kinds of age-pyramids for human populations.

(*b*) How does an age pyramid for human population at given point of time helps the policy-makers in planning for future. **[*CBSE Delhi 2016*]**

Ans. (*a*) Refer to Fig. 13.3.

(*b*) Age pyramid helps in planning the healthcare programmes, the education policies and the infrastructure of the area Analysis of age pyramid of a population can give the correct information about the status of the people in the area and their requirements.

Q. 12. "Analysis of age-pyramids for human population can provide important inputs for long-term planning strategies." Explain. **[*CBSE Delhi 2015*] [*HOTS*]**

Ans. Refer to Basic Concepts Point 9 (last 4 points) and Figure 13.3.

Through analysis of the age pyramids of a population proper planing of health, education, transport, infra-structure, finance, food and employment can be done.

Thus, long-term management of resources can be done so that maximum benefits can be provided to the population.

Q. 13. (*a*) Why are herbivores considered similar to predators in the ecological context? Explain.

(*b*) Differentiate between the following interspecific interactions in a population:

(*i*) Mutualism and Competition (*ii*) Commensalism and Amensalism [*CBSE (AI) 2010*]

Ans. (*a*) Herbivores are animals feeding on plants. Although they are classed differently they are considered predators. Like predators, for transfer of energy across trophic levels, herbivores also do the same. Besides this, they also keep the population of their prey under control. For example, when the prickly pear cactus was introduced in Australia in early 1920s, they spread rapidly, causing havoc. Their population was controlled by introducing cactus-feeding predator (a moth).

(*b*) (*i*)

Table 13.11: Differences between mutualism and competition

S.No.	Mutualism	Competition
(*i*)	This interaction benefits both the interacting species.	In this interaction, both the interacting species suffer negatively.
(*ii*)	The two individuals may be physically or physiologically associated.	There is no physical association between the competitors.
(*iii*)	*E.g.*, Lichens represent mutualism between fungus and algae where fungus absorbs nutrition and provides protection, and algae prepares food.	*E.g.*, In some American Lakes, visiting flamingoes and resident species compete for their common food.

(*ii*) Commensalism and ammensalism

Refer to Basic concept 13 (*iv*) and 13 (*v*)

Self-Assessment Test

Time allowed: 1 Hour **Max. marks: 30**

1. Choose and write the correct option in the following questions. **(3×1 = 3)**

(i) Autecology is the

(a) relation of heterogenous populations to its environment

(b) relation of an individual to its environment

(c) relation of a community to its environment

(d) relation of a biome to its environment

(ii) Ecotone is

(a) a polluted area

(b) the bottom of a lake

(c) a zone of transition between two communities

(d) a zone of developing community

(iii) An ecologist would suspect that a population is growing rapidly if it

(a) contains many more pre-reproductive than reproductive individuals.

(b) is near its carrying capacity.

(c) is limited only by density-dependent factors.

(d) shows a clumped pattern of dispersion

2. In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices. **(3×1 = 3)**

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

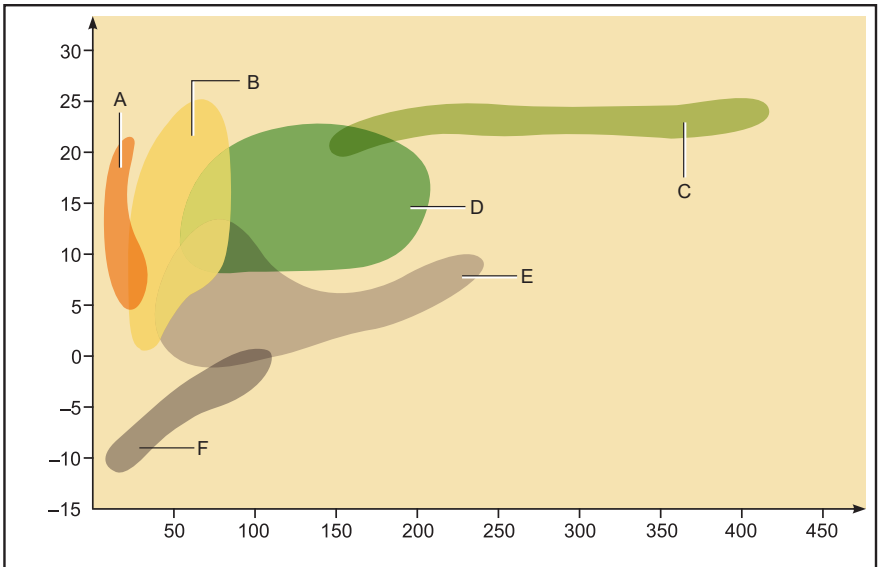
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** Logistic growth model is more realistic in nature.
Reason : No population growth can sustain indefinitely due to finite resources.
(ii) **Assertion :** Ectoparasites line inside the host's body at different sites.
Reason : Parasites are host specific and both parasite and host co-evolve.
(iii) **Assertion :** Euryhaline organisms can tolerate a wide range of salinity.
Reason : Fresh water animals will not survive in marine water due to osmotic problems.

3. Define carrying capacity. **(1)**
4. What is Allen's rule? **(1)**
5. Explain why very small animals are rarely found in polar region. **(2)**
6. Name the interaction in each of the following:
   (i) Clown fish living among the tentacles of sea anemone.
   (ii) Sucker fish lives attached to the shark.
   (iii) Smaller barnacles disappeared when *Balanus* dominated in the coast of Scotland.
   (iv) Wasp pollinating fig inflorescence. **(2)**
7. How does Monarch butterfly defend itself from predators? Explain. **(2)**
8. How does the human body maintains constant temperature both in summers and winters? Explain. **(2)**
9. Distinguish between hibernation and aestivation. Give one example of each. **(3)**
10. The graph given below shows the distribution of biomes: **(3 × 1 = 3)**



   (i) What do the 'X' and 'Y' axes represent?
   (ii) Identify the 'grassland' and 'coniferous forest' biomes, from the above figure.
   (iii) Why is 'F' located at the given position in the graph?
11. How does mutualism differ from commensalism? Give one example of each. **(3)**
12. (i) What is an age-pyramid?
   (ii) Name three representative kinds of age-pyramids for human population and list the characteristics for each one of them. **(5)**

Answers

1. (*i*)—(*b*), (*ii*)—(*c*), (*iii*)—(*a*) **2.** (*i*)—(*a*), (*ii*)—(*d*), (*iii*)—(*b*)