Long Answer Questions (PYQ)

[5 Marks]

Q.1. (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.**

$N_{t+1} = N_0 + [(B + I) – (D + E)]$

Given an explanation for the above equation.

Ans.

- The size of a population depends on food availability, predation pressure and weather. Therefore, size of the population is not a static parameter.
- 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.
  ii. **Mortality:** It is the number of deaths in a given time period. It decreases the population density.
  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.

Q.2. 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. 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:

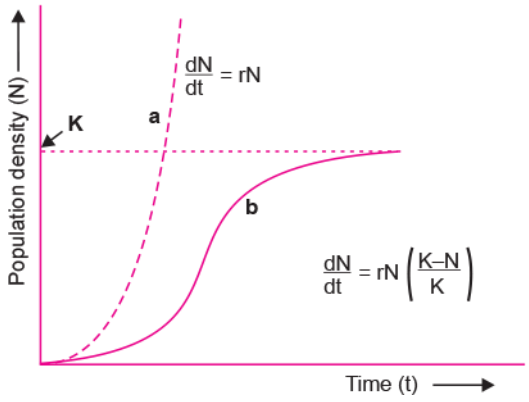
$$\frac{dN}{dt} = rN\left[\frac{K - N}{K}\right]$$

where

N = population density at time t

r = intrinsic rate of natural increase

K = carrying capacity.



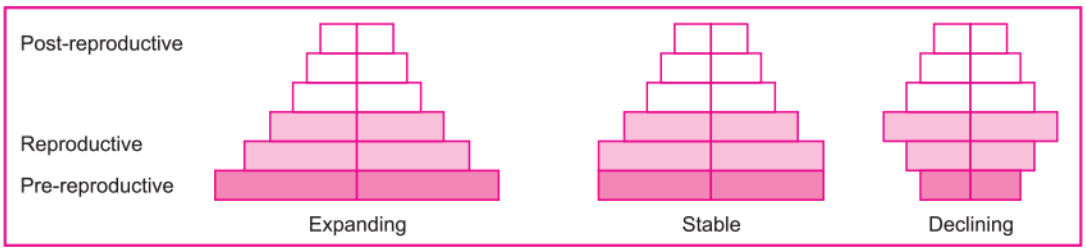
Population growth curve:
(a) When resources are not limiting the growth, plot is exponential. (b) When resources are limiting the growth, plot is logistic, K is carrying capacity.

Q.3. (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.

Ans.

a.



Representation of age pyramids for human population

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

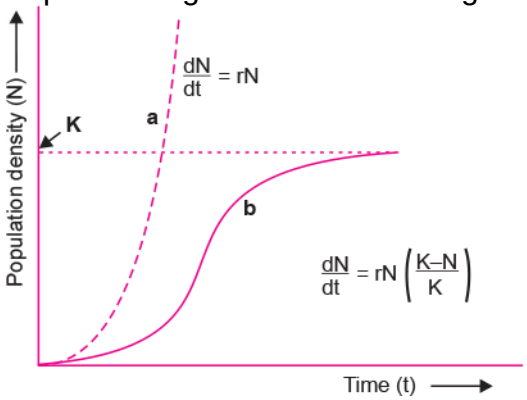
Q.4. (a) Name the two growth models that represent populations growth and draw the respective growth curves they represent.

(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.

Ans.

a. Exponential growth curve and logistics growth curve



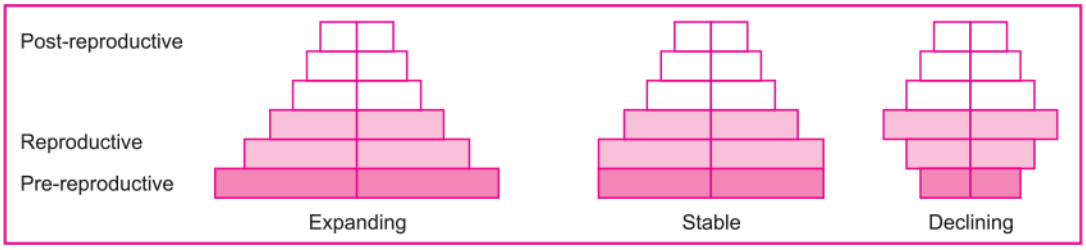
b. The difference in the shape of the curve is due to the amount of resources available for the given population. When resources are unlimited, each species realises its innate potential to grow in number and result in a J-shaped curve in exponential growth while in logistics growth no population has unlimited resources leading to competition or 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.5. "Analysis of age-pyramids for human population can provide important inputs for long-term planning strategies." Explain.

Ans.

- 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)
    b. Stable (Bell shaped pyramid)
    c. Declining (Urn shaped pyramid).
- The pyramids also indicate the ratio of pre-reproductive, reproductive and post-reproductive individuals in a population.



Representation of age pyramids for human population

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.6. Answer the following questions:

Q. List the different attributes that a population has and not an individual organism.

Ans. Attributes of population : Birth rate, death rate, sex ratio, age pyramids/age distribution. (*Any two*)

Q. What is population density? Explain any three different ways the population density can be measured, with the help of an example each.

Ans. 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 basedon pug marks and faecal pellets.

Q.7. Answer the following questions:

Q. Explain with the help of a graph the population growth curve when resources are

i. limiting and
ii. not limiting.

Ans. There are two models of population growth:

- The exponential growth
- Logistic growth

i. **Exponential Growth**
- The exponential or geometric growth is common where the resources (food + space) are unlimited.
- The equation for exponential growth can be derived as follows:

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

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

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

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

i.
- 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, and
  d = death rate.
- 'r' is an important parameter assessing impacts of biotic and abiotic factor on population growth.
- 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

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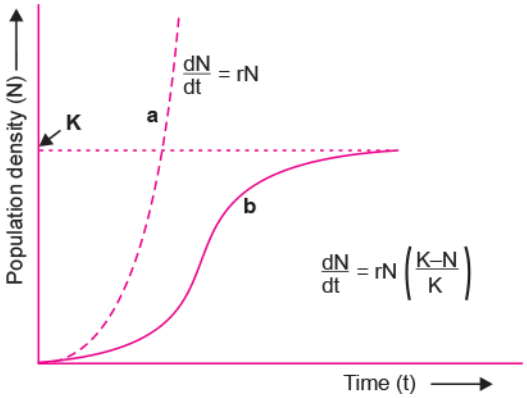


Population growth curve: (a) When resources are not limiting the growth, plot is exponential. (b) When resources are limiting the growth, plot is logistic, K is carrying capacity.

Q. "Nature has a carrying capacity for a species." Explain.

Ans.

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.8. Answer the following questions:

Q. 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.

Ans. 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.

Q. It is impossible to find small animals in the polar regions. Give reasons.

Ans. Small birds have larger surface area relative to their volume, so they lose heat much faster, spend more energy to generate body heat.

Q.9. Answer the following questions:

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

Ans.

J-shaped growth curve	S-shaped growth curve
1. It is common where resources are unlimited.	It is common where resources are limited.
2. Growth is exponential.	It is logistic growth.
3. As resources are unlimited all individuals survive and reproduce.	As resources are limited only the fittest individual will survive and reproduce.
4. Growth equation is given by $\frac{dN}{dt} = rN$ where N is population size, t is time, r = intrinsic rate of natural increase	Growth Equation is given by $\frac{dN}{dt} = rN\frac{K-N}{K}$ where N is population density at time t, r = intrinsic rate of natural increase, K = carrying capacity.

Q. Explain "fitness of a species" as mentioned by Darwin.

Ans. When resources are limited is leads to competition between individuals. Eventually the fittest individual will survive and reproduce to leave more progeny.

Q.10. Answer the following questions:

Q. Why are herbivores considered similar to predators in the ecological context? Explain.

Ans. 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).

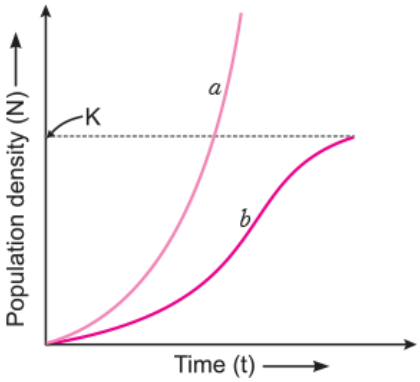
Q. Differentiate between the following interspecific interactions in a population:

i. Mutualism and Competition

Ans. (i)

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.

Q.11. Study the graph given below and answer the questions that follow:



i. Write the status of food and space in the curves (*a*) and (*b*).
ii. In the absence of predators, which one of the two curves would appropriately depict the prey population?
iii. Time has been shown on X-axis and there is a parallel dotted line above it. Give the significance of this dotted line.

Ans.

i. a: unlimited food and space
b: limited food and space
ii. Curve *a*
iii. The dotted line represents the carrying capacity. It is the capacity of a given habitat having enough resources to support maximum possible number, beyond which no further growth is possible.

Long Answer Questions (OIQ)

[5 Marks]

Q.1. What is adaptation? Describe the adaptation of plant and animal in desert.

Ans. Adaptation is the quality of the organism (morphological, physiological, behavioural) that enables the organism to survive and reproduce in its habitat. It adapts organisms to live in different types of habitats.

Adaptation of plant and animal in desert:

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.*

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.

Q.2. Describe the exponential growth model of a population with diagram and curve.

Ans. Exponential Growth

- The exponential or geometric growth is common where the resources (food + space) are unlimited.
- The equation for exponential growth can be derived as follows:

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

$$\text{Let} \quad (b - d) = r, \text{ then}$$

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

$$\text{Or}, \quad N_t = N_0 e^{rt}$$

where, N = population size,
N_t = population density after time t,
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r = intrinsic rate of natural increase,
e = the base of natural logarithms (2.71828),

b = birth rate, and
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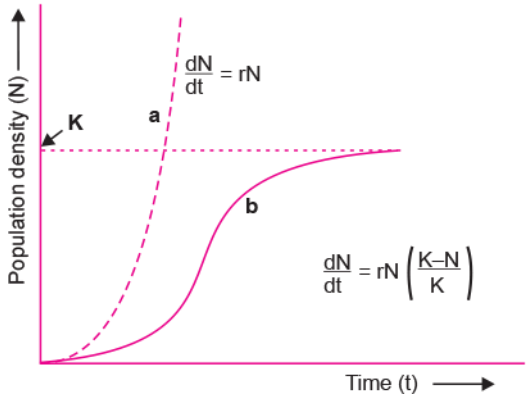
- 'r' is an important parameter assessing impacts of biotic and abiotic factor on population growth.
- In exponential growth, when N in relation to time is plotted on graph, the curve becomes J shaped.



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.

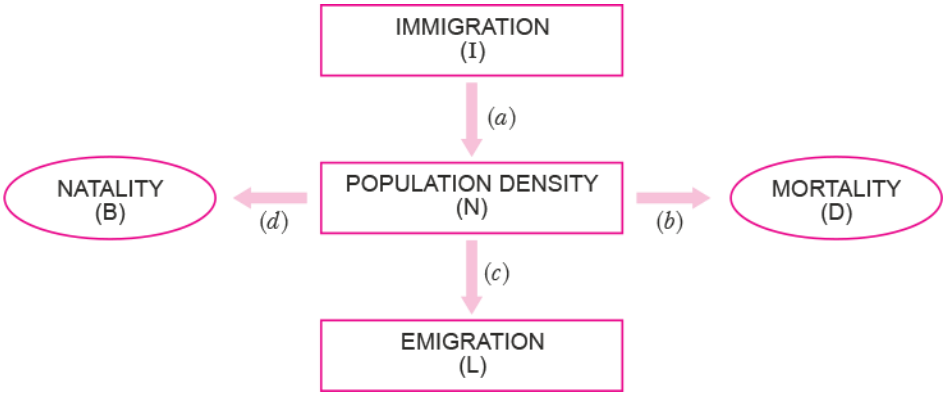
Q.3. What is mutualism? Describe any four examples.

Ans. 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 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. The male bee pseudocopulates with it and during this process of pseudocopulation, the pollen grains are dusted on the body of male bees.
e. With such pollen dusts, male bee pseudocopulates to another flower of the same species and pollination takes place.

Q.4.

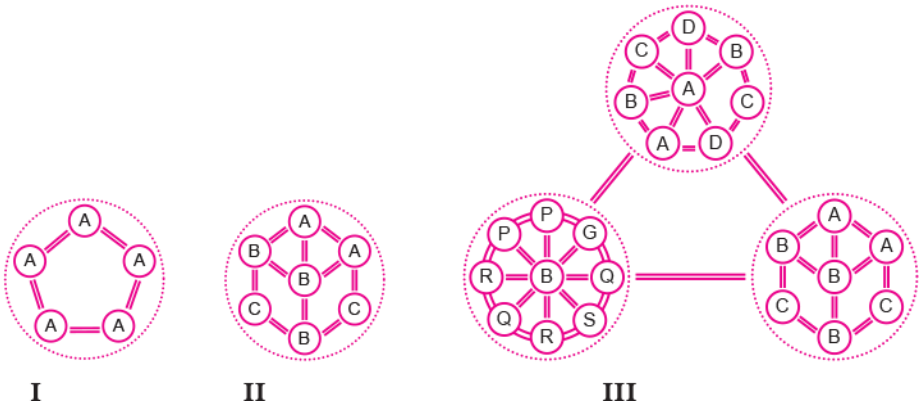


i. Which of the above represents the increase or decrease of population?
ii. If N is the population density at time t, then what would be its density at time (t+1)? Give the formula.
iii. In a barn there were 30 rats. 5 more rats enter the barn and 6 out of the total rats were eaten by the cats. If 8 rats were born during the time period under consideration and 7 rats left the barn, find out the resultant population at time (t+1).
iv. If a new habitat is just being colonized, out of the four factors affecting the population growth, which factor contributes the most?

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 rats
d. Immigration contributes the most.

Q.5. Comment on the following diagrams:
A, B, C, D, G, P, Q, R, S are species.

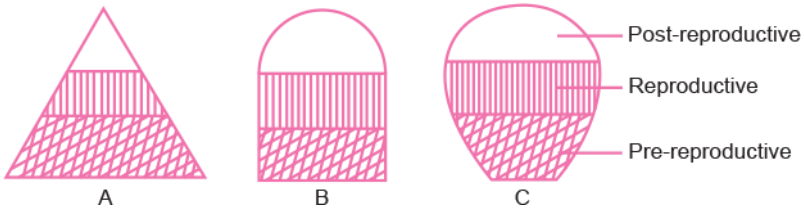


Ans. **Fig. I:** It is a single population and all individuals are of the same species, *i.e.*, A individuals interact among themselves and their environment.

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 arc in the same environment and they interact with each other and their environment.

Q.6. The following diagrams are the age pyramids of different populations. Comment on the status of these populations.



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.