GATE EY-2023

AI25BTECH11016-VARUN

Q.1 - Q.5 Carry ONE mark Each

1) ”You are delaying the completion of the task. Send _____contributions at the earliest.”

a) you are b) your c) you’re d) yore

(GATE EY 2023)

2) References :_____ : : Guidelines : Implement

(By word meaning)

a) Sight b) Site c) Cite d) Plagiarise

(GATE EY 2023)

3) In the given figure, PQRS is a parallelogram with PS = 7 cm, PT = 4 cm and PV = 5 cm. What is the length of RS in cm? (The diagram is representative.)

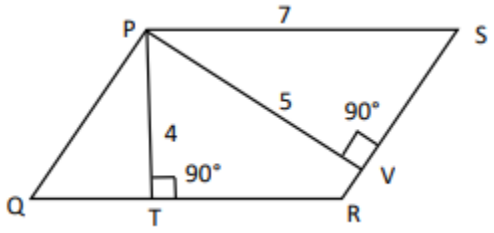

Fig. 1.

a) 20/7 b) 28/5 c) 9/2 d) 35/4

(GATE EY 2023)

4) In 2022, June Huh was awarded the Fields medal, which is the highest prize in Mathematics. When he was younger, he was also a poet. He did not win any medals in the International Mathematics Olympiads. He dropped out of college. Based only on the above information, which one of the following statements can be logically inferred with certainty?

a) Every Fields medalist has won a medal in an International Mathematics Olympiad

b) Everyone who has dropped out of college has won the Fields medal

c) All Fields medalists are part-time poets

d) Some Fields medalists have dropped out of college.

(GATE EY 2023)

5) A line of symmetry is defined as a line that divides a figure into two parts in a way such that each part is a mirror image of the other part about that line. The given figure consists of 16 unit squares arranged as shown. In addition to the three black squares, what is the minimum number of squares that must be coloured black, such that both PQ and MN form lines of symmetry? (The figure is representative)

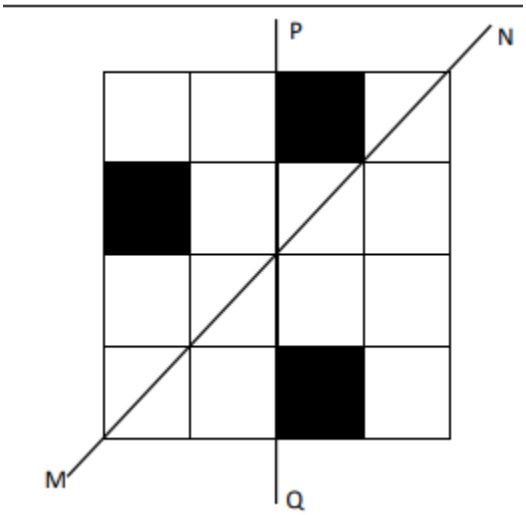

Fig. 2.

a) 3 b) 4 c) 5 d) 6

(GATE EY 2023)

Q.6 - Q.10 Carry TWO marks Each

6) Human beings are one among many creatures that inhabit an imagined world. In this imagined world, some creatures are cruel. If in this imagined world, it is given that the statement ”Some human beings are not cruel creatures” is FALSE, then which of the following set of statement(s) can be logically inferred with certainty?

(i) All human beings are cruel creatures.

(ii) Some human beings are cruel creatures.

(iii) Some creatures that are cruel are human beings.

(iv) No human beings are cruel creatures.

a) only (i) c) only (i) and (ii)

b) only (iii) and (iv) d) only (i) and (ii)

(GATE EY 2023)

7) To construct a wall, sand and cement are mixed in the ratio of 3:1. The cost of sand and that of cement are in the ratio of 1:2. If the total cost of sand and cement to construct the wall is 1000 rupees, then what is the cost (in rupees) of cement used?

a) 400 b) 600 c) 800 d) 200

(GATE EY 2023)

8) The World Bank has declared that it does not plan to offer new financing to Sri Lanka, which is battling its worst economic crisis in decades, until the country has an adequate macroeconomic policy framework in place. In a statement, the World Bank said Sri Lanka needed to adopt structural reforms that focus on economic stabilisation and tackle the root causes of its crisis. The latter has starved it of foreign exchange and led to shortages of food, fuel, and medicines. The bank is repurposing resources under existing loans to help alleviate shortages of essential items such as medicine, cooking gas, fertiliser, meals for children, and cash for vulnerable households. Based only on the above passage, which one of the following statements can be inferred with certainty?

a) According to the World Bank, the root cause of Sri Lanka's economic crisis is that it does not have enough foreign exchange.

b) The World Bank has stated that it will advise the Sri Lankan government about how to tackle the root causes of its economic crisis.

c) According to the World Bank, Sri Lanka does not yet have an adequate macroeconomic policy framework.

d) The World Bank has stated that it will provide Sri Lanka with additional funds for essentials such as food, fuel, and medicines.

(GATE EY 2023)

9) The coefficient of x^4 in the polynomial $(x-1)^3(x-2)^3$ is equal to _____

a) 35 b) -3 c) 30 d) 21

(GATE EY 2023)

10) Which one of the following shapes can be used to tile (completely cover by repeating) a flat plane, extending to infinity in all directions, without leaving any empty spaces in between them? The copies of the shape used to tile are identical and are not allowed to overlap.

a) circle b) regular octagon c) regular pentagon d) rhombus

(GATE EY 2023)

Q.11 - Q.35 Carry ONE mark Each

11) Which one of the following is an example of mechanical potential energy?

a) Activated neuron

b) Polarized cell membrane

c) Stretched tendon

d) Relaxed muscle

(GATE EY 2023)

12) A research team studies the probability of crop damage by wild boar in crop fields. For each crop field sampled, they record '1' if damage was observed, and '0' if damage was not observed. Which one of the following distributions is most appropriate to analyse the probability of crop damage?

a) Binomial distribution
c) Cauchy distribution
b) Poisson distribution
d) Gamma distribution

(GATE EY 2023)

13) To test whether body size differs between two populations of a field mouse species, a researcher measured 100 individuals in each population and calculated the statistic

$$\frac{\overline{X}_1 - \overline{X}_2}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

where $\overline{X}_1$ and $\overline{X}_2$ are the mean body sizes of the two populations, respectively, S_p is the pooled standard deviation, and n_1 and n_2 are the sample sizes for the two populations, respectively.

This statistic is used in the

a) Chi-square test
b) Kruskal-Wallis test
c) Student's t-test
d) Mann-Whitney U test

(GATE EY 2023)

14) Which one of the following ecological processes best explains the observation that seedling establishment increases with distance from the parent tree in a forest?

a) Competition between species
b) Competition within species
c) Facilitation between species
d) Facilitation within species

(GATE EY 2023)

15) In the early 20th century, which one of these scientists made fundamental contributions to both the fields of evolution and statistics?

a) R. A. Fisher
c) August Weismann
b) Niko Tinbergen
d) Thomas Huxley

(GATE EY 2023)

16) The figure depicts how body temperature changes for two species (L and M) as a function of ambient temperature.

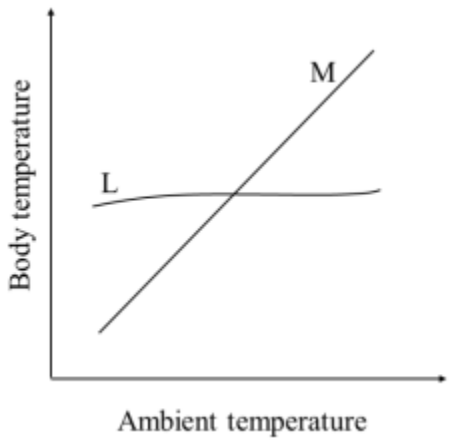

Fig. 3.

Which one of the following statements about how L and M regulate temperature is correct?

a) L and M are both homeotherms.

b) L and M are both homeotherms.

c) L is a homeotherm, whereas M is a poikilotherm.

d) L is a poikilotherm, whereas M is a homeotherm.

(GATE EY 2023)

17) You are a deep-sea organism and your potential mates are several hundreds of kilometers away from you. Which one of the following kinds of mating signals is most likely to help them locate you?

a) Display gestures

b) Electric pulses

c) Body colouration

d) Sounds

(GATE EY 2023)

18) Which one of the following options represents the correct order with respect to levels of organization? B - biomes; E - ecosystems; P - populations; I - individuals; C - communities

a) $I < P < C < E < B$ b) $I < C < P < E < B$ c) $I < E < C < P < B$ d) $I < P < E < C < B$

(GATE EY 2023)

19) Which one of the following options describes the difference between abiotic resources and abiotic conditions?

a) Resource levels can fluctuate but conditions do not.

b) Conditions can fluctuate but resource levels do not

c) Resources can be used up by organisms, whereas conditions cannot.

d) Conditions can be used up by organisms, whereas resources cannot

(GATE EY 2023)

20) Which one of the following ranges correctly represents the percentage of energy that is transferred from a lower to the next higher trophic level in most terrestrial systems?

a) 0.01 % to 1 % b) 33 % to 66 % c) 2 % to 20 % d) 90 % to 95 %

(GATE EY 2023)

21) Whales and dolphins are hypothesized to have evolved along the northern shore of the Tethys Sea, prior to the Indian plate's collision with the Eurasian plate. To which one of the following animals are these aquatic mammals most closely related?

a) pigs b) elephants c) seals d) zebras

(GATE EY 2023)

22) Which one of the following options represents the correct order of decreasing average net primary productivity (g/m2 / year) in natural ecosystems?

a) Swamp and marshes > Tropical forests > Temperate forests > Temperate grasslands > Tundra

b) Swamps and marshes > Tropical forests > Temperate forests > Tundra > Temperate grasslands

c) Tropical forests > Swamps and marshes > Temperate forests > Tundra > Temperate grasslands

d) Tropical forests > Swamps and marshes > Temperate forests > Temperate grasslands > Tundra

(GATE EY 2023)

23) The increase in mean global temperature since the industrial revolution falls in the range of

a) 0°C to 0.5°C b) 0.5°C to 2°C c) 2°C to 5°C d) > 5°C

(GATE EY 2023)

24) Which one of the following endangered species has been the subject of a reintroduction plan in India?

a) Rusty spotted cat b) Jungle cat c) Cheetah d) Jaguar

(GATE EY 2023)

25) Compared with bony fish, many shark species show steeper population declines in response to heavy fishing pressure. Which one of the following options explains this?

a) Sharks are dangerous to humans

b) Sharks evolved over 400 million years ago.

c) Sharks are long lived and late maturing

d) Sharks are only found in open oceans

(GATE EY 2023)

26) Which one or more of the following options describe(s) how ferns differ from angiosperms and gymnosperms?

a) Ferns lack a vascular system

b) Ferns have separate haploid and diploid generations.

c) Ferns are pollinated by flies

d) Ferns are known only from the fossil record

(GATE EY 2023)

27) The IUCN Red List is based on a set of criteria to evaluate species vulnerability to extinction. Which one or more of the options is/are used as criteria?

a) Absolute population size

b) Geographic range

c) Economic value

d) Change in population size over time

(GATE EY 2023)

28) Which one or more of the following processes contribute(s) substantially to increased mean global temperatures?

a) Decreased greenhouse gases in the atmosphere

b) Increased tropical deforestation

c) Decreased methane emissions

d) Increased fossil fuel use

(GATE EY 2023)

29) Depending on soil nutrient availability, which one or more of the following interaction(s) can occur between soil mycorrhizal fungi and plants?

a) Parasitism b) Predation c) Mutualism d) Commensalism

(GATE EY 2023)

30) Which one or more of the following is/are characteristic of r-selected animals?

a) They have a long lifespan.

b) They produce a large number of offspring in each reproductive event

c) They produce a few large bodied offspring in each reproductive event

d) They reproduce at a young age.

(GATE EY 2023)

31) Which one or more of the following represent(s) benefits of Batesian mimicry to the mimic?

a) Increased toxicity against potential predators

b) Reduced cooperation

c) Increased protection from predators without investment in toxicity

d) Reduced competition

(GATE EY 2023)

32) Which one or more of the following is/are developmental feature(s) of hatchlings of an altricial bird species?

a) Eyes open
b) Eyes closed
c) Down feathers present
d) Down feathers absent

(GATE EY 2023)

33) You have a biased coin with the probability of getting a head being 0.6. The probability of getting at least 1 head in 3 tosses is _____. (Rounded off to three decimal places)

(GATE EY 2023)

34) A lake has 20 blue male, 30 red male, 60 blue female and 80 red female fish. A researcher catches one individual at random from the lake. If the caught fish is blue, the probability that it is female is _____ (Rounded off to two decimal places) (GATE EY 2023)

35) A researcher fitted a function to data on how foraging rate (F, number of items consumed per 10 minutes) of a shorebird varied with its group size (G, number of individuals) and obtained the following equation:

$$\log_e F = 3 - 0.2 \times \log_e G$$

According to this equation, the foraging rate (F) of a solitary forager is _____ items per 10 minutes. (Rounded off to the nearest integer) (GATE EY 2023) **Q.36 - Q.65 Carry TWO marks Each**

36) Two species of birds, A and B, are found together in region X. Only species A is present in region Y. Both species produce species-specific alarm calls in response to a predator P. A researcher conducts experiments where she plays recorded calls of both species to species A in regions X and Y. The response of species A to the recorded calls are summarized in the table below.

Call stimulus	**Response in region X**	**Response in region Y**
Alarm call of species A	Species A flies for cover	Species A flies for cover
Alarm call of species B	Species A flies for cover	Species A does not respond

Based on the results, the most appropriate inference is that

a) species A's response to species B's alarm call is a learned behavior
b) species A's response to species B's alarm call is an innate behavior
c) predator P is absent in region Y.
d) predator P exclusively preys on species B

(GATE EY 2023)

37) The table below lists different insects and taxonomic orders. Choose the option that matches the animal to its correct taxonomic order

Animal	**Taxonomic order**
P) Moths	i) Hemiptera
Q) True bugs	ii) Orthoptera
R) Crickets	iii) Coleoptera
S) Beetles	iv) Lepidoptera
	v) Diptera

a) P-ii; Q-i; R-v; S-iv

b) P-iii; Q-v; R-iv; S-i

c) P-iv; Q-i; R-ii; S-iii

d) P-iv; Q-ii; R-i; S-v

(GATE EY 2023)

38) Islands I, II, and III lie off a mainland coast. Which one of the following statements about species richness is consistent with the theory of island biogeography?

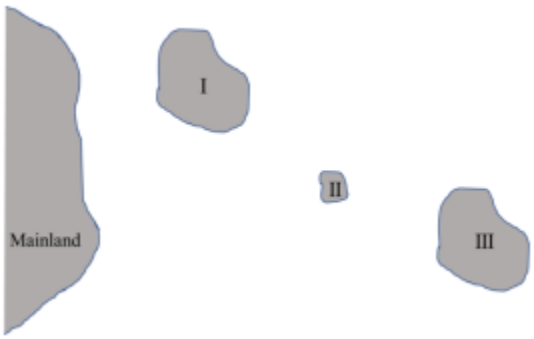

Fig. 4.

a) Island II has the highest species richness because it has the lowest area.

b) Island III has the highest species richness because it is large and farthest from the mainland.

c) Island I has the highest species richness because it is large and closest to the mainland.

d) Islands I and III have equally high species richness because they have roughly the same area

(GATE EY 2023)

39) In a polygynous hummingbird species, males defend and monopolize nectar-rich plants (resource). Females visit these plants for nectar and the defending male will have access to all visiting females for mating. Under which scenario is polygyny expected to be the highest?

a) Resources are abundant and evenly distributed

b) Resources are abundant and clumped

c) Resources are scarce and evenly distributed

d) Resources are scarce and randomly distributed

(GATE EY 2023)

40) A researcher estimates the relationship between reproductive success (N, number of offspring) and horn length (H, in cm) in a wild goat as $N = 40 - 2.2H + 0.04H^2$ Horn length typically varies from 10 cm to 50 cm in this species. Which one of the following graphs correctly represents this relationship?

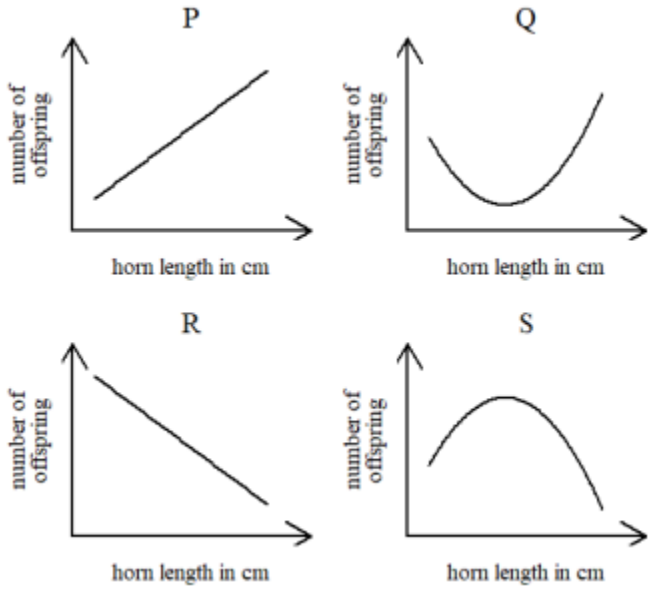

Fig. 5.

a) P b) Q c) R d) s

(GATE EY 2023)

41) Overfishing reduced food availability for sea lions in California, causing a decline in their population size. In 1972, under the US Endangered Species Act, fishing was banned from sea lion foraging areas. Subsequently, the population of sea lions increased in a logistic form as shown in the figure.

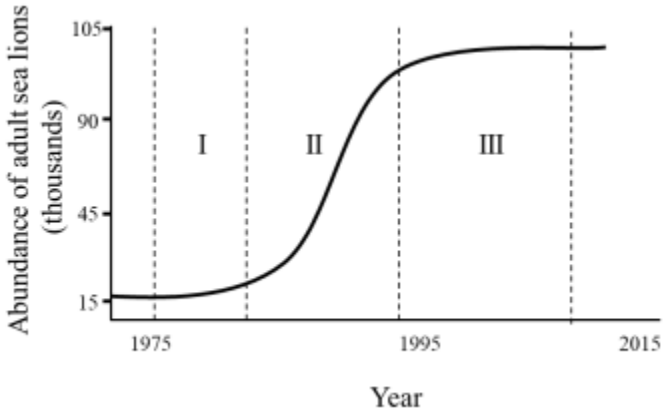

Fig. 6.

The per capita growth rate is highest in the interval _____ and the population growth rate is highest in the interval_____ .

a) I, II b) I, III c) II, II d) III,II

(GATE EY 2023)

42) A locus at Hardy-Weinberg equilibrium in a diploid organism has n alleles. The maximum heterozygosity (i.e., proportion of heterozygotes) for this locus is

a) n b) $1/n$ c) $1-(1/n)$ d) $1-n$

(GATE EY 2023)

43) Match the diseases to the pathogens that cause them.

Diseases	Pathogens
P) Avian malaria	i) Virus
Q) COVID-19 in humans	ii) *Plasmodium*
R) Chytrid disease in frogs	iii) Mosquito
	iv) Fungus

a) P-i; Q-iii; R-iv b) P-iii; Q-i; R-ii c) P-ii; Q-i; R-iv d) P-iv; Q-i; R-ii

(GATE EY 2023)

44) The production of anthocyanin pigments in pea flowers requires the presence of at least one dominant allele in each of two independently assorting genes, C and P. The presence of anthocyanin results in purple flowers, whereas its absence gives white flowers. A cross between two double heterozygous (CcPp) plants is performed. What is the expected ratio of plants with purple flowers to plants with white flowers?

a) 1:3 b) 3:1 c) 5:3 d) 9:7

(GATE EY 2023)

45) In the phylogenetic trees shown, the tips represent different species of geckos (labeled A to E) and the areas to which they belong. Which one of these is most consistent with the hypothesis that the geckos colonized the Western Ghats from Northeast India through the Eastern Ghats?

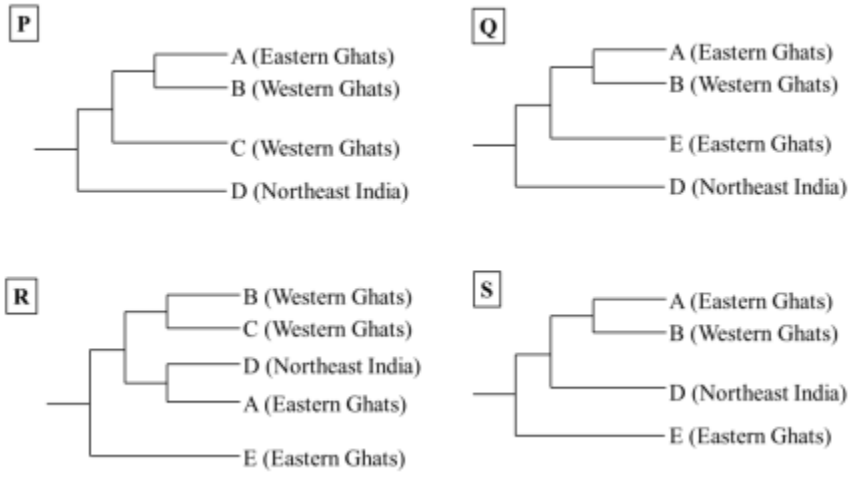

Fig. 7.

a) P b) Q c) R d) S

(GATE EY 2023)

46) The phylogenetic tree depicts the relationship between 5 species of snakes (labelled A to E) and provides information about their habitat specialization. Given the principle of parsimony (least number of evolutionary changes required) and that ancestor Y was terrestrial, which one of the options given is correct?

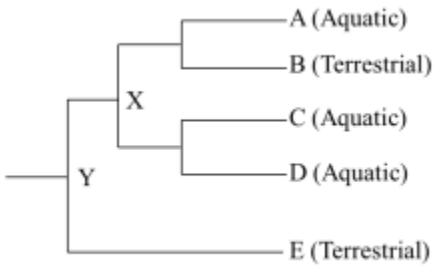

Fig. 8.

a) X was more likely to be aquatic than terrestrial

b) X was more likely to be terrestrial than aquatic.

c) X was equally likely to be aquatic or terrestrial.

d) X was neither aquatic nor terrestrial.

(GATE EY 2023)

47) The mode of speciation in snakes in the Western Ghats is predominantly allopatric. A researcher wants to quantify diversification of snakes in this range. From the options given, choose the most cost and time efficient way to sample snakes.

a) Across an elevational gradient

b) Across barriers such as valleys and rivers

c) Intensively in one or two random locations

d) Intensively across the entire mountain range

(GATE EY 2023)

48) All else being equal, which one of the following population sizes (N) and migration rates (m) would result in the most genetic differentiation between populations (F_{st})?

Note that F_{st} is computed as

$$F_{st} = \frac{1}{4Nm + 1}$$

a) N=500,m=1

b) N=200,m=200

c) N=40,m=10

d) N40,m=1

(GATE EY 2023)

49) Which one or more of the following is/are prediction(s) or assumption(s) of the handicap principle for the evolution of sexual signals?

a) Females prefer costly signals.

b) Honest signals are costly to produce.

c) Males displaying costly signals are not chosen by females.

d) Costly signals are reliable indicators of signaller quality.

(GATE EY 2023)

50) A research team assesses the impact of the invasive species Lantana camara on the seed set of a native flowering plant S. The plant S usually grows in clumps with other individuals of the same or different flowering species. They measure the seed set of flowering individuals of S grown (i) alone; (ii) with a conspecific (same species); (iii) with a native species Q; (iv) with a native species R; (v) with Lantana camara. The figure below shows the mean seed set with 95 % confidence intervals for the different treatments.

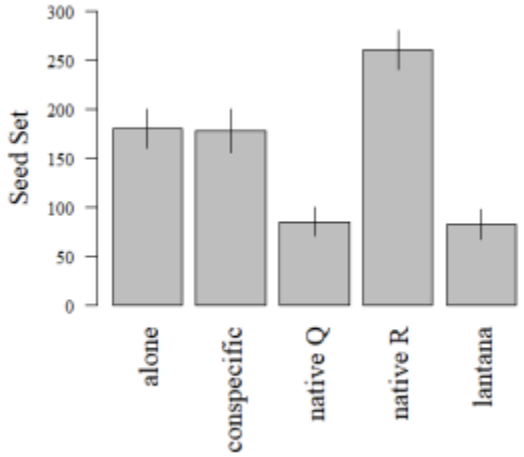

Fig. 9.

Based on the figure provided, which one or more of the options given is/are correct?

a) Seed set is higher in the presence of both the native species than in the presence of a conspecific.

b) Seed set is lower in the presence of Lantana camara than in the presence of both the native species.

c) Seed set is lower in the presence of Lantana camara than in the presence of a conspecific.

d) Seed set is always higher in the presence of other plants than when grown alone

(GATE EY 2023)

51) There are two palatable prey species, Q and R, for an insectivorous bird species in a forest. However, the bird searches for and consumes only species Q. According to optimal foraging theory, which one or more of the following conditions can explain the bird choosing to forage only for Q?

a) The handling time for Q > the handling time of R

b) The handling time for Q < the handling time of R

c) The relative abundance of Q > the relative abundance of R

d) The relative abundance of Q < the relative abundance of R

(GATE EY 2023)

52) Conservation biologists have debated whether protected areas should be designed as a single large patch or as several small patches. Assuming that the total area is the same for the two designs, which one or more of the options describe(s) the conservation benefit(s) of several small patches?

a) Lower rates of local extinction

b) Lower rates of diversification

c) Lower spread of disease across the populations

d) Lower population size

(GATE EY 2023)

53) Which one or more options is/are example(s) of niche partitioning between species?

a) Temporal separation of activity

b) Diet specialization

c) Hybridization

d) Vertical stratification of foraging heights

(GATE EY 2023)

54) In an assemblage of coexisting wild cat species, the size of canine teeth was found to be strikingly different between these species. Which one or more of the following statements explain(s) this observation?

a) Differences in the size of canine teeth were driven by the size of prey captured by the different species.

b) Differences in the size of canine teeth are an example of divergent evolution

c) Differences in the size of canine teeth are an example of convergent evolution.

d) Differences in the size of canine teeth were driven by past competition

(GATE EY 2023)

55) The Biological Species Concept (BSC) states that 'species are groups of interbreeding natural populations that are reproductively isolated from other such groups'. Which one or more of the options could pose challenges for defining species using the BSC?

a) Fertile interspecies hybrids

b) Extinct fossil species

c) Barriers to gene flow

d) Barriers to gene flow

(GATE EY 2023)

56) The barnacle species, Chthamalus stellatus (CS), is found only in the high intertidal zone whereas Balanus glandula (BG) is found only in the low intertidal zone. A researcher transplanted CS from the high to low (T-CS), and BG from the low to high (T-BG) intertidal zones. Additionally, they allowed the species to grow alone or in competition with each other, and quantified survival. Which one or more of the following inferences is/are consistent with the experimental results shown below?

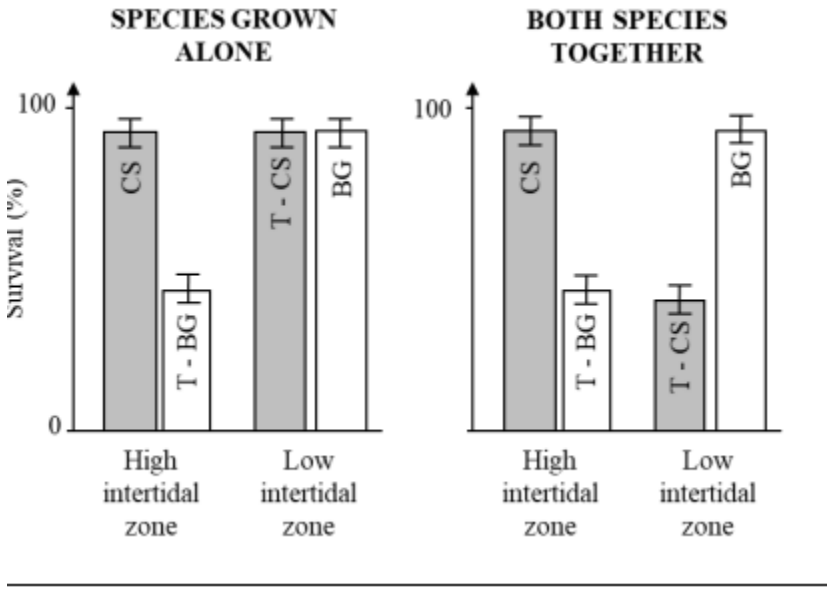

Fig. 10.

a) Only abiotic conditions increase mortality of BG in the high intertidal zones.
b) Only abiotic conditions increase mortality of CS in the low intertidal zones.
c) Interspecific competition increases mortality of BG in the high intertidal zon
d) Interspecific competition increases mortality of CS in the low intertidal zone

(GATE EY 2023)

57) In the figure below, ellipse X represents the combinations of salt concentrations and temperatures that a marine invertebrate species can tolerate. Ellipse Y represents the combinations of salt concentrations and temperatures that this species is actually found in.

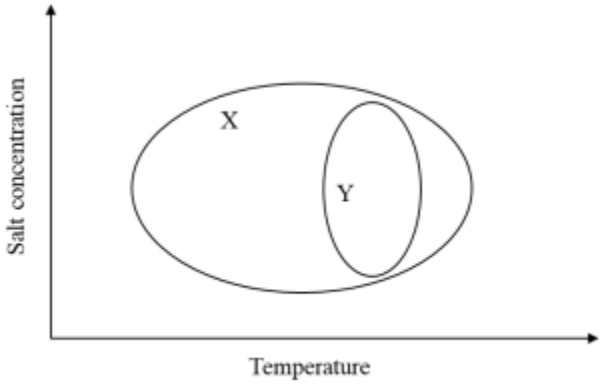

Fig. 11.

Which one or more of the following statements about X and Y is/are correct?

a) X is the fundamental niche of the species, whereas Y is the realized niche.
b) The difference between X and Y can result from biotic interactions.
c) The difference between X and Y can result from dispersal limitation

d) The difference between X and Y results from the species' tolerance to salt concentrations.

(GATE EY 2023)

58) A butterfly species inhabits four types of patchy landscapes (P, Q, R, S). Grey shapes represent occupied habitat and white shapes are unoccupied. Arrows represent the occurrence and directions of possible dispersal.

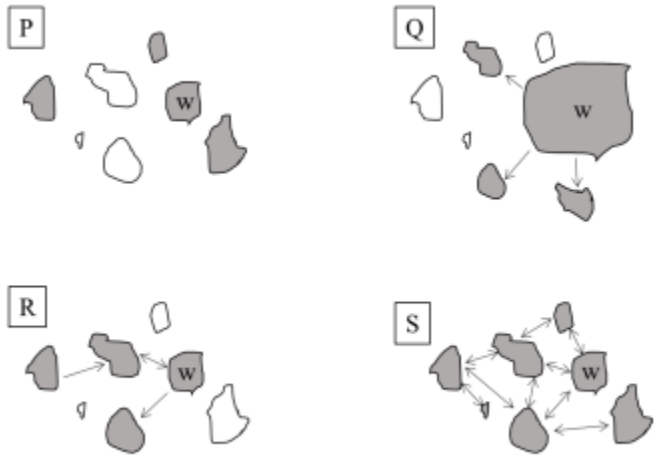

Fig. 12.

Which one or more of the options is/are likely to be correct?

a) In landscape Q, patch w is a source population

b) Landscape R represents a metapopulation.

c) Landscape P has the highest extinction rate.

d) Landscape S has the highest level of inbreeding.

(GATE EY 2023)

59) A new food requesting behaviour has been observed in bonnet macaques in Bandipur National Park. The macaques extend their hand and make a cooing sound only towards humans, which effectively results in food given to them. If this behaviour is to increase in frequency in the population over time by the process of natural selection, which one or more of the options below is/are necessary condition(s)?

a) Food requesting behaviour must be transmitted from one generation to the next.

b) All bonnet macaques in the area must show this behaviour.

c) Macaques who receive food using this behaviour are able to have more offspring.

d) Food requesting behaviour must only be taught by parents to offspring.

(GATE EY 2023)

60) Two co-occurring plant species, A and B, flower at the same time. They are visited by the same pollinator species. If these plants are pollinator-limited, then which one or more of the following statements is/are correct with regard to the figure shown below?

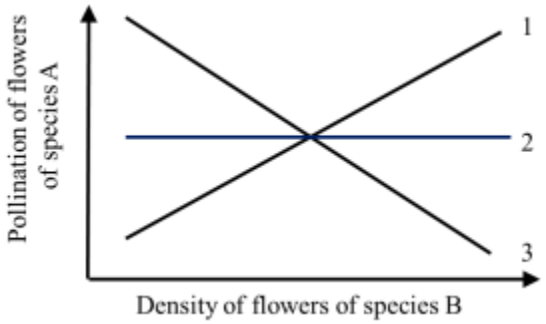

Fig. 13.

a) Line 1 represents competition.

b) Line 2 represents mutualism.

c) Line 3 represents parasitism.

d) Line 1 represents facilitation

(GATE EY 2023)

61) Scorpions on the sand dunes in Syria in September 2022 have the age distribution as shown in Figure P. Scorpions can live to a maximum of 90 days. In all the figure panels, the x-axis represents age class and the y-axis represents number of individuals. Assuming no immigration or emigration, which one or more of the age distribution panels Q, R, S, T is/are possible 30 days later?

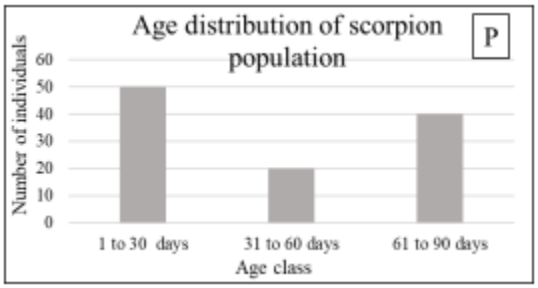

Fig. 14.

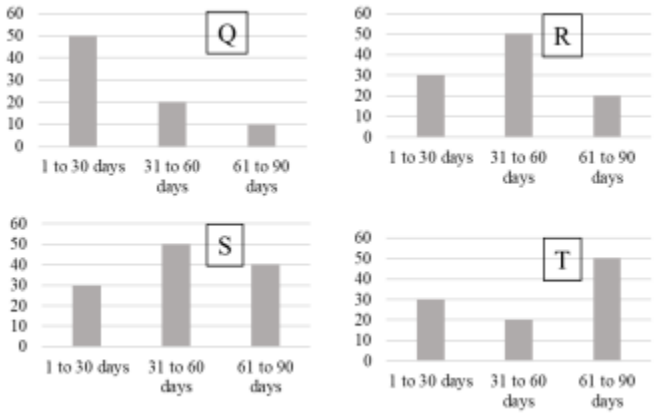

Fig. 15.

a) Q b) R c) S d) T

(GATE EY 2023)

62) The Shannon-Weaver index H is a measure of diversity and is calculated as

$$H = -\sum_{i=1}^{S} p_i \ln(p_i)$$

where S is the total number of species and p_i is the proportional abundance of a species i.

The table below gives the abundance of different species in a community. The Shannon-Weaver index of reptile diversity in this community is_____. (Rounded off to two decimal places)

Species	**Abundance**
Indian gliding lizard	270
Malabar flying frog	325
Travancore tortoise	180
Malabar hornbill	160
Forest cane turtle	120
Malabar pit viper	30

(GATE EY 2023)

63) In haplodiploid organisms, males are haploid and females are diploid. Consider the relatedness diagram shown below. Female A has a full-sister, Y, who has a daughter, B. The relatedness between A and B is _____ . (Rounded off to three decimal places)

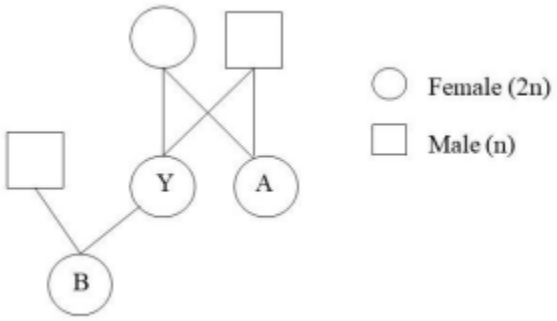

Fig. 16.

(GATE EY 2023)

64) Mixed species flocks of birds include social and solitary species. There are 5 social species and 10 solitary species in a forest. Flocks always have a total of 5 species, of which 2 are social and 3 are solitary. The number of types of flocks with unique species composition is _____. (Answer in integer) (GATE EY 2023)

65) In a zoo, three lions and four tigers eat 390 kg of food every week. In another zoo, four lions and five tigers eat 500 kg of food every week. Lions and tigers eat different amounts of food, but all individuals of the same species eat the same amount. The amount of food a single lion eats per week is _____ kg. (Answer in integer) (GATE EY 2023)

END OF THE QUESTION PAPER