

GATE 2022

EE25BTECH11065 - YOSHITA.J

Q. 1 – Q. 5 carry one mark each.

1) You should _____ when to say _____

- a) no / no
- b) no / know
- c) know / know
- d) know / no

(GATE EY 2022)

2) Two straight lines pass through the origin $(x_0, y_0) = (0, 0)$. One of them passes through the point $(x_1, y_1) = (1, 3)$ and the other passes through the point $(x_2, y_2) = (1, 2)$. What is the area enclosed between the straight lines in the interval $[0, 1]$ on the x -axis?

- a) 0.5
- b) 1.0
- c) 1.5
- d) 2.0

(GATE EY 2022)

3) If

$$p : q = 1 : 2$$

$$q : r = 4 : 3$$

$$r : s = 4 : 5$$

and u is 50% more than s , what is the ratio $p : u$?

- a) 2 : 15
- b) 16 : 15
- c) 1 : 5
- d) 16 : 45

(GATE EY 2022)

4) Given the statements:

- P is the sister of Q.
- Q is the husband of R.
- R is the mother of S.
- T is the husband of P.

Based on the above information, T is _____ of S.

- a) the grandfather
- b) an uncle

- c) the father
- d) a brother

(GATE EY 2022)

- 5) In the following diagram, the point R is the center of the circle. The lines PQ and ZV are tangential to the circle. The relation among the areas of the squares, PXWR, RUVZ and SPQT is

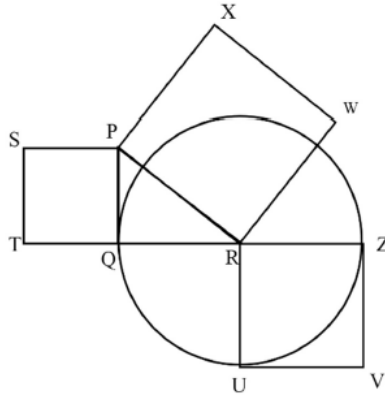


Fig. 5.1

- a) Area of SPQT = Area of RUVZ = Area of PXWR
- b) Area of SPQT = Area of PXWR - Area of RUVZ
- c) Area of PXWR = Area of SPQT - Area of RUVZ
- d) Area of PXWR = Area of RUVZ - Area of SPQT

(GATE EY 2022)

- 6) Healthy eating is a critical component of healthy aging. When should one start eating healthy? It turns out that it is never too early. For example, babies who start eating healthy in the first year are more likely to have better overall health as they get older. Which one of the following is the CORRECT logical inference based on the information in the above passage?
- a) Healthy eating is important for those with good health conditions, but not for others
 - b) Eating healthy can be started at any age, earlier the better
 - c) Eating healthy and better overall health are more correlated at a young age, but not older age
 - d) Healthy eating is more important for adults than kids

(GATE EY 2022)

- 7) P invested ₹5000 per month for 6 months of a year and Q invested ₹x per month for 8 months of the year in a partnership business. The profit is shared in proportion

to the total investment made in that year. If at the end of that investment year, Q receives $\frac{4}{9}$ of the total profit, what is the value of x (in ₹)?

- a) 2500
- b) 3000
- c) 4687
- d) 4687

(GATE EY 2022)

8) .

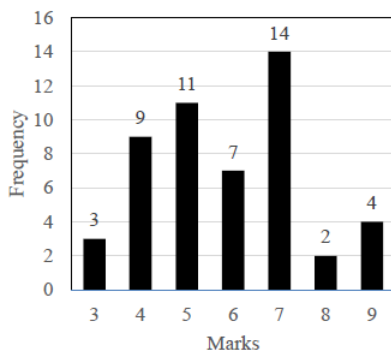


Fig. 8.1

The above frequency chart shows the frequency distribution of marks obtained by a set of students in an exam. From the data presented above, which one of the following is CORRECT?

- a) mean > mode > median
- b) mode > median > mean
- c) mode > mean > median
- d) median > mode > mean

(GATE EY 2022)

- 9) In the square grid shown on the left, a person standing at P2 position is required to move to P5 position. The only movement allowed for a step involves, “two moves along one direction followed by one move in a perpendicular direction” The permissible directions for movement are shown as dotted arrows in the right. For example, a person at a given position Y can move only to the positions marked X on the right. Without occupying any of the shaded squares at the end of each step, the minimum number of steps required to go from P2 to P5 is

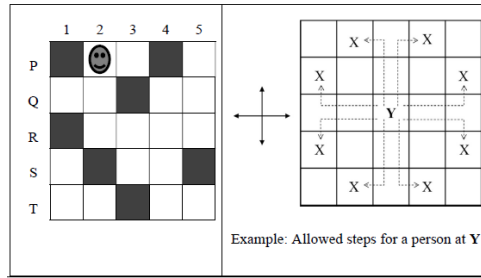


Fig. 9.1

- a) 4
- b) 5
- c) 6
- d) 7

(GATE EY 2022)

10) .

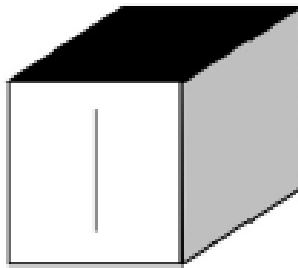


Fig. 10.1

Consider a cube made by folding a single sheet of paper of appropriate shape. The interior faces of the cube are all blank . However, the exterior faces that are not visible in the above view may not be blank. Which one of the following represents a possible unfolding of the cube?

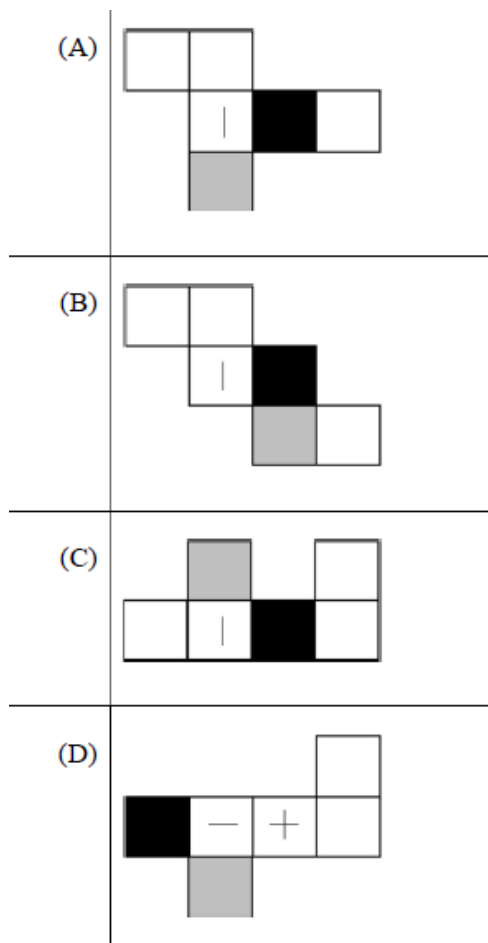


Fig. 10.2

(GATE EY 2022) **Q. 11 – Q. 35** carry one mark each.

- 11) Which one of the following options denotes the time when the majority of animal phyla first appeared in the fossil record? (*MYA* = *Million Years Ago*)
- 65MYA
 - 250MYA
 - 550MYA
 - 700MYA

(GATE EY 2022)

- 12) Consider the following strains of an influenza virus and their basic reproduction numbers (R_0). Assuming that they are all equally virulent, which one of the following strains would be most concerning for a completely vulnerable population of humans?

- a) α -strain with $R_0 = 4.0$
- b) β -strain with $R_0 = 1.0$
- c) γ -strain with $R_0 = 0.5$
- d) δ -strain with $R_0 = 0.2$

(GATE EY 2022)

13) Which one of the following statements is true with respect to energy requirements of photosynthesis in C3 and C4 biochemical cycles?

- a) $C3 > C4$
- b) $C4 > C3$
- c) $C3 = C4$
- d) Energy requirement is unrelated to C3 or C4 cycle

(GATE EY 2022)

14) Which one of the following is a proximate explanation for grouping in animals?

- a) Animals in groups face a lower risk of predation.
- b) Animals form groups to forage efficiently
- c) Groups can navigate their environment better
- d) Groups form when individuals show attraction to others

(GATE EY 2022)

15) The ethologist Konrad Lorenz is known for his discovery of which one of the following processes?

- a) Habituation
- b) Sensitization
- c) Reinforcement
- d) Imprinting

(GATE EY 2022)

16) Male stickleback fish develop red colour on their ventral side in the breeding season and maintain territories. When a conspecific male intruder enters their territory, resident males perform an aggressive display. The ethologist Niko Tinbergen presented models of different shapes to territorial male stickleback fish. He found that models of any shape elicited aggressive displays, provided the ventral part of the models was coloured red. This observation led to the development of which one of the following concepts

- a) Supernormal stimuli
- b) Sign stimuli
- c) Gestalt stimuli
- d) Internal stimuli

(GATE EY 2022)

17) Neuronal circuits that mediate escape responses in animals would perform best if they had which one of the following combination of properties?

- a) Large diameter axons and electrical synapses
- b) Small diameter axons and electrical synapses
- c) Large diameter axons and chemical synapses
- d) Small diameter axons and chemical synapses

(GATE EY 2022)

18) Moth caterpillars that mimic bird droppings are an example of which one of the following phenomena?

- a) Aposematism
- b) Batesian mimicry
- c) Masquerade
- d) Müllerian mimicry

(GATE EY 2022)

19) Which one of the following processes is not likely to lead to the stable coexistence of two species at the same trophic level within an ecological community?

- a) Density-dependent predation
- b) Facilitation
- c) Intense interspecific competition
- d) Niche differentiation

(GATE EY 2022)

20) Which one of the following organisms is a cytoplasmically inherited symbiotic bacterium that can cause extreme female-biased sex ratios in many insects?

- a) *Clostridium*
- b) *Escherichia*
- c) *Mycobacterium*
- d) *Wolbachia*

(GATE EY 2022)

21) A cross between a pure-bred plant with red flowers and a pure-bred plant with white flowers produced F1 generation with pink flowers. If the plants with pink flowers are selfed, what is the proportion of white : pink : red flowers expected in the next generation?

- a) 1 : 1 : 1
- b) 1 : 2 : 1
- c) 2 : 1 : 2
- d) 2 : 2 : 1

(GATE EY 2022)

22) A gene coding for a particular protein exhibits 2% DNA sequence divergence between humans and chimpanzees. However, protein sequences encoded by them are identical. Which one of the following processes explains this?

- a) Nonsynonymous changes in the gene sequences
- b) Synonymous changes in the gene sequences
- c) Nonsense mutations in the gene sequences
- d) Frameshift mutations in the gene sequences

(GATE EY 2022)

23) Which one of the following sets of characteristics is most likely to cause population extinction via demographic stochasticity?

- a) Small geographical range and low population density
- b) Large geographical range and low population density
- c) Small geographical range and high population density
- d) Large geographical range and high population density

(GATE EY 2022)

24) Which one of the following is not an expected impact of global warming?

- a) Birds shifting their distributions to higher elevations
- b) Fish shifting their distributions to deeper waters
- c) Lizards shifting their distributions towards the equator
- d) Mammals shifting their distributions towards higher latitudes

(GATE EY 2022)

25) Which one of the following represents the chemical energy available to herbivores in an ecosystem?

- a) Net Secondary Productivity
- b) Gross Primary Productivity
- c) Net Ecosystem Productivity
- d) Net Primary Productivity

(GATE EY 2022)

26) Which one of the following major mass extinctions is the most recent?

- a) Cretaceous-Paleogene
- b) Late Devonian
- c) Permian-Triassic
- d) Triassic-Jurassic

(GATE EY 2022)

27) Which one of the following does not help maintain genetic diversity at a given locus?

- a) Heterozygote advantage
- b) Genetic drift
- c) Negative frequency dependent selection
- d) Mutation-Selection balance

(GATE EY 2022)

28) Which one of the following is potentially explained by the mid-domain effect?

- a) Increase in body size of mammals at high latitudes
- b) Species richness along an elevational gradient
- c) Cumulative species richness with increasing area
- d) Species richness along a disturbance gradient

(GATE EY 2022)

29) The graph shows the yield of coffee plantations located at different distances from a patch of primary forest

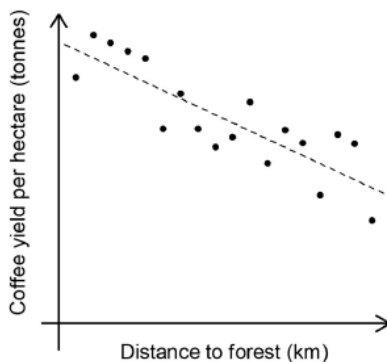


Fig. 29.1

Which one of the following options best explains this pattern?

- a) Carbon sequestration
- b) Seed predation by forest-dwelling insects
- c) Pollination by forest-dwelling insects
- d) Seed dispersal by forest-dwelling birds and mammals

(GATE EY 2022)

30) Which one or more of the following bird species is/are the focus of conservation-oriented captive breeding efforts in India?

- a) Great Indian Bustard
- b) Himalayan Quail
- c) Jerdon's Courser
- d) White-winged Wood Duck

(GATE EY 2022)

31) Which one or more of the following is/are not an example of a zoonotic disease(s)?

- a) Ebola
- b) HIV-AIDS
- c) Lyme disease

d) Poliomyelitis

(GATE EY 2022)

32) Small islands tend to have fewer species than nearby large islands. Which one or more of the following reasons explain(s) this outcome?

- a) Smaller areas have higher extinction rates.
- b) Smaller areas have low environmental heterogeneity.
- c) Smaller areas support smaller populations.
- d) Smaller areas have higher speciation rates.

(GATE EY 2022)

33) The term “living fossil” applies to which one or more of the following organisms?

- a) Coelacanth
- b) Echidna
- c) Horseshoe crab
- d) Rhinoceros viper

(GATE EY 2022)

34) Which one or more of the following reasons has/have been invoked to explain island gigantism?

- a) Absence of interspecific competitors
- b) Absence of predators
- c) Limited habitat
- d) Limited prey base

(GATE EY 2022)

35) Which one or more of the following options represent(s) life history trade-offs?

- a) Egg size versus clutch size
- b) Growth versus age at sexual maturation
- c) Mate choice versus offspring quality
- d) Survival versus reproduction

(GATE EY 2022)

36) Certain plants and animals rely on toxins such as cardiac glycosides for self-defense. Digitoxin and bufalin, structurally similar toxins produced by foxglove plants and bufonid toads, respectively, are one such example. Which one of the following statements about these toxins is correct?

- a) They are structural and functional analogs.
- b) They are structural and functional homologs.
- c) They are structural analogs and functional homologs.
- d) They are structural homologs and functional analogs

(GATE EY 2022)

- 37) A behavioural ecologist records the number of times a kingfisher succeeds in catching fish over multiple five-minute intervals. Which one of the following distributions best describes these data?
- Chi-squared
 - Normal
 - Poisson
 - Student's-t

(GATE EY 2022)

- 38) Excess fertilizers used in agriculture commonly end up as runoff and cause phytoplankton blooms in rivers. To figure out whether these blooms were driven by ammonium or phosphate fertilizers, researchers cultured a phytoplankton species in multiple samples of unpolluted river water. The samples were divided equally among three treatments: ammonium fertilizer added, phosphate fertilizer added and no fertilizer added. They then measured phytoplankton density in each of the samples after a week. Phytoplankton densities (in thousands of cells/ml) are reported in the table shown.

Phytoplankton densities (mean \pm SD) in treatments with		
No fertilizer added	Phosphate fertilizer added	Ammonium fertilizer added
6 ± 1	7 ± 1.5	27 ± 2

Fig. 38.1

Which one of the following inferences is correct?

- Nitrogen is the limiting nutrient for phytoplankton growth
- Phosphorus is the limiting nutrient for phytoplankton growth.
- Both nitrogen and phosphorus limit phytoplankton growth.
- Neither nitrogen nor phosphorus limits phytoplankton growth

(GATE EY 2022)

- 39) S_1 and S_2 are two strains of bacteria. The results of a bacterial growth experiment on these strains measured after 24 hours are shown. Black and white bars represent S_1 and S_2 , respectively.

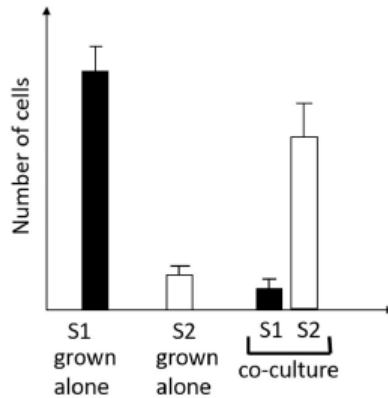


Fig. 39.1

Which one of the following best describes the interaction between $S1$ and $S2$?

- a) Amensalism
- b) Commensalism
- c) Cooperator-cheater
- d) Mutualism

(GATE EY 2022)

40) Habitat P has twice the density of resources as habitat Q. Assume that individuals are identical, can move freely, have perfect information about the environment, and compete for resources when they are in a habitat. At equilibrium, which one of the following represents the predicted outcome?

- a) The number of individuals present and the profitability per individual will be higher in P than in Q.
- b) The number of individuals present and the profitability per individual will be the same in P and in Q.
- c) The number of individuals present will be higher in P than in Q and the profitability per individual will be the same in P and in Q.
- d) The number of individuals present will be higher in Q than in P and the profitability per individual will be higher in P than in Q.

(GATE EY 2022)

41) Consider Holling's Type-III functional response, as shown.

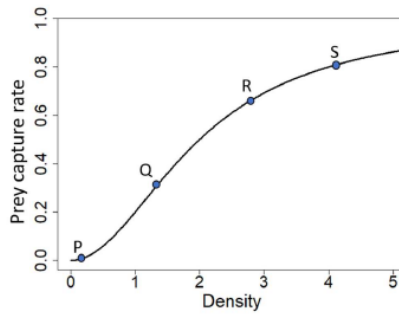


Fig. 41.1

Which one of the marked points has the highest rate-of-change of prey-capture-rate?

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

(GATE EY 2022)

- 42) In a population of birds on an island, the average beak size reduced over one generation. A researcher estimated the association between beak size and relative fitness, shown in the graph. the estimated slope was -0.05 with a 95% confidence interval of -0.15 to 0.09.

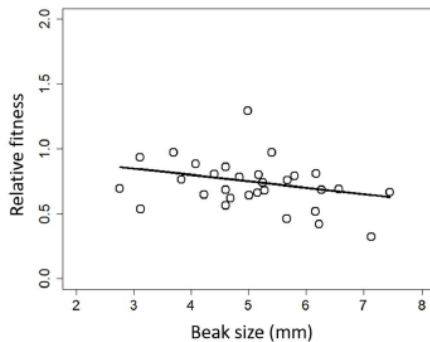


Fig. 42.1

Which one of the following evolutionary processes acting on beak size is the most likely reason for the observed reduction in beak size?

- a) Genetic drift
- b) Group selection
- c) Kin selection
- d) Natural selection

- 43) The Bateman gradient is a popular explanation for why the strength of sexual selection is typically stronger on males than on females. Which one of the following figures is the correct representation of the Bateman gradient? In all figures, the dotted line represents males and the solid line females

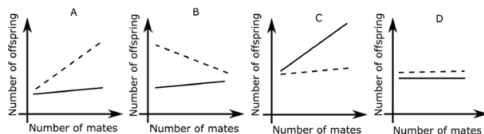


Fig. 43.1

- a) A
- b) B
- c) C
- d) D

(GATE EY 2022)

- 44) Sparrows use two foraging tactics to obtain food. They either search for grains themselves (*Producer tactic P*) or follow other individuals and steal grains from them (*Scrounger tactic S*). The following graphs show how the fitness of each tactic (P : dashed line and S : solid line) varies as a function of the relative frequency of S . Which one of the graphs shows the correct representation of these tactics if they were maintained through negative frequency dependence?

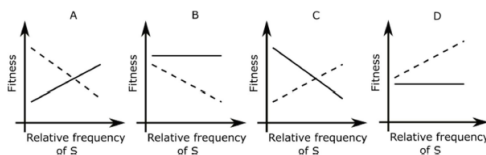


Fig. 44.1

- a) A
- b) B
- c) C
- d) D

(GATE EY 2022)

- 45) Some lizard species show positive allometry in head width, with larger individuals investing disproportionately more in musculature leading to wider heads. To test for positive allometry in a study population, a researcher measures body size and head width for 100 individuals and fits a straight line to a log-log plot of these two

traits. Which one of the following estimated values of the slope indicates support for positive allometry?

- a) 0
- b) 0.5
- c) 1
- d) 1.5

(GATE EY 2022)

46) A team of ecologists laid 100 plots of $50\text{ m} \times 50\text{ m}$ in a forest and counted the number of individuals of a tree species in each plot. They then calculated the mean and variance of the number of individuals per plot. If trees are randomly distributed, then which one of the following relationships between the variance and mean is expected?

- a) Variance > mean
- b) Variance < mean
- c) Variance = mean
- d) Variance is independent of the mean

(GATE EY 2022)

47) The following graphs show rank abundance data for species in three different communities P, Q and R. Based on both species richness and relative abundance, which one of the following options correctly represents the ordering of communities according to their species diversity?

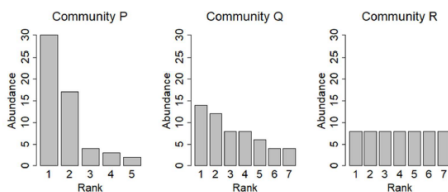


Fig. 47.1

- a) $P > Q > R$
- b) $Q > P > R$
- c) $R > P > Q$
- d) $R > Q > P$

(GATE EY 2022)

48) Which one of the following cladograms represents the correct phylogenetic relationships in the Kingdom Animalia?

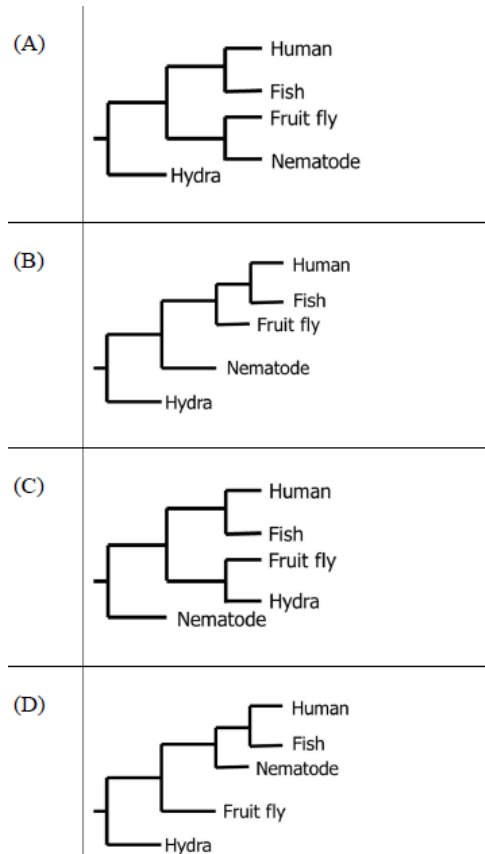


Fig. 48.1

(GATE EY 2022)

- 49) β -diversity quantifies the difference in species composition between two ecological communities. Which one of the following statements is correct about β -diversity?
- Only nestedness affects β -diversity.
 - Only species turnover affects β -diversity.
 - Both nestedness and species turnover affect β -diversity
 - Neither nestedness nor species turnover affects β -diversity

(GATE EY 2022)

- 50) Consider the logistic population growth model, given by

$$\frac{dn}{dt} = rn \left(1 - \frac{n}{k} \right)$$

where r is the intrinsic growth rate, n is the population size and k is the carrying capacity. Which one or more of the following is/are assumption(s) of the model?

- a) Carrying capacity is constant
- b) Density dependence is quadratic
- c) Continuous growth with no time-lags
- d) No genetic, age or size structure

(GATE EY 2022)

51) Which one or more of the following genes/markers is/are typically used for species identification?

- a) 16S rRNA
- b) Cytochrome Oxidase I
- c) IgG
- d) Microsatellites

(GATE EY 2022)

52) A bee species forages for nectar on a plant species which has yellow flowers. To find out what cues the bees use to recognize the flowers, researchers performed the following experiment. They presented individual bees with the stimuli given below and examined the proportion of bees that approached and landed on the stimuli. The results are shown below.

	Stimulus	Response (%)
1	Uncovered yellow flowers	90
2	Yellow flowers in a black porous cloth bag	0
3	Yellow flowers in a transparent plastic bag	90
4	Yellow flowers in a black plastic bag	0

Fig. 52.1

Which one or more of the following interpretation(s) of the experiment is/are correct?

- a) All flower colours other than yellow are ineffective at eliciting approach responses
- b) Olfactory cues are sufficient to elicit approach responses.
- c) Visual cues are necessary to elicit approach responses.
- d) Visual cues are sufficient to elicit approach responses.

(GATE EY 2022)

53) Which one or more of the following reason(s) explain(s) why whales use low frequencies (*infrasound*) for mate-finding and high frequencies (*ultrasound*) for hunting prey?

- a) High frequencies transmit further without distortion than low frequencies.
- b) High frequencies scatter more and allow for high-resolution information
- c) Low frequencies transmit further without distortion than high frequencies.

d) Low frequencies scatter more and allow for high-resolution information

(GATE EY 2022)

54) The table shows the relative abundance of three potential prey species in the environment and in the diet of a bat predator.

Prey species	Relative abundance in diet (%)	Relative abundance in environment (%)
X	0	40
Y	30	40
Z	70	20

Fig. 54.1

Which one or more of the following is/are possible interpretations based on the data?

- a) The predator shows a preference for prey species Z.
- b) The predator shows no preference for any of the three prey species.
- c) Species X is avoided by the predator.
- d) The predator shows a preference for prey species Y.

(GATE EY 2022)

55) Which one or more of the following options represent(s) an evolutionary arms race?

- a) Snake venom toxin specificity and prey receptor modification
- b) Egg discrimination by hosts and brood parasite egg colouration
- c) Cooperative breeding and offspring survival rate
- d) Crypsis in prey and visual acuity in predator

(GATE EY 2022)

56) The figure shows an F probability density function. The two dotted lines represent critical values corresponding to a two-tailed F -test at a level of significance of 0.05. The observed F -statistic for two samples is indicated by the solid line.

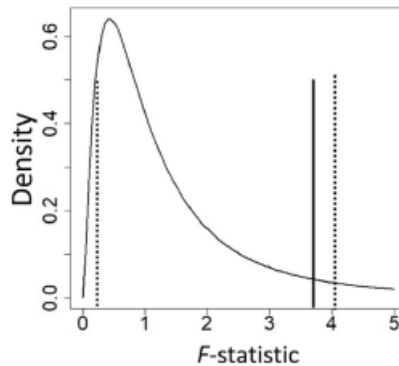


Fig. 56.1

Which one or more of the following inferences is/are correct?

- a) The null hypothesis cannot be rejected
- b) The null hypothesis is true.
- c) The ratio of the variances of the two samples is not statistically significantly different from 1.
- d) The ratio of the skewness of the two samples is not statistically significantly different from 1

(GATE EY 2022)

57) Which one or more of the following conditions can lead to an increase in tree densities in tropical savannas?

- a) Fire suppression
- b) Increase in mean annual rainfall
- c) Increased levels of browsing by herbivores
- d) Increased atmospheric CO_2

(GATE EY 2022)

58) Gene conversion can lead to which one or more of the following evolutionary outcomes?

- a) Concerted evolution
- b) Increased expression
- c) Increased sequence divergence
- d) Increased sequence similarity

(GATE EY 2022)

59) If the observed heterozygosity at a locus is 0.6, which one or more of the following could produce this outcome?

- a) A neutral locus with three alleles
- b) A locus under selection with two alleles

- c) A neutral locus with two alleles
- d) A locus under selection with one allele

(GATE EY 2022)

- 60) Which one or more of the following reasons has/have been invoked to explain high species diversity in the tropics?
- a) Greater area in the tropics
 - b) Higher speciation rates in the tropics
 - c) Lower extinction rates in the tropics
 - d) The tropics are closer to the sun

(GATE EY 2022)

- 61) In a linear regression with a single continuous predictor and 100 data points, the residual degrees of freedom are _____. (Answer in integer)
(GATE EY 2022)

- 62) The genome of an organism has 60% GC (*Guanine – Cytosine*) content. The Adenine in this genome is _____ %. (Answer in integer) (GATE EY 2022)

- 63) The prevalence of flu in a population is 1%. A diagnostic test has a false positive rate of 10 and a false negative rate of 10%. The probability that a randomly chosen person tests positive is _____. (Round off to three decimal places)
(GATE EY 2022)

- 64) In a deer population, the male-to-female ratio is 1 : 2. The probability that a randomly formed group of size three has 2 males and 1 female is _____.
(Round off to two decimal places) (GATE EY 2022)

- 65) The fitness $f(n)$ of an individual in a group of size is given by

$$f(n) = n(10 - n)$$

At evolutionary equilibrium, groups are found in two different sizes. If one group size is 6, the other group size must be _____ (Answer in integer)
(GATE EY 2022)