

Q1) 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)

- (A) 65 MYA
- (B) 250 MYA
- (C) 550 MYA
- (D) 700 MYA

Q2) 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 $R_0 = 0.2$

Q3) 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

Q4) 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.

Q5) The ethologist Konrad Lorenz is known for his discovery of which one of the following processes?

- (A) Habituation
- (B) Sensitization
- (C) Reinforcement
- (D) Imprinting

Q6) 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

Q7) 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

Q8) Moth caterpillars that mimic bird droppings are an example of which one of the following phenomena?

- (A) Aposematism
- (B) Batesian mimicry
- (C) Masquerade
- (D) Mullerian mimicry

Q9) 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

Q10) 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

Q11) 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

Q12) 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

Q13) 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

Q14) 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

Q15) 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

Q16) Which one of the following major mass extinctions is the most recent?

- (A) Cretaceous-Paleogene
- (B) Late Devonian
- (C) Permian-Triassic
- (D) Triassic-Jurassic

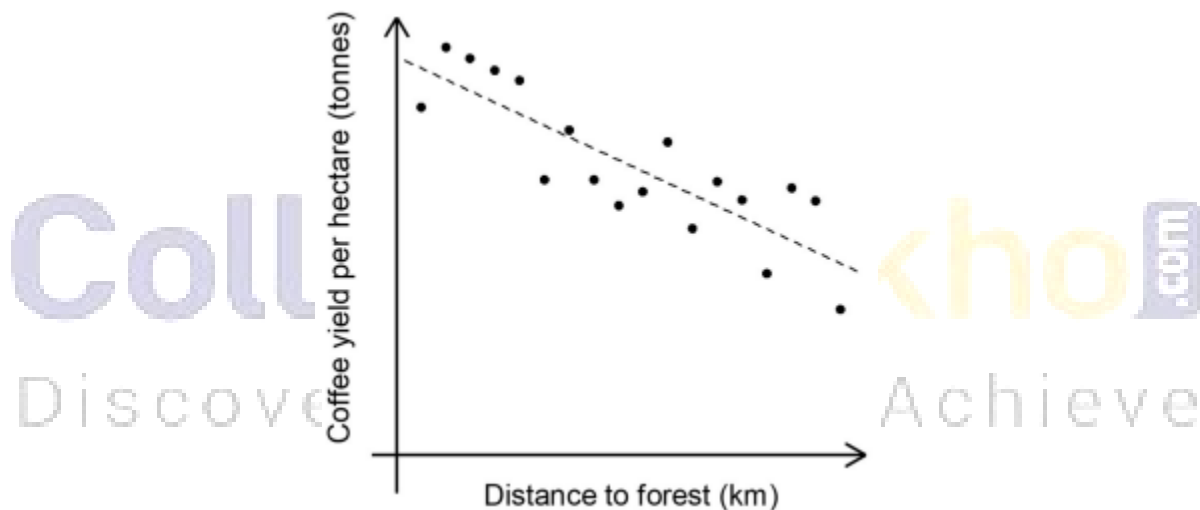
Q17) Which one of the following does not help maintain genetic diversity at a given locus?

- (A) Heterozygote advantage
- (B) Genetic drift
- (C) Negative frequency dependent selection
- (D) Mutation-Selection balance

Q18) 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

Q19) The graph shows the yield of coffee plantations located at different distances from a patch of primary forest.



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

Q20) 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

Q21) 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

Q22) 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.

Q23) The term “living fossil” applies to which one or more of the following organisms?

- (A) Coelacanth
- (B) Echidna
- (C) Horseshoe crab
- (D) Rhinoceros viper

Q23) 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

Q24) 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

Q25) Certain plants and animals rely on toxins such as cardiac glycosides for self-defence. 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?

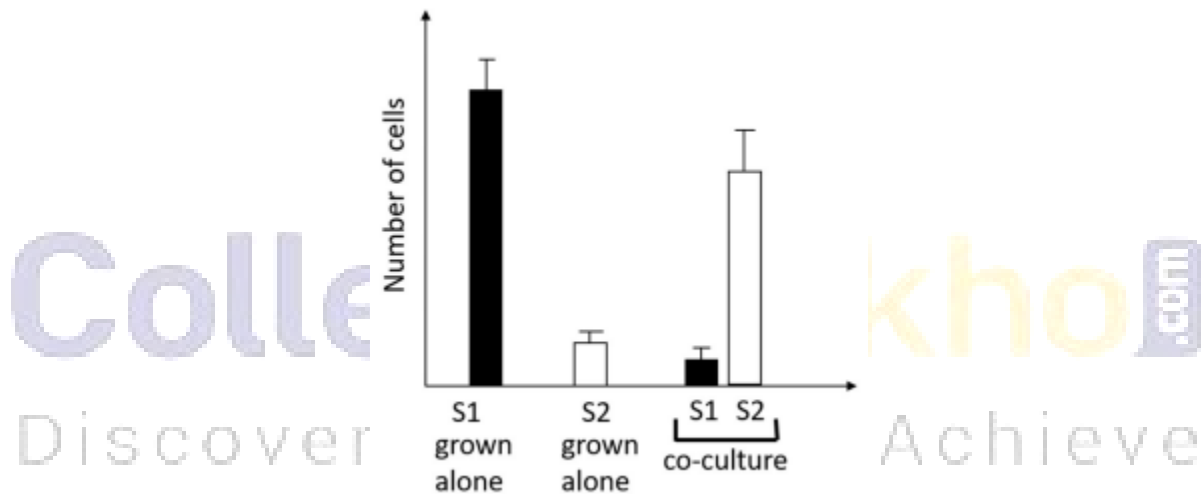
- (A) They are structural and functional analogs.
- (B) They are structural and functional homologs.

- (C) They are structural analogs and functional homologs.
- (D) They are structural homologs and functional analogs.

Q26) 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?

- (A) Chi-squared
- (B) Normal
- (C) Poisson
- (D) Student's-t

Q27) S1 and S2 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 S1 and S2, respectively.



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

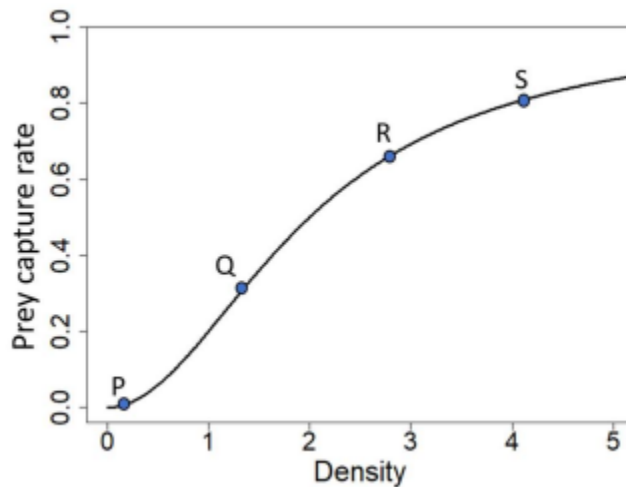
- (A) Amensalism
- (B) Commensalism
- (C) Cooperator-cheater
- (D) Mutualism

Q28) 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.

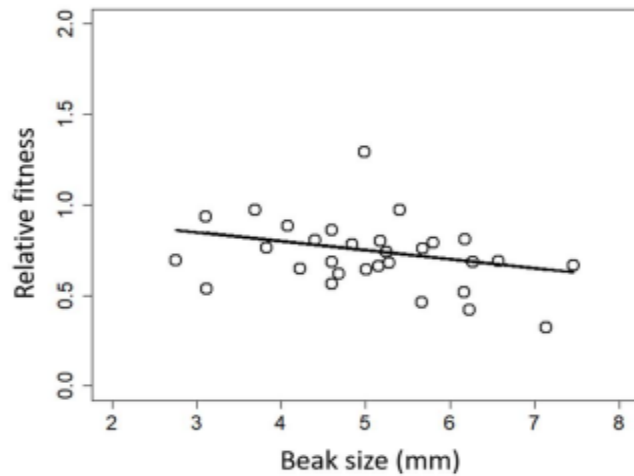
Q29) Consider Holling's Type-III functional response, as shown.



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

- (A) P
- (B) Q
- (C) R
- (D) S

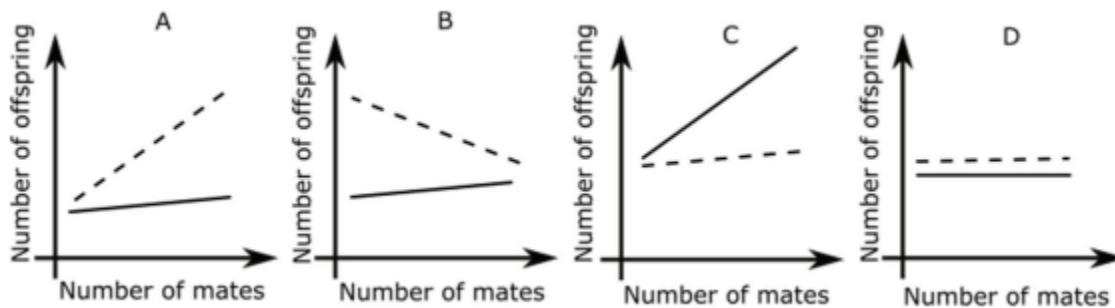
Q30) In a population of birds on an island, the average beak size reduced over one generation. A researcher estimated the association between beak size and relative fitness, shown in the graph. The estimated slope was -0.05 with a 95% confidence interval of -0.15 to 0.09



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

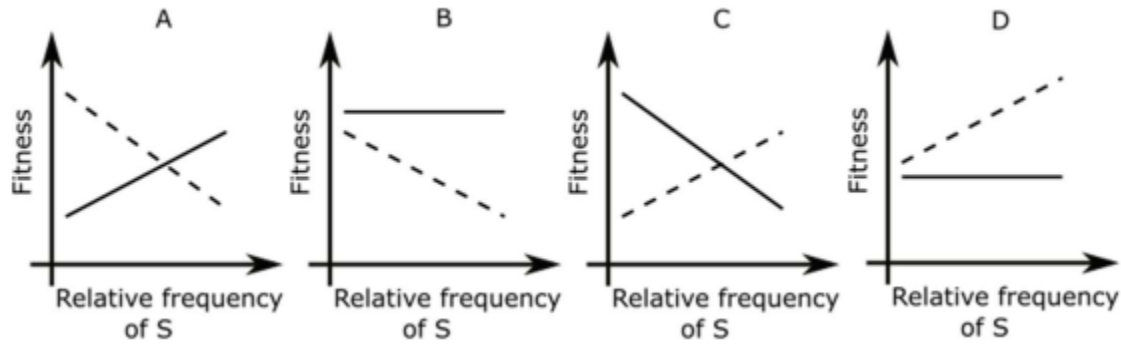
Q31) The Bateman gradient is a popular explanation for why the strength of sexual selection is typically stronger on males than on females. Which one of the following figures is the correct representation of the Bateman gradient? In all figures, the dotted line represents males and the solid line females



- (A) A
- (B) B
- (C) C
- (D) D

Q32) 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?



- (A) A
- (B) B
- (C) C
- (D) D

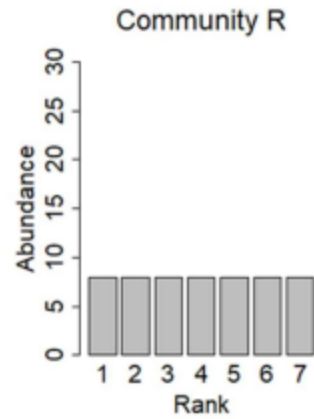
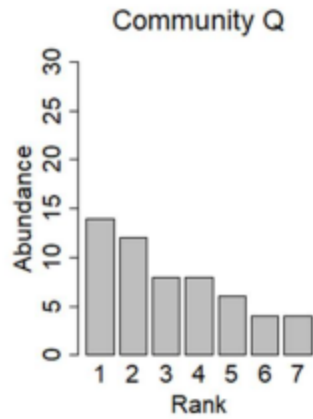
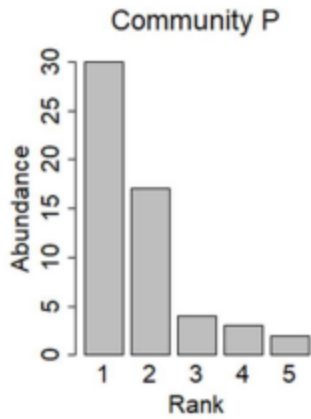
Q33) Some lizard species show positive allometry in head width, with larger individuals investing disproportionately more in musculature leading to wider heads. To test for positive allometry in a study population, a researcher measures body size and head width for 100 individuals and fits a straight 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

Q34) A team of ecologists laid 100 plots of 50 m × 50 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?

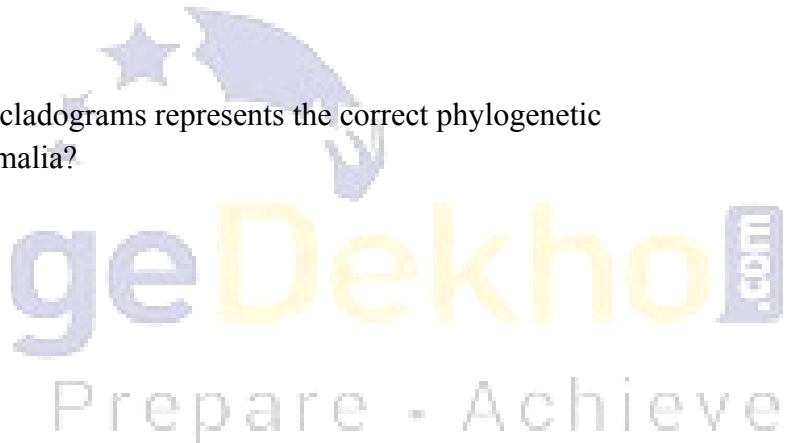
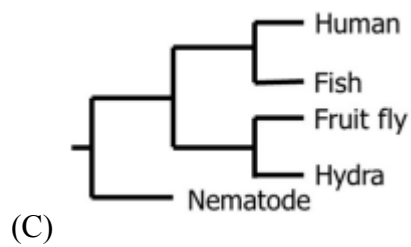
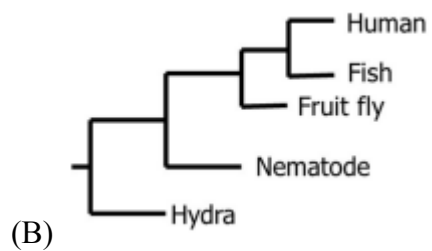
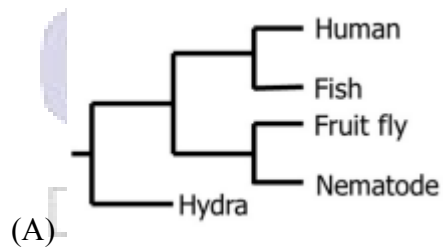
- (A) Variance > mean
- (B) Variance < mean
- (C) Variance = mean
- (D) Variance is independent of the mean

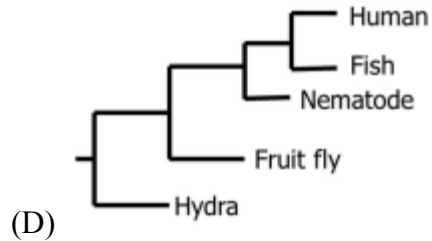
Q35) The following graphs show rank abundance data for species in three different communities P, Q and R. Based on both species richness and relative abundance, which one of the following options correctly represents the ordering of communities according to their species diversity?



- (A) $P > Q > R$
- (B) $Q > P > R$
- (C) $R > P > Q$
- (D) $R > Q > P$

Q36) Which one of the following cladograms represents the correct phylogenetic relationships in the Kingdom Animalia?





Q37) β -diversity quantifies the difference in species composition between two ecological communities. Which one of the following statements is correct about β -diversity?

- (A) Only nestedness affects β -diversity.
- (B) Only species turnover affects β -diversity.
- (C) Both nestedness and species turnover affect β -diversity.
- (D) Neither nestedness nor species turnover affects β -diversity

Q38) 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

Q39) 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.

Q40) 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



