EY: Ecology and Evolution

GA - General Aptitude

Q1 - Q5 carry one mark each.

Q.No. 1   This book, including all its chapters,_____interesting. The students as well as the instructor_____in agreement about it.
(A)   is, was
(B)   are, are
(C)   is, are
(D)   were, was

Q.No. 2   People were prohibited _____their vehicles near the entrance of the main administrative building.
(A)   to park
(B)   from parking
(C)   parking
(D)   to have parked

Q.No. 3   Select the word that fits the analogy:

Do : Undo :: Trust : _____
(A)   Entrust
(B)   Intrust
(C)   Distrust
(D)   Untrust

Q.No. 4   Stock markets _____ at the news of the coup.
(A)   poised
(B)   plunged
(C)   plugged
(D)   probed

Q.No. 5   If P, Q, R, S are four individuals, how many teams of size exceeding one can be formed, with Q as a member?
(A)   5
(B)   6
(C)   7
(D)   8

Q6 - Q10 carry two marks each.

Q.No. 6   Non-performing Assets (NPAs) of a bank in India is defined as an asset, which remains unpaid by a borrower for a certain period of time in terms of interest, principal, or both. Reserve Bank of India (RBI) has changed the definition of NPA thrice during 1993-2004, in terms of the holding period of loans. The holding period was reduced by one quarter each time. In 1993, the holding period was four quarters (360 days).

Based on the above paragraph, the holding period of loans in 2004 after the third revision was _____ days.
(A)   45
(B)   90
(C)   135
(D)   180

Q.No. 7   Select the next element of the series: Z, WV, RQP, ___
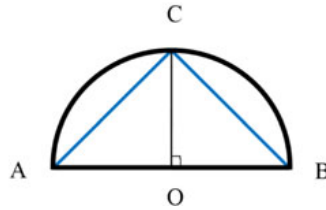(A)   LKJI
(B)   JIHG
(C)   KJIH
(D)   NMLK

Q.No. 8   In four-digit integer numbers from 1001 to 9999, the digit group "37" (in the same sequence) appears _____ times.
(A)   270

(B)   279
(C)   280
(D)   299

Q.No. 9 Given a semicircle with O as the centre, as shown in the figure, the ratio $\dfrac{\overline{AC} + \overline{CB}}{\overline{AB}}$ is _____,

where $\overline{AC}$, $\overline{CB}$ and $\overline{AB}$ are chords.

(A) $\sqrt{2}$
(B) $\sqrt{3}$
(C)   2
(D)   3

Q.No. 10 The revenue and expenditure of four different companies P, Q, R and S in 2015 are shown in the figure. If the revenue of company Q in 2015 was 20% more than that in 2014, and company Q had earned a profit of 10% on expenditure in 2014, then its expenditure (in million rupees) in 2014 was _____.
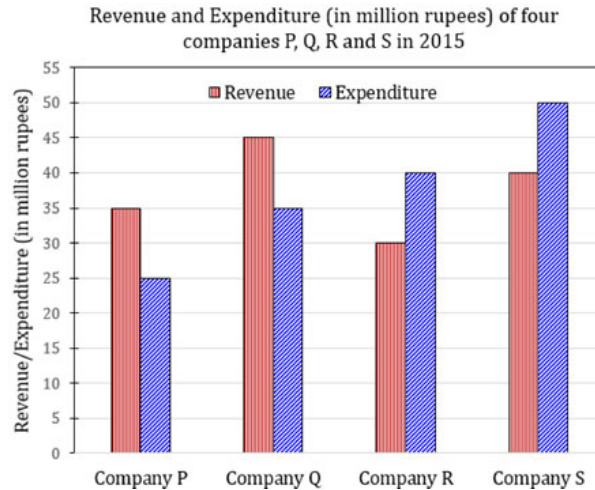
(A)   32.7
(B)   33.7
(C)   34.1
(D)   35.1

EY: Ecology and Evolution

Q1 - Q25 carry one mark each.

Q.No. 1 Who among the following was a strong public supporter of Darwin's theory of evolution by natural selection?
(A)   Jean-Baptiste Lamarck
(B)   Carl Linnaeus
(C)   Thomas Huxley
(D)   Gregor Mendel

Q.No. 2 Analysis of variance (ANOVA) can be used to compare multiple groups of samples. Select the correct option that reflects the principle behind ANOVA.
(A)   The sum of the squares of the variances is calculated for the groups being compared.
(B)   The variance ratio is calculated by subtracting each value from the overall mean, squaring the difference, and summing the resulting squared deviations.
(C)   The variation between groups is compared with the variation within groups.
(D)   The F value is statistically significant if the mean values between the groups are the same.

Q.No. 3   Which of the following information is provided by a phylogenetic tree?
(A)   The topology and the branch lengths of the related taxa.
(B)   The topology and sequence length of the gene.
(C)   The sequence length of the gene and tree length.
(D)   The sequence type and sequence variations within each taxa.

Q.No. 4   Myrmecochory refers to seed dispersal by which of the following agents?
(A)   Bats
(B)   Ants
(C)   Lizards
(D)   Birds

Q.No. 5   Which of the following is NOT capable of photosynthesis?
(A)   Diatoms
(B)   Phytoplankton
(C)   Pteridophytes
(D)   Ascomycetes

Q.No. 6   Which of the following sensory mechanisms do most frugivorous bats primarily use
           while foraging?
(A)   Olfaction
(B)   Electromagnetism
(C)   Vibration
(D)   Echolocation

Q.No. 7   What direct effect does Follicle Stimulating Hormone (FSH) have in vertebrates?
(A)   It causes follicles of the duodenum to contract.
(B)   It causes follicles of the ovaries to grow.
(C)   It causes follicles of the liver to enlarge.
(D)   It causes follicles of muscles to contract.

Q.No. 8   Juvenile rhesus macaques, who have never seen a leopard before, can learn to show
           fear response if they see an adult react fearfully to a leopard. What kind of
           behavioural response is this?
(A)   Imprinting
(B)   Instinct
(C)   Cultural transmission
(D)   Mimicry transmission

Q.No. 9   In a tropical rainforest during the day, which of the following factors does NOT
           affect the spectral irradiance at the forest floor?
(A)   Angle of the sun on the horizon.
(B)   Weather conditions of the atmosphere.
(C)   Structure of the canopy vegetation.
(D)   Spectral reflectance of the leaf litter.

Q.No. 10   What would an evolutionary biologist hypothesize as the ultimate cause for the
           presence of colourful dewlaps in lizards?
(A)   Colour of dewlaps are formed by pigments in the skin.
(B)   Colourful dewlaps are formed by folds in the skin.
(C)   Colourful dewlaps increase mating success.
(D)   Colourful dewlaps are regions where motor neurons control head movement.

Q.No. 11   Which of the following is true about comparisons between herbivorous and
           carnivorous mammals?
(A)   Herbivores have longer digestive tracts and smaller caecum for a given body size
           than carnivores.
(B)   Carnivores have longer digestive tracts and smaller caecum for a given body size
           than herbivores.
(C)   Herbivores have shorter digestive tracts and smaller caecum for a given body size
           than carnivores.
(D)   Carnivores have shorter digestive tracts and smaller caecum for a given body size
   than herbivores.

Q.No. 12

Two isolated populations X and Y have 100 and 10000 individuals, respectively. Both populations have the same starting allele frequencies of p=0.5 and q=0.5. After 1000 generations of genetic drift, which of the following statements is true about the heterozygosity at this locus in these two populations?

(A) The heterozygosity of population X will be more than in population Y.
(B) The heterozygosity of population Y will be more than in population X.
(C) The heterozygosity of both the populations will be identical.
(D) The heterozygosity of these populations will not depend on their population sizes.

Q.No. 13 Which of the following criteria is used to define species under the biological species concept?

(A) Niche partitioning
(B) Reproductive isolation
(C) Morphological divergence
(D) Genetic distance

Q.No. 14 The abundances of three species (P, Q, and R) were measured along a resource gradient. The resultant pattern is summarized in the figure. Which of the following statements can be inferred from niche theory?
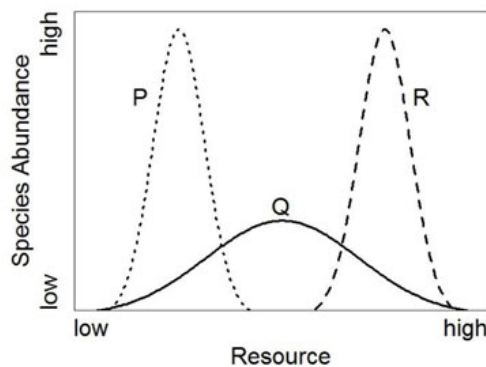
(A) P is a generalist; Q and R are specialists.
(B) Q is a generalist; P and R are specialists.
(C) P and Q are generalists; R is a specialist.
(D) P and R are generalists; Q is a specialist.

Q.No. 15 In the last 3 to 4 decades, the average CO_2 concentration in the Earth's atmosphere has increased from _____.

(A) 3 ppm to 4 ppm
(B) 30 ppm to 40 ppm
(C) 300 ppm to 400 ppm
(D) 3000 ppm to 4000 ppm

Q.No. 16 What effect does myelination have on neurons?

(A) It increases the transmembrane resistance.
(B) It increases the membrane capacitance.
(C) It changes the direction of signal propagation.
(D) It protects synapses from damage.

Q.No. 17 Which of the following processes contributes to an increase in genetic variation?

(A) Genetic drift
(B) Directional selection
(C) Inbreeding
(D) Immigration

Q.No. 18 What characteristic do the plant species, sundew (*Drosera capensis*) and Venus fly trap (*Dionaea muscipula*), share?

(A) They are thigmonastic.
(B) They are nyctinastic.
(C) They are epiphytic.
(D) They are endophytic.

Q.No. 19 What is the study of fish known as?

(A) Malacology
(B) Herpetology

(C)   Physiology

(D)   Ichthyology

Q.No. 20   On one side of a house, a 50 watt bulb attracts moths at a rate of 30 individuals/minute. On the other side of the house, a 15 watt bulb attracts moths at a rate of 10 individuals/minute. There are 20 bats in the area who are foraging for these moths. According to Ideal Free Distribution, the number of bats near the 15 watt bulb should be _____.

Q.No. 21   The Simpson's index of diversity is expressed as:

$$D = 1 - \sum_{i=1}^{n} p_i^2$$

Where p_i is the proportion of the ith species, and n is the total number of species.

Species identity	Number of individuals
P	140
Q	50
R	2
S	2
T	2
U	2
W	2

The Simpson's index of diversity for this dataset is _____ (round off to three decimal places).

Q.No. 22   In a botanical garden, tree species P had an average height of 1.5 m, while tree species Q had an average height of 1.8 m. Pooled together, these two tree species had an average height of 1.7 m. From this, one can infer that the number of trees of species Q in the garden was _____ times the number of trees of species P.

Q.No. 23   A fragment of double stranded DNA has 30% Adenine. The % GC content in this fragment is _____ .

Q.No. 24   A researcher traps rodents in a small, isolated forest patch. In the first trapping session she captures 24 mice and marks them by notching their ears. In the second trapping session she captures 16 mice, of which 8 are already marked. Assuming that the population is closed (no immigration, emigration, birth, or death), the estimated number of mice in the patch is _____.

Q.No. 25

A raptor sitting on a tree sees a rodent on the ground below as shown in the figure (not to scale). If the raptor views the rodent from a height of 10 metres, and the rodent subtends a visual angle of 45° on the raptor's eye, the straight line distance from the raptor to the rodent in metres is _____ (round off to two decimal places).
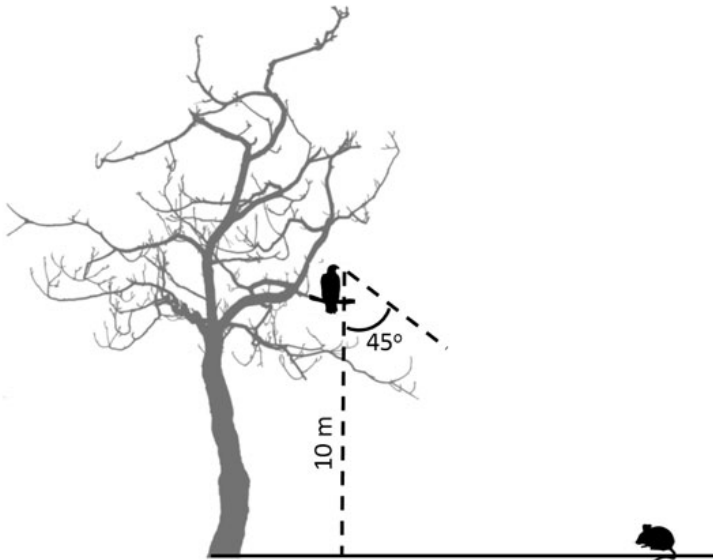
Q26 - Q55 carry two marks each.

Q.No. 26   Beetles of one species have the option of eating plant species X or Y in their environment. Plant species X and Y have the same nutritional quality. When beetle diets comprise a greater proportion of plant X, the population size of beetles increases faster than when beetle diets are dominated by plant Y. Which of the following is NOT a probable explanation for this outcome?

(A)   Xenobiotics in X are physiologically easier for the beetles to detoxify than those in Y.

(B)   Sequestration of xenobiotics from X by the beetles confers greater protection from bird predators than those from Y.

(C)   X attracts parasites of the beetles while Y does not.

(D)   X provides greater protection from bird predators during foraging than does Y.

Q.No. 27   A researcher was documenting the number of tree species in a landscape. Within each of three forest types (P, Q, and R), she laid 100 quadrats and documented all the species found in each quadrat. She then plotted the cumulative species richness for these forest types as shown in the figure. Which of the following statements is FALSE?
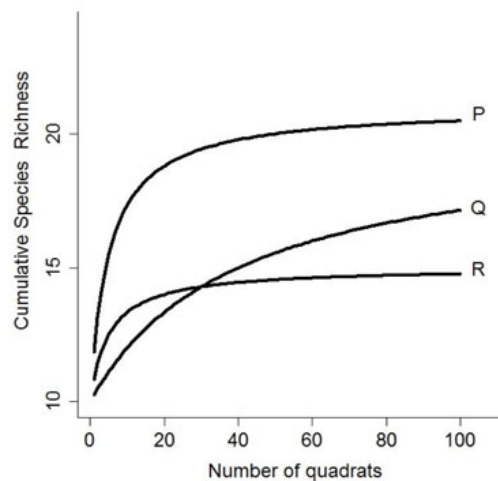
(A)   There are more species of trees in P than in R.

(B)   There are more species of trees in Q than in R.

(C)   More quadrats are required to estimate species richness in P than in Q.

(D)   More quadrats are required to estimate species richness in Q than in R.

Q.No. 28

Which of the following has an endemic species represented in the Andaman and Nicobar Islands for all taxonomic groups in that column?

Column P	Column Q	Column R	Column S
Crocodiles	Megapodes	Sea turtles	Megapodes
Tree shrews	Sea turtles	Tree shrews	Tree shrews
Pit vipers	Crocodiles	Tree frogs	Pit vipers
Megapodes	Pit vipers	Hornbills	Hornbills

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

Q.No. 29 The theory of island biogeography predicts that the number of species on islands is determined by: (i) the rate of colonisation, which depends on the distance of the island from the mainland, and (ii) the rate of extinction, which depends on the size of the island. A researcher surveyed two islands with similar habitats and geological history, and found that both islands have the same number of species. Which of the following statement(s) can explain this observation?

P. The islands are of the same size and are at the same distance from the mainland.
Q. The islands are of different sizes and are at the same distance from the mainland.
R. The islands are of the same size and are at different distances from the mainland.
S. The islands are of different sizes and are of different distances from the mainland.

(A) Only P.
(B) Only Q.
(C) Both P and S.
(D) Both Q and R.

Q.No. 30 In marine fauna, Pelagic Larval Duration (PLD) or the amount of time that larvae spend swimming or drifting in the water column affects their dispersal distance. Successful establishment of the larvae on a substrate also depends on finding a suitable habitat after dispersal, which is influenced by whether the habitat is patchy or continuous. Which of the following species will have the lowest population genetic structure (F_{ST}) across the same spatial scale?

(A) Species with high PLD in patchy habitats.
(B) Species with high PLD in continuous habitats.
(C) Species with low PLD in patchy habitats.
(D) Species with low PLD in continuous habitats.

Q.No. 31 Every lake in Wakanda has three species of fish: P, Q, and R. Species P is a bottom dweller and substrate feeder, species Q is a mid-column dweller and herbivore, and species R is a surface dweller and piscivore. Which of the following processes best explains this distribution pattern?

(A) Speciation within one lake followed by dispersal to other lakes.
(B) Dispersal between lakes followed by speciation within lakes.
(C) Independent speciation events within all the lakes.
(D) Speciation within a lake with no dispersal between lakes.

Q.No. 32

Group living can have both benefits (such as protection from predators) and costs (such as competition for resources). The figure depicts net benefit to individuals as a function of group size. Consider a population with more than hundred individuals, where groups do not split, and individuals can choose to either join a group or remain solitary. Given this information, what is the typical group size predicted?
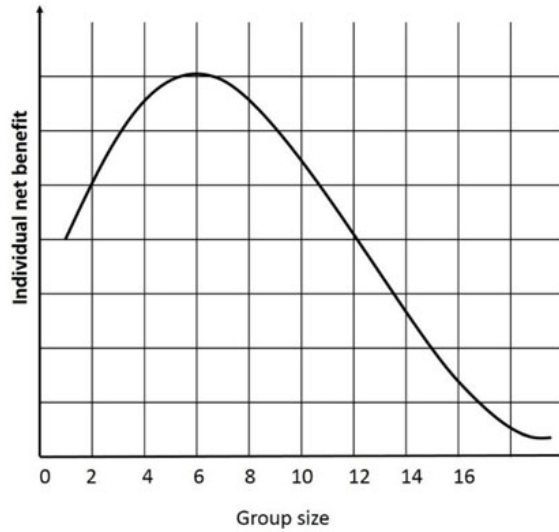
(A) Less than 6
(B) Equal to 6
(C) Between 6 and 12
(D) Greater than 12

Q.No. 33 Two species of snails, P and Q, are found in rivers across a range of temperatures that vary from upstream to downstream. An experiment was conducted in which P was removed from a river and the distribution of Q was measured after a few weeks. In another similar river, the reciprocal experiment was conducted in which Q was removed, and the distribution of P was measured after a few weeks. In the graph below, the filled bars plot the distribution of P and Q when both species are present in a river. The open bars plot the distribution of P when Q is removed, and Q when P is removed. Which of the following statements is true?
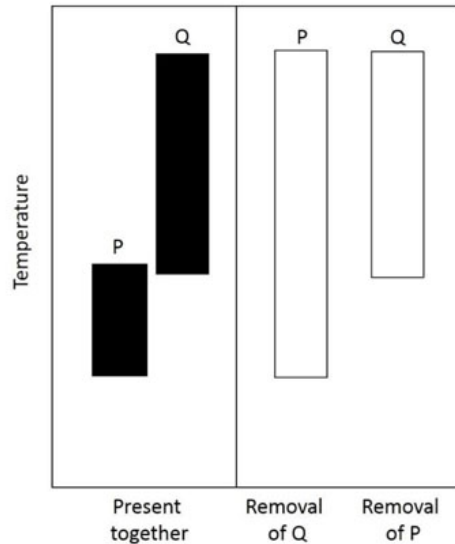
(A) The realised niche of P is smaller than its fundamental niche.
(B) The realised niche of Q is smaller than its fundamental niche.
(C) The realised niche is smaller than the fundamental niche for both species.
(D) The realised niches of both species are equal.

Q.No. 34

In plants with bisexual flowers (hermaphrodites), mate-choice by females is expected to be important under which of the following cases?

      i)   Seed set is pollen-limited rather than resource-limited.
      ii) Obligate self-pollination is present.
      iii) Seed set is resource-limited rather than pollen-limited.
      iv) Obligate cross-pollination is present.

(A)   (i) and (ii)
(B)   (ii) and (iii)
(C)   (iii) and (iv)
(D)   (i) and (iv)

Q.No. 35 Match the breeding system of the plants with their pollen:ovule ratio.

Breeding system	Pollen:ovule ratio
P) Cleistogamy	i) 10000:1
Q) Obligate selfing	ii) 100:1
R) Obligate outcrossing	iii) 10:1
S) Facultative outcrossing	iv) 1:1

(A)   P-i, Q-iii, R-ii, S-iv
(B)   P-ii, Q-i, R-iv, S-iii
(C)   P-iv, Q-iii, R-i, S-ii
(D)   P-iii, Q-iv, R-i, S-ii

Q.No. 36 A particular gene sequence from two different species shows molecular clock-like evolution. Which of the following statements is consistent with this observation?
(A)   The two sequences will show a linear decrease in their genetic distance with time.
(B)   The genetic distance between the two sequences remains constant over time.
(C)   The rate of evolution for this gene sequence is not constant over time.
(D)   The two sequences will show a linear increase in their genetic distance with time.

Q.No. 37 An internal parasite of a mammal does not generate its own heat and yet it can maintain a constant body temperature. Which characteristics describe this parasite?
(A)   Homeothermic ectotherm
(B)   Homeothermic endotherm
(C)   Poikilothermic ectotherm
(D)   Poikilothermic endotherm

Q.No. 38 In a population of infinite size, the frequency of two alleles A1 and A2 at a neutral locus are the same. What are the expected genotype frequencies (A1A1, A1A2, A2A2) after 100 generations of random mating?
(A)   0.25, 0.5, 0.25
(B)   0.5, 0.25, 0.25
(C)   0.25, 0.25, 0.5
(D)   0.05, 0.5, 0.45

Q.No. 39

A certain rodent species shows territoriality, competes for space and food, and their population is at carrying capacity. In the figures, the area within the rectangles (i) to (iv) represents a completely homogenous habitat where resources are distributed throughout, and the grey polygons represent rodent home ranges. Which of the following patterns best represents the expected distribution of home ranges of the rodent species if individuals vary in competitive ability?
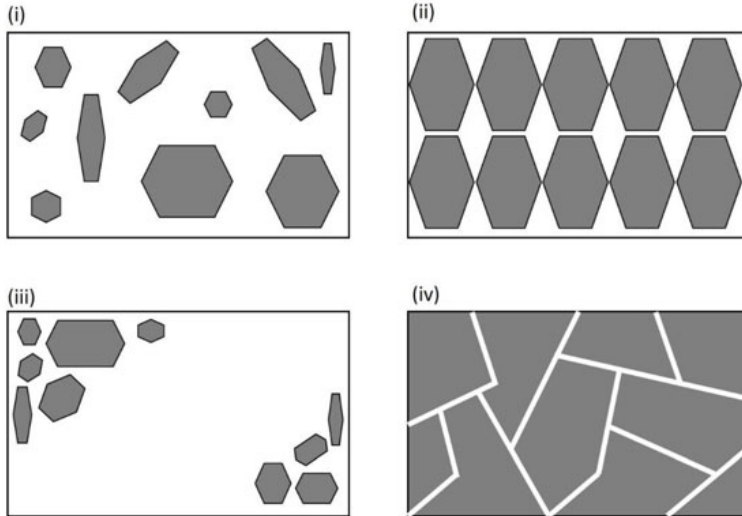
(A)   (i)
(B)   (ii)
(C)   (iii)
(D)   (iv)

Q.No. 40   For a given gene there is 5% DNA sequence divergence between two species, however the protein coded by this gene has identical sequences in the two species. Which of the following types of mutations best explains this pattern in the DNA sequence?

(A)   Nonsense mutation
(B)   Synonymous substitution
(C)   Non-synonymous substitution
(D)   Frame-shift mutation

Q.No. 41   A researcher collects data on plant species composition in two habitats (P and Q) by using 10 quadrats each in both habitats. She calculates the average α-diversity and the β-diversity of each habitat from this data (shown below). Which of the following can be inferred about these habitats?

Diversity	Habitat-P	Habitat-Q
α-diversity	4	4
β-diversity	0.8	0.2

(A)   P and Q have the same total diversity (γ) and P is more heterogeneous than Q.
(B)   Q has lower total diversity (γ) and is more heterogeneous than P.
(C)   P has greater total diversity (γ) and is more heterogeneous than Q.
(D)   Q has greater total diversity (γ) and is more heterogeneous than P.

Q.No. 42

Among four related bird species P, Q, R, and S, species P and Q are nectar feeding with long thin beaks, whereas species R and S are seed eaters with short thick beaks. Which of the following phylogenies unambiguously suggests that seed eating habit was the ancestral state?
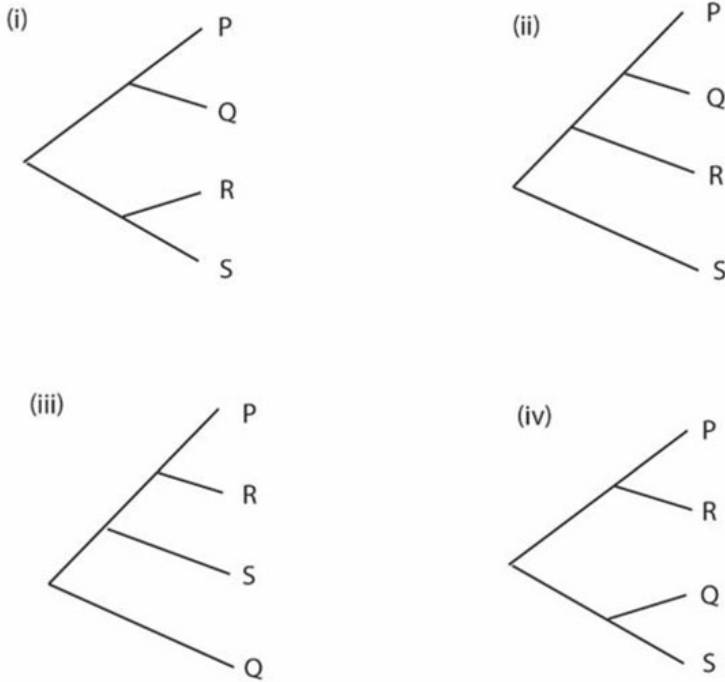
(A)   (i)
(B)   (ii)
(C)   (iii)
(D)   (iv)

Q.No. 43   A population of unicorns is growing over time, but its rate of growth is declining. Which of the following graphs best represents this pattern of growth?
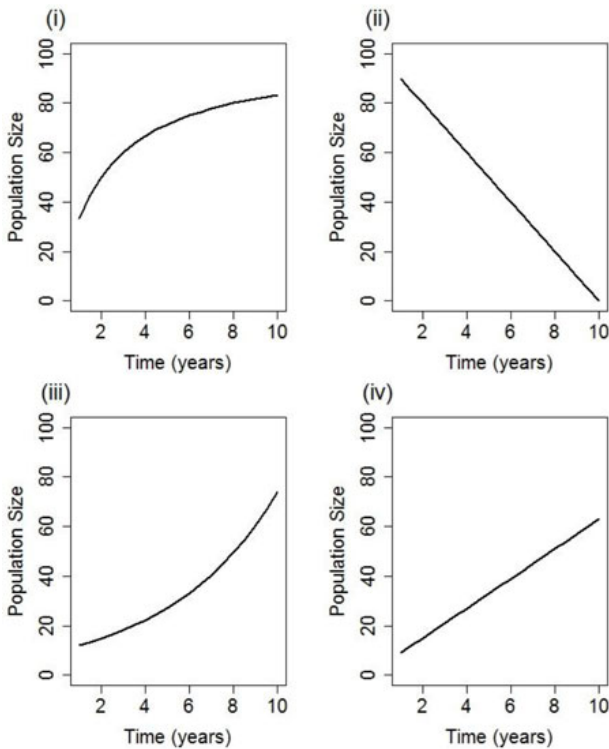
(A)   (i)
(B)   (ii)
(C)   (iii)
(D)   (iv)

Q.No. 44

In a polyploidization event, tetraploid progeny were formed by diploid parents. Hybridization between the tetraploid and a diploid parent gave rise to sterile triploids. Which of the following best explains why these triploids were sterile?

(A) Many mutations during polyploidization have no phenotypic effect.
(B) Some chromosomes are without homologs during meiosis.
(C) Some chromosomes are without homologs during mitosis.
(D) All chromosomes have homologs during mitosis.

Q.No. 45 Blood tests are often used to screen for potential diseases. For a particular disease:

(i) Of 1000 persons who tested negative (T'), 1 person had the disease (D); $\Pr(D|T')$.

(ii) Of 10 persons who tested positive (T), 1 person had the disease (D); $\Pr(D|T)$.

From this we can calculate $\dfrac{\Pr(D|T)}{\Pr(D|T')} = \dfrac{1/10}{1/1000} = 100$

What can be inferred from this value?

(A) 100 people have the disease but they will not test positive.
(B) 1 in 100 people have the disease and they will test positive.
(C) 100 in 1000 people have the disease and their blood tests will be inconclusive.
(D) People with positive tests are 100 times more likely to have the disease than people with negative tests.

Q.No. 46 The relative frequency distributions of values of a trait in two samples, P and Q, are shown in the figure. Which of the following statements is consistent with the figure?
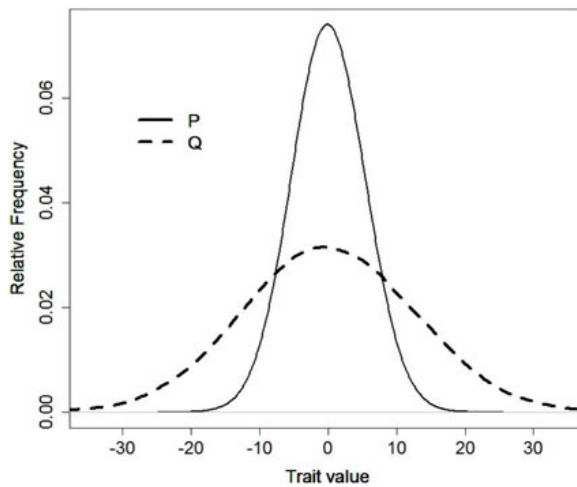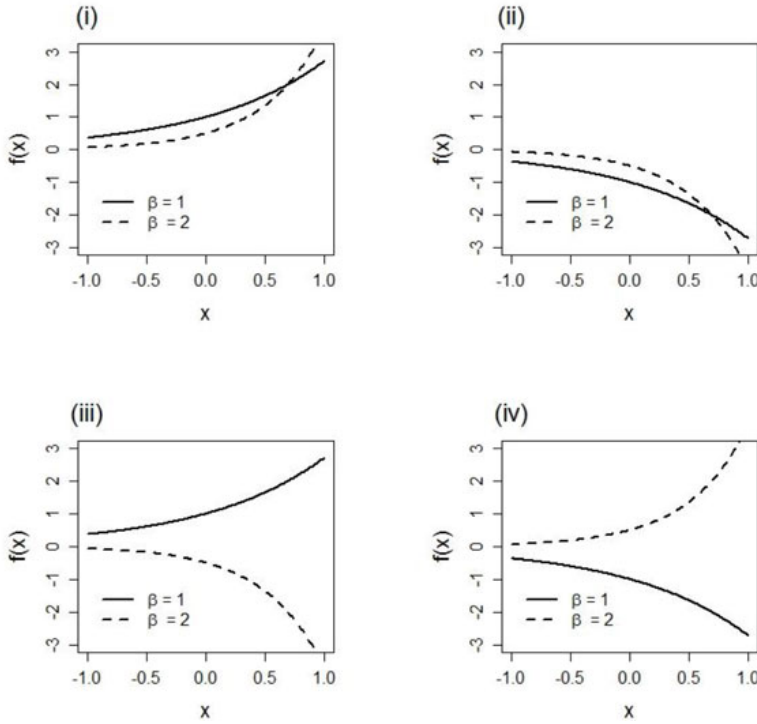

(A) P has a higher mean than Q; Q has a higher variance than P.
(B) P has a higher mean than Q; P has a higher variance than Q.
(C) P and Q have the same mean; Q has a higher variance than P.
(D) P and Q have the same mean; P has a higher variance than Q.

Q.No. 47

Consider the function $f(x) = \left|(e^{\beta x})/(\beta)\right|$

Which of the following graphs represents the relationship between x and $f(x)$?

(A)   (i)
(B)   (ii)
(C)   (iii)
(D)   (iv)

Q.No. 48   In a nocturnal moth species (X), individuals with longer antennae have smaller eyes. This indicates a sensory trade-off. In a closely related but diurnal moth species (Y), individuals exhibit the same obligate sensory trade-off. Which of the following figures describes the relationship between these two traits in moth species Y, if it relies more on vision than olfaction?
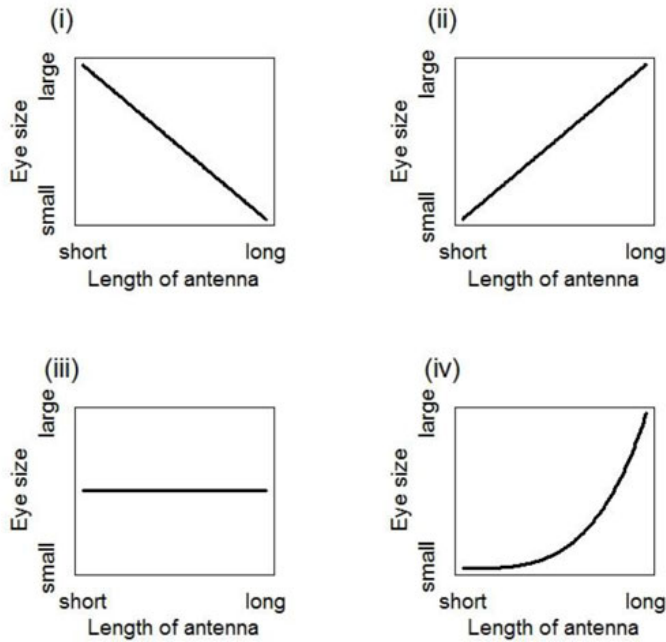
(A)   (i)
(B)   (ii)
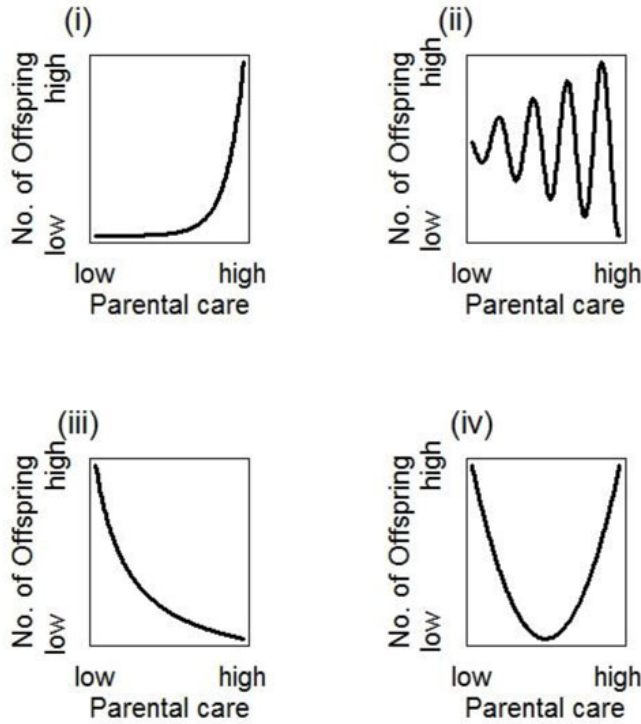(C)   (iii)
(D)   (iv)

Q.No. 49

A researcher compared grass species richness in a 10 m × 10 m plot immediately before (T_0) and 100 days after (T_{100}) a fire. She observed that species richness was higher at T_{100} than at T_0. Which of the following data is required for her to conclude that species richness increased because of the fire?

(A)   Grass species richness of a 10 m × 10 m plot in a nearby area that also burned.

(B)   Grass species richness of a 10 m × 10 m plot only at T_{100} in a nearby area that did not burn.

(C)   Grass species richness of a 10 m × 10 m plot at both T_0 and T_{100} in a nearby area that did not burn.

(D)   Grass species richness of the same 10 m × 10 m plot every 10 days after the fire until T_{100}.

Q.No. 50 Following a gene duplication event, the duplicated copy often loses function and is called a pseudogene. In the absence of positive selection, which of the following is true about these genes?

(A)   The functional gene will accumulate mutations more rapidly than the pseudogene.

(B)   The pseudogene will accumulate mutations more rapidly than the functional gene.

(C)   Both the functional gene and the pseudogene will accumulate mutations at the same rate.

(D)   The pseudogene will not accumulate mutations.

Q.No. 51 Which of the figures represents the expected relationship between parental care and the number of offspring produced across taxa?

(A)   (i)

(B)   (ii)

(C)   (iii)

(D)   (iv)

Q.No. 52 Match the following plant traits with the correct plant group/family:

Plant traits	Plant groups
P) Circinate vernation	i) Orchidaceae
Q) Cauliflory	ii) Rubiaceae
R) Resupination	iii) most Ferns
S) Interpetiolar stipules	iv) Brassicaceae
	v) Moraceae

(A)   P-iv, Q-v, R-i, S-ii

(B)   P-ii, Q-iv, R-iii, S-i

(C)   P-i, Q-ii, R-iii, S-iv

(D)   P-iii, Q-v, R-i, S-ii

Q.No. 53   In a population of 100 individuals of a diploid organism with 1:1 sex ratio, the probability of fixation of a new neutral mutation is _____ (round off to three decimal places).

Q.No. 54   The binomial probability of obtaining exactly k successes in n trials, where the probability of success in a single trial is p, is given by:

$$\Pr(x = k) = {}^{n}_{k}C \cdot (p)^{k} \cdot (1 - p)^{n-k}$$

Here, ${}^{n}_{k}C$ notation refers to number of combinations for k successes among n trials. With a fair and unbiased coin, the probability of getting 2 HEADS in a trial with 5 tosses is _____ (round off to two decimal places).

Q.No. 55   A petrified wood fossil was discovered with 8 g of ^{14}C. The decay of ^{14}C over time is given by:

$$N_T = N_0 \, e^{-0.0001216T}$$

If the half-life of ^{14}C is 5700 years, and the fossil initially had 32 g of ^{14}C, the age of the fossil in years is _____ .