General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each

Q.1	If '→' denotes increasing order of intensity, then the meaning of the words [simmer → seethe → smolder] is analogous to [break → raze → _____]. Which one of the given options is appropriate to fill the blank?
(A)	obfuscate
(B)	obliterate
(C)	fracture
(D)	fissure

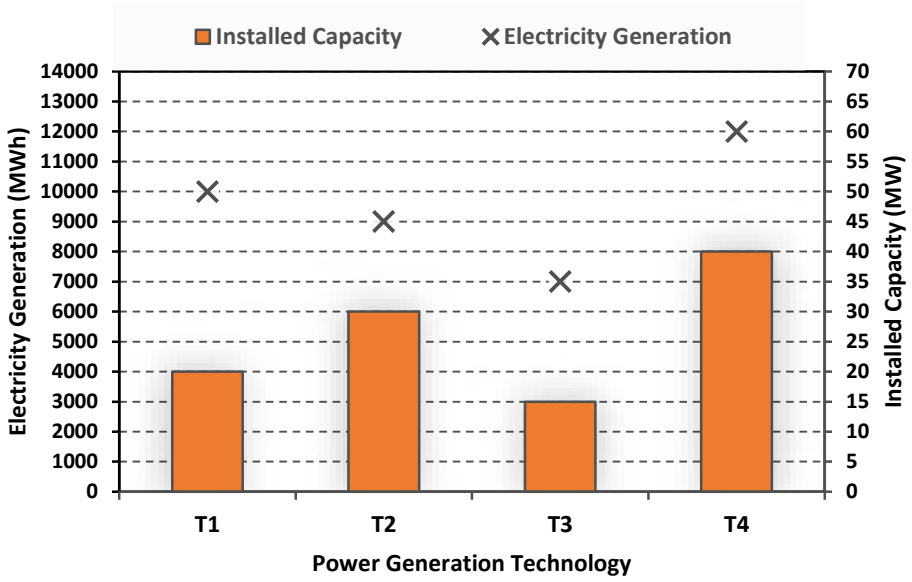
Q.2	In a locality, the houses are numbered in the following way: The house-numbers on one side of a road are consecutive odd integers starting from 301, while the house-numbers on the other side of the road are consecutive even numbers starting from 302. The total number of houses is the same on both sides of the road. If the difference of the sum of the house-numbers between the two sides of the road is 27, then the number of houses on each side of the road is
(A)	27
(B)	52
(C)	54
(D)	26
Q.3	For positive integers p and q, with $\frac{p}{q} \neq 1$, $\left(\frac{p}{q}\right)^{\frac{p}{q}} = p^{\left(\frac{p}{q}-1\right)}$. Then,
(A)	$q^p = p^q$
(B)	$q^p = p^{2q}$
(C)	$\sqrt{q} = \sqrt{p}$
(D)	$\sqrt[p]{q} = \sqrt[q]{p}$

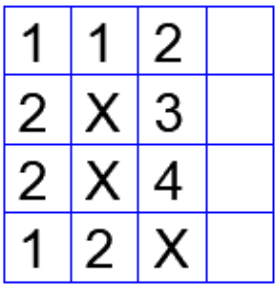
Q.4	Which one of the given options is a possible value of x in the following sequence? 3, 7, 15, x, 63, 127, 255
(A)	35
(B)	40
(C)	45
(D)	31
Q.5	On a given day, how many times will the second-hand and the minute-hand of a clock cross each other during the clock time 12:05:00 hours to 12:55:00 hours?
(A)	51
(B)	49
(C)	50
(D)	55

Q.6 – Q.10 Carry TWO marks Each

Q.6	In the given text, the blanks are numbered (i)−(iv). Select the best match for all the blanks. From the ancient Athenian arena to the modern Olympic stadiums, athletics (i) the potential for a spectacle. The crowd (ii) with bated breath as the Olympian artist twists his body, stretching the javelin behind him. Twelve strides in, he begins to cross-step. Six cross-steps (iii) in an abrupt stop on his left foot. As his body (iv) like a door turning on a hinge, the javelin is launched skyward at a precise angle.
(A)	(i) hold (ii) waits (iii) culminates (iv) pivot
(B)	(i) holds (ii) wait (iii) culminates (iv) pivot
(C)	(i) hold (ii) wait (iii) culminate (iv) pivots
(D)	(i) holds (ii) waits (iii) culminate (iv) pivots

Q.7	Three distinct sets of indistinguishable twins are to be seated at a circular table that has 8 identical chairs. Unique seating arrangements are defined by the relative positions of the people. How many unique seating arrangements are possible such that each person is sitting next to their twin?
(A)	12
(B)	14
(C)	10
(D)	28

Q.8	The chart given below compares the Installed Capacity (MW) of four power generation technologies, T1, T2, T3, and T4, and their Electricity Generation (MWh) in a time of 1000 hours (h).  The Capacity Factor of a power generation technology is: $$\text{Capacity Factor} = \frac{\text{Electricity Generation (MWh)}}{\text{Installed Capacity (MW)} \times 1000\ \text{(h)}}$$ Which one of the given technologies has the highest Capacity Factor?
(A)	T1
(B)	T2
(C)	T3
(D)	T4

Q.9	In the 4 × 4 array shown below, each cell of the first three columns has either a cross (X) or a number, as per the given rule.  **Rule:** The number in a cell represents the count of crosses around its immediate neighboring cells (left, right, top, bottom, diagonals). As per this rule, the **maximum** number of crosses possible in the empty column is
(A)	0
(B)	1
(C)	2
(D)	3

Q.10	During a half-moon phase, the Earth-Moon-Sun form a right triangle. If the Moon-Earth-Sun angle at this half-moon phase is measured to be 89.85°, the ratio of the Earth-Sun and Earth-Moon distances is closest to
(A)	328
(B)	382
(C)	238
(D)	283

Q.11 – Q.35 Carry ONE mark Each

Q. 11	The molecular clock model assumes that mutation rates are
(A)	equal for all genes.
(B)	constant for a gene.
(C)	variable across geographical regions.
(D)	variable across geological time.
Q. 12	The intermediate disturbance hypothesis was proposed to explain patterns of
(A)	species redundancy.
(B)	species diversity.
(C)	species dispersal.
(D)	species extinctions.

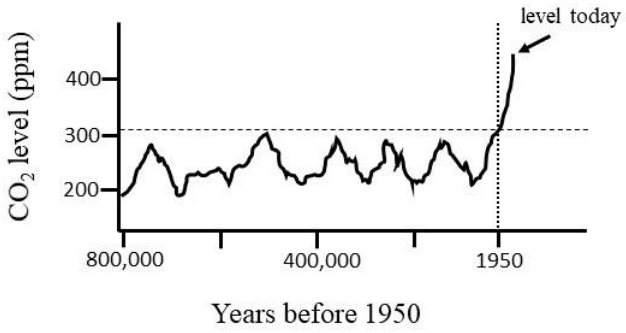
Q. 13	A few years ago, a very small population of zebrafish became isolated by a newly built dam. As a result, which statement is most likely to be true about this population of zebrafish now?
(A)	Genetic variability is low.
(B)	Fixation of genotypes due to drift is low.
(C)	Inbreeding is low.
(D)	Mutation rate is high.
Q.14	A researcher measures the heights of 200 randomly selected individuals of a tree species in a forest. Which one of the following is NOT a measure of variability in the sample?
(A)	Inter-quartile range
(B)	Range
(C)	Standard deviation
(D)	Standard error

Q. 15	Individual lizards were repeatedly presented with a predator model. Over successive trials, they showed a reduction in the duration of their alarm response. Which one of the following is this an example of?
(A)	Imitation.
(B)	Imprinting.
(C)	Habituation.
(D)	Sensitisation.
Q. 16	Among the following vertebrate classes, biparental care is most common in
(A)	amphibians.
(B)	birds.
(C)	fishes.
(D)	mammals.

Q. 17	Based on paleontological evidence, eukaryotic organisms are estimated to have first evolved
(A)	more than 750 million years ago.
(B)	750 to 500 million years ago.
(C)	500 to 250 million years ago.
(D)	65 million years ago.
Q. 18	In a population, there are two morphs, A and B, which reproduce at equal rates. A mutates to B with probability p_1, and B mutates to A with probability p_2 such that $p_1 \gg p_2$ (that is, p_1 is much greater than p_2). Over time, which one of the following statements would be true about this population?
(A)	Both morphs A and B will become equally abundant.
(B)	Morph A will dominate the population.
(C)	Morph B will dominate the population.
(D)	Both morphs A and B will go extinct.

Q. 19	Terrestrial plants conduct gas exchange through stomata. Having only few stomata on the leaf surface is a common adaptation to which one of the following conditions?
(A)	High aridity
(B)	High pH
(C)	Low UV radiation
(D)	Low soil nitrogen
Q. 20	Which one of the following is a result of antagonistic coevolution?
(A)	Convergent evolution of bird wings and bat wings
(B)	Adaptive radiation of beak shape in Darwin's finches
(C)	Caterpillars that feed on chemically-defended host plants
(D)	Specialised morphology of orchid flowers for pollination

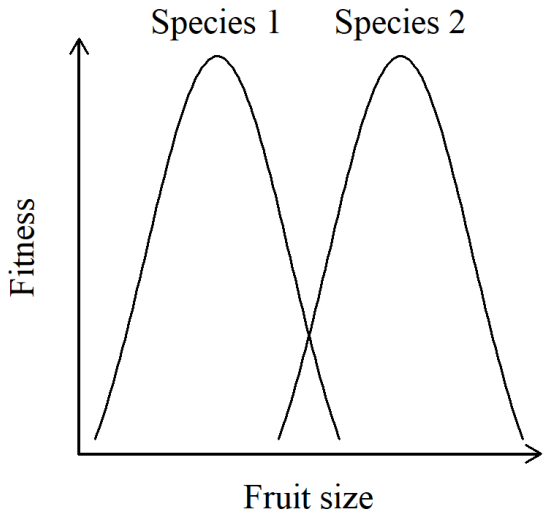
Q. 21	A classical metapopulation at equilibrium is made up of local populations with
(A)	no dispersal between them.
(B)	no local colonisation or extinction.
(C)	weak dispersal between them.
(D)	panmictically breeding individuals across populations.
Q. 22	Which one of the following theories is supported by the distribution patterns of extinct flora such as *Glossopteris* across South America, Africa and Australia, and extant marsupial mammals across South America and Australia?
(A)	Darwin's theory of natural selection
(B)	Wegener's theory of continental drift
(C)	Levins' theory of metapopulations
(D)	MacArthur and Wilson's theory of island biogeography

Q. 23	In linear regression, mean squared regression (effect variance) divided by mean squared error (error variance) is called the
(A)	p-value.
(B)	F-statistic.
(C)	t-statistic.
(D)	R-squared value.
Q. 24	The figure shows the time-series of atmospheric CO_2 concentration on Earth (graph not-to-scale).
	
	Which one of the factors given is the primary reason for the sudden increase in atmospheric CO_2 concentration after 1950?
(A)	Overfishing
(B)	An increase in Arctic sea ice melting
(C)	An increase in fossil fuel burning
(D)	Volcanic eruptions

Q. 25	The population size at which net recruitment is the highest is also when the greatest amount can be harvested, while ensuring the long-term survival of the population. The amount harvested at this population size is known as
(A)	carrying capacity.
(B)	maximum sustainable yield.
(C)	maximum survival density.
(D)	optimal recruitment.
Q. 26	The variance in male mating success is V_m and that of females is V_f. Assuming that the sex ratio is 1:1, in which one of the following mating systems is V_m/V_f expected to be the greatest?
(A)	Monogamy
(B)	Random mating
(C)	Polyandry
(D)	Polygyny

Q. 27	Some air-breathing marine vertebrates such as whales, seals and marine turtles possess adaptations for long, deep dives. Which one or more of the following is/are examples of such adaptations?
(A)	Tolerance to hypoxia
(B)	Slow heart rate
(C)	High levels of haemoglobin
(D)	Salt tolerance
Q. 28	Which one or more of the following statements about evolution is/are true?
(A)	Evolution is change that is heritable across generations.
(B)	Evolution occurs at the level of populations, not species.
(C)	Evolution is a change in gene frequencies through time.
(D)	Evolution occurs through natural selection, but not sexual selection.

Q. 29	Which one or more of the following mammal species is/are endemic to India?
(A)	One-horned rhinoceros
(B)	Lion-tailed macaque
(C)	Bengal tiger
(D)	Cheetah
Q. 30	Under which one or more of the following conditions can altruism evolve in animal societies?
(A)	Individuals in a group are closely related to each other.
(B)	Individuals live in a high resource, low risk environment.
(C)	Individuals in a group mutually help each other at different times.
(D)	Mating opportunities are equally distributed among individuals.

Q. 31	Two species of fruit bats (Species 1 and Species 2) eat fruits of varying sizes. The curves shown represent the ecological niche for these two species. If the curves for both species were to completely overlap, which one or more of the statements given would be correct?
	
(A)	There will be no resource competition between Species 1 and Species 2.
(B)	One of the species may become extinct due to competitive exclusion.
(C)	There will be little competition between Species 1 and Species 2.
(D)	The two species will use identical resources.

Q. 32	During the process of succession in a community, species that are good colonisers are gradually replaced by species that are good competitors. Which one or more of the following statements is/are consistent with this pattern?
(A)	Initially, there is great resource limitation.
(B)	Keystone species must establish first to facilitate the later establishment of higher trophic level species.
(C)	Trees are the climax stage of terrestrial communities and generally have low competitive ability, but high dispersal ability.
(D)	For many taxa, there is a tradeoff between dispersal ability and local competitive ability.
Q. 33	An ornamental shrub species was brought from Japan in the early 1800s to India, where it was planted frequently in gardens and parks. The species persisted for many decades without spreading, and then began to spread invasively fifty years ago. Which one or more of the following processes could have led to it becoming invasive?
(A)	Evolutionary adaptation to the environment
(B)	Open niches due to recent habitat degradation
(C)	Climate change
(D)	Recent introduction of a specialized herbivore of this shrub species

Q. 34	Male voles pair with either a single female (monogamous) or with two females (polygynous) during a given breeding season. The probability of a male being polygynous in a breeding season is 0.2. The reproductive success (number of offspring) of monogamous males is 2, and of polygynous males is 3. A male's expected reproductive success in a breeding season is _____. (Round off to one decimal place)
Q. 35	Consider a randomly breeding population of squirrels with two morphs – white striped and brown striped. In a population, 16% are white striped individuals, while the rest are all brown striped. The trait for stripes is governed by one gene where the allele for brown stripes is dominant. Assuming Hardy–Weinberg equilibrium, the frequency of the allele for white stripes would be _____. (Round off to two decimal places)

Q.36 – Q.65 Carry TWO marks Each

Q.36	Observations of algal species showed that their diversity was higher in pools where there were grazing snails compared to pools without snails. Which one of the following statements best explains this result?
(A)	Snails feed preferentially on the more abundant algal species.
(B)	Snails avoid feeding on algal species.
(C)	Snails feed only on the less abundant algal species.
(D)	Snails feed equally on all the algal species irrespective of algal abundance.
Q.37	Which two of the following processes can result in a decline in heterozygosity in populations? I) inbreeding; II) genetic drift; III) mutation; IV) random mating
(A)	I and II
(B)	II and III
(C)	I and III
(D)	II and IV

Q.38 Given below is a table with ecological observations and processes.

Ecological observations	**Processes**
P) Bright spotted pigmentation in guppy males in low predation habitats	I) Kin selection
Q) Vampire bats share blood meals	II) Sexual selection
R) Cooperative breeding in African weaver birds	III) Reciprocal altruism

Select the option that best matches each ecological observation with its corresponding process.

(A) P-III, Q-I, R-II

(B) P-II, Q-III, R-I

(C) P-I, Q-III, R-II

(D) P-II, Q-I, R-III

Q.39	An ecologist must determine whether (i) the means of two independent samples differ, and (ii) there is an association between two continuous variables. Assuming that all samples are normally distributed, which one of the following options represents the most appropriate statistical tests for (i) and (ii), respectively?
(A)	(i) Spearman's correlation; (ii) Shapiro-Wilk test
(B)	(i) Wilcoxon's matched pairs signed rank test; (ii) chi-squared test
(C)	(i) t-test; (ii) Pearson's correlation
(D)	(i) Kendall's test of concordance; (ii) Kolmogorov-Smirnov test
Q.40	Males of the swordtail fish *Xiphophorus helleri* possess long tails, while those of *X. maculatus* do not. Females of *X. helleri* prefer males with longer tails. Interestingly, experimental studies show that females of *X. maculatus* prefer *X. maculatus* males with attached artificial long tails over those without. If the long-tailed *Xiphophorus* species evolved from ancestors that lacked a long tail, which one of the following processes best explains the evolution of the observed preference among *X. maculatus* females?
(A)	Kin selection
(B)	Sensory bias
(C)	Group selection
(D)	Runaway selection

Q.41 Which one of the options given best matches vector to disease?

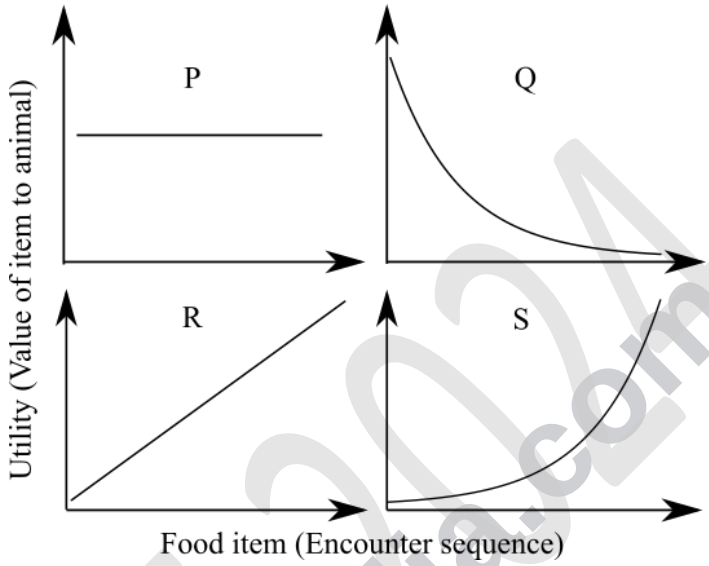
	Vector		**Disease**
I.	Fleas	P.	Kyasanur Forest Disease
II.	Ticks	Q.	Dengue
III.	Mosquitoes	R.	Plague

(A) I-R; II-P; III-Q

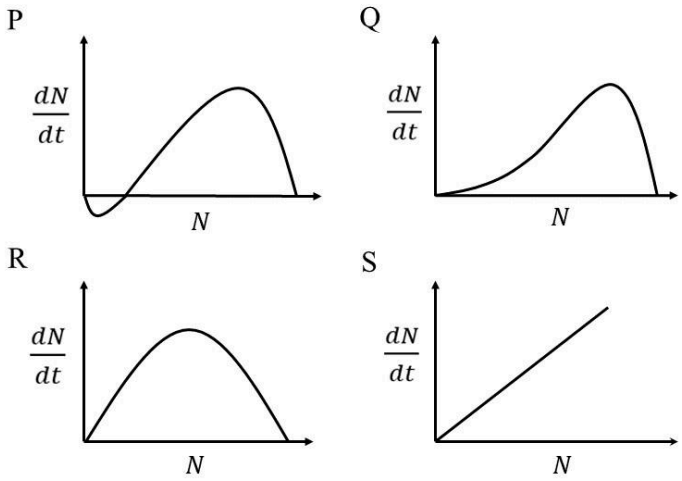
(B) I-P; II-R; III-Q

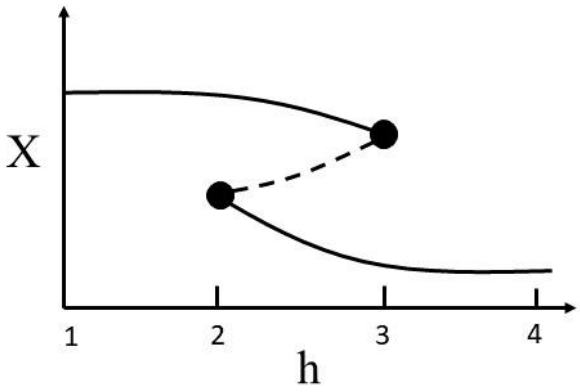
(C) I-R; II-Q; III-P

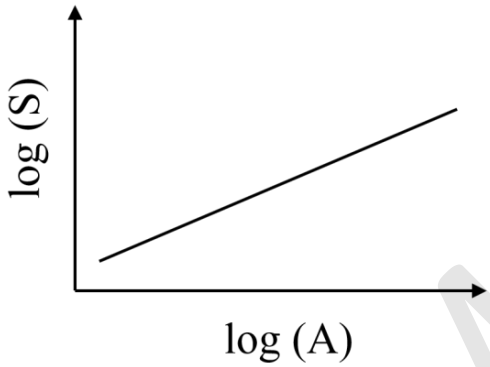
(D) I-P; II-Q; III-R

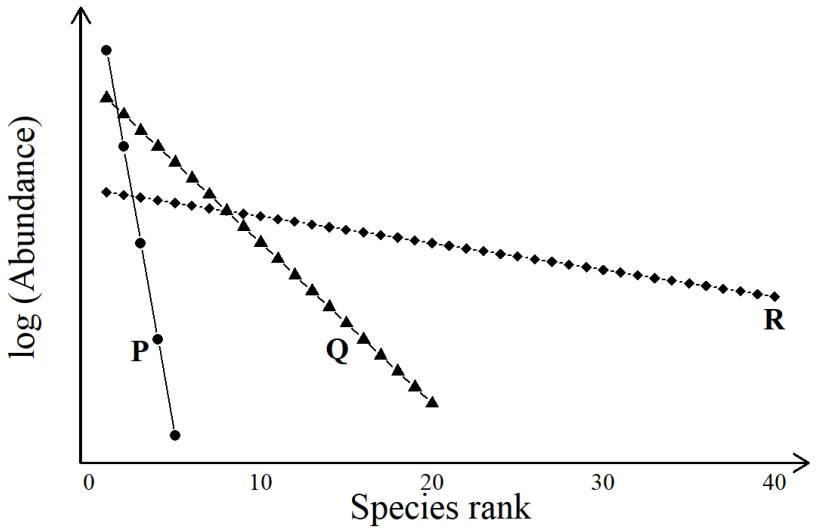
Q.42	Optimal foraging theory predicts whether a foraging animal will be risk-prone, risk-averse or risk-insensitive depending on a utility function that describes the value of each additional food item to the animal. Risk-prone foraging is expected when the utility increases disproportionately with each additional food item encountered. Which one of the graphs shown depicts a scenario where risk-prone foraging would be expected? 
(A)	P
(B)	Q
(C)	R
(D)	S

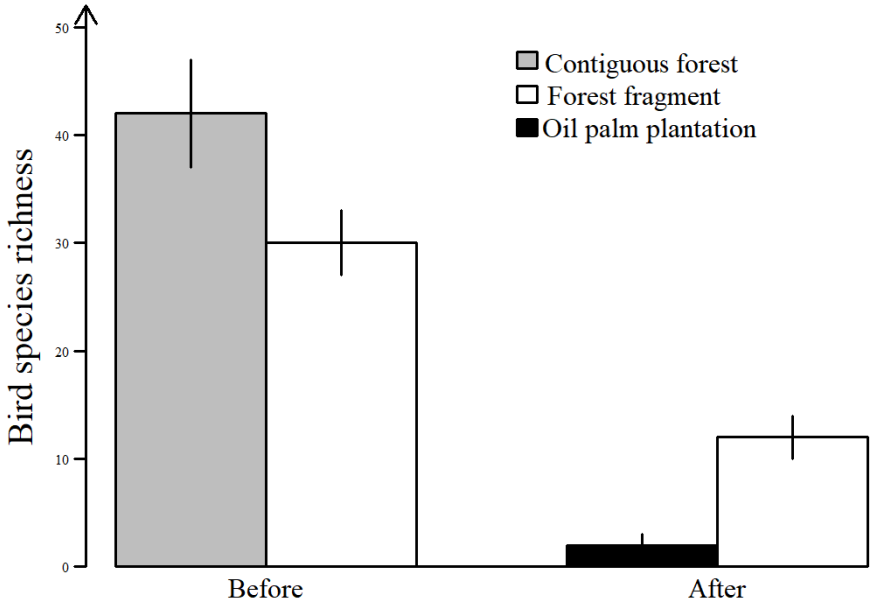
Q.43	There are two species, X and Y, with abundances x and y, respectively. Species X has growth rate α, and species Y has growth rate β. Assume that the sum of the species abundances is constant over time, i.e., $x + y = 1$. Let x and y follow the rate equations: $$\frac{dx}{dt} = \alpha x - \varphi x, \qquad \frac{dy}{dt} = \beta y - \varphi y,$$ where φ is the average species fitness. Which one of the following options correctly represents the expression for φ?
(A)	$\frac{\alpha x^2 + \beta y^2}{\alpha + \beta}$
(B)	$\alpha x + \beta y$
(C)	$\frac{\alpha x + \beta y}{x^2 + y^2}$
(D)	$\frac{1}{\alpha x + \beta y}$

Q.44	The graphs shown represent the relationship between population size (N) and population growth rate $\left(\frac{dN}{dt}\right)$. Which one of the following growth curves represents a density-dependent population that experiences a strong Allee effect? 
(A)	P
(B)	Q
(C)	R
(D)	S

Q.45	The abundance (X) of a plant species with respect to the anthropogenic stressor habitat destruction (h) is shown. The solid and the dashed curves represent stable and unstable population equilibrium abundances, respectively.  In the absence of any stochasticity, and with increasing values of h, what is the value of h at which a sudden population collapse would occur?
(A)	2.5
(B)	2
(C)	4
(D)	3

Q.46	Consider the graph shown, where S is species richness and A is area. S and A are log-transformed and the slope is not equal to 1.  The relationship between untransformed S and A follows a/an
(A)	linear relationship.
(B)	power law.
(C)	exponential relationship.
(D)	Michaelis-Menten function.

Q.47	The graph shows the rank-abundance relationships for species in three communities, **P**, **Q** and **R**.  Which one of the following statements is true with respect to the evenness of the three communities?
(A)	**P > Q > R**
(B)	**Q > P > R**
(C)	**R > Q > P**
(D)	**R > P > Q**

Q.48	The graph shows bird species richness in a large contiguous forest patch and a small adjacent forest fragment, before and soon after the large contiguous forest patch was replaced by an oil palm plantation.  Which one of the following options best explains the pattern shown?
(A)	The contiguous forest is a sink and the forest fragment is a source for bird species.
(B)	The forest fragment has higher species richness than the contiguous forest.
(C)	The bird community in the forest fragment is geographically closed.
(D)	The contiguous forest was contributing to forest fragment species richness via dispersal.

Q.49	Honey bees are haplodiploid, which means that the relatedness is, on average, expected to be 0.75 between
(A)	brother-brother pairs with the same parents.
(B)	brother-sister pairs with the same parents.
(C)	mated female-male pair.
(D)	sister-sister pairs with the same parents.

Q.50 Match the mollusc taxa to their respective orders.

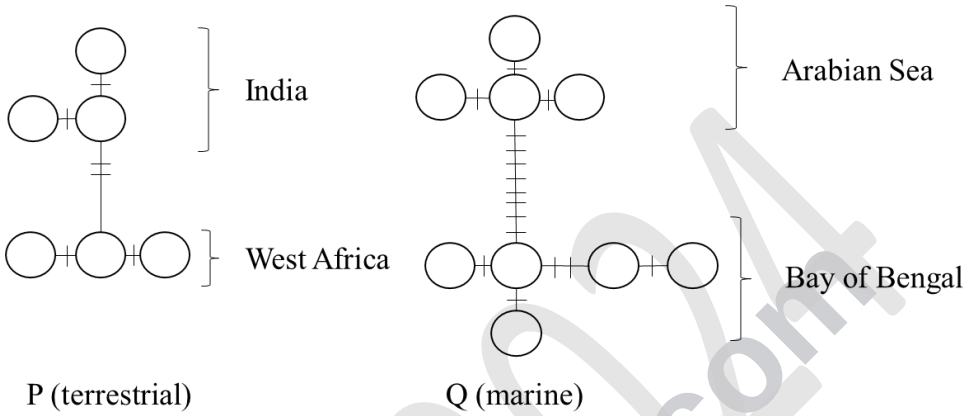
	Mollusc taxa		**Order**
I	Cone snails	P	Bivalve
II	Octopuses	Q	Gastropod
III	Giant clams	R	Cephalopod
IV	Squids		

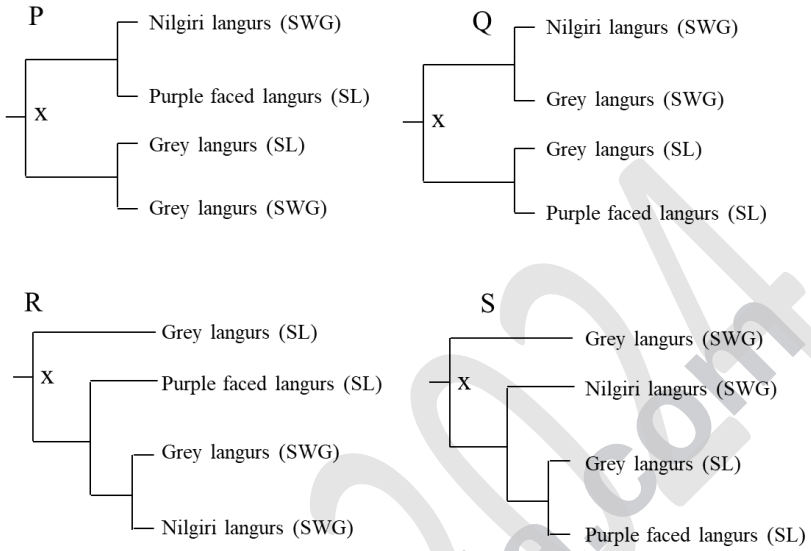
(A) I-P; II-Q; III-R; IV-Q

(B) I-Q; II-R; III-P; IV-R

(C) I-P; II-R; III-P; IV-Q

(D) I-P; II-P; III-R; IV-Q

Q.51	A terrestrial species P is found in both India and West Africa and nowhere else, while a marine species Q is found in the Arabian Sea and the Bay of Bengal. The two species have similar generation times. An ecologist builds haplotype networks based on DNA sequences from these species, where each circle represents one haplotype and each dash (−) represents a mutation. Which one of the following inferences is best supported by the haplotype networks shown?
	
(A)	P has high dispersal ability; Q has low dispersal ability.
(B)	Q has high dispersal ability; P has low dispersal ability.
(C)	P and Q have equal dispersal abilities.
(D)	The genetic structure is not influenced by dispersal ability.

Q.52	Grey langurs found in the southern Western Ghats (SWG) and grey langurs in Sri Lanka (SL) look very similar. Nilgiri langurs (found in SWG) and purple faced langurs (found in SL) also look similar. If allopatry played a role in the early diversification of this group (at point x in the tree), which one of the phylogenetic trees is most likely to be correct? 
(A)	P
(B)	Q
(C)	R
(D)	S

Q.53	Two bird species, A and B, are found on a single mountainside. A is a low-elevation species, found between 500 m and 1500 m Above Sea Level (ASL), while B is a high-elevation species, found between 1000 m and 2000 m ASL. At 1250 m ASL, species A and B have very different bill morphologies, but the bill morphology of species A at 500 m is very similar to the bill morphology of species B at 2000 m ASL. Which one or more of the following explain(s) the difference in bill morphology at 1250 m ASL?
(A)	Competitive exclusion
(B)	Character displacement
(C)	Convergent evolution
(D)	Allopatric speciation
Q. 54	Which one or more of the following is/are greenhouse gas(es)?
(A)	Methane
(B)	Water vapour
(C)	Sulphur dioxide
(D)	Nitrous oxide

Q.55	Males of the Indian robin in two populations sing songs of different lengths. Which one or more of the options given is/are an ultimate (not proximate) explanation(s) of the difference in song length between the two populations?
(A)	Females prefer to mate with males that sing longer songs in one population but not in the other.
(B)	The two populations have different forms of the gene that determines song duration.
(C)	The two populations differ in hormone levels that activate the start and end of singing behaviour.
(D)	Differences between populations in food availability during development affect neural circuitry that is involved in song production.

Q.56 Female *Anopheles* mosquitoes bite humans to get blood. Researchers performed an experiment to study whether females use temperature or scent cues, or both, when locating human hosts. They presented female mosquitoes with membranes kept at different temperatures. Some membranes also had human scent applied to them. The response to each treatment was measured as the percentage of females that landed on the membrane (50 females for each treatment). The table shows the treatments and the corresponding responses.

Temperature and scent	**Response**
Ambient air temperature (25 °C); with human scent	90%
Ambient air temperature (25 °C); without human scent	0%
Human body temperature (37 °C); with human scent	90%
Human body temperature (37 °C); without human scent	90%

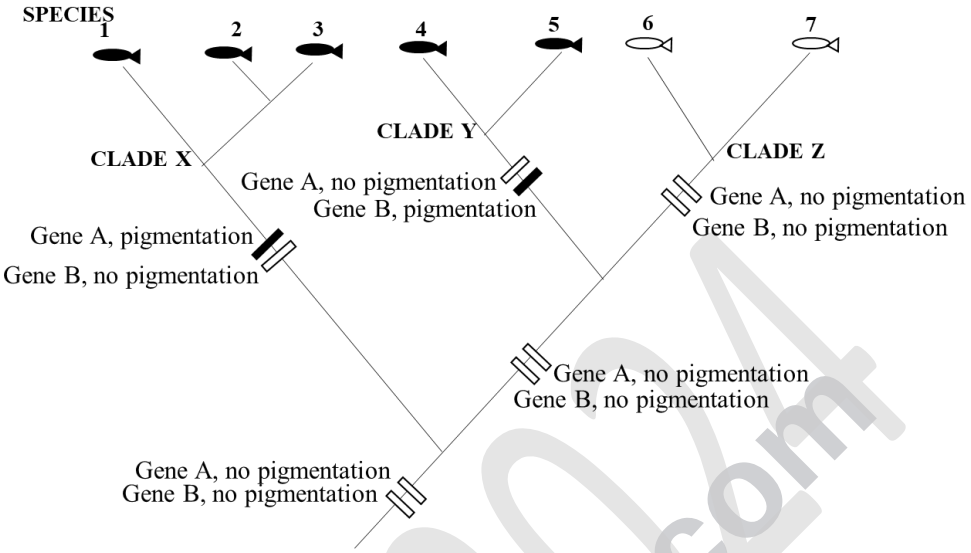
Which one or more of the following inferences is/are supported by these results?

(A) Human scent cues are necessary to locate human hosts.

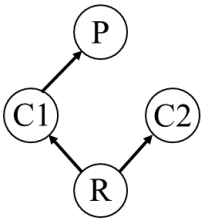
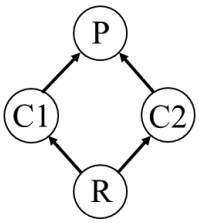
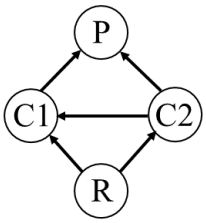
(B) Human scent cues are sufficient to locate human hosts.

(C) Human body temperature cues are necessary to locate human hosts.

(D) Human body temperature cues are sufficient to locate human hosts.

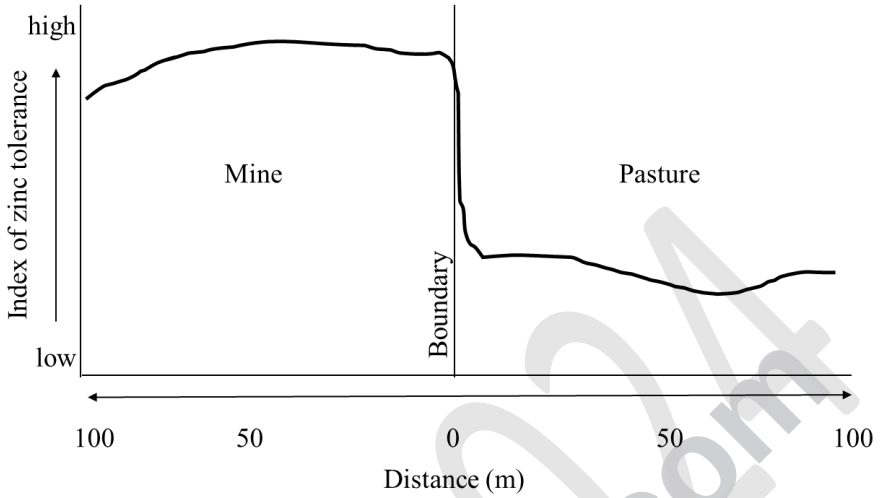
Q.57	A phylogenetic tree for the evolution of two pigmentation traits in species of fish is shown for clades **X**, **Y** and **Z**. Genes A and/or B, if mutated, can cause dark pigmentation in the body.  Which one or more of the following statements is/are correct?
(A)	The character state “pigmentation” is homologous in species 1 and 3.
(B)	The character state “pigmentation” is homologous between species 1 and 4.
(C)	The character state “pigmentation” is not homologous for species 6 and 7.
(D)	The character state “pigmentation” is not homologous between species 2 and 6.

Q. 58	In conservation biology, which one or more of the following is/are used to calculate the effective population size, N_e ?
(A)	the population size required to avoid local extinction in the next 1000 years.
(B)	the carrying capacity of the environment.
(C)	the sum of the sizes of all connected populations in a metapopulation.
(D)	the number of breeding males and females.

Q.59	In the foodweb diagrams shown, R represents the primary producer, C1 and C2 represent intermediate consumers, and P represents the top predator. Which one or more of these diagrams show(s) intraguild predation? E  F  G  H 
(A)	E
(B)	F
(C)	G
(D)	H

Q.60	You are a plant ecologist studying a plant in the genus *Veronica.* You notice that, at open rocky sites, *Veronica* grows as a creeper spreading low to the ground, whereas in grasslands, the stem stands upright. You collect seeds from multiple populations in each habitat type and grow them under uniform conditions in a greenhouse. You find that all the plants grown in the greenhouse have stems that stand upright. Which one or more of the following explanations best support(s) your observations?
(A)	The different morphologies in the natural habitat types are due to phenotypic plasticity.
(B)	Inbreeding depression has led to the creeping form in the rocky sites.
(C)	High gene flow between populations has restricted local adaptation in the two environments.
(D)	The morphological differences between populations demonstrates that growth form is a polygenic trait.

Q.61	One hypothesis for why the tropics have far greater species richness than higher latitudes is that the tropics are relatively aseasonal. Low seasonality can encourage high species richness through which one or more of the following mechanisms?
(A)	Numerous resources are consistently available throughout the year, allowing different species to specialize on different resources, thereby minimizing competition and allowing co-existence.
(B)	Low seasonality is associated with lower rates of predation, allowing large populations to thrive.
(C)	Low seasonality is associated with more stable populations that are less vulnerable to demographic stochasticity and extinction.
(D)	Low seasonality is associated with longer generation times, which enhances species richness.

Q.62	The figure illustrates the soil zinc tolerance of the grass species *Anthoxanthum* along a transect from inside a mine to the middle of a pasture outside the mine.  Which one or more of the following processes explain(s) the observed pattern of zinc tolerance in this grass species?
(A)	Genetic drift
(B)	Local adaptation
(C)	Coevolution
(D)	Introgression

Q.63	In a forest, there are tigers, hare, and deer. On a given day, the probability of a tiger hunting a hare is 0.35, a deer is 0.25, and either a hare or a deer is 0.55. The probability of a tiger hunting both a hare and a deer on a given day is _____. (Round off to two decimal places).
Q.64	Consider a discrete random variable X that takes values from the set S = {0, 1, 2, 3}, being the number of individuals of a species within a habitat. Consider the probability distribution of X with Pr(X = 0) = 0.15, Pr(X = 1) = 0.25 and Pr(X = 3) = 0.5, where Pr denotes probability. The value of Pr(X = 2) is _____. (Round off to two decimal places)
Q. 65	There are nine species of *Impatiens* (balsams) found in laterite plateaus of the northern Western Ghats, each with a distinct colour. If a plateau has exactly 6 species, then the number of possible colour combinations in the plateau is _____. (Answer in integer)