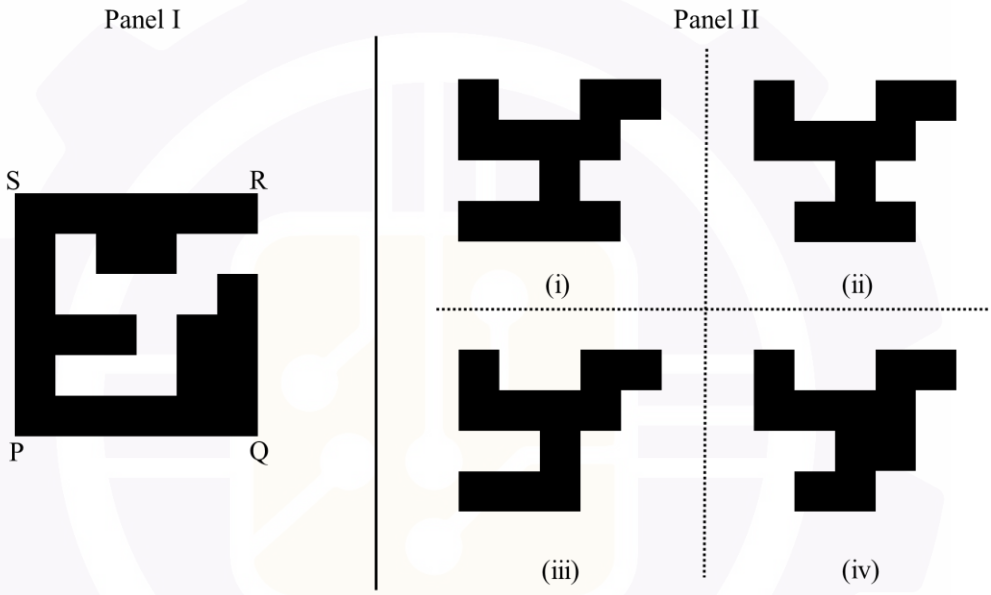
General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each

Q.1	Expedite, Hasten, Hurry, _____ Fill the blank by choosing a word with a meaning similar to that of the words given above.
(A)	Accelerate
(B)	Retard
(C)	Provide
(D)	Disable

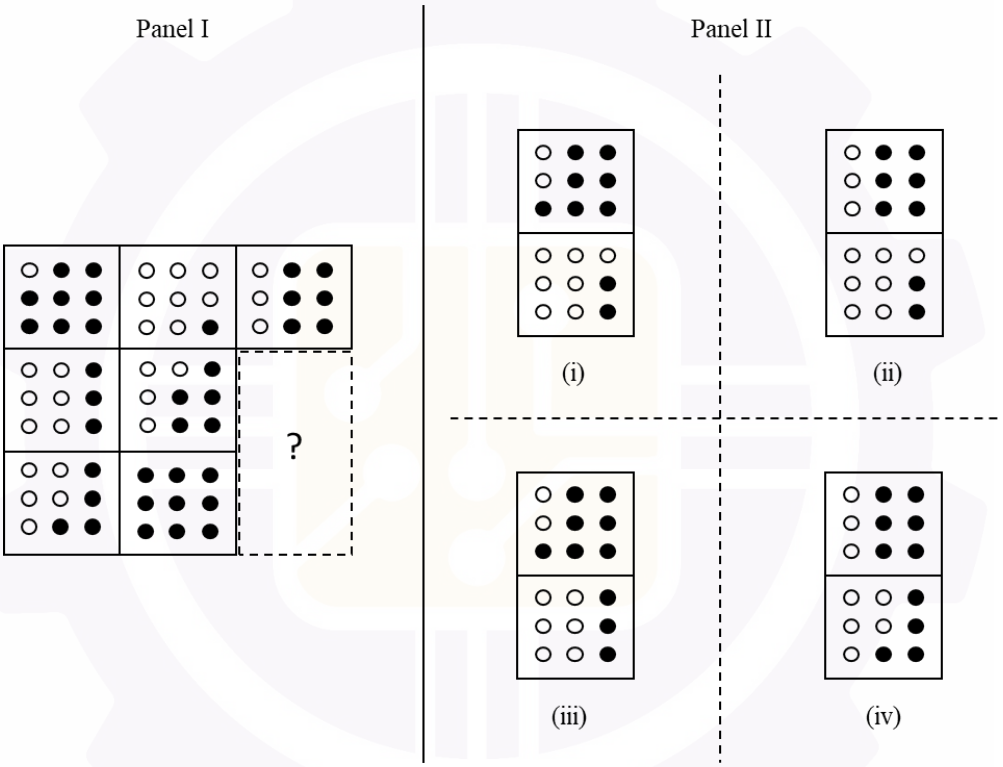
Q.2	A black square PQRS has been cut into two parts. One part of it is shown in Panel I. Which one of the shapes in Panel II is the other part? 
(A)	(i)
(B)	(ii)
(C)	(iii)
(D)	(iv)

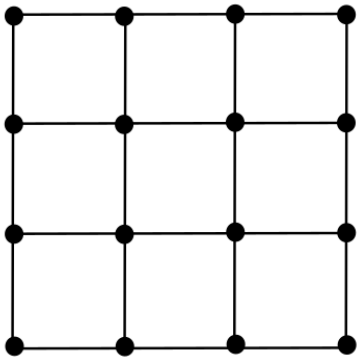
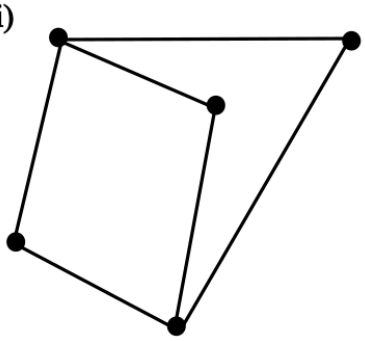
Q.3	A day can only be cloudy or sunny. The probability of a day being cloudy is 0.5, independent of the condition on other days. What is the probability that in any given four days, there will be three cloudy days and one sunny day?
(A)	1/4
(B)	3/4
(C)	2/3
(D)	3/8

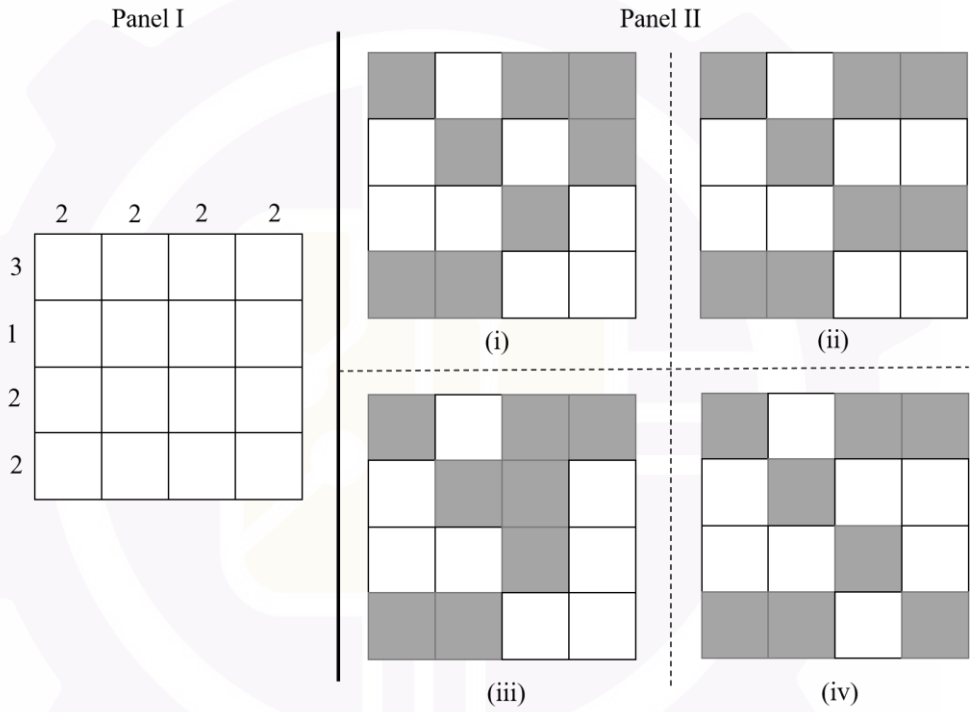
Q. 4	The values of Stock A and Stock B on a particular day are Rs. 50 and Rs. 80, respectively. An investor invests Rs. 100 in Stock A and Rs. 80 in Stock B. He sells all the stocks the next day when the value of Stock A is Rs. 55 and Stock B is Rs. 70. The profit made by the investor is Rs. _____
(A)	0
(B)	5
(C)	10
(D)	20
Q.5	‘When it is raining, peacocks dance.’ Based only on this sentence, which one of the following options is necessarily true?
(A)	Peacocks dance only when it is raining.
(B)	When peacocks dance, it is raining.
(C)	When peacocks are not dancing, it is not raining.
(D)	When it is not raining, peacocks do not dance.

Q.6 – Q.10 Carry TWO marks Each

Q.6	Water : P :: Food : Q Choose the P and Q combination from the options below to form a meaningful analogy.
(A)	P = Thirst; Q = Hunger
(B)	P = Drink; Q = Hunger
(C)	P = Thirst; Q = Satiated
(D)	P = Wet; Q = Critic

Q.7	Two tiles are missing in Panel I. Which one of the options in Panel II is the appropriate choice for the missing tiles? 
(A)	(i)
(B)	(ii)
(C)	(iii)
(D)	(iv)

Q.8	Figures (i) and (ii) represent intercity highway systems. The black dots represent cities and the line segments between them represent intercity highways. A salesperson needs to make a trip. She needs to start from a city, visit each of the remaining cities exactly once, and finally return to the same city from which she started. Which one of the following options is then true? (i)  (ii) 
(A)	Such a trip is possible for (i), but not for (ii).
(B)	Such a trip is possible for (ii), but not for (i).
(C)	Such a trip is possible for both (i) and (ii).
(D)	Such a trip is possible neither for (i) nor for (ii).

Q. 9	The figure in Panel I below is a grid of cells with four rows and four columns. The numbers on the top and on the left represent the number of cells that are to be shaded in that column and row, respectively. Which one of the options shown in Panel II below represents the grid shaded correctly? 
(A)	(i)
(B)	(ii)
(C)	(iii)
(D)	(iv)

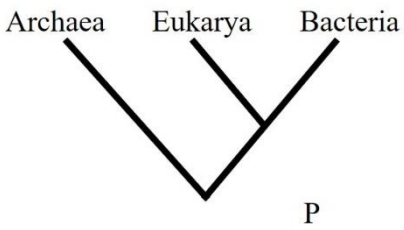
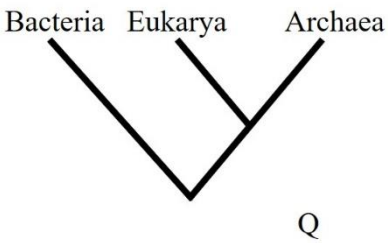
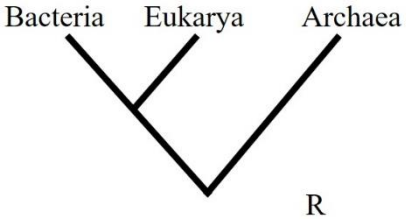
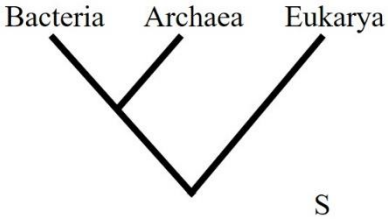
Q.10	An unbiased six-faced dice whose faces are marked with numbers 1, 2, 3, 4, 5, and 6 is rolled twice in succession and the number on the top face is recorded each time. The probability that the sum of the two recorded numbers is a prime number is _____
(A)	$\frac{3}{36}$
(B)	$\frac{13}{36}$
(C)	$\frac{15}{36}$
(D)	$\frac{19}{36}$

Q.11 – Q.35 Carry ONE mark Each

Q.11	Two sister species, A and B, are distributed along a continuous elevational gradient in the Himalayas. Species A is distributed from the foothills to 1800 metres above sea level and species B is distributed from 1800 to 3500 metres above sea level. Which one of the following modes of speciation best explains their distribution?
(A)	Sympatric speciation
(B)	Allopatric speciation
(C)	Parapatric speciation
(D)	Peripatric speciation
Q.12	Which one of the following is an invasive plant species in India?
(A)	*Lantana camara*
(B)	*Myristica malabarica*
(C)	*Terminalia tomentosa*
(D)	*Santalum album*

Q.13	Phytoecdysone is a defensive secondary chemical that _____.
(A)	mimics a neurotransmitter and can cause paralysis or even death in caterpillars
(B)	mimics insect hormones and interferes with insect metamorphosis
(C)	belongs to a category of tannins and reduces the digestibility of plant tissues
(D)	belongs to a category of lignins and deters herbivores
Q.14	The physiologist Ivan Pavlov conducted an experiment on dogs, in which a bell was sounded every time food was provided. In this experiment, dogs eventually showed the salivary reflex (a response to food) when the bell was sounded, even if food was not provided. This is an example of _____.
(A)	conditioning
(B)	imprinting
(C)	instinct
(D)	eavesdropping

Q.15	Ecologists have studied the distributions of birds on archipelagos. Some studies found an interesting ‘checkerboard’ pattern within island groups. Sister species were never present on the same island, even when the islands were very close to each other. Which one of the following processes best explains this checkerboard pattern?
(A)	Mutualism
(B)	Competition
(C)	Predation
(D)	Commensalism

Q.16	Which one of the following phylogenetic trees illustrates the relationship between Archaea, Bacteria and Eukarya?  P  Q  R  S
(A)	P
(B)	Q
(C)	R
(D)	S

Q.17	The Biological Species Concept was proposed by _____.
(A)	Ernst Mayr
(B)	Ronald Fisher
(C)	Sewall Wright
(D)	J. B. S. Haldane
Q.18	In a diploid population of N individuals, the probability of fixation of a new neutral mutation (assuming no other mutation occurs) is _____.
(A)	1/N
(B)	2/N
(C)	1/(2N)
(D)	1/(4N)

Q.19	Species that co-occur in space and time tend to be similar to each other in traits such as tolerance to heat or to drought. This is most likely because of _____.
(A)	limiting similarity
(B)	divergent evolution
(C)	environmental filtering
(D)	competitive exclusion
Q.20	Which one of the following statements is true for most ants and bees?
(A)	Males are diploid and develop from fertilised eggs
(B)	Males are haploid and develop from fertilised eggs
(C)	Females are diploid and develop from fertilised eggs
(D)	Females are diploid and develop from unfertilised eggs

Q.21	Which one of the following concepts describes a co-evolutionary arms race between a pathogen and its host?
(A)	Red Queen hypothesis
(B)	Green Beard model
(C)	Sympatric speciation
(D)	Reinforcement
Q.22	A flask containing nutrient-rich media is seeded with 100 isogenic bacteria. Assuming that no bacteria die in the flask, after approximately how many generations will the population reach a size of 10^5?
(A)	10
(B)	1000
(C)	100000
(D)	1

Q.23	The field of allometry assesses how species traits scale with each other. Given the relationship between metabolic rate and body mass, which one of the following statements is true?
(A)	Elephants expend more energy per gram per hour than mice do
(B)	Mice expend more energy per gram per hour than humans do
(C)	Elephants expend less total energy per day than mice do
(D)	Humans and elephants expend similar amounts of total energy per day
Q.24	According to life history theory, when parents can only provide limited nutrients and care to their offspring, the number and size of the offspring are expected to be _____.
(A)	negatively correlated
(B)	positively and linearly correlated
(C)	uncorrelated
(D)	positively and exponentially correlated

Q.25	Which one of the following elements cycles the LEAST (mass per year) through the atmosphere?
(A)	Carbon
(B)	Nitrogen
(C)	Phosphorus
(D)	Sulphur
Q.26	The colour and markings of the eggs of the common cuckoo (*Cuculus canorus*) are similar to those of the eggs of the great reed warbler (*Acrocephalus arundinaceus*). Which one or more of the following options explain(s) this similarity?
(A)	The two species are closely related and belong to the same genus
(B)	The two species compete for the same insect larvae to feed their chicks
(C)	The common cuckoo is a brood parasite of the great reed warbler
(D)	The great reed warbler is a predator of the common cuckoo

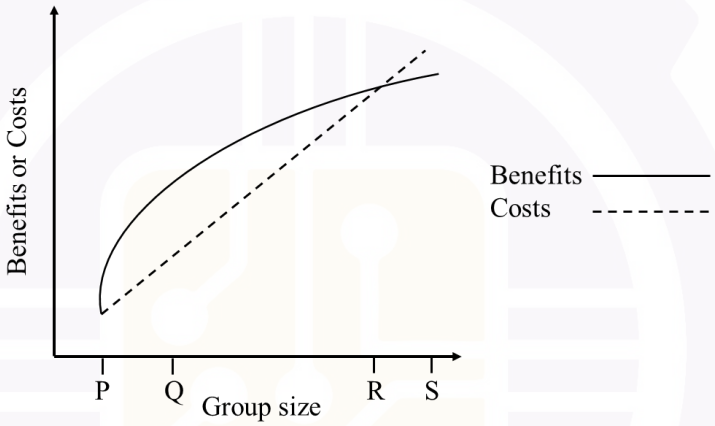
Q.27	Which one or more of the following is/are NOT essential for evolution by natural selection to take place in a population?
(A)	There must be variation in the trait
(B)	The trait must be linked with differential reproductive success
(C)	The trait must be either fully or partially heritable
(D)	The population must comprise of sexually reproducing organisms
Q.28	In a null hypothesis significance test, the significance level α was set to 0.01. For which one or more of the following *p* values would the null hypothesis be rejected?
(A)	$p = 0.004$
(B)	$p = 0.02$
(C)	$p = 0.10$
(D)	$p = 0.009$

Q.29	Which one or more of the following benefits can explain the evolution of dispersal of animals from their natal area?
(A)	Reduced competition with kin
(B)	Increased predation risk outside natal areas
(C)	Inbreeding avoidance
(D)	Outbreeding avoidance
Q.30	Which one or more of the following is/are signalling mechanism(s) that birds are known to use to beg their parent for food?
(A)	Playing dead
(B)	Vocalisations
(C)	Fluttering of wings
(D)	Mouth gape and colouration

Q.31	Which one or more of the following diseases is/are zoonotic?
(A)	Nipah virus infection
(B)	Ebola Haemorrhagic Fever
(C)	Cholera
(D)	Kyasanur Forest Disease
Q.32	Which one or more of the following phenomena make(s) small populations vulnerable to extinction?
(A)	Inbreeding depression
(B)	Demographic stochasticity
(C)	Intraguild predation
(D)	Continuous population growth
Q.33	In a population of birds, the proportion of blue individuals is 0.4 and the proportion of males is 0.3. Assuming that colour and sex are independent of each other, the probability that a randomly sampled individual from this population is a blue male is _____ (*Round off to two decimal places*)

Q.34	Assume that the human haploid genome is 3×10^9 base pairs long. The mutation rate, when DNA is copied, is 5×10^{-11} per base pair per replication. Based on these numbers, the expected number of mutations that take place per replication of the human haploid genome is _____ (*Round off to two decimal places*)
Q.35	The coefficient of relatedness *r* is the probability that a gene in one individual is identical by descent with a gene in another individual. In a large, diploid, sexually reproducing population with outbreeding, the value of *r* for two offspring with the same mother but different fathers is _____ (*Round off to two decimal places*)

Q.36 – Q.65 Carry TWO marks Each

Q.36	Living in groups confers benefits but also imposes costs. The figure below depicts how per capita benefits (solid line) and costs (dashed line), both measured in the same units, vary as a function of group size. Given these patterns in benefits and costs, which one of the group sizes P, Q, R, S best represents the optimal group size? 
(A)	P
(B)	Q
(C)	R
(D)	S

Q.37 The table below provides the abundances of species 1 to 10 for communities P, Q, and R, with a total of 100 individuals in each community. The Simpson's diversity index D for each of these communities can be calculated using the formula: $D = 1 - \Sigma_i \, p_i^2$, where p_i is the proportion of individuals in the community that belong to the i^{th} species.

Species	Community P	Community Q	Community R
1	69	45	70
2	18	43	21
3	5	4	4
4	4	4	3
5	1	1	0
6	1	1	0
7	0	0	1
8	1	1	0
9	0	0	1
10	1	1	0

Which one of the following statements is true about the comparison of Simpson's index between these communities?

(A) P is more similar to Q than either of them is to R

(B) P is more similar to R than either of them is to Q

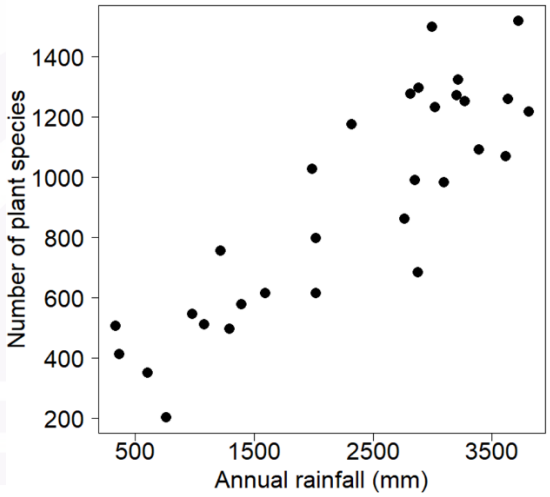
(C) Q is more similar to R than either of them is to P

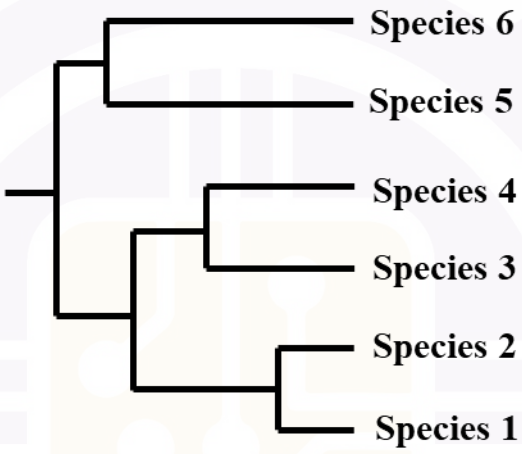
(D) P, Q, and R are equally similar to each other

Q.38	Many species of reef fish change sex once during the course of their lives. In these fish, big body size increases competitive ability. When high male-male competition results in high variance in fitness among males, which one of the following scenarios is most likely?
(A)	Fish start their reproductive life as females and become males at larger sizes
(B)	Fish start their reproductive life as males and become females at larger sizes
(C)	Female-female competition leads to male sterility
(D)	Male-male competition does not influence the sequence of sex change in an individual
Q.39	When comparing life-history traits across animal species, which one of the following relationships is LEAST expected under r- and K-selection theory?
(A)	Development time is positively correlated with age at first reproduction
(B)	Development time is negatively correlated with lifespan
(C)	Lifespan is positively correlated with body size
(D)	Lifespan is negatively correlated with number of offspring per breeding attempt

Q.40	Two isolated populations M and N have population sizes of 100 and 1000 individuals, respectively. The starting allele frequencies p and q are 0.5 in both populations. Assuming no selection, which one of the following is expected after 100 generations?
(A)	p is expected to be higher than q in population M but not in population N
(B)	p is expected to be lower than q in population M but not in population N
(C)	2pq in population M is expected to be higher than 2pq in population N
(D)	2pq in population M is expected to be lower than 2pq in population N

Q.41	Two bacterial variants are growing together in the same flask. At any relative frequency of the two variants, the population growth rate of the rarer variant is higher. The above is an example of _____.
(A)	sexual selection
(B)	positive selection
(C)	negative frequency-dependent selection
(D)	positive frequency-dependent selection

Q.42	The graph below shows a plot of annual rainfall on the X axis and number of plant species on the Y axis. Based on the pattern in the graph, which one of the following statistical methods would be most appropriate to model the relationship between annual rainfall and the number of plant species? 
(A)	Kruskal-Wallis test
(B)	Student’s t-test
(C)	Linear regression
(D)	Chi-squared test

Q.43	The phylogeny of six species of birds is illustrated below, where the horizontal branch lengths correspond to genetic distance. These six species are distributed in three islands X, Y, and Z. Island X harbours species 1, 4, 6; Island Y harbours species 1, 2, 4; and Island Z harbours species 3, 4, 5. Which one of the following is true about the phylogenetic diversity of these islands? 
(A)	X > Y > Z
(B)	X < Y < Z
(C)	X > Y and Z > Y
(D)	X < Y and Z < Y

Q.44	Terrestrial biomes such as tundra, taiga, temperate forests, and tropical forests are distributed in different parts of the world. Which one of the following options best represents the environmental factors that determine the distribution of these biomes?
(A)	Temperature and elevation
(B)	Rainfall and wind
(C)	Temperature and rainfall
(D)	Fire and elevation

Q.45 In a population, the frequency of an allele changes with time as given in the table:

Year (x)	0	10	20	30	40
Allele frequency (y)	0.1	0.2	0.3	0.4	0.5

Which one of the following describes how allele frequency changes with year?

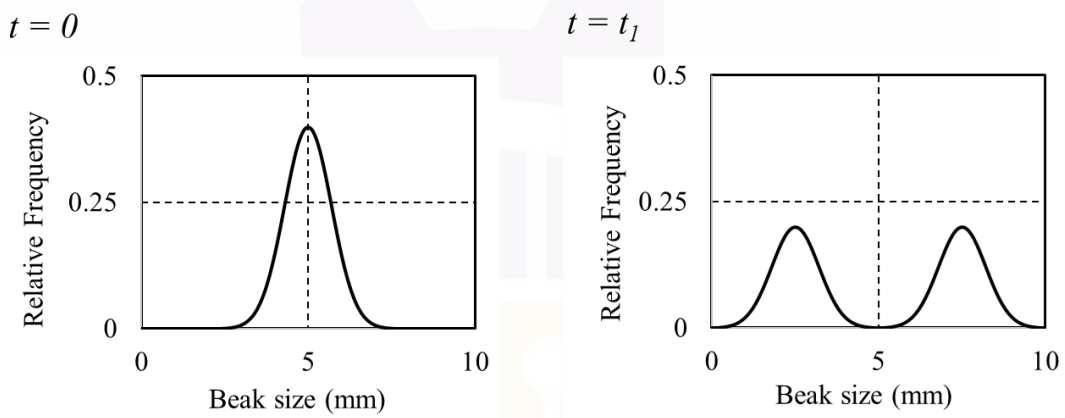
(A) $y = 0.01x + 0.1$

(B) $x = y + 0.1$

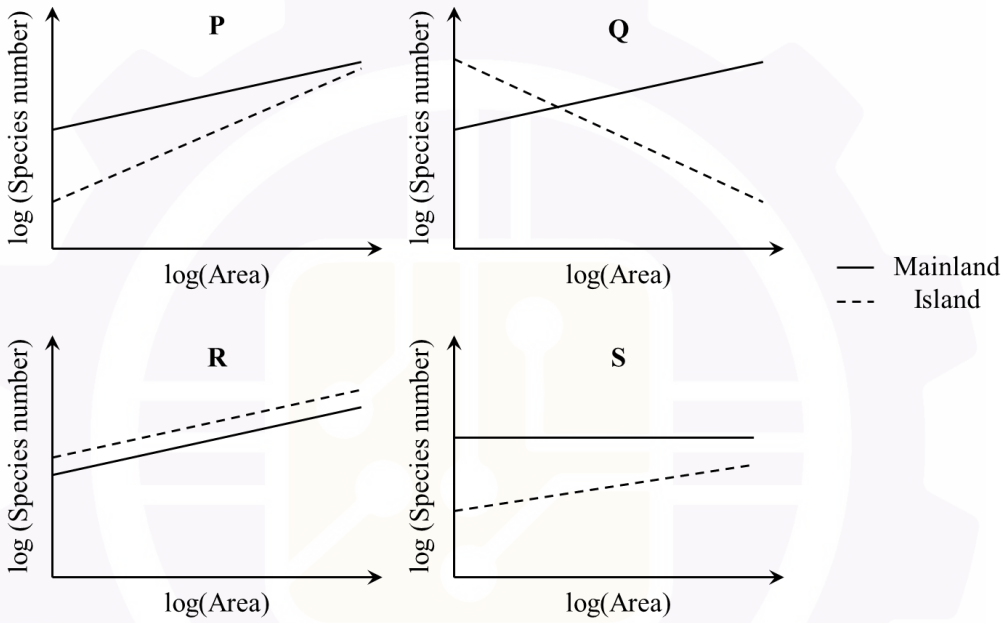
(C) $x = 0.1 + 0.01y$

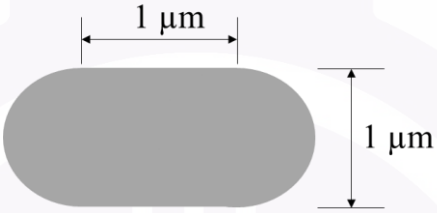
(D) $y = x + 0.1$

Q.46	Despite their striking morphological similarity to each other, Old World and New World vultures are not phylogenetically related. Old World vultures are most closely related to eagles, while New World vultures are most closely related to storks. The morphological similarity between Old World and New World vultures is an example of _____.
(A)	adaptive radiation
(B)	cladogenesis
(C)	divergent evolution
(D)	convergent evolution

Q.47	The distributions of beak size in a bird population at two different times are shown below. In going from time $t = 0$ to $t = t_1$, the variance of the distribution in beak size in the population has _____. 
(A)	increased
(B)	decreased
(C)	reduced to zero
(D)	stayed the same

Q.48	Percent sequence divergences between two sister species were calculated for an exon (E), intron (I), and the flanking neutral (N) region of a gene under purifying selection. Which one of the following options best describes the expected divergence in E, I, and N between the sister species?
(A)	E > I > N
(B)	E > I = N
(C)	E < I = N
(D)	E = I > N

Q.49	Islands typically have higher species extinction rates and are more isolated than the mainland. In the figures below (P, Q, R, S), the solid line denotes the relationship between species richness and increasing area within a mainland; the dashed line denotes the relationship between species richness and islands of different sizes.  Which one of the figures above represents the most likely relationships?
(A)	P
(B)	Q
(C)	R
(D)	S

Q.50	A bacterium can be approximated as a cylinder with a hemisphere at each end, as shown in the figure. The cylinder has a height of 1 µm and diameter of 1 µm. Assuming that the density of the bacterium is equal to that of water, what is the approximate mass of this bacterium?  Given: density of water = 10^3 kg/m^3; 1 µm = 10^{-6} m Volume of a cylinder = $\pi r^2 h$, where r is the radius and h is the height of the cylinder Volume of a sphere = $\frac{4}{3}\pi r^3$, where r is the radius of the sphere
(A)	10^{-12} kg
(B)	10^{-18} g
(C)	10^{-15} kg
(D)	10^{-15} g

Q.51 Students M and N sampled body lengths of two populations of a fish species using the same study design. A summary of their data (mean ± standard error) is shown below.

	Body length (cm)	
	Population *I*	Population *II*
Student M	8.0 ± 1.2	6.2 ± 0.7
Student N	10.0 ± 0.6	5.1 ± 0.3

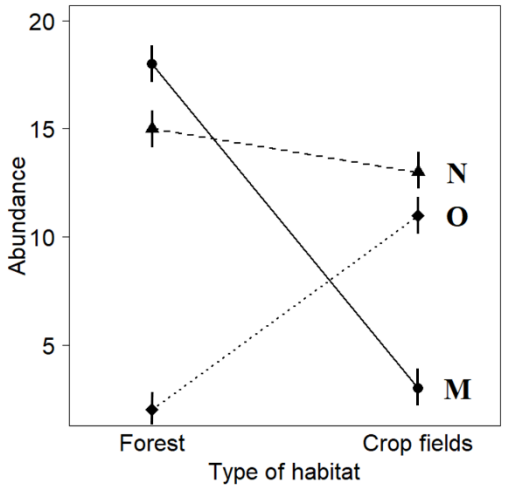
Given that the data are normally distributed, when comparing the means of the populations using a t-test, which student will find a lower *p*-value?

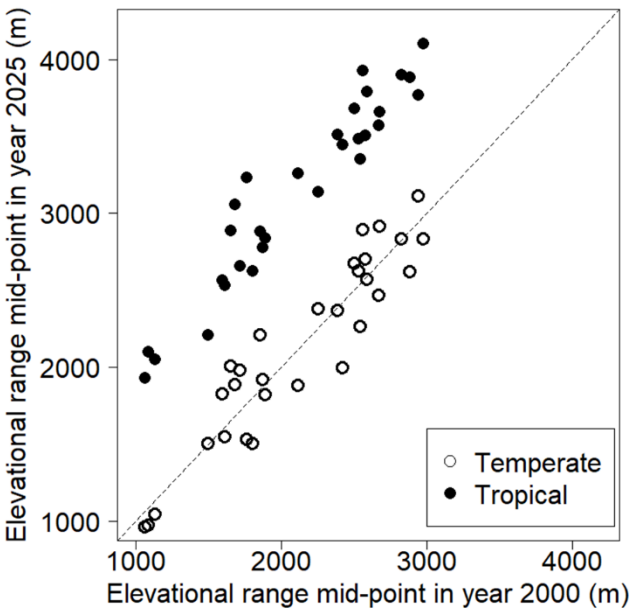
(A) Student M

(B) Student N

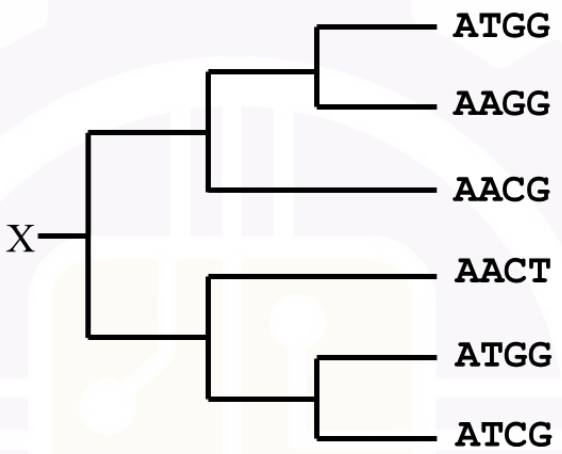
(C) Insufficient information to comment

(D) *p*-values will be zero in both cases

Q.52	Forest patches are embedded within a landscape dominated by crop fields. The crop fields around fragmented forest patches are thought to affect the abundance of different butterfly species to different extents. The graph below shows the pattern of butterfly abundance (means, and error bars representing 95% confidence intervals) of three species, M, N, and O between the forest patches and the crop fields.  Which one of the following options best describes the impact of fragmentation on the three different butterfly species?
(A)	M – strongly positive; N – weakly negative; O – strongly negative
(B)	M – strongly negative; N – weakly positive; O – strongly positive
(C)	M – strongly negative; N – weakly positive; O – strongly negative
(D)	M – strongly negative; N – weakly negative; O – strongly positive

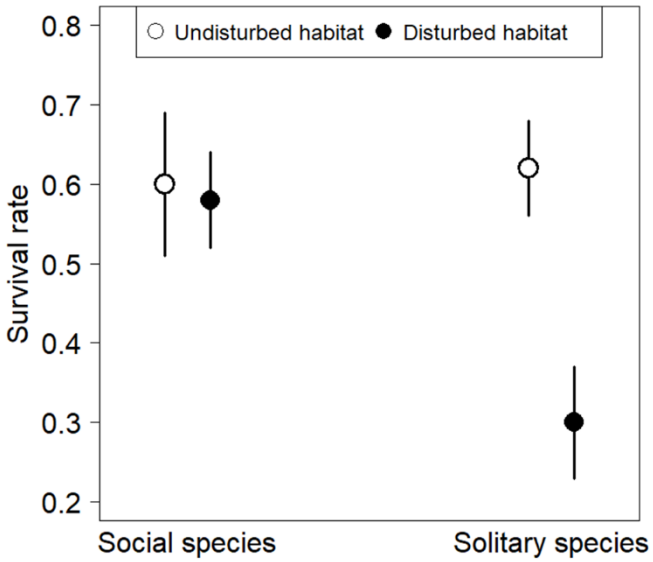
Q.53	Many species in mountain ranges are shifting their ranges to higher, cooler elevations in response to warming temperatures because of climate change. The graph below shows how the midpoint of elevational range in the year 2025 is related to the midpoint of the elevational range in the year 2000 for species in temperate (open circle) and tropical (solid circle) mountain ranges. Each point represents a species, and the dashed line is the 1:1 or the identity line (with intercept = 0 and slope = 1).  Which one of the following statements is consistent with the above graph?
(A)	Tropical species are more sensitive than temperate species to temperature change
(B)	Temperate species are more sensitive than tropical species to temperature change
(C)	Both tropical and temperate species are equally sensitive to temperature change
(D)	No conclusion can be reached about the relative sensitivities of tropical and temperate species to temperature change

Q.54	Two species of butterflies are equally toxic to their main potential predator. Their morphological similarity helps to reduce predation rates on both species. This phenomenon is known as _____.
(A)	Batesian mimicry
(B)	Müllerian mimicry
(C)	parasitism
(D)	sensory overload

Q.55	The phylogeny below shows the relationship between six species based on whole genome data. The sequence of a part of a particular gene from each species is provided at the tips of the tree. Based on the principle of parsimony, which one of the following is the expected sequence for the ancestor X? 
(A)	ATGG
(B)	AACG
(C)	AGCG
(D)	AATG

Q.56	Consider a predator encountering two prey types P_1 and P_2. Assume the energy value of P_1 is greater than that of P_2. Assume also that the search time to find each prey type is inversely proportional to its abundance in the habitat. The prey-choice model in optimal foraging theory evaluates whether the predator should specialise on P_1 or generalise to feed on both P_1 and P_2. This model predicts specialising on P_1 when: $$\frac{E_1}{S_1 + h_1} > \frac{E_2}{h_2}$$ where E_1 is the energy value of P_1; h_1 is handling time for P_1; E_2 is the energy value of P_2; h_2 is handling time for P_2; S_1 is the search time for P_1. According to the condition given above, which one or more of the following options does the decision to specialise on P_1 depend on?
(A)	Handling time of P_1
(B)	Handling time of P_2
(C)	Abundance of P_1
(D)	Abundance of P_2

Q.57	In some insect species, males are much larger than females. Which one or more of the following evolutionary hypotheses can explain such male-biased size dimorphism?
(A)	Body size provides a competitive advantage to females, but not to males
(B)	Body size provides a competitive advantage to males, but not to females
(C)	Clutch size is positively correlated with body size in females
(D)	The mating success of males and females is not related to body size

Q.58	A researcher is interested in understanding whether multi-species sociality (in which species form cohesive groups with other species) plays a role in helping species cope with habitat disturbance. She estimates the survival rates of social species and solitary species in undisturbed and disturbed habitats, and these are plotted in the graph below. Circles represent mean survival rates and error bars represent 95% confidence intervals.  Based on the means and confidence intervals presented in the graph ($\alpha = 0.05$), which one or more of the following can be reasonably concluded?
(A)	There is no evidence that the survival rates of social species are different between undisturbed and disturbed habitats
(B)	Solitary species have lower survival in disturbed habitats
(C)	There is no evidence that the survival rates of social and solitary species are different from each other in undisturbed habitats
(D)	There is no evidence that the survival rates of social and solitary species are different in disturbed habitats

Q.59	A research group studied the timing of Arctic ground squirrel emergence from hibernation. They collected data over a 25-year period and found that female and male ground squirrels differed in how variable their emergence times were. Across years, no matter what the above-ground temperatures were, male ground squirrels emerged in the same week in April. Females usually emerged during the same week as the males if it coincided with snowmelt; but in colder years, they re-entered hibernation and emerged later after snowmelt. Which one or more of the following statements is/are possible **proximate** cause(s) for this phenological pattern?
(A)	Males build up testosterone before emergence, which inhibits them from re-entering hibernation
(B)	Early emergence helps males increase their reproductive success by gaining early access to females
(C)	Hibernating females respond to both hormonal levels and environmental cues
(D)	Female fecundity is negatively affected by colder temperatures

Q.60	A native species of butterfly at one site in North America used to feed on plant species P. In the 1960s, an exotic plant species Q was introduced at this site. The butterfly switched to feeding on Q, so much so that it was no longer found feeding on P. When the plant species Q was removed from the site in the 1990s, the butterfly species went locally extinct. Later, a population of the same butterfly species from elsewhere, that still fed on plant P, came and occupied the same site. Which one or more of the processes listed below has/have occurred here?
(A)	Re-colonisation
(B)	Local extinction
(C)	Inbreeding depression
(D)	Changing trophic levels
Q.61	Species 1 and 2 belong to the same genus and co-occur at the same site. Which one or more of the following strategies would facilitate their coexistence at the site?
(A)	Species 1 has high frequency calls, Species 2 has low frequency calls
(B)	Species 1 and 2 specialise on the same limited resource
(C)	Species 1 nests near the ground, Species 2 nests in the canopy
(D)	Species 1 and 2 breed at different times of the year

Q.62

A researcher carried out an experiment to study how daylength and temperature influence diapause in a moth species. He placed larvae in one of four treatment conditions for 2 weeks, with 30 larvae in each condition. The treatments involved two temperatures (18 °C or 27 °C) and two lighting conditions (12h:12h Light:Dark (LD) or complete darkness (DD)). At the end of the experiment, he counted the number of larvae that had entered diapause and those that had not. The data are shown below.

Condition	**Larvae in diapause**	**Larvae NOT in diapause**
Treatment 1 27 °C, 12:12 LD	2	28
Treatment 2 18 °C, 12:12 LD	7	23
Treatment 3 27 °C, DD	12	18
Treatment 4 18 °C, DD	29	1

Which one or more of the following conclusions can he reasonably make from these findings?

(A) Diapause is independent of abiotic conditions

(B) Only temperature influences diapause

(C) Only daylength influences diapause

(D) Both temperature and daylength influence diapause

Q.63	Population growth of a species can be modelled as $$\frac{dN(t)}{dt} = rN(t)(1 - \frac{N(t)}{K})$$ where $N(t)$ is the population size at time t; r is the growth rate; and K is the carrying capacity of the environment. For K = 9000, $\frac{dN(t)}{dt}$ is maximized at N = _____ (*Answer in integer*)
Q.64	The genome of a diploid species has 10 genes. In a population of this species, if each gene has two unique alleles, then the number of possible unique genotypes in this population is _____ (*Answer in integer*)
Q.65	Bob is studying the effect of coral and sponge species on reef ecosystems using experiments in artificial square tanks. In each tank, he places 3 species of corals and 2 species of sponges. If there are 6 species of corals and 5 species of sponges to choose from, the minimum number of tanks required to test all combinations of 3 coral and 2 sponge species is _____ (*Answer in integer*)