Previous Year

Solved Question Paper

of

IISc. ENTRANCE TEST 2010

ECOLOGICAL SCIENCE

RESEARCH (Ph.D)

(Original Question Paper with Answer Key)

INDIAN INSTITUTE OF SCIENCE
BANGALORE - 560012

ENTRANCE TEST FOR ADMISSIONS - 2010

Program : Research

Entrance Paper : Ecological Sciences

Paper Code : ES

Day & Date

SUNDAY, 25TH APRIL 2010

Time

9.00 A.M. TO 12.00 NOON

GENERAL INSTRUCTIONS

1. This **paper consists of** 100 **questions** and carries a total of 100 marks, **one** mark **for each question.**

2. **Answers** *to* all the **questions should** be marked only **on the OMR** sheet **provided.**

3. **For** each **question,** darken the **appropriate** bubble **to** indicate your **answer.**

4. **Use only HB pencils for bubbling answers.**

5. **Mark** only one **bubble per** question. **If you mark** more than one **bubble,** the **answer will** be **evaluated as incorrect.**

6. **If you** wish **to change your answer,** please **erase the existing mark** completely before **making** the other bubble.

7. **There will** be no negative **marking for** wrong answers.

8. **Candidates should** fill in the **required** fields on the OMR **sheet attached.**

ECOLOGICAL SCIENCES

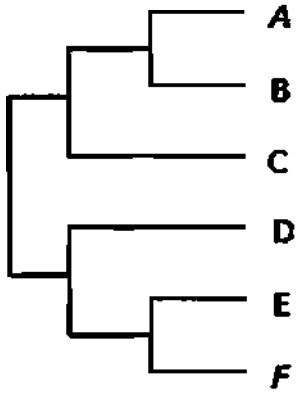
1. The plant growth regulator involved in fruit ripening is

(A) Indole-3-acetic acid
(B) Zeatin
(C) Ethylene
(D) 24-dichlorophenoxy acetic acid

2. Monocarpic plants are

(A) those that flower once in their life tirne.
(8) those that bear a single flower in their life time.
(C those that bear a single flower every time they bloom.
(D) those plants that develop a single fruit from the entire inflor'escence.

3. Following is the phylogeny showing relationships between six bird species. Species A and F are nectar feeding birds and possess long, thin, curvy beaks, while the remaining species are seed eaters and possess thick beaks. The evolution of beak character in species A **and F** can **be explained by:**



(A) convergent evolution
(B) directional selection
(C) disruptive selection
(D) reversal

4. The neutral theory of molecular evolution was proposed by

(A) Ronald Fisher

(B) Sewall Wright
(C) Motoo Kimura
(D} Gregor Mendel

5. The plant species that is extensively used as a model system and considered as *Drosophila* of the plant world is

(A) ***Aotirrhinum majus***
(8) Arabidopsis thaliana
(C) ***Zea mays***
(D) ***Avena sativa***

6. The entire genetic material in a sexually reproducing species is contained in a single chromosome per individuat, and that chromosome is present in two copies (this is a diploid species). Suppose Mendelian segregation takes place during meiosis, but there is no mutation or recombination. Then, among the 16 great-great grandparents of any individual, the number that actually form part of his or her genetic ancestry is precisely

(A) 2
(B) 4
(C) 8
(D) 16

7. If the polar ice rnelts entirely because of global warming, the rate at which the earth rotates around its own axis should

(A) slow down.
(B) speed up.
(C) vary cyclically.
(D) remain unchanged.

8. An individual performs a certain task correctly 90% of the time (i.e., 10% is the failure rate on each performance). What is the probability that if there are two such individuals who function independently, at least one of them will perform the task correctly?

(A) 99.99%
(B) 99.9%
(C) 99%
(0) **90%**

9. Often the identical mutation is found in many children born to the same parents. Neither parent carries the mutation. A likely explanation is that the mutation occurred in

(A) the germ line of both parents after meiosis
(B) the soma of both parents
(C) the germ line of one parent before meiosis
(D) all the affected zygotes

10. A rare X-linked allele is present in the human population at a frequency of 1 in 105. Among those who carry the allele, the proportion of males is about

(A) 1 in 2
(B) 1 in 3
(C) 1 in 4
(D) 1 in 5

11. A weed growing in a lake doubles in area every week. If it takes a month for it to cover the entire surface of the lake, how long does it take to cover 1/4th of the surface?

(A) *0.5* weeks
(B) 1.0 weeks
(C) 1.5 weeks
(D) *2.0* weeks

12. Assume that an animal generates heat at a rate proportional to its volume and can radiate heat at a rate proportional to its body surface area. Which of these animals would be best at maintaining its body ternperature in a cold climate?

(A) Mouse
(B) Bear
(C) Rabbit
(D) Fox

13. As substrate concentration increases, the initial velocity of an enzyme-catalysed reaction (measured in different experiments that are carried out at different substrate concentrations) increases proportionately, but later begins to increase more and more gradually. This is because

(A) All chemical reactions slow down at high reactant concentrations
(B) The system begins to heat up
(C) Less and less of the enzyme is available for binding by the substrate
(D) The enzyme begins to get inactivated.

14. The Weber-Fechner law states that the magnitude of a perceived sensation increases as the logarithm of the stimulus intensity. Assume a background stimulus level of 1 unit. Suppose this is increased to 10 units (situation A) or to 100 units (situation B).Then the perceived sensation in situation B is stronger than the sensation perceived in situation A by a factor of

(A) 1
(B) 2
(C) 10
(D) 100

15. You are conducting an experiment under controlled conditions in a greenhouse in which paddy and maize are being grown. Keeping all other factors constant you increase the concentration of carbon dioxide in the greenhouse by 25% above normal atmospheric levels of this gas. The most likely outcorne of this experiment would be

(A) Increase in growth rates of paddy
(B) Increase in growth rates of maize
(C) Increase in *growth* rates of paddy and rnaize
(D) Decrease in growth rates of paddy

16. If temperatures increase by more than 4º C due to global warming the most likely impact on forests in the tropics would be

(A) Stimulated growth of trees resulting in increased biomass
(B) Increase in the diversity of trees in tropical forests
(C Increase in respiration over photosynthesis resulting in decreased biomass
(D) Migration of temperate tree species to the tropics

17. Which of the following is not characteristic of all vascular plants?

(A) development of seeds
(B) alternation of generations
'(c) xylem and phloem for transport
(D) lignin in the cell wall

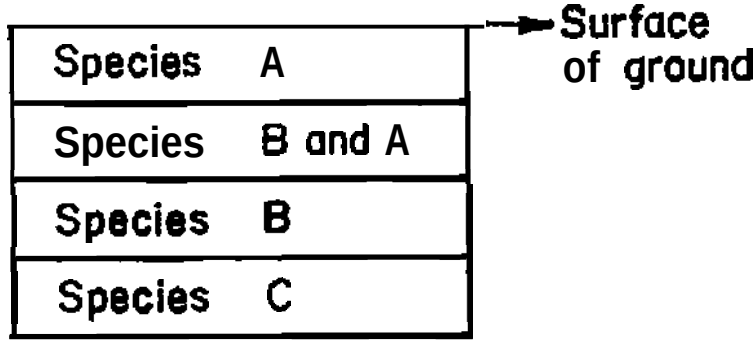
18. The DNA from which taxon would be the best to use to prove the connection between India and Seychelles in geological time?

(A) Bats
(B) Birds
(C) Frogs
(D) Sharks

19. Two nucleotide sequences found in two different species are almost exactly the same. This suggests that these species

(A) are evolving into the same species
(B) contain identical genome
(C) may share the same ancestor
(D) have the same number of mutations

20. The diagram below represents a section of undisturbed layers of sedimentary rock in the Western Ghats and shows the location of fossils of several closely related species. According to currently accepted evolutionary theory, which is the most probable assumption about species A, B, and C?



(A) Species B is more abundant than species C.
(B) Species C existed before species B.
(C) Species A and B are genetically identical.
(D) Species B descended from *species* A.

21. Which statement best explains why invertebrates regenerate lost tissue more readily than most vertebrates do?

(A) Invertebrates contain specialized cells that produce the hormones necessary for this process.
(B) Invertebrate cells exhibit a higher degree of uncontrolled cell division than vertebrate cells do.
(C) Invertebrate animals reproduce asexually, but vertebrate animals reproduce sexually.
(D) Invertebrate anirnals have more undifferentiated cells than vertebrate animals have.

22. In an animal species, the gene for gray fur (G) is dominant over the gene for black fur (g). If 50% of a large litter of these animals are gray, the parental cross that produced this litter was most likely

(A) GG x Gg
(B) GG x gg
(C) Gg x gg
(D) gg x gg

23. The number of copies of an autosomal gene in a population of diploid species of N individuals is 2N. Assuming that the gender ratio in the population equals one, the number of copies of a gene on the X chromosome in a population of N individuals will be:

(A) 2N
(B) 1.5N
(C) N
(D) 0.5N

24. The location of a sound source in horizontal space (azimuth) is determined by the human auditory system using the difference in arrival time of sound between the two ears, which ranges from zero when the source is at the midline to 180 µs when the source is located 90 degrees laterally. For the system to have an angular resolution of one degree in azimuth, what should be the time resolution of the auditory system?

(A) 1 µs
(B) 2 µs
(C) 4 µs
(D) 0.5 µs

25. The total number of species of birds in two large forest areas is the same. Within each of these forests are two smaller patches. Individual patches in forest 2 have more species of birds than individual patches in forest 1. Which of the following is true?

(A) In Forest 1, species are more evenly distributed than in Forest 2.
(B) The nurnber of species shared by individual patches within a forest is the same for both forests.
(C) Species are distributed uniformly in both forests.
(D) In Forest 2, the two patches share more species than do the patches in forest 1.

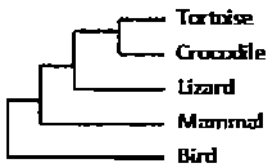
26. Two identical DNA sequences of 100 basepairs length accumulate nucleotide substitutions at the same rate of one change per year or 0.01 change/site/year. The percent nucleotide difference between these two sequences after infinite time will be

(A) 100
(B) 75
(C) 50
(D) 25

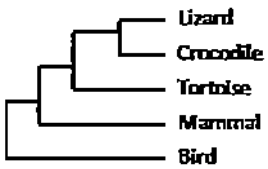
27. Semelparous reproduction, where the organism produces all its offspring in a single reproductive event, is favoured when

(A) juvenile survival is high relative to adult survival
(B) adult survival is high relative to juvenile survival
(C) juvenile survival increases with size at birth
(D) does not depend on survival rates

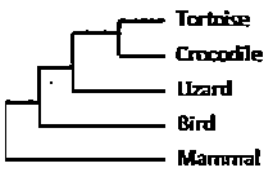
28. Which of the following trees shows the right evolutionary relationship between bird, tortoise, crocodile, lizard and mammal?



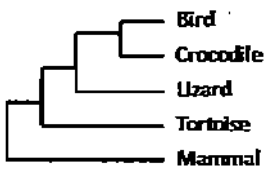
Tree 1



Tree 2



Tree 3



Tree 4

(A) Tree 1
(B) Tree 2
(C) Tree 3
(D) Tree 4

29. In which of the following places would you expect the highest number of plant species per hectare of forest?

(A) Corbett National Park
(B) Ranthambore National Park
(C) Mudumalai National Park
(D) Silent Valley National Park

30. DNA sequences of the mitochondrial cytochrome b gene from two species of birds were compared and found to have 4 differences between them. Nevertheless when the cytochrome b protein sequences were campared they were identical in the two species. This is because the differences at the DNA sequence were most probably

(A) due to insertions
(B) at the second position of the codon
(C) at the third position of the codon
(D) due to deletions

31. A metapopulation structure is most likely to prevent the regional extinction of a species when

(A) the dynamics of the local populations are asynchronous.
(B) the dynamics of the local populations are synchronous.
(C) individuals move extensively between local populations so that they behave like one large population.
[D) local populations are isolated and closed.

32. Mitochandrial genes are different from nuclear genes in that, mitochondrial genes

[A) have fewer stop codons
(B) do not have introns
(C) have a different start codon
(D) are shorter than nuclear genes

33. You are given individuals of three species of fish. Of these, species A is covered with multi-coloured spots all over the body, species B is black with very large eyes and species C is brown with reduced eyes. The prediaed habitats of the three species (A, B and C) would be

(A) Coral reefs, benthos and estuaries respectively.
(B) Coral reefs, estuaries and benthos respectively.
(C) Benthos, estuaries and coral reefs respectively.
(D) Estuaries, benthos and coral reefs respectively.

34. Resources are not evenly distributed in time and space. The type of resource distribution in time that most closely resembles a patchily distributed resource in space is

(A) scarce resource
(B) common resource
(C) perennial ***resource***
{D) fluctuating resource

35. A species of moth that pollinates a night-flowering plant species is subjected to the following experiment. In a Ftowering patch of the plant species outdoors, four treatments are applied in equal nurnbers: 1. Black cloth bags enclosing individual natural flowers 2. Artificial unscented model flowers 3. Artificial unscented rnodel flowers covered with black cloth bags and 4. Control unmanipulated natural flowers. The number of moths approaching each flower between 6 p.m. and 10 p.m. is noted. The results are shown below:

Treatment	Number of moths approaching
Control unmanipulated natural flowers	35
Natural flowers covered by cloth bags	1
Artificial unscented model flowers	32
Artificial unscented model flowers covered with cloth bags	0

The results suggest that

(A) Olfactory cues are necessary for the rnoths to recognize the flowers.
(B) Olfactory cues are sufficient for the moths to recognize the flowers.
(C) Visual cues are sufficient for the moths to recognize the flowers.
(D) Visual cues are necessary but not sufficient for the moths to recognize the flowers.

36. Darwin predicted the existence of an undiscovered species of moth based on the existence of a species of orchid with an exceptionally long nectar spur in the flower. This prediction was based on the assumption of

(A) Natural selection
(B) Adaptive radiation.
(C) Convergent evolution
(D) Coevolution

37. The songs of individuals of a bird species living in dense forest consist mostly of long whistles, while those of a population of the same species in a neighbouring grassland contain more short trills. This difference is likely to be due to

(A) Genetic drift
(B) Parapatric speciation
(C) Isolation by distance
(D) Plastic local adaptation

38. Fruit flies are attracted to the smell of bananas (ethyl acetate) at low concentrations but repelled by high concentrations of the same odour. This is because

(A) The activity of ethyl acetate receptors in the fly saturates at high concentrations.
(B) The activity of ethyl acetate receptors in the fly shuts off due to adaptation at high concentrations.
(C) Exposure to high concentrations of the odour may be toxic to the fly.
(D) Bananas are beneficial when consumed in small quantities but toxic in large quantities.

39. Batesian and Muellerian mimicry can evolve because

(A) Predators have very good perceptual abilities and discriminate between similar prey.
(B) Predators have poor learning ability.
(C) Predators have good learning ability and generalize across similar patterns.
(D) Predators are short-lived compared to prey species.

40. Sharks typically rest on the ocean floor when they are not swimming. This is because

(A) Predation risk for sharks is lower on the ocean floor.
(B) They prefer to rest in darkness and light does not penetrate to the ocean floor.
(C) They lack swim bladders and sink when they are not swimming.
(D) They are driven out of the upper ocean layers by competing species.

41. There are two sympatric species of cicadas, of which adults of the first emerge once in 13 years and those of the second species emerge once in 17 years. Assuming that both species have emerged together this year (zeroth generation), and laid eggs at the same time, which of the following will be closest to synchrony in their emergence times?

(A) The third generation of the 13-year cicada and the second generation of the 17-year cicada.
(B) The fourth generation of the 13-year cicada and the third generation of the 17-year cicada.
(C) The fifth generation of the 13-year cicada and the fourth generation of the 17-year cicada.
(D) The fifth generation of the 13-year cicada and the third generation of the 17-year cicada.

42. Pigs belong to the order

(A) Perissodactyla
(B) Artiodactyla
(C) Proboscidea
(D) Lagomorpha

43. Which cellular features do you expect to find in neuronal pathways mediating escape responses in animals?

(A) Long, small-diameter axons
(B) Long, large-diameter axons
(C) Short, small-diameter axons
(D) Short, large-diameter axons

44. A monkey is briefly presented with a mirror and allowed to see its own image in it. A red spot is then applied to its forehead and, a few minutes later, it is again presented with the mirror in which its own image is visible. The monkey then wipes the spot off its forehead. For which ability does this experiment provide supporting evidence?

(A) Visual memory
(B) Long term memory
(C) Self-awareness
(D) Deception

45. In the history of life on earth, during which geological period did amphibians appear?

(A) The Cambrian
(B) The Devonian
(C) The Jurassic
(D) The Tertiary

46. Stalk-eyed flies have their eyes at the end of a pair of stalks on the head. In a mate choice experiment, females were offered a choice between pairs of males. Each pair was represented by one male with shorter than average eye stalks and one with longer than average eye stalks. It was found that females with short eye stalks preferred males with short eye stalks, and those with long eye stalks preferred males with long eye stalks. This suggests that male eye stalks are under

(A) Directional selection
(B) Stabilizing selection
(C) Frequency-dependent selection
(D) Disruptive selectiom

47. Two species of aquatic predators A and B were introduced into a lake along with three prey species C, D and E. Individuals of the three prey species were introduced in the following proportions: C = 0.6, D = 0.3 and E = 0.1. Predators and prey encountered each other randomly. Shown below are the proportions of the three prey species found in the diet of the two predators:

	Proportion of prey species in the diet		
Predator	C	D	E
A	0	0.75	0.25
B	0.5	0.1	0.4

Which of the following statements is true?

(A) Predator A does not discriminate between prey species D and E.
(B) Predator A prefers prey species D over E.
(C) Predator B prefers prey species C over E.
(D) Predator B does not discriminate between prey species D and E.

48. The number of hours (P) in a day that a territorial male lizard spends patrolling a territory is related to the number of neighbouring territorial males (N) by the equation $P = 1.2e^{0.2N}$ When the male is solitary, that is, there are no neighbouring territorial males, P is

(A) 0
(B) 1.2

(C) 0.2
(D) $1.2^{0.2}$

49. An endangered frog species is found in only three isolated, closed populations. Suppose the probability of local extinction in a time period of 10 years of each of these three populations is the same and equals 0.7, what is the probability that at the end of ten years, the species does not become extinct?

(A) 0.7
(B) 0.343
(C) 0.657
(D) 0.133

50. Researchers studying red-vented bulbuls catch birds and place colored bands around the legs of individual birds in order to be able to identify them individually. What is the maximum number of unique colour codes that are possible if 3 bands are placed on the right leg alone, 5 different colours are used (red, blue, green, yellow, black), repeated colours are not used on an individual bird, and a given set of three colours can be used as different arrangements (i.e., one individual can get red blue green, another green red blue, another blue green red or any other arrangement of these three colours) but each arrangement can only be used once?

(A) 60
(B) 120
(C) 3125
(D) 125

51. The coefficient of variation in body size in three populations of tigers - P1, P2, and P3 - is 120%, 150% and 90% respectively. All three populations have identical variances in body size. Which of these three populations has the smallest mean body size?

(A) P1
(B) P2
(C) P3
(D) More information is needed

52. Sexual selection, the selection process acting on traits involved in the competition for reproductive opportunities, is thought to be stronger in male mammals than in female mammals. Which of the following is an explanation of this phenomenon?

(A) Males experience greater energy expenditure through maintenance of weapons, such as horns and antlers, than do females.
(B) Male reproductive success is limited by access to forage more than female reproductive success is by access to forage.
(C) Isogamy.
(D) Male reproductive success is more limited by access to females than female reproductive success is by access to males.

53. When examining whether individuals (of a forest tree species, for example) are distributed randomly in space or not, a common approach used is to lay many spatial plots and estimate the density of the focal species in each plot. The ratio of the variance in local density to mean local density is used as a measure of whether data points are distributed randomly in space. A ratio of 1 suggests that individuals are randomly distributed. A ratio much smaller than 1 would indicate that individuals are most likely to be:

(A) uniformly distributed
(B) clumped
(C) low in density
(D) scattered at random

54. For a behaviour to be considered altruistic by an evolutionary biologist, which of the following conditions should be demonstrated?

(A) The behaviour should have no cost to the donor and increase the individual fitness of the recipient
(B) The behaviour should increase the individual fitness of the donor and increase the individual fitness of the recipient
(C) The behaviour should decrease the individual fitness of the donor and increase the individual fitness of the recipient
(D) The behaviour should increase the individual fitness of the recipient; the effect on the individual fitness of the donor is not relevant

55. Fossil evidence suggests that terrestrial plants evolved around

(A) 25 million years ago
(B) 50 million years ago
(C) 100 million years ago
(D) 500 million years ago

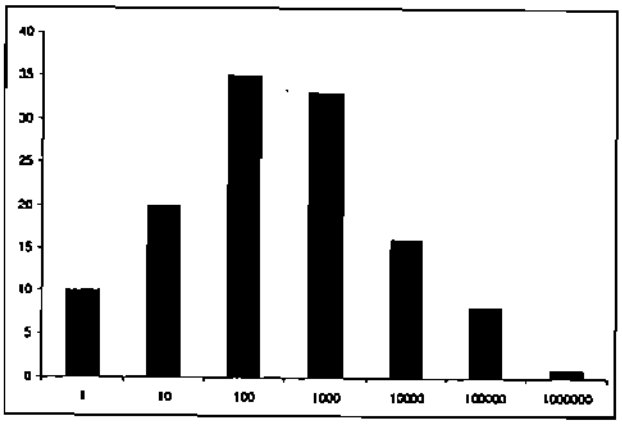
56. The Shannon's index of diversity is calculated as $H' = -\Sigma p_i \ln p_i$, where p_i is the proportion of the i^{th} species.

Species identity	# of individuals in Community A	# of individuals in Community B
A	13	6
B	4	4
C	18	5
D	2	6
E	5	2
F	6	4
G	30	5
H	5	4
I	3	3
J	4	6
Total	90	45

Which of the following is true?

(A) Community A has a higher index of diversity
(B) Community B has a higher index of diversity
(C) The index of diversity is the same for both communities
(D) Community A has a higher species richness

57. The log normal distribution describes the pattern of abundance of species in a community. This is usually plotted as the number of species in each class. In the following figure, the classes are plotted on a $\log_{10}$ scale,



The maximum number of species are:

(A) very rare
(B) very abundant

(C) equally abundant and rare
(D) of intermediate abundance

58. Ten plots were established to count trees. Each plot was 10 m X 10 m in size. The number of trees counted were 19, 3, 12, 11, 32, 11, 21, 8, 9, 19. What is the density of trees per square kilometre ?

(A) 145,000
(B) 1,450,000
(C) 145
(D) 1.45

59. The effective population size of a population of elephants is:

(A) larger than the absolute population size
(B) equal to the total number of adult males and females
(C) between the total number of adults and the total population size
(D) smaller than the total population size

60. An ecologist studies seed rain in a tropical forest. The method includes the placement of a sticky board that is 1 m by 1 m in size at different distances from the tree. The board has a circle painted on it, which touches the four sides of the square. If seeds fall randomly at a given distance, what percentage of seeds that fall on board fall outside the circle?

(A) About 10
(B) About 20
(C) About 30
(D) About 50

61. In community ecology studies, competition between two species is best demonstrated by:

(A) studying their use of habitats
(B) conducting reciprocal removal experiments
(C) conducting food choice experiments
(D) comparing their genetic sequences

62. In a *Drosophila* population in Hardy-Weinberg equilibrium, 9% of the flies have white eyes. If white eye is caused by a recessive allele at one locus, what is the expected frequency of the wild type allele in that population?

(A) 70%
(B) 30%
(C) 49%
(D) 21%

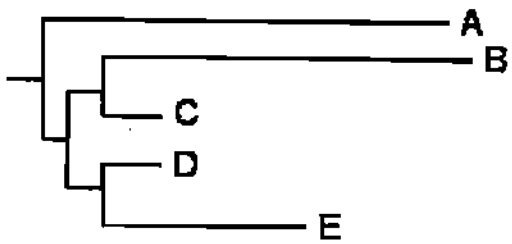
63. The genetic relatedness between you and your grandfather's brother is:

(A) 0.1
(B) 0.125
(C) 0.25
(D) 0.5

64. Which of the following is expected to eat the largest amount of food per gram body weight?

(A) Rat
(B) Cat
(C) Wolf
(D) Elephant

65. Given the phylogeny below, which one of the following statement is correct?



(A) Species A and B are sister taxa
(B) Species C is more closely related to D than to B
(C) Species D is more closely related to C than to E
(D) Species D and E share an immediate common ancestor

66. In a sexually reproducing diploid population of N individuals a new mutation arose in the Y chromosome of an individual. Assuming that the gender ratio in the population is 1:1, the probability of fixation of this new mutation is:

(A) 1/2N
(B) 1/N
(C) 2/N
(D) 4/N

67. Which of the following is least likely to cause reduction of genetic variation in a population?

(A) drift
(B) inbreeding
(C) non-random mating
(D) immigration

68. Two isolated populations (X1 and X2) have the same starting allele frequency at a locus such that p=q. X1 and X2 have 100 and 1000 individuals respectively but the gender ratios in both populations is 1:1. After 100 generations 2pq in

(A) X1 > X2
(B) X2>X1
(C) X1=X2
(C) X2>0.5

69. The Andaman and Nicobar Islands have many endemic species, including geckos of the genus *Phelsuma*. Genus *Phelsuma* is found no where else except in Madagascar and adjoining islands. Recent molecular studies suggest that *Phelsuma* in Andaman and Nicobar Islands diverged from their counterparts in Madagascar around 2 million years ago. It is also well known that the center of origin of genus *Phelsuma* is Madagascar. Given this information the most likely explanation for the presence of *Phelsuma* in Andaman and Nicobar Islands is

(A) Recent human mediated transport
(B) Continental drift
(C) Long distance transoceanic dispersal
(D) Dispersal by land via Africa and Asia

70. A mature mRNA molecule is 153 nucleotides long and includes the translation initiation and termination codons. The number of amino acids it codes for is

(A) 52
(B) 51
(C) 50
(D) 49

71. In a population, the genotype frequencies at a locus with two alleles A1 and A2 are A1A1: 0.25, A1A2: 0.50 and A2A2: 0.25. After 5 generations of selection the frequency of the A1 allele goes up by 20%. Assuming Hardy-Weinberg equilibrium for the fifth generation, what is the percent increase in the A1A1 genotype?

(A) 20%
(B) 25%
(C) 36%
(D) 44%

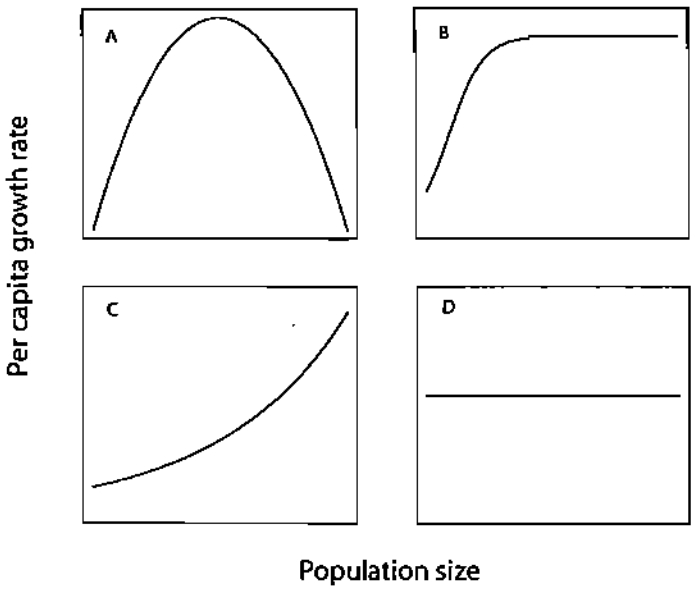
72. In several birds and mammals, offspring from one year stay back and help parents bring up offspring in the next year. If the main benefit they get from such helping is inclusive fitness benefits, then which of the following processes is most likely to favour helping behaviour?

(A) extensive intraspecific brood parasitism
(B) long reproductive tenure and genetic monogamy
(C) frequent turn-over in reproducing adults
(D) extensive extra-pair fertilisations

73. Consider a foraging individual feeding in a habitat where food occurs as patches. Suppose that travel costs between patches are minimal and the individual has perfect information. Then, an optimally foraging individual seeking to maximize food acquisition rate should stop feeding in one patch and move to the next when:

(A) no prey items are left in Patch 1
(B) when very few prey items are left in Patch 1
(C) when there are fewer prey items in Patch 1 than the average for the habitat
(D) when the habitat average for prey items is high

74. Which of the graphs below describes the *per capita growth rate* of a population showing exponential growth ($N_t = N_0 e^{rt}$)



75. The *Red Queen* evolutionary dynamics refers to which of the following types of selection processes?

(A) coevolution
(B) convergent evolution
(C) adaptive radiation
(D) disruptive selection

76. In an aphid species where each adult female occupies only one leaf, 65% of the total number of adult females on a tree were found on the largest leaves, which constituted only 2% of the total number of leaves on the tree. This observation suggests that

(A) The female aphids were actively avoiding the smallest leaves
(B) The female aphids were actively avoiding the largest leaves
(C) The females aphids had distributed themselves randomly with respect to leaf size
(D) The female aphids were actively selecting the largest leaves

77. The greatest amount of free energy is available at which of the following levels?

(A) Tertiary consumers
(B) Secondary consumers
(C) Decomposers
(D) Producers

78. Gause's competitive exclusion principle states that

(A) if two competitors are grown together, one will always exclude the other.
(B) if two species consume each other's limiting resource, one will always competitively exclude the other.
(C) if two species consume some resource that is essential to the survival of both, one will eventually exclude the other.
(D) if two competitors permanently coexist, they must have different limiting resources.

79. Which of the following indicate the correct sequences of events in species that recently have begun to overlap in their distribution and that severely compete?

(A) character displacement, niche displacement
(B) adaptive radiation, niche displacement
(B) adaptive radiation, behavioral displacement
(D) niche displacement, character displacement

80. The webs of individuals of a social spider species are arranged in concentric circles radiating outward from a central point. Given below are the probabilities of predation (being eaten) and prey capture for large and small spiders in peripheral and central locations in the colony:

	Large spiders	Small spiders
Predation risk at periphery	0.8	0.3
Predation risk at centre	0.2	0.2
Prey capture probability at periphery	0.7	0.8
Prey capture probability at centre	0.3	0.2

The results predict that

(A) Large spiders will try to occupy positions at the centre and small ones at the periphery of the colony.
(B) Large spiders will try to occupy positions at the periphery and small ones at the centre of the colony.
(C) Both large and small spiders will try to occupy central positions in the colony.
(D) The distribution of large and small spiders in the colony will be random.

81. When the operational sex ratio in a population switches from being highly male-biased to highly female-biased, mating system theory predicts a corresponding switch from:

(A) Monogamy to polygyny
(B) Polygyny to polyandry
(C) Polyandry to polygyny
(D) Polyandry to monogamy

82. The Allee effect refers to

(A) Positive density dependence at low population size
(B) ,Negative density dependence at low population size
(C) Positive density dependence when the population is at carrying capacity
(D) Negative density dependence when the population is at carrying capacity

83. In a simple linear regression (regression model is $Y = a + bX$), the coefficient of determination r^2 represents the fraction of the total variation in Y that is explained by the variation in X. Which of the following conditions will yield an r^2 of 1?

(A) the slope of the regression line is 1
(B) the slope of the regression line is zero
(C) when all observations fall exactly on the regression line
(D) when all observations exactly equal the mean of the observations

84. Which of the following conditions will allow an ecological pyramid of productivity for an ecosystem to be inverted?

(A) Efficient energy use by secondary and tertiary consumers
(B) Input of resources from outside the ecosystem
(C) Increased efficiency of the use of solar energy
(D) Decrease in lifespans and, hence, standing crop of primary producers

85. Dispersal of male offspring from their natal areas is most likely to occur when

(A) the cost of dispersal is lower for male offspring than for female offspring
(B) the net benefits of dispersal are higher for male offspring than for female offspring

(C) when the cost of dispersal is lower than the cost of staying back for males
(D) when for males the net benefits of dispersal are higher than the net benefits of staying back

86. A species of gecko is found on two groups of islands. In one group of islands, the islands are distributed as a network at varying distances from each other. In the other group, the islands are an archipelago, distributed as a linear chain. There is no difference in the average pairwise distance between nearest neighbours. Occasionally, a species goes extinct on one of the islands and is recolonised from a neighbouring island. If all islands are occupied to begin with:

(A) the archipelago is likely to have more empty islands
(B) the network is likely to have more empty islands
(C) both will have the same number of empty islands
(D) the archipelago is likely to have higher immigation

87. In general, tropical rainforests are known to have a very high diversity of species. Which of the following is the least plausible explanation for this pattern ?

(A) Rainfall
(B) Temperature
(C) Latitude
(D) Longitude

88. An ecologist studies the community ecology of grasslands. He proposes that the the diversity of the grasslands is determined by fire, grazing and human disturbance. How many experimental treatments does he need to separate the impacts of these parameters ?

(A) three
(B) four
(C) eight
(D) sixteen

89. Two species of endemic primates in India are

(A) Hoolock gibbon and crab eating macaque
(B) Slender loris and bonnet macaque
(C) Bonnet macaque and nilgiri langur
(D) Nilgiri langur and capped langur

90. There is a well known study on the distribution of barnacles in the intertidal zone in Scotland. Two species, *Balanus balanoides* and *Chthamalus stellatus* have a stratified distribution on intertidal rocks. *Chthamalus* occurs higher than *Balanus* in the intertidal zone. In the experiment, each species was excluded to see the effect on the other. When *Chthamalus* was excluded, *Balanus* did not spread higher up the rocks because it apparently cannot tolerate the stress of dessication. However, when *Balanus* was excluded, *Chthalamus* spread down the rock. Which of the following statements is true?

(A) The realized niche of *Balanus* is similar to its fundamental niche.
(B) The realized niche of *Chthamalus* in the presence of *Balanus* is larger than its fundamental niche.
(C) The fundamental niche of *Balanus* is smaller than its realised niche
(D) The fundamental niche of *Chthalamus* is the same as its realised niche

91. While conducting studies of amphibians in a forest patch, a researcher lays quadrats in which he searches for amphibian species. In order to get a good estimate of species richness, the number of quadrats he lays should be determined by

(A) the amount of time spent in each quadrat
(B) the size of each quadrat
(C) the total species richness in the forest patch
(D) the number of new species encountered in each quadrat

92. In a species of frog, large males are susceptible to predation by bats but make up for it by being preferred by the females. Small males are less preferred by the females but make up for it by also not being preferred by bats. Intermediate sized males seem to have the worst of both – they are often eaten by bats and are not much preferred by the females. In such a population, male body size will evolve by:

(A) Sexual selection
(B) Directional selection
(C) Stabilizing selection
(D) Disruptive selection

93. Which of the following is NOT an explanation for the preponderance of sexual reproduction?

(A) Increased genetic variability
(B) Winning in the arms race with parasites
(C) Avoidance of inbreeding
(D) Adaptation to heterogeneous environments

94. Which of the following insects have male helpers?

(A) Honey bees
(B) Ants
(C) Termites
(D) Wasps

95. What is required for sympatric speciation?

(A) Geographical isolation
(B) Inbreeding
(C) Rapid environmental fluctuation
(D) Reproductive isolation

96. Which of the following is NOT a characteristic of invasive species?

(A) Rapid growth
(B) Large body size
(C) High fecundity
(D) Short generation time

97. Which of the following is true? The number of species on an island is

(A) Inversely proportional to the distance from the mainland.
(B) Inversely proportional to the size of the island.
(C) Inversely proportional to the rainfall on the island.
(D) Inversely proportional to the age of the island.

98. Forest X has 5 species of trees with 20 individuals in each species and forest Y has 6 species of trees with 75, 10, 5, 5, 3 and 2 individuals respectively. Which of the following statements is true?

(A) Forest X has greater species richness and less species diversity, compared to forest Y.
(B) Forest Y has greater species richness and less species diversity, compared to forest X.
(C) Forest X has greater species richness and diversity, compared to forest Y.
(D) Forest Y has greater species richness and diversity, compared to forest X.

99. Which of the following was not present on earth before life evolved?

(A) Hydrogen
(B) Ammonia
(C) Oxygen
(D) Methane

100. The time taken for a new neutral mutation at a locus to attain fixation is 4Ne generations, wherein Ne is the effective population size or the population size of the reproducing individuals. The Ne for a gene also depend on whether the gene is present on the autosomal, X, Y chromosome or in the mitochondrial DNA (mtDNA). Given this information and assuming a diploid organism with 1:1 gender ratio which of the following is true? The time to fixation for a new mutation

(A) Is higher for mtDNA than Autosomal locus
(B) Is higher for mtDNA than Y chromosomal locus
(C) Is the same for mtDNA and Y chromosomal locus
(D) Is the same for mtDNA and X chromosomal locus

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