Previous Year

Solved Question Paper

of

IISc. ENTRANCE TEST 2008

ECOLOGICAL SCIENCE

RESEARCH (Ph.D)

(Original Question Paper with Answer Key)

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INDIAN INSTITUTE OF SCIENCE
BANGALORE - 560012

ENTRANCE TEST FOR ADMISSIONS - 2008

Program : Research
Entrance Paper : Ecological Sciences
Paper Code : ES

Day & Date
SUNDAY, 27TH APRIL *2008*

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 HE 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. Allopatric speciation is a speciation event that arises from

   (A) Temporal separation of two populations.
   (B) Geographic separation of two populations.
   (C) An individual having parents of different species.
   (D) Reproductive isolation of two populations.

2. Supposing a genetic analysis was carried out on populations of saltwater crocodiles along the east coast of India and freshwater crocodiles in the rivers along the same coast. Theoretically, one would expect to find

   (A) Greater genetic differences between the saltwater crocodile populations.
   (B) Greater genetic differences between the freshwater crocodile populations.
   (C) Lower mutation rates in freshwater populations.
   (D) Higher mutation rates in fieshwater populations.

3. Recently, a new species of frog was discovered in the Western Ghats whose closest relatives are in Seychelles and Madagascar. This proves that

   (A) India was connected to these islands in the past.
   (B) Frogs are good at dispersing across oceans.
   (C) Frogs are living fossils.
   (D) hdia was a part of Gondwanaland.

4. The deletion of a DNA sequence does not lead to any change in an organism's traits. This means that the sequence may have

   (A) Been non-functional.
   (B) Coded for RNA but not a protein.
   (C) Been part of an enhancer.
   (D) Been part of an exon.

5. Which of the following molecules is a key player in the formation of short-term memory?

(A) cGMP (cyclic guanosine monophosphate)
(B) cAMP (cyclic adenosine monophosphate)
(C) ATP (adenosine triphosphate)
(D) GTP (guanosine triphosphate)

6. The time spent scanning for predators by a gazelle in grassland habitats is explained well by the size of the group in which it is and the height of the grass in the vicinity. The following equation describes this relationship:

$$V = 40 - 0.8N - 1.5G + 0.05N \times G$$

where V = time spent scanning for predators in seconds; N = number of individuals in a group; G = grass height in cm. Using the above equation, for a gazelle in a group of 50 individuals, what would you predict at two locations L1 and L2 where grass height measures 1 cm and 5 cm respectively?

(A) V at L1 > V at L2.
(B) V at L1 = V at L2.
(C) V at L1 < V at L2.
(D) The information given is insufficient.

7. One of the criteria that conservationists typically use to identify habitats for conservation is high species diversity. This may not always be a good criterion because

(A) Low diversity areas are common.
(B) Some common habitats have high diversity.
(C) Some unique habitats have low diversity.
(D) High diversity areas are unique.

8. The two important causal agents of evolutionary change are

(A) Selection and genetic drift.
(B) Selection and migration.
(C) Genetic drift and migration.
(D) Genetic drift and mutation.

9. A species of moth feeds on nectar from the white flowers of a particular plant species. In an experiment, individual moths were presented with white model flowers mimicking real ones and scent extracts of the flowers presented separately on paper. The two cues were separated by different distances in different treatments. The cues were placed at the end of a flight tunnel in the laboratory and moths were released one at a time and their behaviour observed. Moths were scored as showing a positive response if they attempted to feed from either the visual or the scent cue. The results are shown below:

Distance between visual and scent cues (cm)	Percentage of tested moths attempting to feed on either models or scented paper
0	95
2	95
10	50
50	0

This experiment shows that

(A) Visual and olfactory cues from flowers are equally effective in attracting moths.
(B) Visual cues are more effective than olfactory ones for flower recognition.
(C) Olfactory cues are more effective than visual ones for flower recognition.
(D) Moths integrate visual and olfactory cues in the process of flower recognition.

10. Consider a population that shows exponential growth over time: $N_t = N_0 e^{rt}$ where N_0 is initial population size at time = 0, N_t is population size at time t, r is the intrinsic rate of increase, and e is the constant 2.7i8... In such a population

(A) Population growth rate is highest when the population is small and declines over time.
(B) Population growth rate is smallest when the population is small, increases with time and reaches an asymptote.
(C) Population growth rate is smallest when the population is small and increases with time.
(D) Population growth rate is constant.

11. At a locus with two alleles with frequencies p and q, assuming Hardy-Weinberg equilibrium, the genetic diversity (measured as heterozygosity) is the highest when

(A) $p>q$
(B) $p<q$
(C) $p=q$
(D) $p+q<1$

12. Mass extinction of the dinosaurs occurred at ihe boundary of which geological periods?

(A) Jurassic and Cretaceous
(B) Cretaceous and Tertiary
(C) Tertiary and Quaternary
(D) Pleistocene and Holocene

13. The glow emitted by a firefly is due to

(A) Iridescence
(B) Incandescence
(C) Bioluminescence
(D) Fluorescence

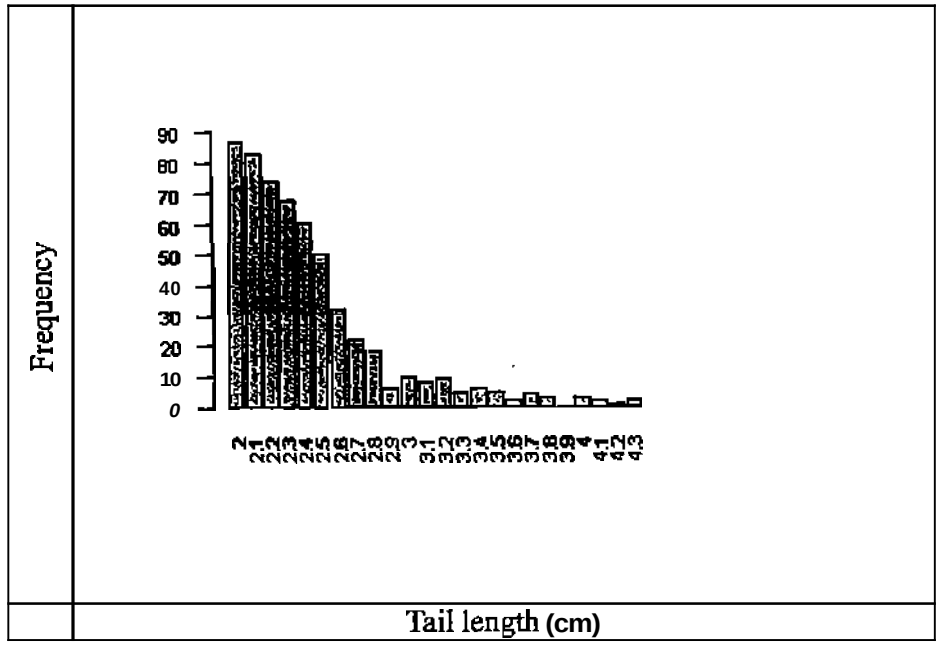
14. Batesian mimicry is an example of:

(A) assortative mating.
(B) heterozygote advantage.
(C) stabilizing selection.
(D) frequency-dependent selection.

15. Bacterial genes are transferred by viruses via the process of

(A) Transduction
(B) Transformation
(C) Conjugation
(D) Syngamy

16. **The figure below shows the distribution of tail lengths in a population of birds.**



For such a distribution, measures of central tendency will show the following pattern:

(A) mean > median > mode
(B) median > mode > mean
(C) mode > median > mean
(D) mode = median = mean

17. **Conservationists argue over whether reserves should be set aside in single large blocks or several small blocks. Single large reserves may be better because larger areas support more species. However, small areas may have advantages as well. One of the arguments proposed in favour of several small patches concerns**

(A) Habitat loss.
(B) Global climate change.
(C) Minimum viable populations.
(D) Disease.

18. A forest patch has 100 deer on Sunday, May 1, 2007. Hunting season opens on May 8,2007. Hunters kill 20 deer every Sunday. Each deer eats 1 kg of grass per day. If none *of* these populations are reproducing, how much grass would there need to be for the hunters to wipe out the deer population before the grass is wiped out?

(A) 700 kg
(B) 1.4 tonnes
(C) 2.1 tonnes
(D) 1.8 tonnes

19. Bird species A and B both nest in marshes. Species A is dominant over B when they are found together. Species B will occupy the entire marsh if Species A is absent, but if Species A is present, it will exclude Species B from the marsh center, and restrict Species B to the edge of the marsh. For Species B, the entire marsh would represent its

(A) realized niche.
(B) babitat.
(C) range.
(D) fundamental niche.

20. Marsupials are found in

(A) Australia and South America.
(B) Australia alone.
(C) Australia and Madagascar.
(D) Australia and Africa.

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

(A) Presence of seeds
(B) Alternation of generations
(C) Presence of xylem and phloem
(D) Presence of lignin in cell walls

22. A genome consists of four distinct DNA sequences. Assuming that any subset of these sequences can determine a trait, the maximum number of possible traits is

(A) 16
(B) 24
(C) 25
(D) 15

23. In a classical conditioning experiment, it was found that rats could be trained to avoid food that made them sick a few hours after ingestion if the food was paired with a specific odour during presentation. The aversive conditioning did not, however, work if the food was paired with a sound rather than an odour. This experiment shows that

(A) Rats are not as sensitive to sound stimuli as they are to odours.
(B) Both sound and odours need to be presented simultaneously with the food for successful conditioning.
(C) The efficacy of taste aversion conditioning varies for different kinds of stimuli.
(D) Taste aversion is harder to condition than other behaviours.

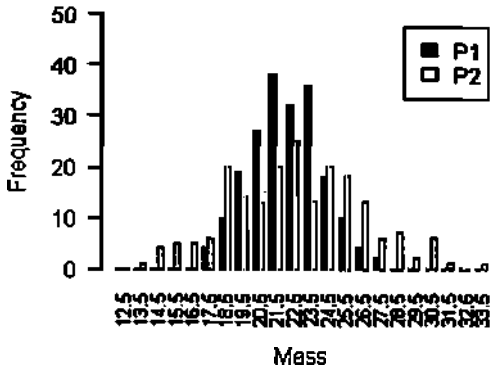
24. Mongooses belong to the Family

(A) Mustelidae
(B) Viverridae
(C) Herpestidae
(D) Hystricidae

25. Due to global warming, species of plants and animals can generally be expected to migrate from

(A) Higher altitudes to lower altitudes.
(B) Lower altitudes to higher altitudes.
(C) West to East along a given latitude.
(D) East to West along a given latitude.

26. The graph below shows the distribution of body masses in two populations P1 and P2. Which of these two populations needs a larger sample size to accurately estimate the mean?



(A) P1
(B) P2
(C) The information provided is not sufficient.
(D) Similar sample sizes are needed for both populations.

27. The following scientist is associated with both the field of sociobiology and the theory of island biogeography

(A) Konrad Lorenz
(B) Joseph Connell
(C) Stephen Hubbell
(D) E. O. Wilson

28. In a population of 100 diploid individuals, the frequencies of neutral alleles A1 and A2 are 0.4 and *0.6* respectively. Assuming Hardy-Weinberg equilibrium and no change in population size, the frequency of heterozygotes after five generations is

(A) *0.24*
(B) $(0.48)^5$
(C) 0.48
(D) *0.5*

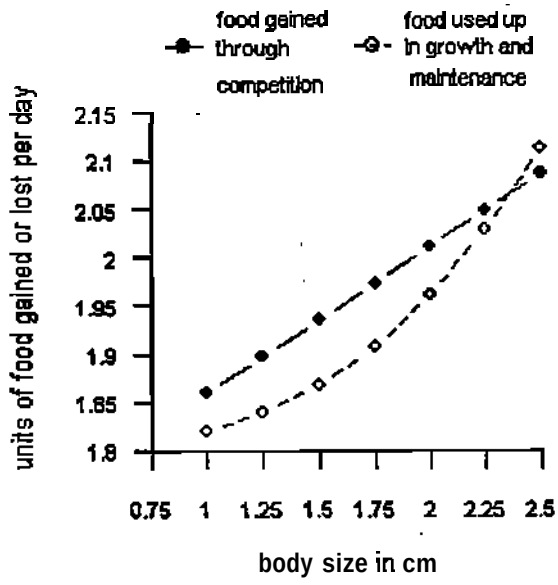
29. Climate change, habitat loss, ultraviolet radiation, fungal disease, overexploitation and invasives have been implicated in the decline of

(A) Frogs
(B) Vultures
(C) Tigers
(D) Snakes

30. Which of the following is not a source of genetic variation?

(A) Base substitution
(B) Genetic drift
(C) Recombination
(D) Base insertion

31. In a certain species of insect, larger-bodied individuals are better competitors for food, but large bodies also need more food for growth and maintenance. The graph below shows the relationship between body size and i. food gained in competition; ii. food required for growth and maintenance. What is the optimum body size according to this graph if we assume that individuals are maximizing net food gained after taking care of growth and maintenance?



(A) 1 cm
(B) 2.5 cm
(C) 2.25 cm
(D) 1.5 cm

32. Two resources may be described as antagonistic when

(A) Consuming both kills the animal.
(B) One can replace the other in an animal's diet.
(C) The animal requires proportionately more resources when both are consumed together.
(D) The animal cannot consume both simultaneously.

33. Chimpanzees are more closely related to humans than they are to gorillas, yet chimpanzees and gorillas appear morphologically very similar to each other. This is because

(A) Morphological characters have evolved convergently in chimpanzees and gorillas.
(B) Chimpanzees and gorillas have retained ancestral traits.
(C) Chimpanzees and gorillas are apes.
(D) Chimpanzees and gorillas hybridize.

34. The Shannon's index of diversity is calculated as $H' = -\sum p_i \ln p_i$, where p_i is the proportion of the i^{th} species. From the table below, we may conclude that

Species identity	Community A	Community B
A	3	1
B	4	2
C	8	1
D	2	3
E	5	2
F	6	1
G	4	15
H	5	13
I	3	3
J	5	4
Total	45	45

(A) Community A has a higher index of diversity.
(B) Community B has a higher index of diversity.
(C) The index of diversity is equal for the two communities.
(D) It is not possible to calculate this.

35. Starting from the outside of a cell and moving towards the inside, which of the following components of a 'typical' plant cell are organized correctly?

(A) Middle lamella ==> primary cell wall ==> secondary cell wall ==> plasma membrane ==> cytoplasm
(B) Plasma membrane ==> primary cell wall ==> secondary cell wall ==> middle lamella->cytoplasm
(C) Cytoplasm ==> plasma membrane ==> middle lamella ==> secondary cell wall ==> primary cell wall
(D) Middle lamella ==> secondary cell wall ==> primary cell wall ==> plasma membrane ==> cytoplasm

36. The cross between a mutant mother and a normal father gives rise to offspring *that* are all mutant; the reciprocal cross gives rise to offspring that are all normal. This means that the mutation is likely to be

(A) In the mitochondrial genome.
(B) In the nuclear genome.
(C) Dominant.
(D) Recessive.

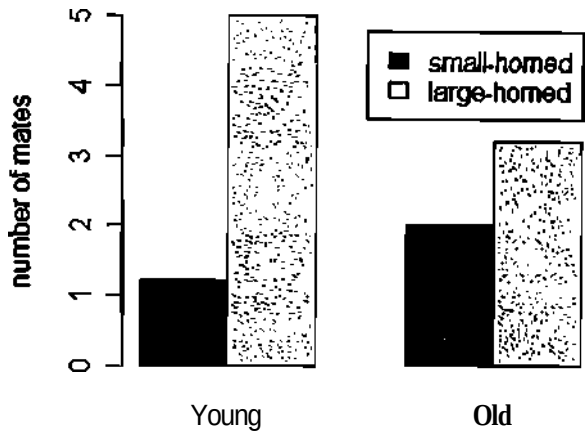
37. Isolated islands such as the Hawaiian and Galapagos islands have a higher proportion of closely related endemic species occupying different niches than the mainland. Which of ihe following statements is not a plausible explanation for the above observation?

(A) Very few species from the mainland colonize these islands.
(B) Species that colonize these islands eventually radiate into multiple species.
(C) Isolated islands often have numerous unoccupied niches.
(D) These islands have higher rates of species extinction

38. C4 plants and CAM plants are similar in their photosynthetic adaptations in which of these respects?

(A) In both cases, the stomata normally close during the day.
(B) Both types of plants make their sugar without the C3 (Calvin) cycle.
(C) In both cases, an enzyme other than Rubisco carries out ihe first step in carbon fixation.
(D) Both types of plants make most of their sugar in the dark.

39. Soay sheep males show two types of horn phenotypes: large-horned or small-horned. The mating success of the two phenotypes shows the following pattern:



Which of the following statements is <u>least</u> supported by the graph?

(A) Among small-horned males, mating success increases with age.
(B) Mating success of old, small-horned males is lower than that of old, large-horned males.
(C) Large-horned morphs consistently have greater mating success than small-horned morphs.
(D) Mating success of the two horn morphs changes with age in the same manner.

40. In population A, each woman bears exactly two female children, born at maternal ages 20 and 25. Population B is the same, except that the children are born when the mother is 25 and 30. Assume that these are the only differences between A and B. When the sizes of the two populations are monitored over time, we will find that

(A) Both are stationary.
(B) Both grow at the same rate.
(C) B grows faster than A.
(D) A grows faster than B.

41. *The* number of individuals or biomass at each trophic level is usually depicted as an ecological pyramid. Sometimes, inverted pyramids such as produced by a host parasite system, may be observed. These can be seen in

(A) Pyramids of numbers and biomass, but never energy.
(B) Pyramids of biomass and energy, but never numbers.
(C) Pyramids of energy and numbers, but never biomass.
(D) All kinds of pyramids.

42. If the average molecular weight of one amino acid is 110, the molecular weight of a peptide made up of 10 amino acids is expected to be

(A) 1100
(B) 938
(C) 876
(D) 744

43. You wish to compare the overall similarity in body form between four species of insects belonging to a particular group. To this end, you perform detailed morphometric measurements using 42 different characters on ten individuals of each species. An appropriate statistical test to quantitatively analyse morphological similarity would be

(A) A principal components analysis.
(B) An analysis of variance.
(C) A multiple regression analysis.
(D) A cluster analysis.

44. Which of the following is least likely to explain greater bird species diversity in the terrestrial tropics along a latitudinal gradient?

(A) Higher plant diversity
(B) Greater area
(C) Higher temperatures
(D) Higher rainfall

45. The maximum absorbance of light for a visual pigment is at 420 nm. A point mutation in the gene encoding this pigment shifts the wavelength of maximum absorbance to 320 nm. This would result in a transition in colour vision for the organism from

(A) Red to green sensitivity..
(B) Green to blue sensitivity.
(C) Blue to ultraviolet sensitivity.
(D) Blue to green sensitivity.

46. The total number of species of insects in two large fields is the same. Within each of these fields are two smaller patches. In Field 1, the two patches share very few species. In the other, the two patches share most species. Which of the following statements is true?

(A) The individual patches in field 1 have more species than in field 2.
(B) The individual patches in field 2 have more species than in field 1.
(C) The individual patches in both fields have the same number of species.
(D) There is high species turnover between fields 1 and 2.

47. Species that are most likely to have atrophied vision are those that

(A) Live in caves or underground.
(B) Live underwater.
(C) Are nocturnal.
(D) Live in the Arctic.

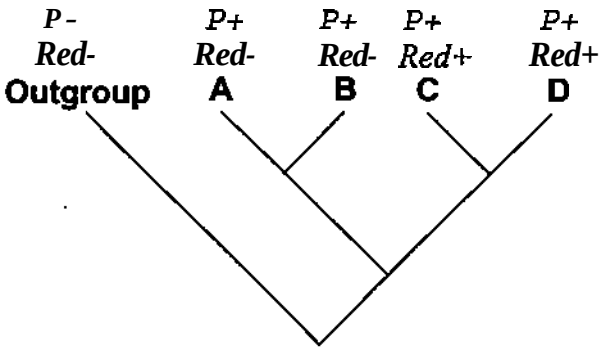
48. Which of the foliowing sets <u>does not</u> represent four members of Artiodactyla found in India?

(A) Chital, blackbuck, wild ass, barking deer.
(B) Blackbuck, chinkara, four homed antelope, gaur.
(C) Nilgiri tahr, barking deer, sambar, blue sheep.
(D) Blue sheep, Nilgiri tahr, goral, serow.

49. Which statement about Mendel's cross of *TT* peas with *tt* peas is ***not*** true?

(A) Each parent can produce only one type of gamete.
(B) F_1 individuals produce two types of gametes.
(C) Three genotypes are observed in the F_2 generation.
(D) Three phenotypes are observed in the F_2 generation.

50. The figure below shows evolutionary relationships among several species of fish. The distribution of two traits among these species is also shown. *Red+* indicates that males in this species show red colour on the throat while *Red-* indicates the absence of this trait. *P+* indicates that females in this species prefer to mate with males with a red throat in an experimental setting. P- indicates that females do not show such a preference. According to this figure, which of the following statements about the evolution of the red colour and the preference is best supported according to the principle of parsimony (simplest explanation involving the fewest evolutionary changes)?



(A) The preference evolved first followed by the evolution of the red colour.
(B) The red colour evolved before the preference and was subsequently lost in species A and B.
(C) The preference and the red colour evolved at the same time but the red colour was subsequently lost in species A and B.
(D) The preference evolved independently in species A, B, C and D, while the red colour evolved independently in species C and D.

51. The resolving power of the human eye is about

(A) 1 metre
(B) 0.1 m
(C) 1 millimetre
(D) 0.1 millimetres

52. Let us suppose there are 10 red socks and 10 green socks in a drawer. Suppose we were to draw two socks from the drawer at random, one after the other, without replacement (i.e. without putting back the first sock). What is the probability of getting two green socks?

(A) 0.237
(B) 0.278
(C) 0.5
(D) 1

53. Which of the following is not a shared feature of all chordates?

(A) Pharyngeal slits.
(B) Notochord.
(C) Dorsal nerve cord.
(D) Four-chambered heart.

54. In terrestrial vertebrates, sounds are sensed by

(A) Ciliary cells.
(B) Hair cells.
(C) Pillar cells.
(D) Basal epithelial cells.

55. Consider a plant with dehiscent seed pods. At what angle to the ground should the seeds be expelled if they are to travel the largest possible horizontal distance?

(A) 30 degrees.
(B) 60 degrees.
(C) 45 degrees.
(D) 90 degrees.

56. An island in the Indian Ocean is first colonized by bird species A. Several decades later, bird species B, a close relative of species A with a similar sized beak, also arrives and establishes itself on this island. Subsequently, the beak sizes of the two species diverge. This is an example of

(A) Adaptive radiation.
(B) Character displacement.
(C) Competitive exclusion
(D) Co-evolution.

57. Marine reptiles and mammals drink seawater to satisfy their water needs. They rid themselves of excess salts

(A) By producing concentrated, hyperosmotic urine.
(B) By secreting them out through specialised salt glands.
(C) By sweating.
(D) Through the faeces.

58. Oil starts to smell bad after being stored for a long time. This is because of

(A) A process of adaptation in our sense of smell.
(B) Glycolysis.
(C) Sedimentation .
(D) The conversion of hydrocarbon double bonds to single bonds.

59. Individuals of a bird species that sings at dawn were captured and kept singly in complete darkness for two months and their singing activity was continuously monitored. Each bird typically produced song everyday but, with time, the singing period no longer coincided with the dawn. When exposed to normal light the birds, within a couple of days, synchronised their singing activity with the dawn.
Which of the following statements is false?

(A) Light is not necessary for maintenance of a daily singing rhythm.
(B) Singing is controlled by a system with a periodicity of exactly twenty four hours.
(C) Singing is controlled by a system with a periodicity of approximately twenty four hours.
(D) Light is necessary to reset the rhythm of the song control system.

60. Which of the following is not a passerine?

(A) Magpie robin
(B) Small green barbet
(C) Crow pheasant
(D) Leaf warbler

61. In the fruit fly, a point mutation in one gene can cause the fly to develop four wings instead of two. This is likely to be because

(A) The mutation removed a piece of the chromosome.
(B) The mutation added an extra piece to the chromosome.
(C) One gene can regulate the activities of many other genes.
(D) There is a gene for four wings.

62. The presence of living and extinct ratites (flightless birds such as the ostrich) in Australia, Africa, New Zealand, Madagascar and South America can be best explained by

(A) Continental drift.
(B) Long-distance dispersal.
(C) Convergent evolution.
(D) Human-mediated transport.

63. Which statement about alleles is ***not*** true?

(A) They are different forms of the same gene.
(B) There may be several alleles at a locus.
(C) One allele might be dominant over the other.
(D) They occupy different loci on the same chromosome.

64. In honeybee colonies, the levels of mRNA of a specific gene called period (per) were found to be elevated in foragers as opposed to non-foraging members of the colony. Foragers are typically older than non-foragers in bee colonies. A few young 'precocious' foragers were found and their per mRNA levels were found to be as high as normal foragers. This experiment demonstrates that

(A) Foraging leads to an increase in per mRNA level.
(B) Increase in per mRNA level results in foraging behaviour.
(C) Per mRNA levels are higher in older bees, who also happen to be foragers.
(D) There is a positive correlation between per mRNA level and foraging behaviour.

65. Ears of different moth species are found on different parts of the body, including the thorax, wings, abdomen and proboscis. This suggests that

(A) Moths are evolving more rapidly than other insect groups.
(B) Ears in moths arose as a single event in their phylogenetic history.
(C) Ears in moths arose multiple times in their phylogenetic history.
(D) The structure of moth ears is different from those of other insect groups.

66. Imagine that we were interested in the surface area of a bird's wing, divided by the body length of the bird (call this "relative wing area" or RWA). From geometrical considerations alone, what would you expect when comparing the RWA of a small bird with that of a large bird? Assume that there is a strong positive correlation between wing length and body length.

(A) RWA of a small bird is expected to be larger than RWA of a large bird.
(B) RWA of a small bird is expected to be smaller than RWA of a large bird.
(C) RWA of a small bird is expected to be the same as the RWA of a large bird.
(D) RWA does not depend on the size of the bird.

67. Müllerian mimicry is when

(A) A harmless species mimics a dangerous species.
(B) A dangerous species mimics a harmless species.
(C) One harmless species mimics another.
(D) One dangerous species mimics another.

68. A study looked at how foraging animals should distribute themselves in an area where the habitat consists of many patches that vary in the abundance of resources. It proposed that the foraging rate of an individual in each resource patch should increase with the amount of resources available and decrease with the number of conspecifics in ihat patch. At equilibrium, all individuals attempt to maximise their foraging rates by moving between the patches. Which of the following assumptions is <u>not</u> made by this model?

(A) Individuals compete for resources.
(B) The amount of resources in a patch decreases with each additional arrival.
(C) Some individuals are better at competing for resources than other individuals.
(D) Individuals behave as if they bave complete information about the resources at all patches.

69. In the evolution of flowers, there have been major trends towards

(A) Radial symmetry, proliferation and separation of parts and ovary above the petals.
(B) Radial symmetry, reduction and fusion of parts and ovary below the petals.
(C) Bilateral symmetry, reduction and fusion of parts and ovary below the petals.
(D) Bilateral symmetry, proliferation and separation of parts and ovary above the petals.

70. The bacteria which cause septicaemia are fast becoming resistant to the antibiotics used for controlling them. Which one of the following explanations fits best?

(A) Each and every individual bacterium, in order to survive, develops a resistance to the antibiotic when exposed to it, and passes that resistance on to future generations.
(B) Only some bacteria, in order to survive, develop a resistance to the antibiotic when exposed to it, and pass that resistance on to future generations.
(C) A few bacteria bave a natural heritable resistance to the antibiotic, so they survive when exposed to it, and pass that resistance on to future generations.
(D) All the bacteria have a natural heritable resistance to the antibiotic, so they survive when exposed to it, and pass that resistance on to future generations.

71. You carefully study populations of two very similar field mice, one from Karnataka and one from Kerala. You want to know whether the populations belong to the same species or to two different species. You could most confidently decide this if you could

(A) Show that the ranges of the two mice overlap without hybridization occurring
(B) Bring the two types of mice into the laboratory to see if they will mate.
(C) Demonstrate that the natural ranges of the two types of mice are entirely allopatric.
(D) Show that the Karnataka mice Live in wetter habitats than the Kerala mice.

72. When plants do not receive enough water their photosynthetic rate drops significantly. This is because

(A) Water is a raw material needed for the light dependent reactions.
(B) The stomata close and carbon dioxide is not available.
(C) Sugar builds up and inhibits photosynthesis.
(D) Not enough oxygen is produced to keep glycolysis running.

73. Which of the following is the new species of macaque recently discovered in Arunachal Pradesh?

(A) *Macaca radiata*
(B) *Macaca mulatta*
(C) *Macaca munzala*
(D) *Macaca silenus*

74. In an aversive conditioning paradigm, bees were trained to associate the colour yellow with bitter tasting KCl solution. Bees that once experienced the bitter taste for 30 seconds in the presence of a yellow card placed next to the solution refused to sample any solution in the presence of the yellow card on subsequent encounters when tested 10, 30, 60 minutes, one day and one week after training. If the bees were cooled to 4 degrees C for 30 minutes immediately after encountering the stimuli, they no longer formed the association. If the cooling was started 10 min after the encounter, however, they were able to make the association. This experiment shows that

(A) Short term memory formation requires 30 minutes of exposure to the stimuli.
(B) Long term memory formation requires 30 minutes of exposure to the stimuli.
(C) Memory formation occurs within 10 rminutes of encountering the stimuli.
(D) Memory forrnation begins 10 minutes after encountering the stimuli.

75. You can see the sal tree *(Shorearobusta)* growing naturally in which of these regions?

(A) Aravallis of Rajasthan.
(B) Dooars of Bengal.
(C) Western Ghats of Karnataka.
(D) Andaman and Nicobar Islands.

76. A one sq.km forest patch contains 1000 trees. The average gbh (girth at breast height) is 6.2 m. The area of the canopy is 100 times the cross sectional area at breast height. If no sunlight penetrates through the canopy when the sun is overhead, what percentage of the forest floor receives sunlight? (Take pi = 3.1)

(A) About 30%
(B) About 50%
(C) About 70%
(D) About 90%

77. There is a small population of tigers. A genetic study shows that there is relatively little genetic difference between individuals. The most likely cause for this is

(A) They have a rare genetic disease.
(B) Recent heavy mortality due to poaching.
(C) The population was reduced to a few individuals in its recent history.
(D) Low diversity of prey species.

78. The lens of manyvertebrate eyes is the crystallised form of a protein that also functions during digestion as a metabolic enzyme. This is an illustration of the fact that

(A) Evolution is opportunistic.
(B) Digestion co-evolved with vision.
(C) Digestion evolved after vision.
(D) Vision evolved after digestion.

79. An ordered data set consists of one million DNA sequences arranged according to length. If you *were* asked to find a sequence of desired length, choosing each sequence in your search at random, you should be able to find the desired sequence in about

(A) 2 steps.
(B) 20 steps.
(C) 200 steps.
(D) 2000 steps.

80. During a study on fish in a pond, 200 fish are caught and marked on the first day. On the second day of sampling, 150 fish are caught, of which 50 are already found to be marked. What is the estimate of the total number of fish in the pond?

(A) 600
(B) 300
(C) 150
(D) 1200

81. A plant ecologist has to study the diversity of plants in a forest with a strong gradient of rainfall from North to South. A good sampling design would be

(A) Random placement of quadrats in the forest.
(B) Placement of quadrats fiom North to South.
(C) Placement of quadrats from East to West.
(D) Enumeration of all individuals in the forest.

82. From our understanding of energy flow through various trophic levels of an ecosystem, which of the following statements is correct?

(A) About 50% *of* the energy in one trophic level is passed on to the next level.
(B) Primary consumers have the highest ecological efficiency.
(C) Only a negligible amount of energy is lost along each link in the food chain.
(D) Producing meat is an inefficient way of obtaining energy trapped by photosynthesis.

83. Which of the following is closest to being iso-osmoiic to its environment?

(A) A freshwater protozoan
(B) A marine jellyfish.
(C) A marine reptile
(D) A freshwater bony fish.

84. In flying insects such as dragonflies, butterflies and grasshoppers, the wing beat frequency is low and each nerve impulse results in wing muscle contraction. In flies and bees, however, the wing beat frequency is several times the nerve impulse frequency. Which of the following is not an adaptation to achieve this?

(A) Synchronous contraction of horizontal and vertical muscles.
(B) An elastic thorax that acts as a mechanical oscillator.
(C) Alternate contraction of horizontal and vertical flight muscles.
(D) Fibrillar muscles that contract in response to being stretched.

85. In humans, the genetic relatedness between first cousins is

(A) 0.5
(B) 0.25
(C) 0.125
(D) 0.0625

86. Which of the following is not an exarnple of a fixed action pattern?

(A) Courtship singing by a male fruitfly
(B) The headstand display of a fighting fish.
(C) Goslings following their mother in single file.
(D) Pecking behaviour of newly hatched chicks.

87. Wild pigs regularly feed on sorghum crops but only within 1 m of the boundary of the crop field. Given this crop feeding behaviour, if a farmer wished to minimise the area damaged by wild pigs, which of the following configurations of crop fields should he prefer?

(A) One 20 X 20 m field.
(B) Four 10 X 10 m fields
(C) Hundred 2 X 2 m fields
(D) Twenty five 4 X 4 m fields

88. In a simple ecological system with two competitor species A and B competing over a single resource, theory predicts that stable co-existence of the two species is most likely when

(A) Interspecific competition is stronger than intraspecific competition in species A.
(B) Intraspecific competition is weaker than interspecific competition in species B.
(C) Intraspecific competition is stronger than interspecific competition in both species.
(D) Interspecific competition is stronger than intraspecific competition in both species.

89. Mites belong to the Class

(A) Diplopoda
(B) Crustacea
(C) Arthropoda
(D) Arachnida

90. When the net primary productivity (NPP) of a grassland is plotted as a function of the mean annual rainfall (R), which of the following functions would best describe the relationship between them?

(A) Linear
(B) Hyperbolic
(C) Negative exponential
(D) Positive exponential

91. Twenty transects were laid in an undisturbed evergreen forest and thirty were laid in an adjoining degraded forest, and data on the number of species of snakes seen in each of them over a one year period were recorded. To test whether species composiiion between evergreen and degraded forests is significantly different, which would be the most appropriate method of statistical analysis?

(A) Mann-Whitney U-test
(B) *t*-test
(C) Chi-square test
(D) Analysis of variance

92. Which of the following life history adaptations is least expected when predation pressure on a fish species that grows continuously throughout its lifespan is focused on large size classes?

(A) Allocate more resources preferentially to early reproductive effort than to growth.
(B) Allocate more resources preferentially to growth than to early reproductive effort.
(C) Early age at maturity.
(D) Produce many small offspring in relatively few reproductive seasons.

93. Which of the following is not an explanation for higher species richness in a community?

(A) Species are more specialised in their use of resources.
(B) Species have more overlap in their use of resources.
(C) A greater range of resources is available.
(D) Some species are better at utilising resources.

94. Which of the following is likely to be heard at the furthest distance from source from the caller (given that all calls are produced with the same loudness)?

(A) The alarm call of a langur.
(B) The chirping of a cricket.
(C) The song of a magpie robin.
(D) The clicks of a bat in a roost.

95. Identical genomes can give rise to strikingly different phenotypes. Which of the following is not an example of this?

(A) Morphological castes within social insect species.
(B) The larva and adult of a butterfly species.
(C) Male and female peafowl.
(D) Fraternal twins.

96. The influx of which ion is critical for neurotransmitter release at the synapse?

(A) Sodium
(B) Potassium
(C) Calcium
(D) Magnesium

97. Which of the following is a wrong explanation for why temperate and Arctic lakes never freeze completely solid?

(A) The hydrogen bonds in ice make ice less dense than liquid water.
(B) Water expands when it solidifies.
(C) Water is denser as a solid than as a liquid.
(D) Floating ice insulates the liquid water below.

98. The axolotl, a species of salamander, does not metamorphose, continues to be aquatic, and retains juvenile traits such as external gills even as an adult. This developmental phenomenon where juvenile traits are retained in adults is known as

(A) Embryogeny
(B) Neoteny
(C) Fluctuating asymmetry
(D) Developmental asynchrony

99. Which of the following is least likely as a general explanation for the evolution of aging?

(A) The force of selection on deleterious mutations acting late in the lifespan is weaker.
(B) Because of predation and stochastic events organisms have a lower probability of living long and therefore should invest more in reproduction than in body maintenance and repair.
(C) Because resources are typically limited, older individuals should avoid competing with their offspring for resources and therefore selection should reduce lifespan to prevent competition across generations.
(D) Pleiotropic genes that increase fitness earlier in life rnay have negative effects later in life that result in ageing.

100. The least likely explanation for the extinction of dinosaurs is

(A) Competition with mammals.
(B) Deccan trap volcanism.
(C) Climate change.
(D) Meteor impact.

End of Question Paper

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