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BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
Integrated Biology (BIO F214)
First Semester 2015-16
Mid Semester Test – Closed Book (Inbuilt Paper)

Date: 06/10/2015 Duration: 90 min Max Marks: 50 (25% weightage)

NAME: **ID NO.:**

Part I: MCQs [16 x 0.75M=12M]

Note: In the questions given below, select the most appropriate option. Each correct answer carries 0.75 mark; each wrong answer carries minus 0.25 mark.

1. Read the given statements and mark the correct choice.
Statement I: In some birds, such as the peacock, the males are more colorful than the females.
Statement II: The selective agent producing the evolution of conspicuous features is climate.

a. I is the correct explanation of II.
b. II is the correct explanation of I.
c. I is correct but II is not its correct explanation.
d. Both I and II are incorrect statements.

2. Natural selection acts on an organism's:
i. dominant alleles ii. recessive alleles
iii. phenotype iv. genotype

a. Only i is correct
b. Both i and ii are correct
c. Only iii is correct
d. Both iii and iv are correct

3. Which of the following can result in homoplasy?
i. Convergent evolution ii. Evolutionary reversal
iii. Divergent evolution iv. Shared ancestry

a. Only i
b. Both i and ii
c. Only iv
d. Both iii and iv

4. A plant population that reproduces by self-pollination is an extreme example of
a. bottleneck effect
b. founder effect
c. disruptive selection
d. assortative mating

5. Evolution of body size in horses would represent _____ selection, assuming constant evolutionary change through time.
a. Stabilizing
b. Directional
c. Disruptive
d. Frequency dependent

6. A deleterious allele decreases more rapidly in frequency if it is
a. recently mutated
b. rare
c. recessive
d. dominant

7. Sympatric speciation occurs most commonly in
i. mammals ii. fishes
iii. plants iv. birds

a. i and iv
b. i, ii and iv
c. ii
d. iii

8. Since the Pleistocene Ice Age, deserts have gradually formed in the southwestern United States. As the lakes and rivers of these areas shrunk into isolated springs, the fishes developed strong potential for
a. interspecies hybridization
b. speciation
c. autopolyploidy
d. alloploidy

9. A given allopolyploid has four sets of chromosomes. These have most likely come from
a. a single parental species
b. two parental species
c. four parental species
d. multiple interspecific hybridizations

10. The evolutionary history of a species or group of related species is its _____. The identification and classification of species is an area of biology known as _____.
a. taxonomy, phylogeny
b. systematics, phylogeny
c. phylogeny, systematics
d. phylogeny, taxonomy

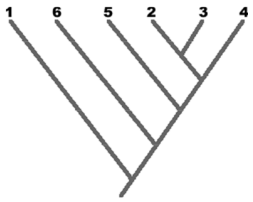
11. Genes are found in the same order for large stretches of the X chromosome in the rat and mouse genomes, indicating
a. regular aneuploidy
b. formation of pseudogenes
c. conservation of synteny
d. possible existence of hybrids

12. Characteristics between the branch points of a cladogram that are shared by all organisms above the branch point and are not present in any below it are called
a. homologous characters.
b. homoplastic characters.
c. ancestral characters.
d. derived characters.
e. novel characters.

13. Imagine two species of birds with similar beak sizes and diets. Where the two species are allopatric, we would expect that their beak sizes
a. should differ more than when sympatric.
b. should differ less than when sympatric.
c. should be larger than when sympatric.
d. should be smaller than when sympatric.

14. Consider the cladogram shown. Which pair of species shares the greatest number of derived characters (synapomorphies)?

a. 1 and 4
b. 2 and 3
c. 2 and 4
d. 3 and 4
e. 6 and 5



15. According to one report, populations of peppered moths (*Biston betularia*) of England changed from 1% dark and 99% light individuals to 99% dark and 1% light individuals between 1848 and 1898. The selective agent causing the change was
a. birds
b. humans
c. toxins from smoke
d. tree bark

16. Read the given statements and mark the correct choice.
Statement I: Founder effect may lead to formation of new species.
Statement II: Founders carry all the parental gene pool to a new location.
a. I is the correct explanation of II.
b. II is the correct explanation of I.
c. Both I and II are incorrect statements.
d. I is a true statement; II is a false statement.

Part II: Short answer type questions [8x1M=8M]

1. Which mechanism of prezygotic reproductive isolation is represented in each of the following cases?

(i) Two species of garter snakes occur in the same geographic area, but one lives mainly in water and the other mainly on land. Consequently they do not interbreed.

(ii) The genus *Rhagoletis* is a group of small, brightly coloured flies. Each species in the genus feeds, during its larval stage, on the fruit of just one plant family, and when the larvae hatch into adults, they court and mate on the same fruit. The species that feed on fruits from different plant families do not interbreed.

2. Arrange the following in order of increasing group size, beginning with the smallest: family, kingdom, species, phylum, genus, order, class

3. How do new alleles originate in the gene pool?

4. How could living fossils be used as an argument against Darwinian concept of speciation?

5. A paleontologist estimates that when a particular rock formed, it contained 12 mg of the radioactive isotope potassium-40.The rock now contains 3 mg of potassium-40. The half-life of potassium-40 is 1.3 billion years. From this information, estimate the age of the rock.

6. What is meant by 'alternation of generations'? In which organisms does it generally occur?

7. Mention in one line the ultimate objective achieved by character displacement.

8. Mention any two key factors that led to collapse of the ancient Mayan civilization according to the author Jared Diamond.

Part III: Subjective Type Questions [10x3M=30M]

Note 1: *Answer to the point.*
Note 2: *Justification is necessary for every answer. Simply answering without justification (or calculation, if required) would not fetch marks.*

1. Read the following paragraph and answer the questions that follow:
"The northern population of elephant seals was reduced by hunting to only 20 animals; it then returned to a large population of over 30,000. In the 24 gene loci examined by researchers, only a single allele was found at each of the loci."

(i) What conclusions would you draw as an evolutionary biologist? What problems do you foresee in restoring the original condition?
(ii) Can the above be called as convergent evolution? Justify briefly.

2. One out of every 10,000 newborns in the United States has phenylketonuria (PKU), a debilitating disease (when untreated) and a recessive disorder. What is the frequency of carriers of this disease (assuming Hardy-Weinberg equilibrium)? Show calculations clearly.

3. Imagine a population of 100 snails in which shell color is controlled by two alleles: B (black) and b (yellow).
(i) What is the total number of loci for the gene for shell color in this population? Show clearly how you arrived at the answer.
(ii) If, out of 80 black snails, 30 are homozygous and 50 are heterozygous, how many of the loci for this gene are occupied by the B allele? Show clearly how you arrived at the answer.

4. Fill in the blanks of the given paragraph with appropriate words/terms and represent the essence of the completed paragraph diagrammatically.
"A tetraploid individual forms _____ offspring when it crosses with a normal diploid from its parental species. Organisms with this number of chromosomes are _____. A new species is formed when a tetraploid mates with _____ or _____."

Diagram →

5. Mention briefly what are homologous genes. How are orthologous genes different from paralogous genes?

6. Show diagrammatically (well-labeled) the role played by the product of CFTR gene in the lungs of a normal person and that of a person affected with cystic fibrosis. Why do mice not suffer from cystic fibrosis-like condition even if the corresponding gene is present in mutated condition?

7. Humans share about 99% genomic similarity with chimps. Then why are the two so different? Also, depict the technique with a well-labeled diagram using which scientists could understand where the difference actually lies (in spite of the above similarity).

8. Animals with elaborate courtship behaviors evolve in areas where many similar species coexist. Why? Secondly, also answer with justification if this could qualify as an example of reinforcement.

9. What is antisense technology? Show diagrammatically (well-labeled) how this technology could be used as a drug for disease-treatment.

10. Briefly mention the different mechanisms of horizontal gene transfer in bacteria. How are these beneficial to the bacteria?

ROUGH WORK

Name: ID No.: