# 2016

## M.Sc.

## 3rd Semester Examination

## ZOOLOGY

### PAPER—ZOO-302

*Full Marks : 40*

*Time : 2 Hours*

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*Illustrate the answers wherever necessary.*

**Use separate Answer-scripts for Group-A & Group-B**

### Group-A

### ( Evolution )

1. Answer any *two* questions of the following :          2×2

   (a) State in brief at least two methods used in constructing phylogenetic tree.

   (b) Selection eliminates deleterious alleles from a population but recurrent mutation replerishes. Suppose recessive lethal allele (b) created at the rate of $2 \times 10^{-4}$ per generation. What is the expected frequency of lethal alleles in a population in mutation-selection equilibrium.

(c) Take a look at the $\alpha$-globin and $\beta$-globin sequences in human and horse. Which sequences are more similar? Based on your answer, would you conclude that the gene duplication that gave rise to the $\alpha$-globin and $\beta$-globin genes occured before or after the divergence of human and horses?

(d) Huntington disease results from a dominant mutation and the early on set reduces the reproductive fitness of affected individual by 20%. The frequency of dominant allele is 0.00005. Assume that population undergoes random mating and is in equilibrium. What is the estimated mutation rate to the dominant deleterious allele.

2. Answer any *two* questions of the following : 4×2

(a) In the distance matrix shown here, which pair of taxa should be joined first and what is the resulting UPGMA distance matrix?

|   | B | C | D |
|---|---|---|---|
| A | 8 | 15 | 19 |
| B |   | 18 | 16 |
| C |   |   | 5 |

(b) Describe what happens to allele frequencies during the bottle neck effect. Discuss the relevance of this effect with regard to species that are approaching extinction.

*(Continued)*

(c) Individuals with the genotype bb are 20 percent less fit than individuals with the genotypes BB or Bb. If B mutates to b at a rate of $10^{-6}$ per generation, what is the expected frequency of the allele b when the population reaches mutation-selection equilibrium ?

(d) Ten percent of the males of a large randomly mating population are color blind. A group of 1000 from this population migrates to a South Pacific Island, where there are already 1000 inhabitants and where 30% of the males are color blind. Assuming that Hardy-Weinberg conditions apply throughout, what fractions of males are expected to be color blind in the generation immediately following the arrival of the migrants ?

**3.** Answer any *one* of the following :　　　　　　　$8 \times 1$

(a) Pigmentation in a species of insect is controlled by a single gene existing in two alleles, D for dark and d for light. In a heterogeneous environment the allele frequencies are D = 0.7 and d = 0.3. This polymorphism is maintained because the environment contains some dimly lit forested areas and some sunny fields. During a hurricane, a group of 1000 insects is blown to sunny area. In this environment, the fitness values are DD = 0.3, Dd = 0.7 and dd = 1.0. Calculate allele frequencies in the next generation.

(b) (i) Explain the following equation in light of migration —

$$f(A) = {}^m P_x + {}^{(1-m)} P_y$$

(ii) Following is the estimated $T_{50}H$ value among four species (A – D) :

|   | A | B | C | D |
|---|------|-----|-----|---|
| A | 0 | | | |
| B | 0.4 | 0 | | |
| C | 0.3 | 0.5 | 0 | |
| D | 0.55 | 0.7 | 0.6 | 0 |

Calculate the actual evolutionary distance and draw a cladogram. 2+6

## Group-B

### ( Biochemistry )

4. Answer any *two* questions from the following : 2×2

(a) An enzyme catalyzed reaction has Km of 1 mM and $V_{max}$ of 5 $nM.S^{-1}$. What is the reaction velocity when the substrate concentration is —

(i) 0.25 mM

(ii) 10 mM 2

(b) Explain why ATP act as a competitive inhibitor in phosphorylation reaction of hexokinase. 2

(c) What type of rotational symmetry are possible for a protein with

(i) four or

(ii) six identical subunits ?

Give reason.                                              2

(d) Mention the differences between Type-I and Type-II $\beta$ bend.                                              2

5. Answer any *two* questions from the following :          $4 \times 2$

(a) State the process of $\beta$-oxidation of $\alpha$-linolenic acid in mitechondria.                                              4

(b) Illustrate the mechanism of aldol cleavage with proper diagram.                                              4

(c) The effect of pH on the activity of an enzyme was examined. At its active site, the enzyme has a ionizable group that must be negatively charged for substrate binding and catalysis to take place. The ionizable group has a pKa of 6.0. The substrate is positively charged throughout the pH range of the experiment.

$$E + S^+ \rightleftharpoons E - S^+ \longrightarrow E^- + P^+$$

$+$

$H^+$

$\Updownarrow$

$EH$

*(Turn Over)*
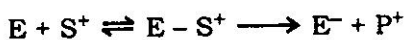
(i) Draw the $V_0$ versus – pH curve when the substrate concentration is much greater than the enzyme $K_m$.

(ii) Draw the $V_0$ versus – pH curve when the substrate concentration much less than the enzyme $K_m$.

(iii) At which pH will the velocity equal one half of the maximal velocity attainable under these conditions.

$$1+1+2$$

(d) Explain the repetative secondary structure of Myoglobin with the help of Ramachandran's diagram. 4

6. Answer any *one* of the following : 8×1

(a) (i) Illustrate the relationship of electron flow in Ubiquinone oxidoreductase and cytochrome oxidase.

(ii) What is Ketogenic amino acid ? 6+2

(b) (i) A mutation leads to carnitine deficiency. Deduce the mechanism of fatty acid oxidation in such a carnitine deficient cells.

(ii) State the reactions of oxidative phase of pentose phosphate pathway. 5+3

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