PG/IIIS/ZOO-302/15

M.Sc. 3rd Semester Examination, 2015

ZOOLOGY

PAPER – ZOO-302 (Gr.-A & B)

Full Marks : 40

Time : 2 hours

Answer **all** questions

The figures in the right-hand margin indicate marks

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

Write the answers to questions of each Group in separate books

GROUP – A

(*Evolution*)

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

   (*a*) Why the sequences of human and horse β-globin are much similar than the sequences of the human α-globin and human β-globin ?

(b) The frequency of new born intants homozygous for a recessive lethal allele is about 1 in 25,000. What is the expected frequency of carriers of this allele in the population ?

(c) What factors cause genetic drift ?

(d) A gene with two alleles is segregating in a population. The fitness of the recessive homozygotes is 90 per cent that of the heterozygotes and the dominant homozygotes. What is the value of the selection coefficient that measures the intensity of natural selection against the recessive allele ?

2. Answer any *two* of the following :   4 x 2

(a) Individuals with the genotype bb are 20% 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 ?

    (*Continued*)

(b) What is the UPGMA distance matrix for the gene tree shown here ?
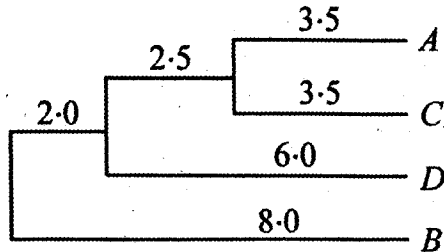
(c) Approximately one normal allele in 30,000 mutates to the X-linked recessive allele for haemophilia(h) in each human generation. Assume that one h allele in 3,00,000 mutates to the normal allele in each generation. The mutation frequencies are indicated in the following equation :

$$ h^+ \xrightarrow[\;\;\;\;v\;\;\;\;]{\;\;\;\;u\;\;\;\;} h $$
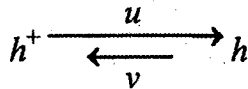
Where $u = 10\,v$, What allele frequencies would prevail at equilibrium under mutation pressures alones in these circumstances ?

(*d*) At a particular locus, there are two alleles, *B* and *b*. The mutation rate of *B* to *b* is 3.5×10^{-4} whereas the mutation rate of b to *B* is 6×10^{-8}. What is the equilibrium frequency of the *b* allele, assuming no other factor is operating in this population ?

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

(*a*) A population of 60 adult squirrels resides on VU campus and the frequency of G6PD allele among them is 0·70. Another population of squirrels is found in nearby forest and there the frequency of G6PD allele is 0·6. During flood 40 squirrels from the forest migrate to campus for food and shelter, what will be the allele frequency of G6PD allele in the campus population after migration ?

(*b*) A homologous DNA region, which was 1000 bp in length was sequenced among four different species. The following number of nucleotide differences were obtained :

	Human	Baboon	Chimpanzee	Gorilla
Human	0	44	72	50
Baboon	·44	0	79	40
Chimpanzee	72	79	0	77
Gorilla	50	40	77	0

Construct a phylogenetic tree that describes the evolutionary relationships among these 4 species. Your tree should include values that show the percentage of nucleotide differences.

GROUP – B

(*Biochemistry*)

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

 (*a*) Name the amino acids present in glutathione and its role in insulin metabolism. 1 + 1

 (*b*) Why are uncompetitive and mixed inhibitors generally considered to be more effective in vivo than competitive inhibitors. 2

(c) What are the differences between domain and motif of a functional protein ?   2

(d) Explain why degradation of odd chair fatty acids can boost the activity of cytric acid cycle.   2

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

(a) Define allosteric enzymes. Mention the properties of allosteric enzyme.   1 + 3

(b) Explain how does the co-ordinated actions of transaldolase and transketolase recycles xylulose-5 phosphate to Glucose-6 phosphate.   4

(c) State the mechanism of glucose induced structural changes in hexokinase and comment on its biochemical significance. 3 + 1

(d) State the biochemical steps of oxidation of propionyl-CoA. In what ways peroxisomal β-oxidation are different from mitochondrial β-oxidation.   2 + 2

(*Continued*)

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

(*a*) (*i*) Illustrate flow of electrons through *Q* cycle and describe the structure of two diffusable electron carrier associated with the *Q* cycle.

   (*ii*) Explain the types of symmetric patterns of protein folding in multimeric proteins.   3 + 3 + 2

(*b*) (*i*) Describe the structure of TIM barrel (α/β barrel).

   (*ii*) What are the advantages of having final product of multistep metabolic pathway inhibit the enzyme that catalyzes the first step.

   (*iii*) Comment on Hydrophobic interactions must be important determinant of protein structures.   4 + 2 + 2

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