Introduction to Biology II

End semester question paper

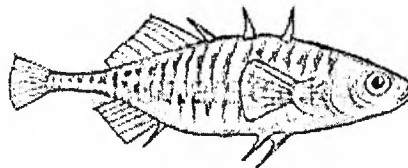7th May 2019

Duration = 2.5 hours   Total = 40 marks (30+ 10)

This question paper consists of two parts. Part A deals with Evolutionary Biology, while Part B deals with Genetics. Please answer Part A in the main answer paper and Part B in the supplementary sheet. Do not tie these two answer paper together.

PART A

Answer any five questions. Each question carries 2 marks

1) Consider the Stickleback fish, a diagram of the same has been provided below. Note the spines on its body. Frame two proximate and two ultimate questions regarding this structure.

2) How is artificial selection similar to natural selection, explain with an example.

3) Write three differences between the theory of evolution proposed by Lamarck and the theory of Natural selection.

4) Give an example of parallel evolution and convergent evolution. Why are they considered to be different from each other?

5) Draw a tree of life based on the following information. On this tree depict the following species. Species A has evolved from species Z in the recent past. Species B which is extinct had evolved from species Z several thousand years back. Species C evolved from species B and has shown adaptive radiation into species E, F, G and H.

ichthyosaur, dolphin.

6) Outline the five points that constitute the theory of natural selection in your own words. Mention when it was proposed and who proposed it.

7) What is intra-sexual selection? Explain how this impacts the fitness of females and males of the species. Mention one organism that displays this kind of selection.

Answer any five questions. Each question carries 4 marks

8) A large number of lions within a National park, died due to a viral infection recently. In order to conserve Lions biologists came up with two strategies. The first one was to keep the whole population of lions within one geographical area and the second one was to sub divide the population into two/three and house them in separate geographical locations within the country. The living conditions, protection and all other factors in the different areas where lions are going to be released are suitable for them. As a student of Evolution, what is your suggestion regarding the best strategy? Justify your answer.

9) Consider a small bird the size of a sparrow. This bird breeds during summer and migrates to an island which is warm during winter.At the onset of summer they are known to setup territories, choose partners and nest as soon as they come back from their migration. One subpopulation of these birds has recently discovered a new wintering area that was half the distance as compared to their usual migrating island, thus this subpopulation gets back to the summer grounds significantly faster. What are the likely consequences for the main population and this subpopulation over the next 100 thousand years, assuming that they continue to migrate in a similar manner?

10) Is there any experimental proof for the theory of Natural selection? If yes, explain this experiment and its results in a simple flow

diagram. If no, mention why such experimental proof has not been provided.

11) A spider that lives in the Rainforests of Brazil has a black coloured body with yellow dots on it. This spider is undergoing disruptive selection regarding these dots. Make a diagram of the original population and the resultant population. Also give a possible reason/speculate on why there is a selection pressure on these yellow spots.

12) Researchers examining the Indian peacock found that males that had long tails had smaller number of parasites in their body, while those with smaller tails had a larger number of parasites in their body. Further they found a negative correlation between tail length and parasite load in these birds. Can you explain why this maybe happening and what is the implication of this finding?

13) There was a mutation A1 in the DNA within a somatic cell which caused a major change in the translation product of a gene. There was a mutation A2 in the DNA within germ cells, and this did not cause any change in the translation product of a gene. There was another mutation A3 in the DNA within germs cells, which caused a conformational change in the translation product of a gene. All of these mutations occurred in different individuals in a population of crabs living off the coast of Orissa. What is the impact of A1, A2 and A3 on the population of these crabs? Which of these mutations is likely to have a bigger impact on the evolution of these crabs?

PART B

(Attempt any two questions)

Q1. A polypeptide has the following amino acid sequence: **Met-Ser-Pro-Arg-Leu-Glu-Gly**
The amino acid sequence of this polypeptide was determined in a series of mutants listed below. For each mutant, indicate the type of mutation that occurred in the DNA (single-base substitution, insertion, deletion) and the phenotypic effect of the mutation (nonsense mutation, missense mutation, frameshift, etc.).

a. Mutant 1: Met-Ser-Ser-Arg-Leu-Glu-Gly
b. Mutant 2: Met-Ser-Pro
c. Mutant 3: Met-Ser-Pro-Asp-Trp-Arg-Asp-Lys
d. Mutant 4: Met-Ser-Pro-Glu-Gly
e. Mutant 5: Met-Ser-Pro-Arg-Leu-Leu-Glu-Gly

Please comment on the nature/identity of the mutagen that might have caused the possible change in each case with proper reasoning. (5)

Q2. What is basic principle of Sanger Dideoxy Sequencing? Draw the bands that should appear on the gel from the four sequencing reactions. The output DNA sequence information from the gel is 5'- TGACTAGTGATGCATAGC-3'? (5)?

Q3. In *D. melanogaster*, cherub wings (ch), black body (b), and cinnabar eyes (cn) result from recessive alleles that are all located on chromosome 2. A homozygous wild-type fly (ch$^+$, b$^+$, cn$^+$) was mated with a cherub, black, and cinnabar fly (ch, b, cn) and the resulting F1 females were test-crossed with cherub, black, and cinnabar males. The following progeny were produced from the testcross:

ch b$^+$ cn	105
ch$^+$ b$^+$cn$^+$	750
ch$^+$ b cn	40
ch$^+$ b$^+$ cn	4
ch b cn	753
ch b$^+$ cn$^+$	41
ch$^+$ b cn$^+$	102
ch b cn$^+$	5
Total	1800

a. Determine the linear order of the genes on the chromosome (which gene is in the middle? (2)
b. Calculate the recombinant distances between the three loci. (3)