Introduction to Biology II

End semester question paper 4th May 2016

Duration = 3 hours   Total = 50 (35+15) marks

Part 1 = Evolutionary Biology

Make sure that you write short to the point answers. There is no need to repeat the question just mention the question numbers.

I.   **Answer the following 6 questions. Each question carries 1 mark**

1. Worker honeybees commit suicide in order to protect their colonies. This is explained by
    A) Sexual selection
    B) Handicap principle
    C) Natural selection
    D) None of the above

2. A form of evolution in which organism that interact with each other evolve similar changes despite their ancestors being very dissimilar is termed as
    A) Convergent evolution
    B) Adaptative radiation
    C) Parallel evolution
    D) Divergent evolution

3. Even though two rather dissimilar looking lizards that lived on islands were seen mating with each other but they did not produce any offspring. What is this phenomenon
    A) Allopatric speciation
    B) Sympatric speciation
    C) Hybrid infertility
    D) Geographic isolation

4. Which of the following words is derived from Latin and means "to unfold"
    A) Species
    B) Adaptations
    C) Evolution
    D) None of the above

5. The central motto of Evolutionary Biology is
   A) Increase your fitness
   B) Increase variation within populations
   C) Humans are the most evolved species on the planet
   D) All of the above

6. What are the three postulates of Lamarck's theory of evolution? When did he propose this theory?

7. In a population of fresh water fish, the males were brightly coloured as compared to females. Males were known to fight with each other and set up territories. Following which females would visit these territories. During these visits males displayed with their fins and body colorations. Only if the females were impressed with the size of the territory and the display of the males they stayed within territory to build a nest and produce offspring. What is this phenomenon?

II.   Answer any seven questions. Each question carries 2 marks

8. Explain what is discontinuous and continuous variations. Give one example each in humans. If there is a change in the environment are discontinuous or continuous more likely to be impacted?

9. What is artificial selection? How can this be used to support the theory of natural selection?

10. Explain the Biological species concept and how it is different from Morphological species concept.

11. Consider the following schematic diagram. Point out 4 problems in this depiction of Natural selection.

Generation 1   Generation 2

———→   Within the lifetime
- - -→   Parent to offspring
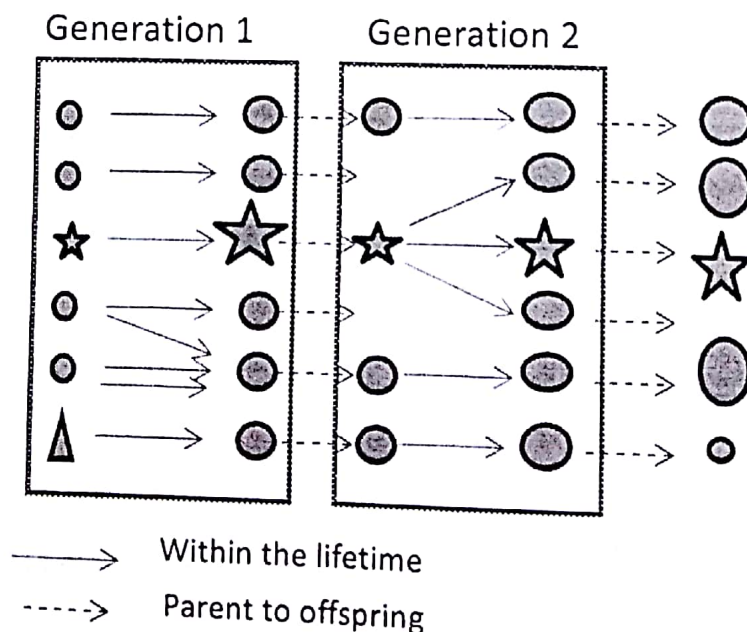
12. Inside a small cave in the Himalayan range, scientists have discovered an object. This object responds to stimulus and is capable of generating energy. Based on these findings can we conclude that this object has life? Given reasons for your answer.

13. Mention three reasons why organisms are not built to perfection by Natural Selection?

14. Who proposed the Handicap principle? How is it applicable to the lions?

15. Scientists note a mutation in a gene that codes for an important enzyme in the protein synthesis pathway of a virus that causes a deadly disease in mouse. This mutation enhances the virus's ability to replicate. Can you apply the concepts of differential fitness to this population of virus and speculate on the implications.

16. What are the processes that can alter the frequency of different alleles within a population? Name these processes and explain one of them with an example.

III.   Answer any three questions. Each question carries 5 marks

17. Outline the five points that constitute the theory of natural selection. Mention the names of the people who proposed it.

18. Consider a small bird – Red vented Bulbul that lives in our campus. This brown-black bird has a red coloured area at the base of its tail. Speculate on three possible functions for this red coloured patch and design an experiment to test one of your speculations.

19. List five different concepts that support the theory of Natural selection and give one example for each.

20. Consider two islands that are about the same size. However one of them is three times further away from the mainland as compared to the other. Can we predict the number of species of birds that these islands will host? Explain your answer.

PART 2 = Genetics

Attempt any two questions only. (7.5X2)

Q1a). Black fur in mice (B) is dominant to brown fur (b) Short tails (T) are dominant to long tails (t). What fraction of the progeny of the cross BbTt × BBtt will have black fur and long tails? (3.0)

Q1b). A man with type AB blood marries a woman with type B. The woman's mother has O type blood group. List the expected geneotype and phenotype of the newly maried man and woman. (3.0)

progenies of

Q1c). In a cross *AaBbCc* × *AaBbCc*, what is the probability of producing the genotype AABBCC? (1.5)

<center>OR</center>

Q2a) The following is the amino acid sequence of a part of a protein encoded by a gene "X"

....Phe Leu Val Pro Ser Tyr Cys...

A mutant for gene "X' is isolated following treatment with a mutagen. The amino acid sequence of the same region encoded by the mutant gene is as follows:

...Phe Leu Phe Arg Arg Ile......

Which mutagens is most likely used? (3.0)

Q2b) A transcription factor X recognises and binds to a DNA sequence GAATC. But in presence of glucose, the factor X cannot bind to DNA. Due to a certain mutation the mutant factor X now recognises a DNA sequence GAAGC and binds to DNA even in presence of glucose. What is the type of mutation the factor X has acquired? Justify your answer. (2.5)

Q2c). Acridine orange is known to induce mutations. Two bacterial cultures i) log phase culture and ii) stationary phase culture were subjected to acridine orange. Please compare the mutation rate between the two cultures and explain. (2.0)

<center>OR</center>

Q3a). Two recessive genes in *grasshopper* (*pr* and *wg*) produce purple body and rudimentary wings respectively. A third recessive gene, *vermilion (v)*, produces vermilion eye colour. When wild type *grasshopper* are testcrossed all the F₁ flies are trihybrid. When the F₁ females are test crossed, the results are as follows:

Wild type : 664
purple, vermilion, wingless: 652
purple,vermilion: 72
wingless: 68
purple : 70
vermilion, wingless: 62
purple, wingless : 4
vermilion: 8

Find the order of the genes and map distance between them (4.5)

Q3b). In the F2 generation of a hybrid tomato experiment 3629 fruits were red, while 1175 were yellow. A 3:1 ratio was expected. Are the discrepancies between observed and expected significant? Please use the chi square table given below for analysis. (3.0 marks)

Table 5-2

Critical Values of the χ^2 Distribution

df	p 0.995	0.975	0.9	0.5	0.1	0.05	0.025	0.01	0.005	df
1	.000	.000	0.016	0.455	2.706	3.841	5.024	6.635	7.879	1
2	0.010	0.051	0.211	1.386	4.605	5.991	7.378	9.210	10.597	2
3	0.072	0.216	0.584	2.366	6.251	7.815	9.348	11.345	12.838	3
4	0.207	0.484	1.064	3.357	7.779	9.488	11.143	13.277	14.860	4
5	0.412	0.831	1.610	4.351	9.236	11.070	12.832	15.086	16.750	5
6	0.676	1.237	2.204	5.348	10.645	12.592	14.449	16.812	18.548	6
7	0.989	1.690	2.833	6.346	12.017	14.067	16.013	18.475	20.278	7
8	1.344	2.180	3.490	7.344	13.362	15.507	17.535	20.090	21.955	8
9	1.735	2.700	4.168	8.343	14.684	16.919	19.023	21.666	23.589	9
10	2.156	3.247	4.865	9.342	15.987	18.307	20.483	23.209	25.188	10
11	2.603	3.816	5.578	10.341	17.275	19.675	21.920	24.725	26.757	11
12	3.074	4.404	6.304	11.340	18.549	21.026	23.337	26.217	28.300	12
13	3.565	5.009	7.042	12.340	19.812	22.362	24.736	27.688	29.819	13
14	4.075	5.629	7.790	13.339	21.064	23.685	26.119	29.141	31.319	14
15	4.601	6.262	8.547	14.339	22.307	24.996	27.488	30.578	32.801	15