

BIOLOGY B242: EVOLUTIONARY AND ECOLOGICAL GENETICS

EXAM 2002

Answer ONE question from section A, TWO questions from section B, and ALL OF section C (overleaf). Each section carries 1/3 of the marks on the paper.

SECTION A. Answer ONE of questions 1-3.

1. "Punctuated equilibrium" has been the subject of intense debate within evolutionary biology. Use at least three appropriate examples to evaluate the validity of this concept.
2. How does sexual selection differ from natural selection?
3. Describe in full how one would use a "phenetic" approach to reconstruct a phylogeny. Include an assessment of the plausibility of the assumptions of the method.

SECTION B. Answer TWO of questions 4-8.

4. "Mimicry is a marvellous example of natural selection." Discuss with reference to natural examples.
5. Typically, natural populations display significant variation at the level of the phenotype. Use illustrative examples to show how such variation can arise from a) discontinuous environmental variation and b) discontinuous genetic variation.
6. "No-one has ever witnessed speciation." Is this true? And what other evidence might we use to understand speciation.
7. Describe and discuss three ways in which genetic drift might be an important component of evolution in nature.
8. "The sex-ratio of 50% males and 50% females is an example of an evolutionarily stable strategy (ESS)." Explain the logic behind such a statement.

Remember to answer Section C overleaf!

TURN OVER

SECTION C. Attempt ALL parts of question 9.

9. Jaeken syndrome consists of severe skeletal and liver abnormalities in humans. The disease is due to a recessive effect of 24 different alleles ($Pmm2^{d-}$) at an autosomal gene coding for the enzyme phosphomannomutase 2. A survey affected individuals focusing on one of these alleles, $Pmm2^{d-141}$, revealed the following genotypes:

$Pmm2^{d-other}/Pmm2^{d-other}$	$Pmm2^{d-other}/Pmm2^{d-141}$	$Pmm2^{d-141}/Pmm2^{d-141}$
11	43	0

- Calculate the allele frequencies among the population of affected individuals.
- Calculate the genotypic frequencies expected under the hypothesis of random mating. (Note: genotypic groups within populations, in this case the affected individuals, can be treated as randomly mating if the whole population is randomly mating).
- Carry out a chi-square test of the hypothesis of random mating. Is there any evidence for a deviation from the expected genotypic frequencies? Whether or not the deviation is significant, what, in your view, would be the most likely cause of such a deviation?
- Use your results to calculate the strength of the effect for which you have argued in (c).
- Has medical science allowed a massive increase in the frequency of deleterious genetic diseases?
 - What can and should we do to prevent genetic diseases from spreading?
 - Should inbreeding be allowed?

Describe briefly how population genetics might help to answer each of these questions.

END OF PAPER