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# SL Paper 3

- a. Compare sympatric speciation and allopatric speciation. [2]
  - c. Discuss the concept of punctuated equilibrium. [3]
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- a. Compare convergent and divergent evolution. [2]
  - b. Explain how polyploidy can contribute to speciation. [4]
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Discuss gradualism and punctuated equilibrium as ideas about the pace of evolution.

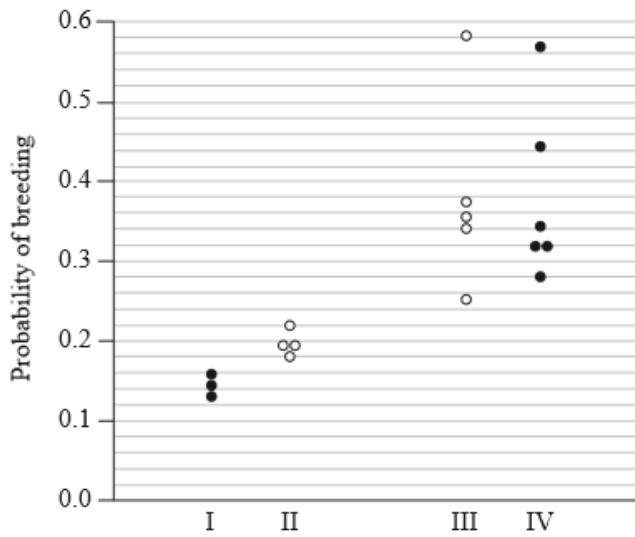
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- a. Outline the process of adaptive radiation. [3]
  - b. There has been a change of thinking; moving from gradualism to punctuated equilibrium demonstrates the changing nature of science. Discuss [4] these two ideas about the pace of evolution.
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Populations of threespine sticklebacks (*Gasterosteus sp.*), a fish living in small freshwater lakes in British Columbia, Canada, are derived from the marine threespine stickleback (*Gasterosteus aculeatus*). In order to investigate the process of speciation in these populations, three small lakes were studied. Each lake contained two varieties of stickleback: a large, bottom-dwelling variety that fed on invertebrates near the shore and a small, plankton-eating variety that lived in the open water. The probability of breeding between pairs of individuals was measured under laboratory conditions in the following breeding combinations:

- I different varieties (small × large) from the same lake
- II different varieties from different lakes
- III same variety (small × small) and (large × large) from different lakes
- IV same variety from the same lake.

The data are summarized below.



From H. D. Rundle et al. (2000) *Science*, 287, pp. 306–308. Reprinted with permission from AAAS.

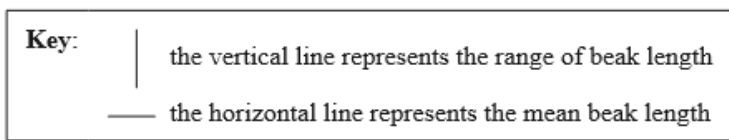
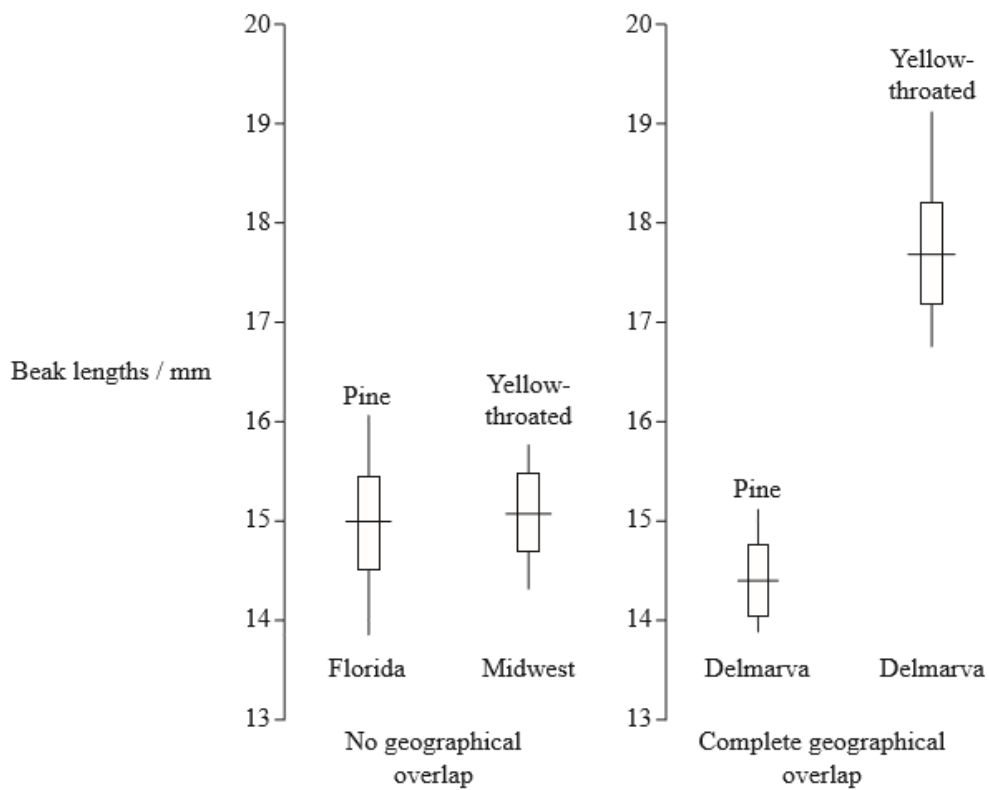
- a. Identify the highest and lowest probabilities of breeding for individuals of the same variety from different lakes. [1]

Highest probability: .....

Lowest probability: .....

- b. Identify the breeding combination that results in the lowest probability of breeding. [1]
- c. Analyse the probability of breeding between individuals from the same lake. [2]
- d. Scientists concluded that speciation is taking place in these populations. Discuss the evidence for speciation provided by the data. [3]

Competition between genetically similar species of birds may lead to changes of one or more characteristics. One characteristic that results from this kind of selection is differences in the beaks. Researchers studied the beak lengths of two species of warblers. The graphs below show the beak lengths of Pine Warblers (*Dendroica pinus*) and Yellow-throated Warblers (*Dendroica dominica*) from three geographically isolated areas in the USA.



R. Ficken *et al.* (1968) *Evolution*, 27, pp. 307–314. Republished with the permission of Wiley-Blackwell.

- a (i) Identify the species with the shortest mean beak length. [1]
- a (ii) Determine the difference in the mean beak length of the two populations of Yellow-throated Warblers in Midwest and Delmarva. [1]
- a (iii) Compare the range of variation in beak length of the Yellow-throated Warblers in Midwest to the beak length of the Yellow-throated Warblers in Delmarva. [1]
- b. Suggest an advantage for the longer beaks of Yellow-throated Warblers in Delmarva. [1]