



ANSWER BOOK

Speciation: how one gene pool becomes two, and why the line is genuinely fuzzy

Evolution and speciation · Unit B19

AQA 3.4.5, 3.7.3 · OCR A 4.2.2, 6.1.2 · Edexcel A Topic 4, Topic 5 · CAIE 17.3, 18.1

6 questions · 22 marks

NAVY EDITION

SECTION A · Short, 1 to 2 marks

- A1** **B1** a group of organisms with similar characteristics that can interbreed to produce fertile offspring, and which are reproductively isolated from other such groups. **B1** reproductive isolation is the state in which gene flow between two populations has stopped, because of some feature of the organisms themselves or of where and when they breed. [2]
-

SECTION B · Standard, 3 to 5 marks

- B1** the island population is geographically isolated from the mainland one, so gene flow between them stops and alleles no longer pass from one gene pool to the other. **B1** different random mutations occur in the two populations, and because they are no longer interbreeding those mutations are not shared. **B1** conditions on the island are not identical to those on the mainland, so different selection pressures act and different alleles are advantageous in each population. **B1** the island population is small and was founded by a sample of the mainland alleles, so genetic drift changes its allele frequencies by chance as well. **B1** over many generations the two gene pools diverge until the differences include features affecting reproduction, so the two forms could no longer interbreed to produce fertile offspring even if they met: they are reproductively isolated and are two species. [5]
-
- B2** **B1** two related species hybridise, and the hybrid carries one set of chromosomes from each parent. **B1** those chromosomes have no partner to pair with at meiosis, so the hybrid cannot make functional gametes and is sterile. **B1** the chromosome number then doubles, so every chromosome acquires a partner, meiosis works again and the plant is fertile with others like itself. **B1** crossed back to either parent species it gives offspring whose chromosomes cannot pair evenly, so it is reproductively isolated from both parents from the moment it forms. *Spartina anglica* arose this way on British salt marsh around 1890. [4]
-
- B3** **B1** prezygotic mechanisms act before a zygote forms and stop the gametes ever meeting, whereas postzygotic mechanisms act after fertilisation, on the zygote or on the hybrid. **B1** prezygotic examples include temporal isolation, where plants whose flowering peaks are a month apart exchange almost no pollen, and behavioural isolation, where a female does not respond to another population's courtship display. **B1** postzygotic examples include hybrid inviability, where the embryo develops abnormally and dies, and hybrid sterility, as in the mule, whose 63 chromosomes cannot pair at meiosis. **B1** postzygotic mechanisms are wasteful, because gametes and often an embryo have been spent for nothing, whereas prezygotic mechanisms prevent that expenditure, and most well-established species pairs are kept apart by several mechanisms at once. [4]
-

-
- B4** **B1** on the biological species concept they are not yet two species, because [4]
they can interbreed to produce fertile offspring, so no postzygotic barrier has
developed. **B1** gene flow in the lake is nevertheless much reduced, because the two
forms spawn in different places, which is ecological isolation acting before any
gametes meet. **B1** the difference in colour may act as a behavioural barrier as well, if
each form recognises and prefers a mate of its own colour, so matings between the
forms are rare even where the fish do meet. **B1** this is sympatric divergence in progress:
there is no geographical barrier, and if the separation persists the two gene pools may
diverge far enough for reproductive isolation to become complete.
-
- B5** **B1** in allopatric speciation a physical barrier stops gene flow completely from [3]
the start, so the two gene pools change independently of each other. **B1** in sympatric
speciation the two groups remain in the same place, so individuals can still meet and
interbreed and gene flow can continue. **B1** gene flow mixes the alleles of the two groups
and so erases the divergence as it accumulates, which means an ecological,
behavioural or temporal separation, or else polyploidy, has to reduce interbreeding
from the outset for divergence to build up at all.
-