

(a) Explain the meaning of each of the following terms.

(i) Species.

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[2]

(ii) Isolating mechanism.

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[2]

(b) Distinguish between each of the following pairs.

(i) Allopatric speciation and sympatric speciation.

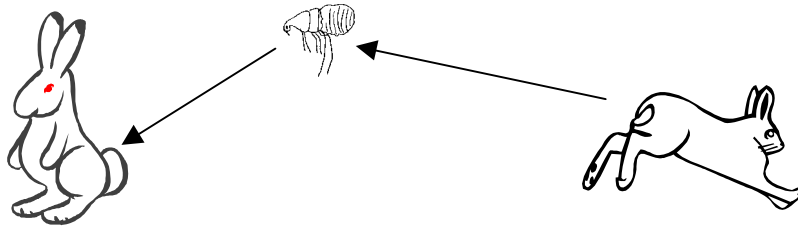
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[4]

(ii) Prezygotic reproductive isolation and postzygotic reproductive isolation.

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[4]



Myxomatosis is a virus disease in rabbits which is transmitted from rabbit to rabbit by rabbit fleas. The virus causes blindness and then death. 12 rabbits were released in Australia in 1859. They reproduced rapidly and started to spread quickly, so that by 1886 they were advancing at about 66 miles per year. By 1905 they had spanned the continent. Rabbit proof fencing was inadequate to halt their progress.

In an attempt to control the huge rabbit population myxomatosis was introduced in 1950. It spread through the rabbit population resulting in a 99.9% mortality rate. Over the next few years, however, the rabbit population recovered although not to the pre-myxomatosis numbers. The mortality rate to myxomatosis in rabbits at present is around 40%.

(a) Suggest two reasons for the rapid spread of rabbits across Australia between 1859 and 1905.

- 1
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- 2
- [2]

(b) Suggest two reasons for the very high mortality rate in the rabbit population when myxomatosis was introduced in 1950.

- 1
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- 2
- [2]

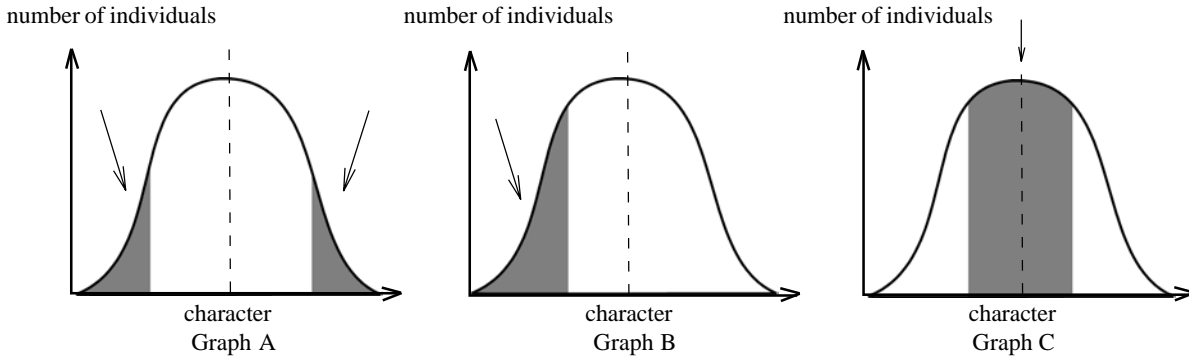
(c) With reference to the genetic mechanisms involved explain the recovery of the rabbit population from the devastating effects of myxomatosis after its introduction in 1950.

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- [4]

(d) Suggest why there is still a 40% mortality rate to myxomatosis in present day rabbit populations.

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- [2]

The graphs below show three types of natural selection. The shaded areas marked with arrows show the individuals in the population which are being selected against. The dotted vertical lines show the statistical means.

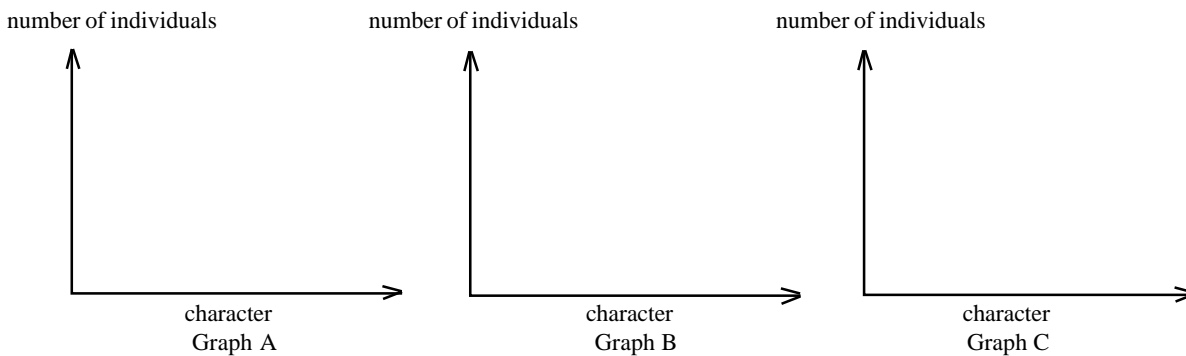


(a) What names are given to the types of selection shown in graphs A, B and C.

- A:
- B:
- C:

[3]

(b) Draw graphs on the three sets of axes below to show the distribution of phenotypes in A, B and C after the selection has operated for several generations. Indicate the new means with dotted lines.



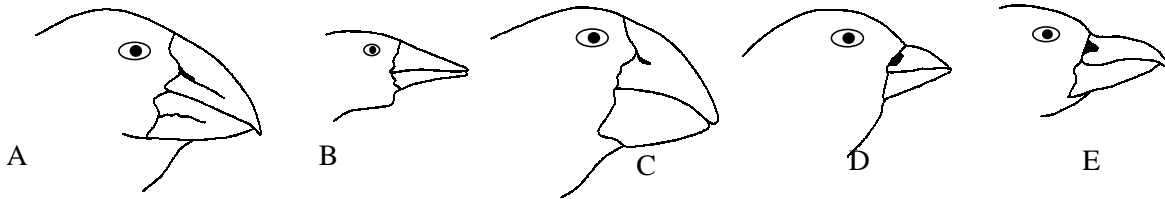
[6]

(c) Describe one specific example of the type of selection shown in graph B, naming the organism and describing the character selected in your answer.

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[3]

Diagrams A to E below show the heads of five species of finch inhabiting a volcanic oceanic island in the Galapagos group. The Galapagos islands lie about 600 miles from the South American mainland.



(a) What major difference between the five species is shown in the diagram?

..... [1]

(b) How might this difference be related to the habits of the finches?

.....

 [3]

(c) Darwin suggested that these finches probably descended from a common ancestral stock of finches. Suggest how these ancestral finches may have reached the Galapagos islands.

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 [2]

(d) Suggest how the modern diversity of finches arose from the ancestral stock.

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 [4]

(e) The different finch species on the island do not interbreed. What does this suggest?

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 [2]

(f) The plumage of the different finch species present is very similar. Suggest two ways in which males and females of the same finch species may recognise each other.

- 1:
- 2:

[2]

Explain why each of the following statements is incorrect.

(a) Cross pollination enlarges the gene pool of a species.

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[2]

(b) Different phenotypes are always the result of different genotypes.

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[2]

(c) Offspring from self fertilisation are genetically identical.

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[2]

(d) DNA replication must be 100% accurate.

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[3]

In the box below is a list of evolutionary terms, (i) to (x), and a jumbled list of definitions, A to J is provided underneath. Select the correct definition for each term by placing the appropriate letter in the appropriate box.

Evolutionary term	Letter
(i) Isolation	
(ii) Polymorphism	
(iii) Deme	
(iv) Adaptation	
(v) Sympatric speciation	
(vi) Analogy	
(vii) Natural selection	
(viii) Allopatric speciation	
(ix) Industrial melanism	
(x) Homology	

- A. A local unit of population of a species in which there is random mating.
- B. The restriction of interbreeding thus preventing gene flow between demes or species.
- C. The production of species by isolation mechanisms operating on a gene pool in the same geographical region.
- D. The presence of two or more distinct forms of a species found in the same locality at the same time.
- E. The production of species by physical separation of the gene pool into different geographical regions thus restricting gene flow in the gene pool.
- F. Structural similarity which results from similar specialisation in unrelated organisms.
- G. Features evolve in an organism which enable it to cope better with its environment.
- H. Structural similarity due to common ancestry.
- I. Differential reproduction rates in nature leading to the increase in frequency of some genes and a decrease in frequency of other genes.
- J. The selection of darkened phenotypes of a species due to industrial pollution.

[10]

(a) (i) What is meant by the term 'allele frequency'?

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[2]

(ii) Suggest three causes of allele frequency change in a population.

1:

2:

3:

[3]

(b) The algebraic statement of the Hardy-Weinberg principle is:

$$p^2 + 2pq + q^2 = 1$$

where p and q are the frequencies of the two alleles and $p + q = 1$.

State the Hardy-Weinberg principle in words.

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[3]

(c) A gene in humans controls the ability to taste the chemical phenylthiocarbamide (PTC). The ability to taste is endowed by the presence of the dominant allele T, so that people with genotypes TT and Tt are tasters. Individuals with genotype tt are non tasters. In a group of people, 195 individuals were able to taste PTC and 105 could not taste it.

Assuming that the Hardy-Weinberg principle applies in this case, calculate the frequency of individuals with genotype Tt. Show your working.

Answer: [4]

QUESTIONSHEET 8

Read the passage below and then answer the questions that follow.

Line 1 Natural selection occurs when there is a struggle for survival in nature. This is a result of an enormous reproductive capacity operating in a limited environment. The phenotypes of those organisms that have gained an advantage through some new heritable variation will tend to persist from generation to generation. By accumulating such variations over many generations new varieties within species will gradually appear. The sum total of all these adaptive changes is called evolution. However, the actual production of new species from these genetic variations will require a limitation of gene flow between the variant
Line 7 organisms and the original-type organisms by isolation mechanisms.

(a) What is meant by the following terms?

(i) Natural selection. (*line 1*)

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[2]

(ii) Reproductive capacity. (*line 2*)

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[2]

(iii) Heritable variation. (*line 3*)

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[2]

(iv) Species. (*line 4*)

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[2]

(b) What is the importance of having ‘an enormous reproductive capacity operating in a limited environment’?
(lines 1 & 2)

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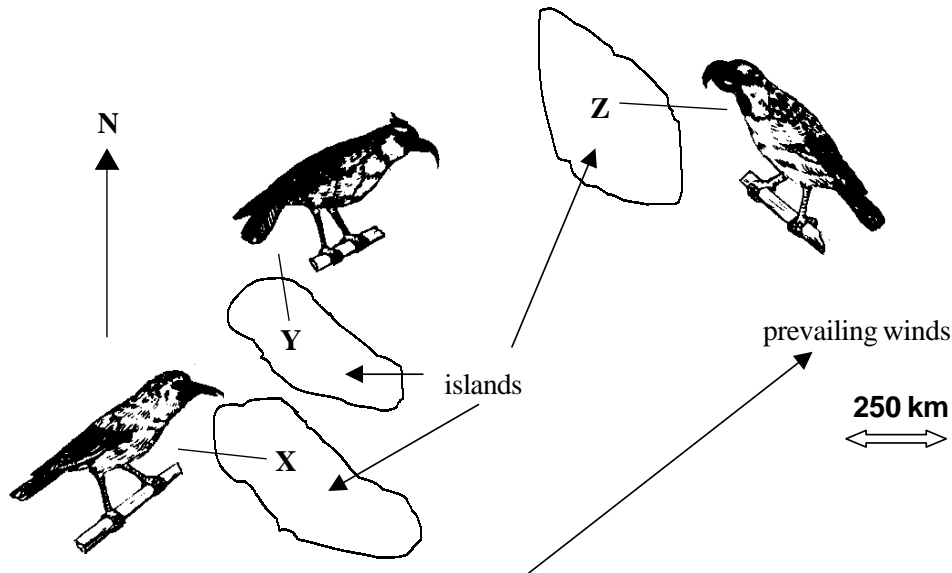
[2]

(c) Explain how the ‘isolation mechanisms’ (line 7) might operate.

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Three distinct populations of birds, X, Y and Z live on live separately on three isolated oceanic islands. The birds are all omnivorous, eating insects, tiny seeds and nectar, but have slightly different beaks and feather colourings. The islands are frequently swept by strong south-westerly gales. Populations X and Y can interbreed and form fertile offspring. Population Y can interbreed with population Z but the offspring are sterile. Population X will not even mate with population Z and artificial insemination of Z birds with X bird sperm is unsuccessful.



(a) Suggest an explanation why populations X and Y can still interbreed and form fertile offspring.

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(b) Suggest an explanation why mating between Y and Z produces infertile offspring.

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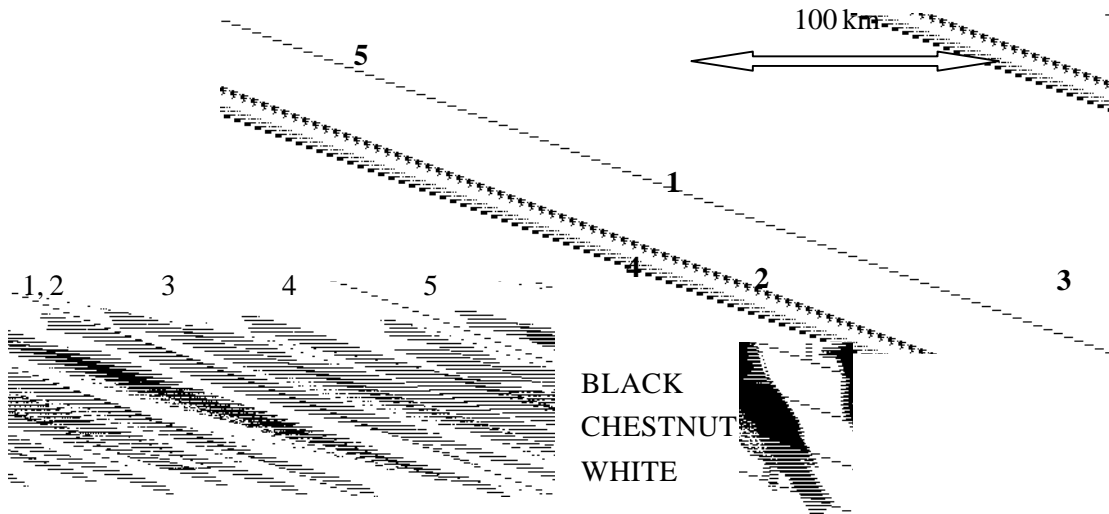
 [5]

(c) Suggest an explanation for the inability of populations X and Z to mate.

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 [5]

The diagram below shows plumage variation in four subspecies of the flycatcher, *Monarcha castaneiventris* of the Solomon Islands in the South Pacific Ocean, and their distribution throughout the islands. These subspecies of flycatcher can still successfully interbreed.



(a) (i) Suggest and explain a mechanism by which the different subspecies may have arisen.

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..... [5]

(ii) What further events must occur before the subspecies become full independent species? Explain your answer.

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..... [4]

(b) Distinguish between prezygotic and postzygotic isolation.

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..... [4]

Read through the following passage about speciation and isolation mechanisms and then complete it by filling in the spaces with the most appropriate word or words.

Isolation mechanisms (barriers) restrict..... flow between populations thus allowing the separated populations to diverge genetically from one another leading to the formation of new separate species.

Speciation occurring due to an isolation mechanism operating within a gene pool, in a single geographical region, is known as speciation.

Speciation due to isolation mechanisms operating on gene pools in different geographical regions is known as speciation. The type of isolation mechanism which results in this type of speciation is isolation.

Reproductive isolation is classed into two main types. The first type is isolation in which populations may be prevented from completing fertilisation and zygote formation. This type of isolation mechanism includes isolation when populations live in the same locality but mature at different times of the year and isolation when populations live in the same area but in different habitats.

The second type of reproductive isolation is isolation in which fertilisation occurs but the hybrids formed are either or

Suggest explanations for the following evolutionary events:

(a) the rapid development of warfarin resistance in rodents in Great Britain in the 1960s.

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..... [4]

(b) the development of industrial melanism in peppered moths (*Biston betularia*) in Great Britain in the mid 1800s.

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(c) the continual failure to develop a vaccine to give long term protection against influenza virus.

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..... [4]

(d) the incompleteness of the fossil record.

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..... [4]