Natural and artificial selection

Question Paper 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Selection and evolution
Sub Topic	Natural and artificial selection
Booklet	Theory
Paper Type	Question Paper 1

Time Allowed : **57 minutes**

Score : **/ 47**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 *Spartina alterniflora* is a grass that grows in salt marshes. It spreads by means of seeds and by underground stems. On its native east coast of North America it prevents salt marshes from being eroded by the sea and provides a food source for a large number of different species of animals.

Some time after its introduction to the west coast of North America in 1973, *S. alterniflora* hybridised with Californian cord grass, *S. foliosa*. The hybrid now outcompetes the native species.

The hybrid differs from its parent species in a number of ways:

- it is taller
- it produces very large numbers of pollen grains which are dispersed by wind to the other species, producing yet more hybrid plants
- it produces larger numbers of seeds capable of germination
- it can self-pollinate.

(a) State the structural features that are characteristic of a wind-pollinated flower **and** explain how each feature contributes to successful pollination.

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(b) Suggest how self-pollination could help the population of hybrid plants to increase.

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(c) Suggest why the hybrid plant is **not** considered to be a new species of *Spartina*.

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[Total: 9]

2 Artificial selection has been carried out for thousands of years. An example of this is the Santa Gertrudis breed of cattle, which grow fast and tolerate high temperatures and high humidity. This breed was developed from the following two breeds:

- English shorthorn cattle, which grow fast but do not tolerate high temperatures and high humidity.
- Brahman cattle from India, which tolerate high temperatures and high humidity.

(a) Explain how artificial selection has taken place to produce Santa Gertrudis cattle.

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(b) Suggest **two other** characteristics that may be selected for when carrying out artificial selection in cattle.

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(c) Artificial selection can result in inbreeding.

Suggest problems that may result from inbreeding.

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[Total: 8]

3 Myostatin is a protein that is produced in mammalian skeletal muscle cells. It circulates in the blood and acts on muscle tissue to slow down further differentiation and growth.

In thoroughbred racehorses, a mutation involving the substitution of a single nucleotide has been identified in the *MSTN* gene which codes for myostatin. At the site of this mutation, the DNA nucleotide has either a cytosine (C) base or a thymine (T) base, giving race horses three possible genotypes for this mutation: CC, CT or TT.

(a) At two years of age, racehorses with the *MSTN* CC genotype have greater muscle mass than those with the TT genotype.

Suggest an explanation for this difference.

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(b) Racehorses that had won races of different distances were tested to determine their *MSTN* genotype.

The results are shown in Fig. 2.1.

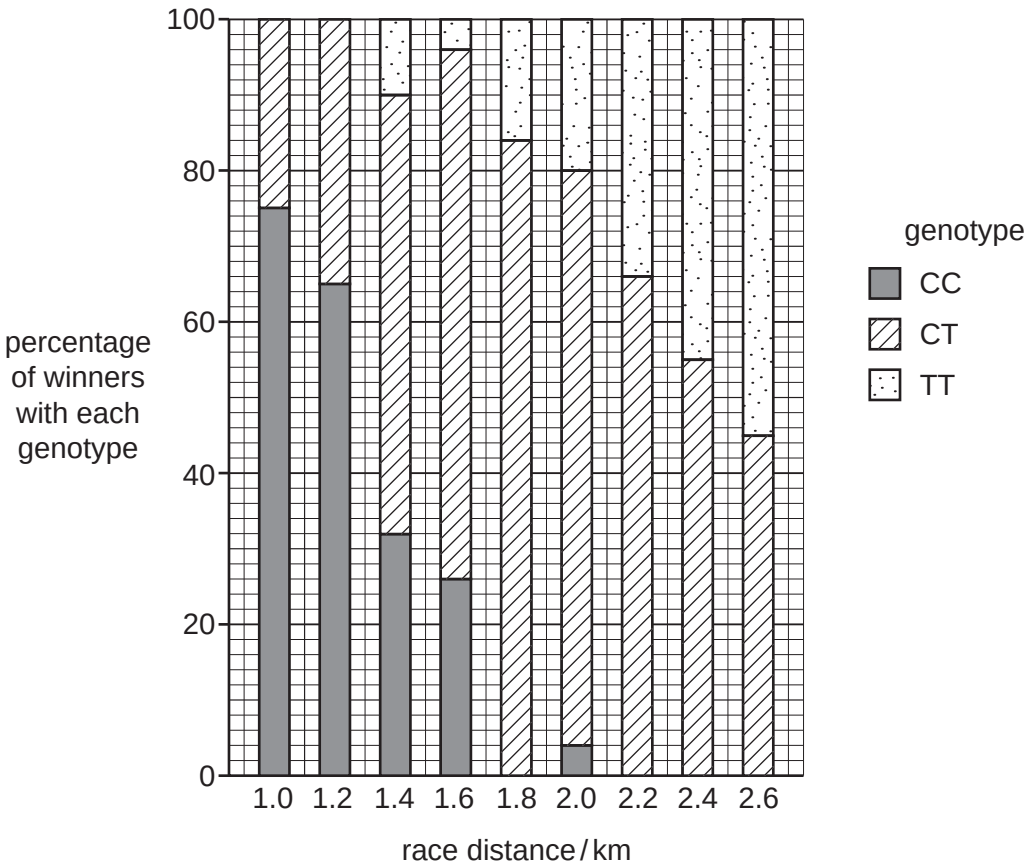

Fig. 2.1

With reference to Fig. 2.1, describe the effect of the *MSTN* genotype on the ability of racehorses to win races of different lengths.

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(c) Modern thoroughbred racehorses are the result of many years of artificial selection.

Explain:

(i) what is meant by *artificial selection*

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(ii) how genetic tests for the *MSTN* genotype can help in the selective breeding of racehorses.

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[Total: 10]

4 The following passage is a summary of the main principles of natural selection.

Some of the words have been omitted.

Write the most appropriate term in each space.

Individuals in a population have great ..... potential and yet the numbers in a population remain roughly ..... . This is because many die due to environmental factors and therefore do not reproduce. There is ..... amongst members of a population and those with the features best adapted to the environment survive. They reproduce and pass on their ..... to their offspring. This may lead to a change in the ..... pool of the population and over time may lead to evolutionary change.

[5]

[Total: 5]

5 **(a)** Explain how changes in the nucleotide sequence of DNA may affect the amino acid sequence in a protein. [7]

(b) Explain how natural selection may bring about evolution. [8]

[Total: 15]

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