

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



BIOLOGY

9700/42

Paper 4 A2 Structured Questions

May/June 2014

2 hours

Candidates answer on the Question Paper.

Additional Materials: Answer Paper available on request.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer **one** question.

Circle the number of the Section B question you have answered in the grid below.

Electronic calculators may be used.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
1	
2	
3	
4	
5	
6	
7	
8	
Section B	
9 or 10	
Total	

This document consists of **22** printed pages and **2** lined pages.

- (c) Changes in the atmospheric carbon dioxide concentration, light intensity and temperature alter the rate of photosynthesis. These three factors directly affect different stages of photosynthesis.

Complete the table below using a tick (✓) if the factor **directly** affects the stage or a cross (✗) if it does not affect the stage.

factor	stage	✓ or ✗
carbon dioxide concentration	Calvin cycle
	photolysis
light intensity	Calvin cycle
	photolysis
temperature	Calvin cycle
	photolysis

[3]

[Total: 7]

- 2 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.

.....

.....

.....

.....

.....

.....[2]

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

The results are shown in Fig. 2.1.

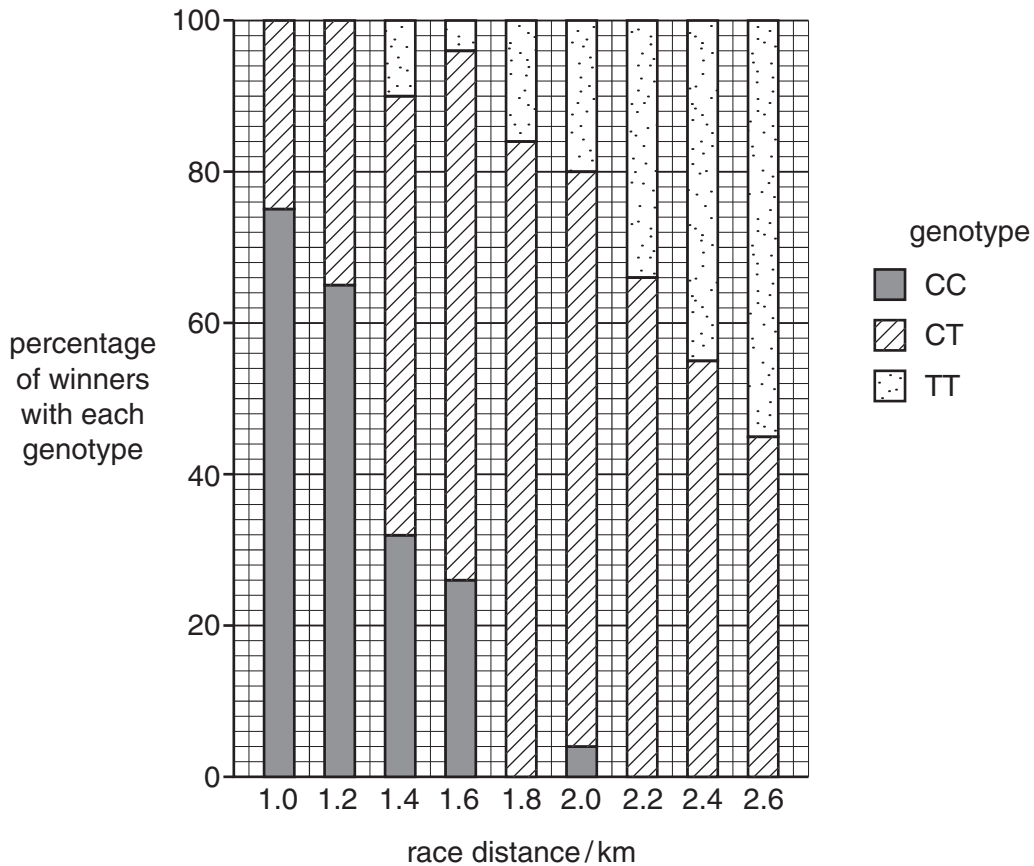


Fig. 2.1

(ii) Explain why it would be difficult to transfer this resistance into susceptible rice plants by genetic engineering.

.....
.....
.....
.....
..... [2]

(iii) Explain why the presence of large numbers of Xoo in the intercellular air spaces of rice plants affects the ability of the plants to grow with their roots submerged in water.

.....
.....
.....
.....
.....
.....
.....
.....
..... [4]

[Total: 14]

(b) Fig. 4.2 shows the number of offspring sired plotted against the body length of the adult male lizards.

Fig. 4.3 shows the number of offspring sired plotted against the fastest running speed (sprint speed) of the adult male lizards.

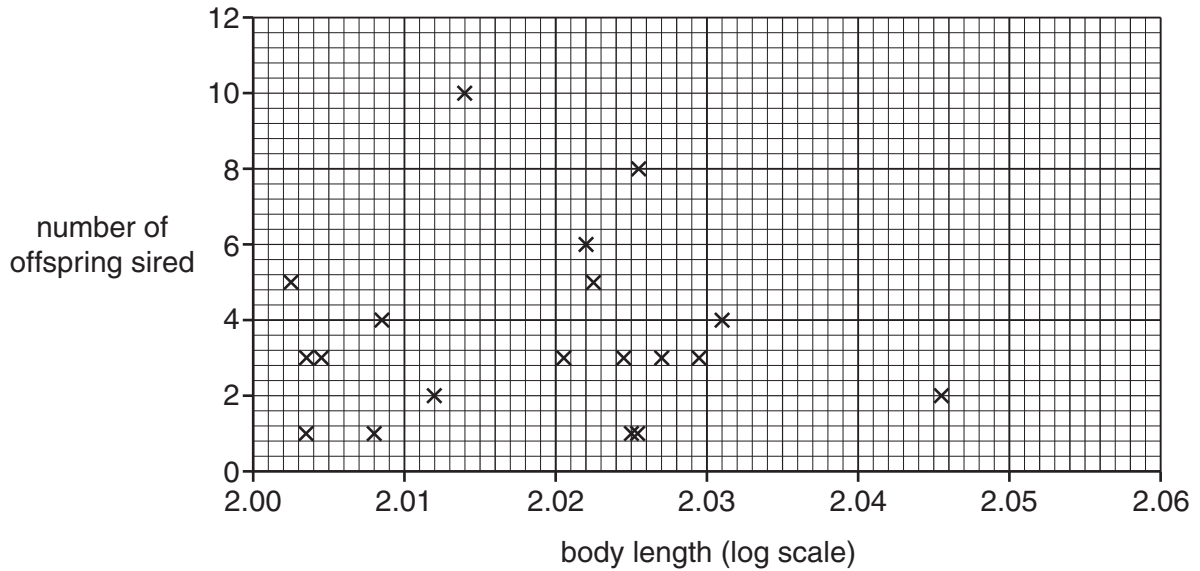


Fig. 4.2

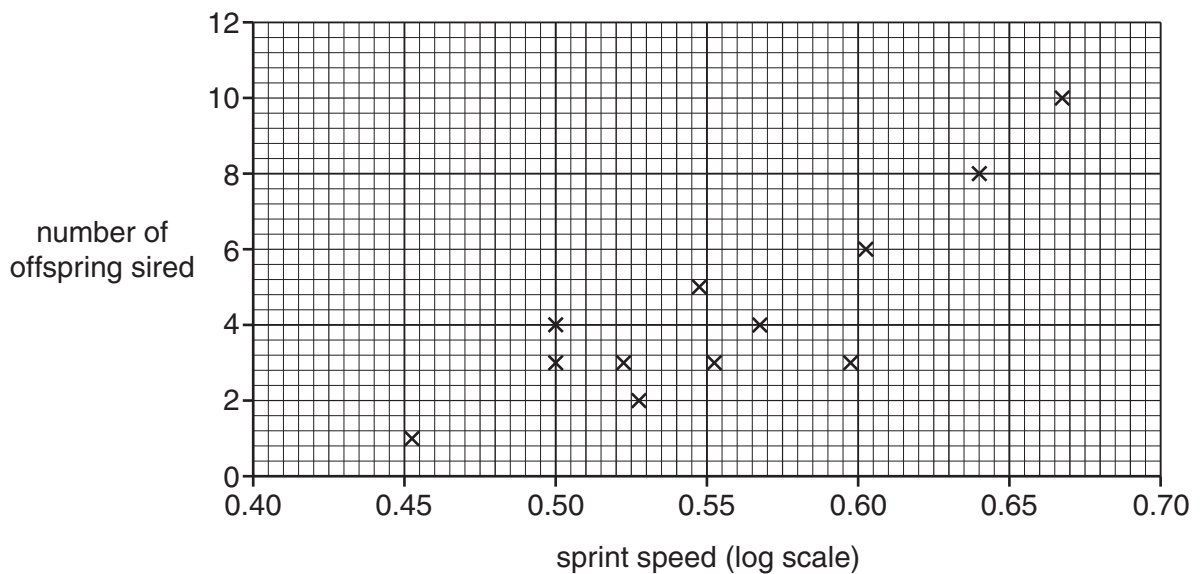


Fig. 4.3

- (i) With reference to Fig. 4.2 and Fig. 4.3, describe the relationships between
- body length and the number of offspring produced
 - sprint speed and the number of offspring produced.

body length

.....
.....
.....
.....

sprint speed

.....
.....
.....
.....

.....[4]

- (ii) Research has also shown that, in a population of collared lizards with varying leg lengths, those with longer hind legs are able to run faster.

With reference to the results shown in Fig. 4.3, explain how, over time, this could lead to a change in the mean hind leg length in a population of collared lizards.

.....
.....
.....
.....
.....
.....
.....
.....

.....[3]

Question 5 starts on page 14

5 The hormone FSH (follicle stimulating hormone) plays important roles in the reproductive cycles of mammals.

(a) State the precise site of secretion of FSH.

.....[1]

(b) Certain cells in the ovaries and testes have receptors for FSH in their cell surface membranes. FSH can bind with these receptors, which triggers the cells to respond to the hormone.

Mice were genetically modified so that they lacked functioning alleles of the gene that codes for the production of FSH receptors.

(i) Female mice without FSH receptors were sterile. They were found to have normal primary and secondary follicles in their ovaries, but no Graafian (ovarian) follicles or corpora lutea.

Explain these observations.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....[4]

- (ii) Spermatozoa were collected from male mice with and without FSH receptors. The mean number of spermatozoa per mouse was estimated. The percentage of spermatozoa that could swim actively was calculated. Table 5.1 shows the results.

Table 5.1

	male mice with FSH receptors	male mice without FSH receptors
mean number of spermatozoa per mouse	5.6×10^6	3.6×10^6
percentage of spermatozoa that could swim actively	62	47

Discuss what these results suggest about the role of FSH in the development of spermatozoa in male mice.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 8]

6 (a) In mammals, the water potential of the blood is constantly monitored by osmoreceptor cells in the hypothalamus of the brain. When the water potential of the blood decreases, ADH (antidiuretic hormone) is produced by cells in the hypothalamus and released into the blood via an endocrine gland.

(i) Explain what is meant by the term *water potential*.

.....
.....
.....[1]

(ii) Describe the effect on water potential of adding solute to a solution.

.....
.....[1]

(iii) State precisely where ADH is released into the blood.

.....[1]

(iv) The decrease in the water potential of the blood is sometimes due to the loss of water from the body of a mammal.

List **two** ways by which water may be lost from the body.

.....
.....[1]

7 Neurofibromatosis (NF) is a genetically inherited condition in humans where tumours grow in the nervous tissue. One symptom, which can develop around the age of 20 years, is loss of sight due to tumours on the optic nerve.

(a) If one parent has NF, there is at least a 50% chance that his or her children will develop the condition, even if the other parent is unaffected.

Complete the genetic diagram below to show how NF may be transmitted from parent to child.

key to symbols

.....

.....

parental phenotypes

parent with NF

unaffected parent

parental genotypes

gametes

offspring genotypes

offspring phenotypes

[3]

(b) Suggest how a person may develop NF when there is no family history of the condition.

.....

.....

.....

.....

..... [2]

- (b) Mitochondria in BAT cells function differently from those in other cells during periods of cold environmental conditions.

Fig. 8.1 shows part of a mitochondrion in a BAT cell.

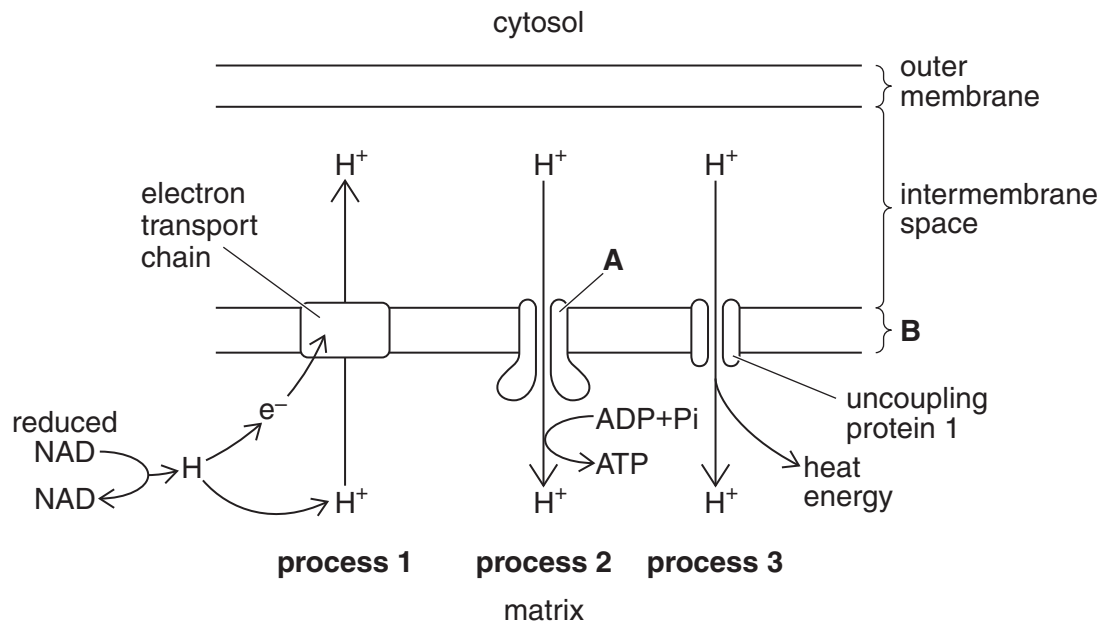


Fig. 8.1

- (i) Name structures **A** and **B**.

A

B [2]

- (ii) Draw an arrow on Fig. 8.1 to indicate the direction of the proton gradient that exists between the matrix and the intermembrane space. [1]

- (iii) State the **two** processes, shown in Fig. 8.1, that will be more active during periods of cold external environmental conditions.

.....[1]

- (iv) State the by-product that is obtained as a result of processes **1** and **2**.

.....[1]

- (v) Suggest the main respiratory substrate for BAT cells.

.....[1]

[Total: 12]

