OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

BIOLOGY

Control, Genomes and Environment

F215

F21607061

Candidates answer on the question paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Monday 13 June 2011
Afternoon

Duration: 1 hour 45 minutes

F215

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Knowledge of the nitrogen cycle can be used to make decisions about management of farmland. A farmer uses her grass meadow to raise sheep. In a separate field she grows cabbages.

(a) Fig. 1.1 shows part of the nitrogen cycle. The four boxes on the bottom line of the diagram refer to substances in the soil.

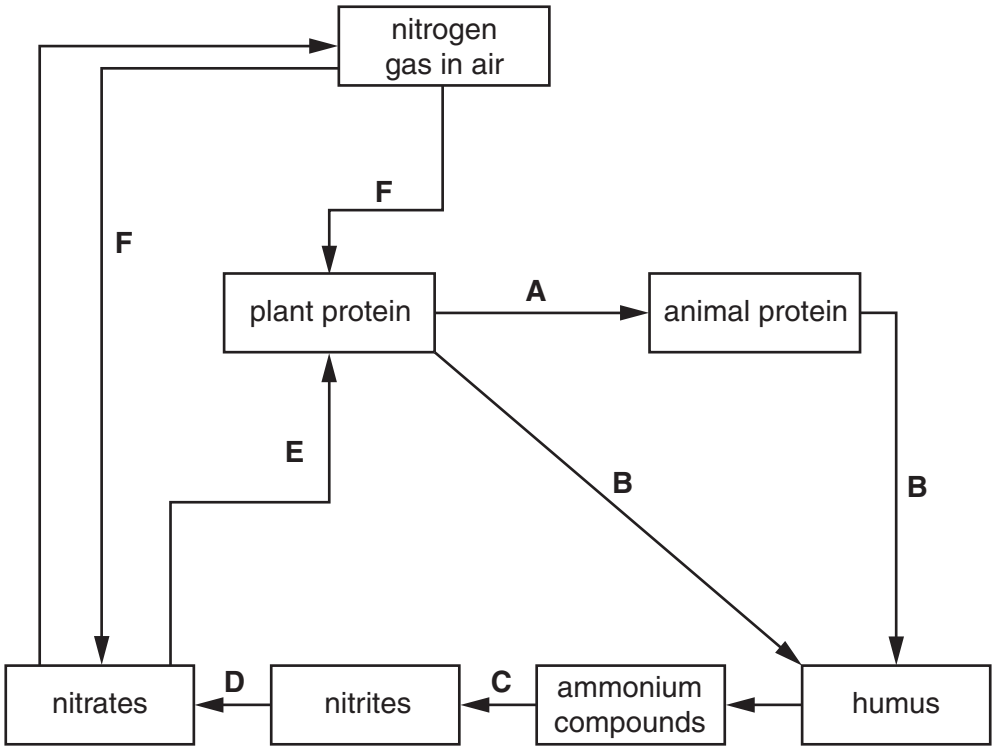

Fig. 1.1

(i) Briefly describe the steps that must occur for plant protein to be converted to animal protein in the farmer's sheep, as shown by arrow **A** on Fig. 1.1.

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(ii) List the processes which contribute to **B** in the meadow where sheep are raised.

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

(iii) Name the bacteria that carry out processes **C** and **D, and** explain the significance of these bacteria for the growth of plants.

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(iv) Use the letters on Fig. 1.1 to explain why the soil nitrate concentration will decrease in the cabbage field if it is used to grow repeated crops of cabbages year after year.

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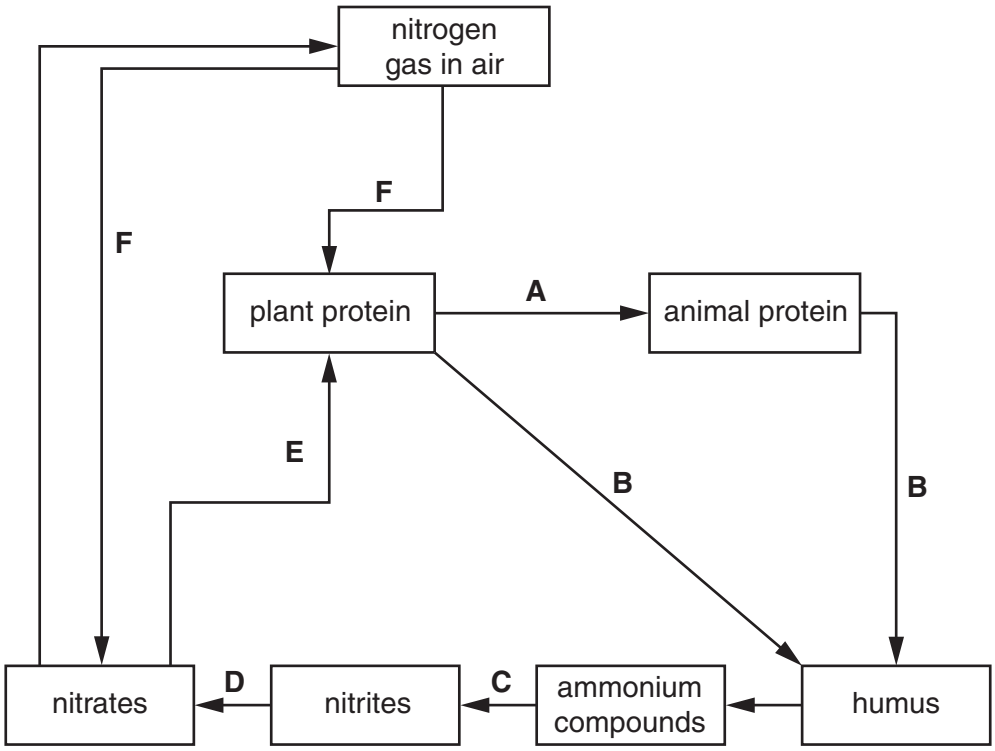

Fig. 1.1

(v) The farmer does not wish to use inorganic fertiliser to replace the nitrate in the soil of the cabbage field. She wishes to make use of process **F**.

Suggest a crop she could plant that would allow process **F** to occur **and** explain how this would add nitrate to the soil.

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..... **[3]**

(b) The sheep on this farm belong to a rare breed called Greyface Dartmoor. The Rare Breeds Survival Trust (RBST) gives advice on looking after these sheep and keep records to monitor the breeding of these sheep, in order to maintain a healthy population.

Why is the continued existence of rare breeds of farm animals desirable?

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

(c) North Ronaldsay sheep are listed as 'endangered' by the Rare Breeds Survival Trust. These sheep were raised on a small Scottish Island where they were kept along the seashore for most of the year. The sheep developed an unusual metabolism that allowed them to survive by eating seaweed. They are, however, susceptible to copper poisoning when fed on grass.

(i) State the **two** essential steps that must have occurred for a breed to develop a distinctive metabolism, such as the ability to eat mainly seaweed.

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

(ii) Suggest what particular problems make the North Ronaldsay breed one of the most endangered sheep breeds in the United Kingdom.

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

[Total: 20]

2 Animals behave in ways that enhance their survival and reproductive capacity. This behaviour may be innate or learned.

(a) Describe what is meant by:

(i) innate behaviour

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

(ii) learned behaviour.

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(b) Describe the advantages to animals of innate **and** learned behaviour, with reference to specific examples of each type of behaviour.

Your answer should include both types of behaviour and make clear the advantages to the animals of your chosen examples.

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.... [11]

[Total: 15]

3 Molecular evidence has shown that all specimens of the English Elm tree, *Ulmus procera*, form a genetically isolated clone. English Elms developed from a variety of elm brought to Britain from Rome in the first century A.D.

Although English Elm trees make pollen, they rarely produce seeds. Instead they spread by developing structures known as suckers from their roots. Each sucker can grow into a new tree.

This tendency of elms to create suckers has been exploited by humans, who have separated the suckers, with roots attached, and used them to plant hedges and establish new woodlands.

(a) (i) Suggest a technique that could be used to provide **molecular** evidence that all English Elm trees form a clone.

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

(ii) State why the English Elm clone is genetically isolated from other varieties of elm.

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

(iii) State the name given to the process in which plants reproduce asexually by means such as suckers.

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

(b) In 1967, a new, virulent strain of an elm disease fungus arrived in Great Britain on imported timber. Beetles that lived under the bark of elm trees spread the fungus.

The saws used to cut down dead branches were not sterilised after use. When the saws were used to prune healthy trees, these trees became infected. Approximately 25 million elm trees, most of the English Elm population, died within a few years of the arrival of this fungus.

Explain why there was such a rapid loss of elm trees in Britain as a result of this elm disease.

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(c) Elm trees respond to fungal infection by plugging their xylem vessels. The leaves on the upper branches of the tree then turn yellow and die. When most of the branches have lost their leaves and died, the roots are weakened and may also die.

(i) Explain why the plugging of xylem vessels will result in the leaves of the upper branches turning yellow.

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

(ii) Explain why the loss of leaves from the tree may result in the death of the tree's roots.

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QUESTION 3(d) STARTS ON PAGE 10

(d) Many ornamental plants for gardens can be cloned by tissue culture.

Describe the process of cloning plants by tissue culture.

In your answer you should make clear the order in which the steps of the process occur.

[7]

(e) List **two** advantages and **two** disadvantages of cloning plants by tissue culture.

advantage 1 .....

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advantage 2 .....

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disadvantage 1 .....

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disadvantage 2 .....

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

[Total: 22]

4 Wading birds (waders) are birds that feed in shallow water. Table 4.1 shows changes in the population size of four species of wader in two areas of the Western Isles off the coast of Scotland.

- Area 1 is an area that has remained free of hedgehogs.
- Area 2 is an area where four hedgehogs were introduced from the mainland in 1974. Since then, they have established a large population.

Hedgehogs eat the eggs of ground-nesting birds like waders.

Table 4.1

	number of breeding pairs of wader birds			
	area 1 (hedgehogs absent)		area 2 (hedgehogs present)	
year / species of wader	1983	2000	1983	2000
lapwing	1104	1364	1869	1287
redshank	486	733	1288	760
dunlin	803	558	2016	884
snipe	172	154	655	280

(a) (i) Calculate the percentage decrease in the number of breeding pairs of **snipe** in **area 2** between 1983 and 2000.

Show your working.

Answer = ... % **[2]**

(ii) Use the data in Table 4.1 to describe **and** explain the effect of the introduction of hedgehogs on the number of breeding pairs of waders in **area 2**.

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..... **[6]**

(iii) Suggest **two** factors that might have allowed a large population of hedgehogs to increase from just four individuals in **area 2**.

Explain how each factor has led to an increase in the hedgehog population.

1 .....

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2 .....

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

(b) Three suggested methods to reduce the effect of hedgehogs on the numbers of waders in area 2 were considered. These were:

- trapping and moving hedgehogs to the mainland
- trapping hedgehogs and keeping them in captivity indefinitely
- trapping of hedgehogs followed by humane killing.

The third method was judged to be the most effective and likely to succeed in reducing hedgehog numbers.

Comment on the ethical issues involved in making this decision.

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[Total: 15]

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QUESTION 5 STARTS ON PAGE 16

5 Fig. 5.1 is a circular representation of the genetic code.

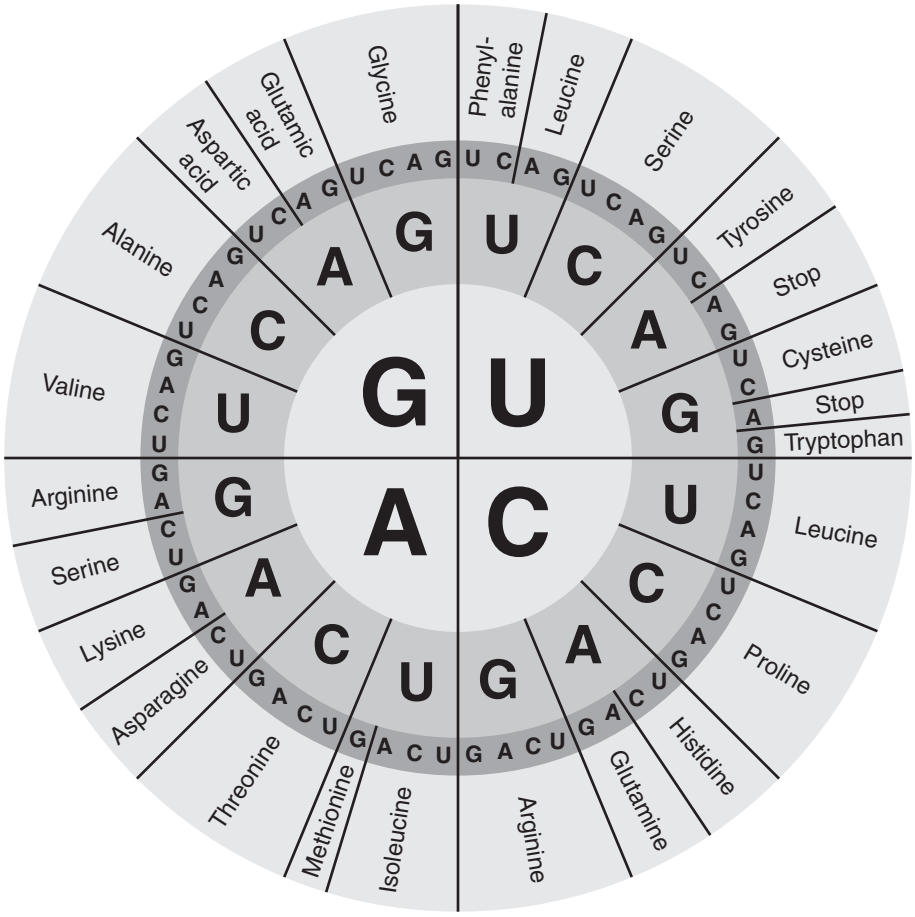

Fig. 5.1

(a) **Fig. 5.2** shows a sequence of bases coding for a sequence of amino acids. The name of the third amino acid in the sequence has been filled in.

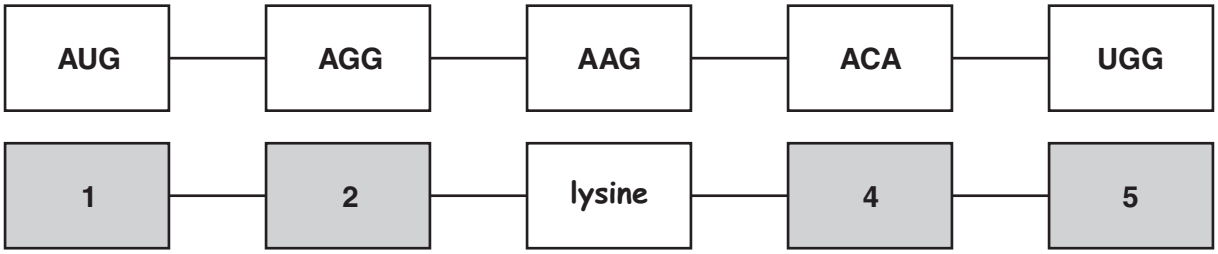

Fig. 5.2

Identify the remaining amino acids in the sequence.

1 .....

2 .....

3 lysine

4 .....

5 ..... **[2]**

(b) State the name of the stage of protein synthesis represented in Fig.5.2 **and** name the organelle in the cell where this takes place.

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

(c) Identify the type of nucleic acid that holds the sequence of bases shown in Fig. 5.2.

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(d) Using the information in **Fig. 5.1**, list the **three** triplet codons that would cause termination of a polypeptide chain (stop codons) **and** explain why these codons have this effect.

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

(e) What name would be given to a mutation that resulted in a change of the codon **UUU** to **UUC**?

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

[Total: 9]

6 Describe the differences between:

(a) somatic cell gene therapy and germ line cell gene therapy

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

(b) the central nervous system and the peripheral nervous system

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(c) prophase 1 of meiosis and prophase 2 of meiosis.

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[Total: 8]

7 Two-spot ladybirds, *Adalia bipunctata*, show a colour polymorphism. They are normally red with two black spots. However, melanic individuals occur which are black with two red spots.

A student investigated the proportion of these colour forms in the ladybird population along a transect going up a hill near his school.

(a) (i) Suggest a suitable technique by which the student might have collected his samples of ladybirds along this transect.

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

(ii) The student's teacher suggested he should make several transects up the hill rather than just one transect.

Explain why this is good experimental design.

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

QUESTION 7(b) STARTS ON PAGE 20

(b) The student's results are shown in Table 7.1.

Table 7.1

height above sea level (m)	total number of red form of ladybird	total number of black form of ladybird
100	93	7
200	78	13
300	71	16
400	54	14

(i) Suggest a method of processing this data to make comparisons between the frequency of the red form and black form of ladybird at the different altitudes more valid.

Explain why your method is an improvement.

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(ii) Evaluate whether the student was correct to conclude as follows:

"My data showed a positive correlation between increasing altitude and the frequency of the black form of the ladybird. I therefore concluded that high altitude causes the black form to survive better."

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(c) The black, melanic, form of the ladybird is caused by an allele (**B**) that is dominant.

The red form of the ladybird is therefore homozygous recessive at this locus (**bb**).

(i) State what is meant by the term *recessive*.

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

(ii) The data in Table 7.1 give the total number of the red form of ladybird found as 296, and the total number of the black form of ladybird as 50.

The Hardy-Weinberg principle states that:

$$p + q = 1$$

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

Use the Hardy-Weinberg principle and the figures given above to calculate the frequency of the dominant allele, p, and the recessive allele, q, in the two-spot ladybird population.

Show each step in your working. **Give your answers to 2 decimal places**.

p = ...

q = ... **[3]**

[Total: 11]

END OF QUESTION PAPER

ADDITIONAL PAGE

If additional space is required, you should use the lined pages below. The question number(s) must be clearly shown.

ADDITIONAL PAGE

ADDITIONAL PAGE