OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

Advanced GCE

BIOLOGY

F215 QP

Unit F215: Control, Genomes and Environment

Specimen Paper

Candidates answer on the question paper.
Additional Materials:

Scientific calculator

Time: 2 hours

Candidate Name	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED.

INFORMATION FOR CANDIDATES

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

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**23**	
2	**6**	
3	**10**	
4	**17**	
5	**9**	
6	**8**	
7	**11**	
8	**16**	
TOTAL	**100**	

This document consists of **16** printed pages and **2** blank pages.

  [Turn over

Answer **all** the questions.

1 (a) (i) A gene controlling coat colour in cats is sex linked. The two alleles of this gene are black and orange. When both are present the coat colour is called tortoiseshell.

Define the following terms:

gene.....

.....

allele .....

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

(ii) Explain why there are no male tortoiseshell cats.

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

Two pure breeding strains of snapdragon, a garden plant, were obtained. One strain had red flowers and the other had white flowers. The two strains were crossed yielding F_1 plants all with pink flowers. The F_1 were then interbred to produce F_2 plants with the following colours:

red	**62**
pink	**131**
white	**67**

The following hypothesis was proposed:

Flower colour is controlled by a single gene with two codominant alleles.

(b) Complete the genetic diagram to explain this cross. Use the following symbols to represent the alleles:

C^r = red, C^w = white

Parental phenotypes:	red flowers	x	white flowers
Parental genotypes:	.....		.....
Gametes:	.....		.....

F_1 genotypes: .....

F_1 phenotypes: .....

Gametes: .....

F_2 genotypes: .....

F_2 phenotypes: .....

Expected F_2 phenotypic ratio:.....**[6]**

(c) A chi-squared (χ^2) test is carried out on the experimental data to determine whether the hypothesis is supported.

(i) Complete Table 1.1 by calculating the expected numbers.

Table 1.1

F_2 phenotype	observed numbers	expected numbers
red	62	
pink	131	
white	67	
total	260	260

[3]

The χ^2 statistic is calculated in the following way:

$$\chi^2 = \Sigma \frac{(\text{observed} - \text{expected})^2}{\text{expected}} \qquad \Sigma = \text{"sum of ..."}$$

(ii) Calculate the value of χ^2 for the above data. Show your working.

χ^2 value = ...**[2]**

(iii) The critical value of χ^2 for this type of investigation with two degrees of freedom is 5.991.

Explain whether your answer to **(b) (ii)** supports the hypothesis.

.....

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

(d) Phenotype is influenced by genetic and environmental factors.

Describe **one** example of how the **environment** influences phenotype.

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

(e) The bacterium *Escherichia coli* (*E. coli*) uses glucose as a respiratory substrate. In the absence of glucose, *E. coli* can use lactose. The use of a different substrate is determined by the interaction between genes and the environment.

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

[Total: 23]

2 (a) Cystic fibrosis (CF) in humans is caused by mutations of a gene coding for transmembrane protein (CFTR) which acts as an ion pump. A large number of different mutations of the gene have been found. Explain what is meant by a gene mutation.

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

(b) CFTR regulates the transport of chloride ions (Cl-) across the plasma (cell surface) membrane. Tissues that express the normal CFTR allele secrete alkaline fluids, whereas the secretions of tissues expressing some mutant alleles are acidic.

The transport of Cl^- by epithelial cells expressing the normal CFTR allele was compared with that by epithelial cells expressing one of 10 different mutant CFTR alleles. The results are shown in table 2.1.

In the table, normal digestive functioning of the pancreas associated with a particular allele is indicated with a tick (✓) and the absence of normal functioning by a cross (✗).

Table 2.1

CFTR allele	percentage of Cl^- transported in comparison with normal allele	normal digestive functioning in pancreas
normal	100	✓
mutation 1	6	✗
mutation 2	4	✗
mutation 3	0	✗
mutation 4	3	✗
mutation 5	1	✗
mutation 6	33	✓
mutation 7	41	✓
mutation 8	46	✓
mutation 9	37	✓
mutation 10	44	✓

With reference to the information given in the table, explain why some mutant CFTR alleles allow normal digestive functioning of the pancreas and others do not.

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

[Total: 5]

3 Fig 3.1 represents the transfer of energy through a woodland ecosystem.

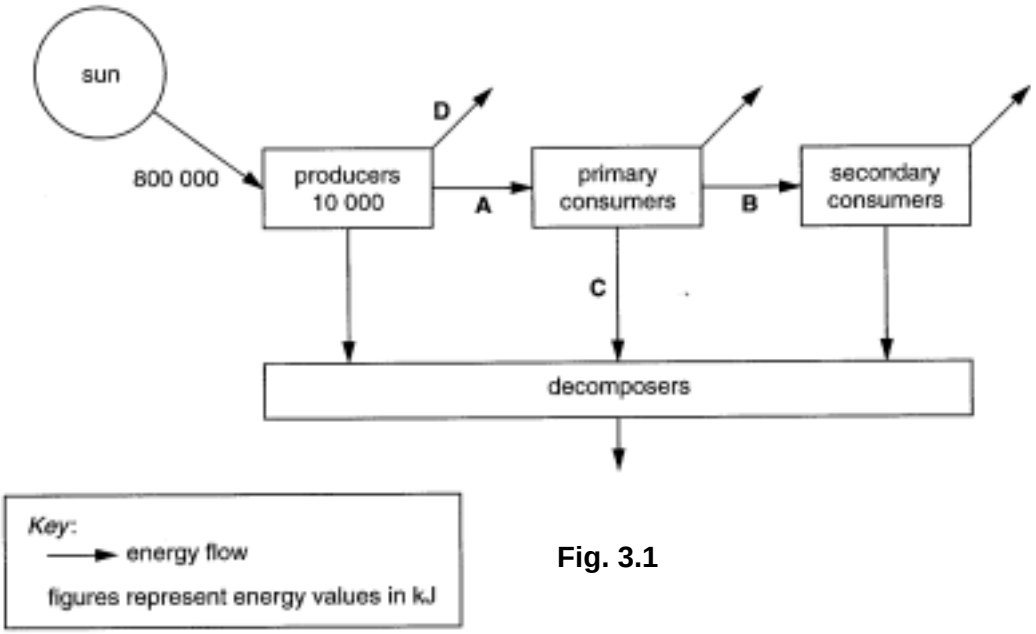

Fig. 3.1

(a) Of the 800 000 kJ of energy which reaches the producers, only 10 000 kJ of energy is converted to growth in the producers.

(i) Calculate the percentage of the energy reaching the producers that is converted to growth in the producers. Show your working.

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

(ii) Explain what happens to the energy reaching the producers that is **not** converted to growth.

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

(iii) Name **one** decomposer.

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

(iv) State two ways in which energy is transferred from primary consumers to decomposers at **C**.

1.....

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

(b) Suggest why the percentage energy transfer between producers and primary consumers at **A** is less than that between the primary consumers and secondary consumers at **B**.

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

[Total: 10]

[Turn over

4 One product manufactured using microorganisms is insulin. The process involves genetically engineering bacteria to synthesise human insulin.

(a) **(i)** Describe how the isolated human insulin gene is inserted into a bacteria plasmid.

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

(ii) Suggest **two** ways in which the bacteria which take up the modified plasmids can be identified.

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

(b) Suggest **one** reason why it is considered preferable to use genetically engineered sources of human insulin rather than insulin obtained from pigs.

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

(c) Another product manufactured using microorganisms is single cell protein (SCP).

Describe how a protein would be synthesised in the cell of a single celled fungus.

In your answer, you should make clear the sequence of the steps in the process.

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[Total: 17]

[Turn over

5 Fig. 5.1 is a drawing of the brain that shows the origin of the cranial nerves.

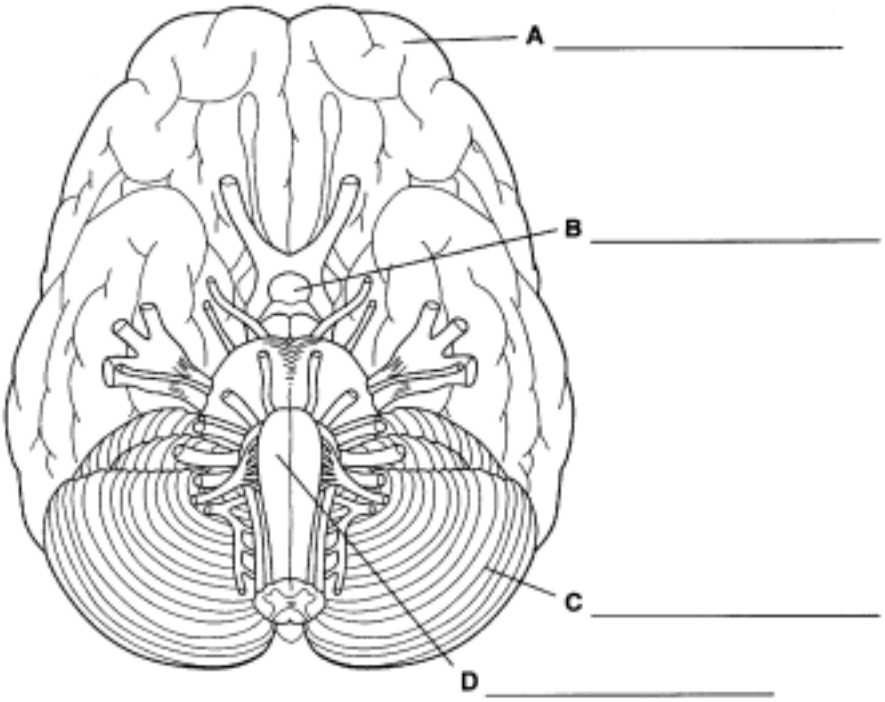

Fig. 5.1 Taken from Human physiology: Foundations and Frontiers, © Moffett, D., Moffett,S., Schauf, Times-Mirror Mosby Publishers ,1990, ISBN 08016435540

(a) State the direction from which the brain has been drawn.

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

(b) **(i)** Name the structures **A**, **B**, **C** and **D** shown on Fig. 5.1.

A .....

B .....

C .....

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

(ii) State **two** roles of structure **D**.

1. .....

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

(c) The hypothalamus constantly monitors and regulates the concentration of hormones in the blood. Outline how the hypothalamus regulates the concentration of hormones in the blood.

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

[Total: 9]

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6 An investigation was carried out into the effects of two plant growth substances, gibberellins and auxins, on apical dominance. The terminal (apical) buds of a number of pea plants were removed and discarded. The tops of each of the remaining shoots were given one of the following treatments:

- Coated with a paste containing gibberellin.
- Coated with a paste containing auxin (IAA).
- Coated with a paste without any plant growth substance.

In addition, a control group of plants did not have their terminal buds removed and were not coated with paste.

The growth of the side shoots was measured at regular time intervals and a mean value calculated. The results are shown in Fig. 6.1.

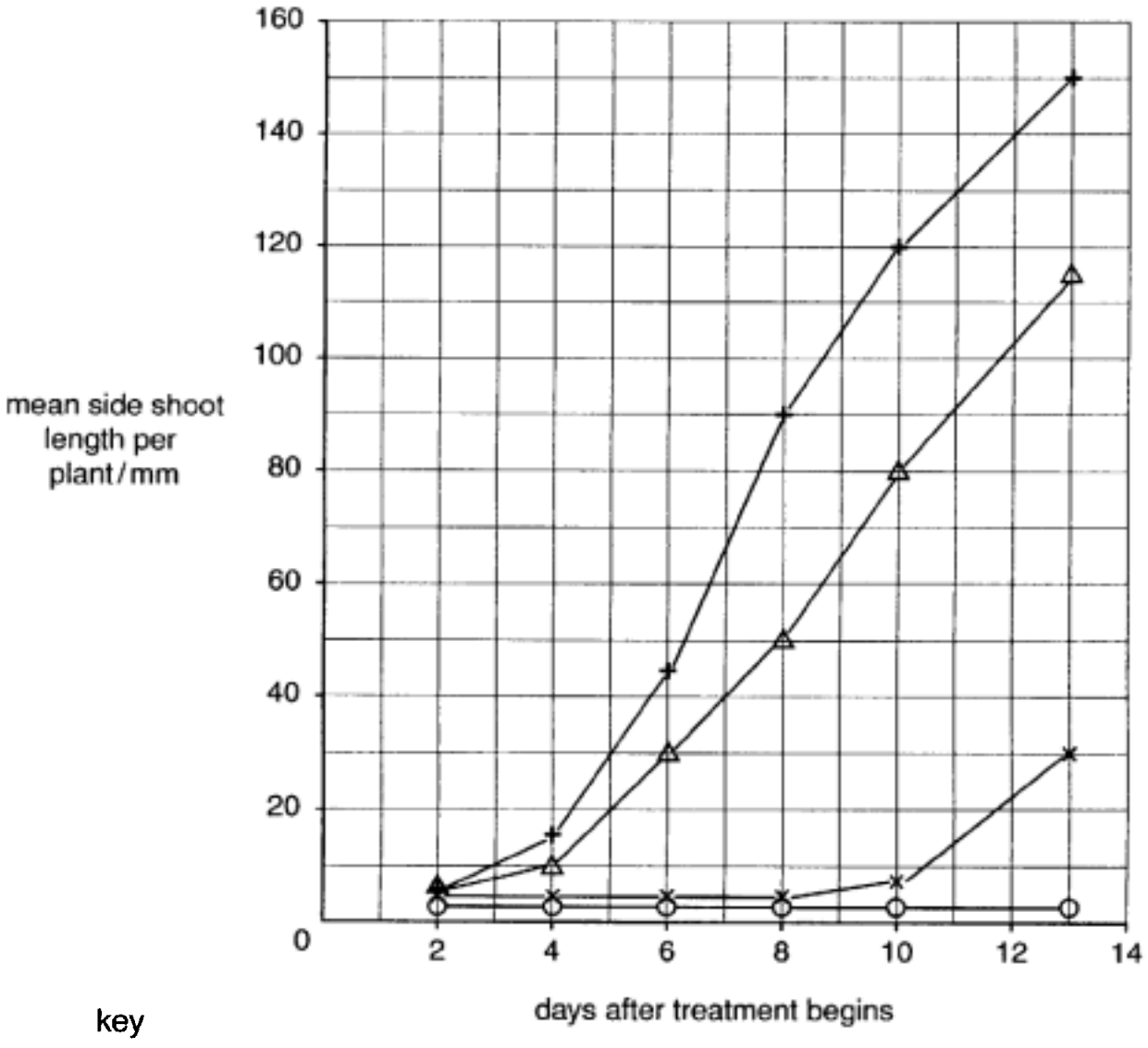

Fig. 6.1

(a) Explain why the side shoots grow when the terminal buds are removed.

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

(b) Side shoots show greater growth when paste containing gibberellin is applied than when paste without any plant growth substance is applied.

Calculate the percentage increase in growth due to gibberellin in 8 day old seedlings compared to seedlings with paste only. Show your working.

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

(c) Using data from Fig. 6.1 describe **and** explain the effect of auxin (IAA) on the growth of side shoots.

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[Total: 8]

7 (a) Immobilised enzymes can be used in bioreactors that attach to space suits. The bioreactors recover water from the astronauts' urine. The bioreactors use immobilised urease enzyme which catalyses the hydrolysis of urea, forming carbon dioxide and ammonia. These products react to form ions, which are then removed by the bioreactor.

(i) State the meaning of the term immobilised enzyme *and describe how immobilisation can be achieve*d.

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

(ii) Suggest three practical advantages of using an immobilised urease bioreactor in a spaceship.

1. .....

2. .....

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

(b) An investigation was carried out to compare lipase in soluble and immobilised forms. Palm oil was hydrolysed to produce fatty acids and glycerol.

- The two forms of lipase showed optimal activity at the same pH and temperature (pH 7.5 and 35^{o}C).
- At that pH and temperature, 100% of the oil was hydrolysed in two minutes.
- If the temperature was increased to 45^{o}C, the immobilised enzyme hydrolysed 100% of the oil but the soluble enzyme hydrolysed only 80% of the oil in two minutes.

(i) Define the term *hydrolysis*.

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

(ii) Explain, **using the information in the passage**, the advantages of using an immobilised enzyme to hydrolyse palm oil.

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

[Total: 11]

8 (a) Explain the meaning of the term *primary succession*.

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

Fig. 8.1 shows a primary succession in a temperate climate.

X represents an example of deflected succession.

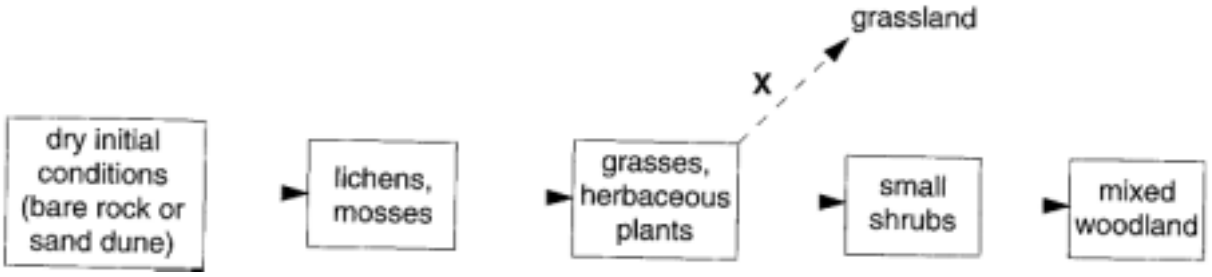

Fig. 8.1

(b) Explain the role of pioneer plants in succession on a bare rock or sand dune.

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

(c) Suggest **two** ways in which deflected succession at **X** could be caused.

1.....

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

(d) Explain how biomass changes during a **primary** succession.

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

[Turn over

(e) Using timber production in a temperate country as an example, explain how ecosystems can be managed in a sustainable way.

✎ *In your answer, you should make clear how the management is sustainable.*

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[Total: 16]

Paper Total [100]

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