OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY 2805/04

Microbiology and Biotechnology

Thursday **30 JANUARY 2003** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator
Ruler (cm/mm)

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Read each question carefully before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	14	
2	10	
3	16	
4	15	
5	19	
6	16	
TOTAL	90	

This question paper consists of 15 printed pages and 1 blank page.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Fig. 1.1 shows a diagram of a virus.

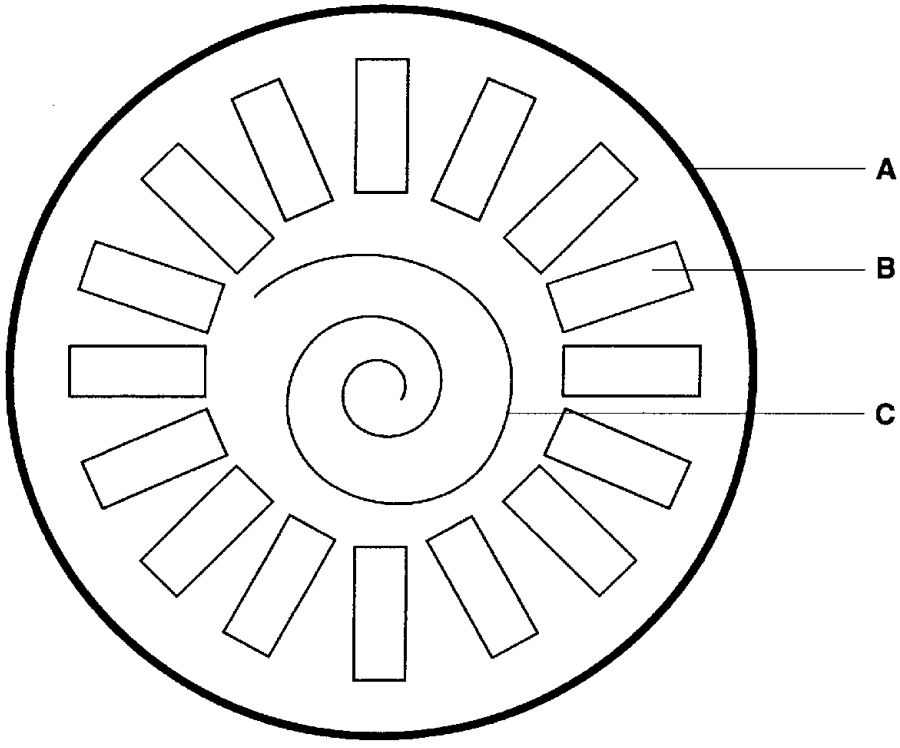

Fig. 1.1

(a) Name the **three** major features labelled **A**, **B** and **C**.

A .....

B .....

C ..... [3]

(b) Complete the table below to show **three** ways in which viruses are different from bacteria.

feature	virus	bacteria
genetic material		
size range		0.1 to 10 μm
ribosome		

[4]

For Examiner's Use

(c) **(i)** Name the type of asexual reproduction shown by *Escherichia coli.*

..... [1]

(ii) Explain how the process of asexual division in *E. coli* differs from mitosis.

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(d) Many organisms that are parasitic reproduce asexually during their life cycle.

Explain the advantages of asexual reproduction to a parasite.

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..... [3]

[Total: 14]

2 Penicillin acylase is an enzyme used to prepare 6-aminopenicillanic acid (6 APA) from naturally occurring penicillin G.

6 APA is an important organic molecule as it can be used to synthesise different types of penicillin. When penicillin acylase is used to produce large quantities of 6 APA the enzyme is immobilised.

(a) Explain the term *immobilised enzyme.*

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..... [1]

(b) Table 2.1 shows the rate of reaction when using penicillin acylase in solution or when immobilised at different temperatures.

Table 2.1

temperature / °C	rate of reaction as a percentage of the rate at 20 °C	
	penicillin acylase in solution	penicillin acylase when immobilised
20	100	100
30	105	105
40	110	110
50	120	120
60	90	135
70	50	130

(i) Explain what happens to the structure of the enzyme in solution between 50 and 60 °C.

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..... [3]

(ii) Use evidence from the table to describe how immobilisation affects the activity of the enzyme at different temperatures.

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(iii) Suggest how immobilisation causes the change in activity at high temperatures.

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..... [1]

(c) Apart from their stability at high temperatures, explain **two** other advantages of using immobilised enzymes.

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..... [2]

[Total: 10]

[Turn over

3 Vegetarians ought to be thankful to Dr. Arnold Spicer, who in the 1960s led a research team to produce a food material rich in protein, using cheap starch as a starting point. Their work led to the development of mycoprotein, the basis of many vegetarian products.

(a) **(i)** Name the type of microorganism used to produce mycoprotein.

..... [1]

(ii) Describe the advantages of using **continuous culture** to produce mycoprotein.

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..... [2]

(iii) Describe the disadvantages of using **continuous culture** to produce mycoprotein.

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..... [2]

(b) Outline the downstream processing of the microorganism used to produce mycoprotein and describe how mycoprotein is prepared for use as a food.

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..... [3]

For Examiner's Use

(c) In this question, one mark is available for the quality of written communication.

A sealed tube of agar contains two different colonies of bacteria that have been identified as contaminants in a fermenter.

Describe how you would isolate and culture one of the bacterial colonies using aseptic techniques.

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..... [7]

Quality of Written Communication [1]

[Total: 16]

[Turn over

4 In 1994, ordinary brewer's yeast, *Saccharomyces cerevisiae*, was modified by the transfer of a gene from another type of yeast, *Saccharomyces diastaticus*. This gene enabled brewer's yeast to use carbohydrates, other than sugars, as energy sources. The yeast was used to make a beer called Nutfield lyte that was used for research purposes only.

Restriction enzymes cut DNA at specific places called restriction sites. Table 4.1 shows the restriction sites of a number of restriction enzymes. The letters A, T, C, G represent the nitrogenous bases of DNA and the dotted lines show where each enzyme cuts.

Table 4.1

restriction enzyme	restriction site
BamH I	G ¦ G A T C C
EcoR I	G ¦ A A T T C
Hae III	G G ¦ C C
Hha I	G C ¦ G C
Hind III	A ¦ A G C T T

(a) **(i)** Use the information shown in table 4.1 to mark where Hind III and Hae III will cut the DNA sequence shown in Fig. 4.1. [2]

G C G T C C A A G C T T G A T A T C G G G C C T A C A
C G C A G G T T C G A A C T A T A G C C C G G A T G T

Fig. 4.1

(ii) Explain why BamH I and EcoR I are more useful enzymes to genetic engineers than Hae III and Hha I.

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..... [3]

(iii) Name the type of enzyme used to rejoin broken pieces of DNA.

..... [1]

(iv) Define the term *recombinant DNA*.

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..... [1]

For Examiner's Use

(b) The DNA sequence shown in Fig. 4.2 is a part of a gene that codes for the production of glucoamylase. Glucoamylase is an extracellular enzyme made by *S. diastaticus*. This enzyme breaks down starch.

Fig. 4.2

(i) Explain why a substitution of the base thymine (T), which is indicated by an arrow in Fig. 4.2, may not alter the structure of the enzyme, glucoamylase.

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..... [2]

(ii) Explain why a deletion of the same base may lead to the synthesis of a very different protein, which does not act as an enzyme.

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..... [2]

(c) Discuss the likely advantages for the production of beer of transferring the glucoamylase gene from *S. diastaticus* to *S. cerevisiae*.

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..... [4]

[Total: 15]

For Examiner's Use

5 In one type of tissue culture, plant cells are taken and grown to produce new plants. Fig. 5.1 shows how, during this process, crop plants can be made resistant to herbicides, such as glyphosate.

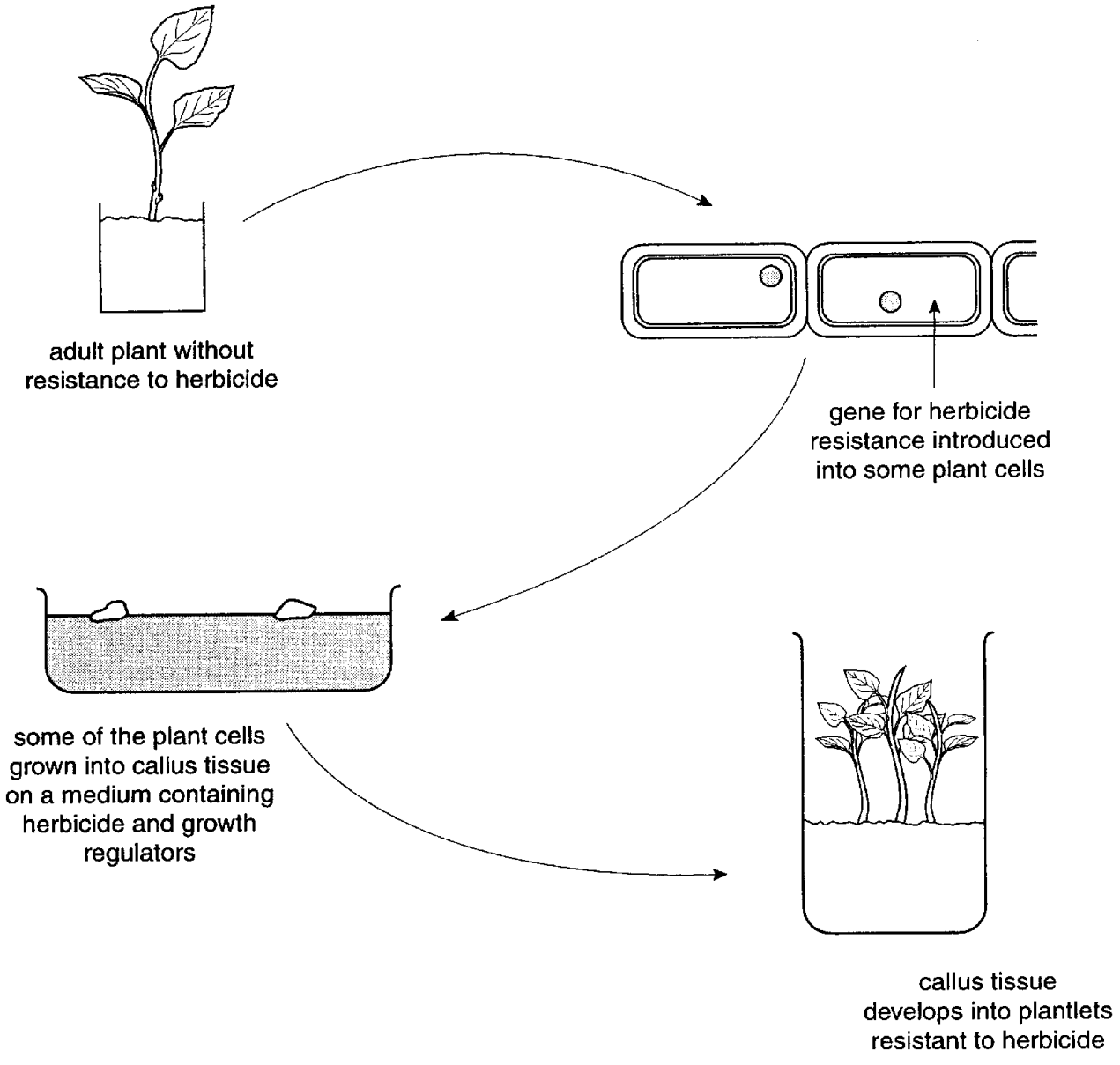

Fig. 5.1.

(a) **(i)** Describe how genes, such as those for herbicide resistance, are usually introduced into plant cells.

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..... [2]

For Examiner's Use

(ii) Explain why all the plantlets produced by this method are herbicide resistant.

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..... [2]

(b) In this question, one mark is available for the quality of written communication.

Protoplast fusion is a method of producing plants that are resistant to disease.

Explain how new plants are produced by protoplast fusion.

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Quality of Written Communication [1]

(c) Describe and explain the advantages of tissue culture when compared with other methods of producing plants.

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..... [4]

(d) Explain why all plant tissue culture methods must be carried out under sterile conditions.

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..... [2]

[Total: 19]

[QUESTION 6 FOLLOWS ON PAGE 14]

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For Examiner's Use

6 **(a)** **(i)** Name **two** types of genetically modified microorganism used to produce human insulin.

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..... [2]

(ii) State **three** conditions that have to be controlled within the fermenter during the production of insulin by a genetically modified microorganism.

1 .....

2 .....

3 ..... [3]

(iii) Explain the reasons for using microorganisms in the large-scale production of insulin rather than extracting insulin from dead animals.

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..... [4]

(b) Vaccines can be used to encourage an organism to produce its own antibodies against the foreign proteins of pathogens. These proteins are known as antigens. Traditionally, the pathogen was grown and then treated in some way to stop its reproduction. It was then introduced into the bloodstream where the body's immune system reacted to the antigen.

Plants, such as bananas, are now being used to produce vaccines. DNA that codes for the antigen proteins of vaccines is identified and inserted into the banana plants.

(i) Explain how the cells of such plants produce vaccines.

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For Examiner's Use

(ii) Discuss the advantages and disadvantages of using plants as a source of vaccines.

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[Total: 16]