OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY 2805/04

Microbiology and Biotechnology

Thursday **19 JUNE 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 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	9	
2	10	
3	18	
4	15	
5	20	
6	18	
TOTAL	90	

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

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For Examiner's Use

Answer **all** the questions.

1 Fig. 1.1 shows the main parts of a glucose biosensor.

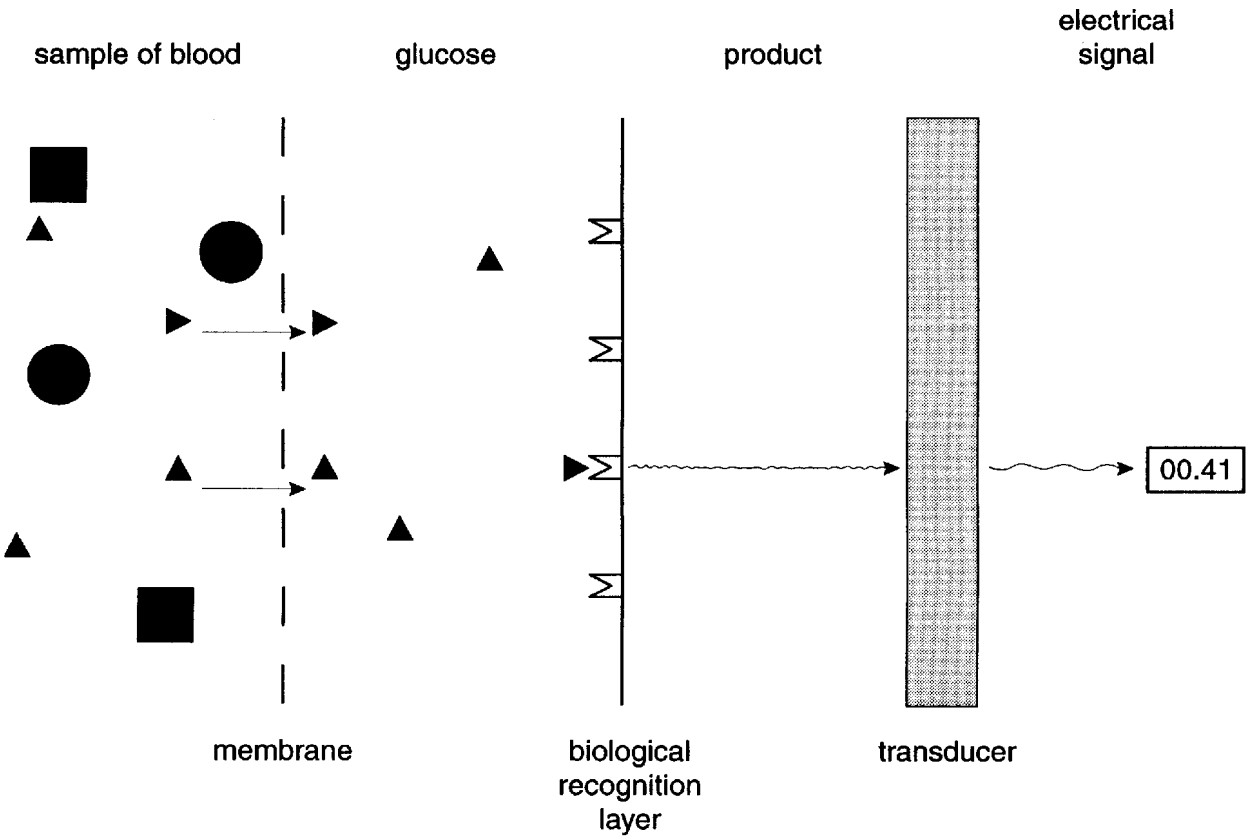

Fig. 1.1

(a) Using the information in Fig. 1.1, explain how the biosensor enables the concentration of glucose in the blood to be measured.

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(b) Explain why molecules other than glucose in the blood do not affect the reading shown on the display.

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(c) Suggest **two** advantages of using a biosensor to measure the concentration of glucose in blood.

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[Total: 9]

2 The enzyme amylase breaks down starch into a reducing sugar.

$$\text{starch} \xrightarrow{\text{amylase}} \text{maltose}$$

An experiment was carried out to investigate the activity of immobilised amylase. A solution of starch was passed through a column of immobilised enzyme as shown in Fig. 2.1. Tests were carried out on the product collected at the end of the column.

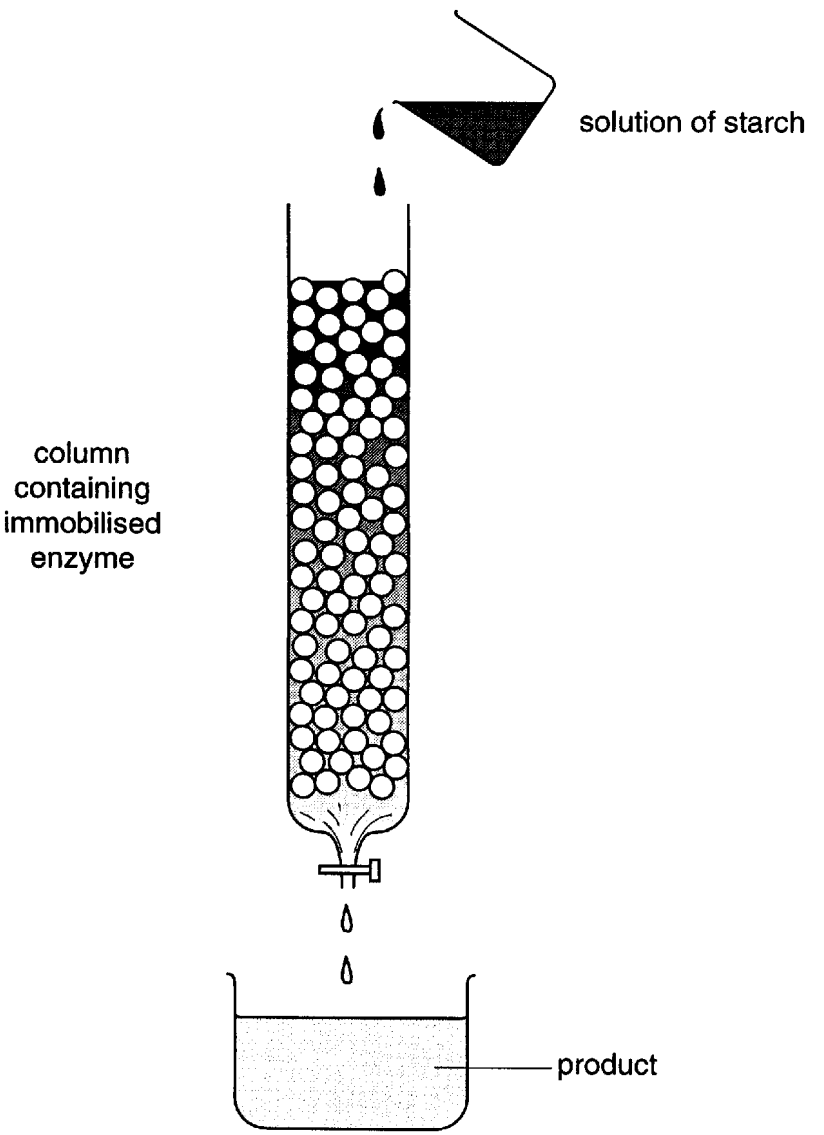

Fig. 2.1

(a) Describe how amylase may have been immobilised.

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(b) Describe how the product could be tested to find out whether it had been contaminated by the enzyme.

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(c) To produce a greater yield, the product can be collected and passed through the column of immobilised enzyme. This process can be repeated.

Explain how it would be possible to determine experimentally how many times the process should be repeated to produce the optimal yield.

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(d) Explain **two** advantages of using immobilised enzymes in an industrial process.

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[Total: 10]

3 Wine and beer tend to be produced by batch fermentation. In Gascony, France, laboratory trials were carried out before introducing large-scale fermentation processes for producing wine.

(a) Describe **three** problems that have to be solved when 'scaling up' pilot laboratory models of fermenters using microorganisms.

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

Some wine producers have experimented with continuous fermentation as an alternative method to batch fermentation.

Describe the differences between batch and continuous fermentation, pointing out the advantages and disadvantages of each.

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Quality of Written Communication [1]

(c) Genetic engineering of yeast cells used in brewing has resulted in different, commercially useful strains being produced.

(i) Suggest **two** phenotypic features of yeast that could be modified by genetic engineering.

1 .....

2 ..... [2]

(ii) Outline the way that new strains of yeast could be produced by genetic engineering.

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[Total: 18]

4 **(a)** Yeast cells were added to a culture medium and allowed to grow and reproduce. Samples were removed at regular intervals and the turbidity of each sample was measured. The results obtained are shown Fig. 4.1.

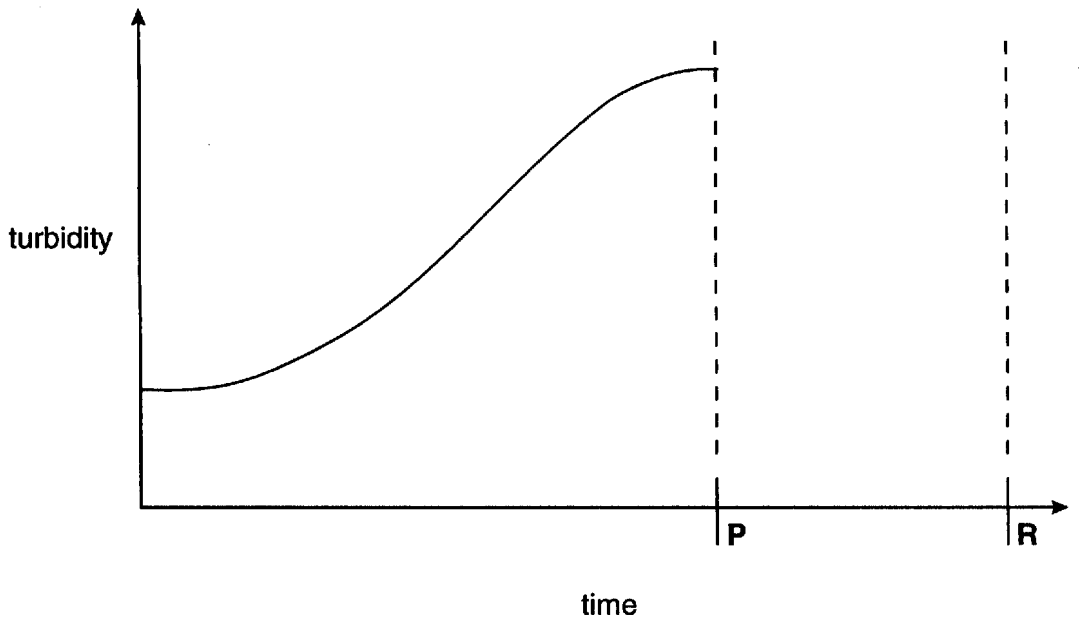

Fig. 4.1

(i) Explain why turbidity did not initially increase.

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..... [2]

(ii) Explain why measuring turbidity is **not** a good way of estimating the size of the yeast population.

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..... [1]

(iii) This experiment was continued from time **P** to time **R**.

Sketch, on Fig. 4.1, a line to show what would happen to the turbidity between times **P** and **R**. [1]

(b) Describe a method for determining the **viable** numbers of yeast cells present in a culture.

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(c) The primary metabolic products of yeast are used in industries such as brewing and bread making. In some cases, microorganisms are grown for the secondary metabolic products they produce.

(i) Explain the difference between primary and secondary metabolic products.

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(ii) Give an example of a secondary metabolic product.

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(d) Fig. 4.2 shows changes in cell mass of the fungus *Penicillium* with time.

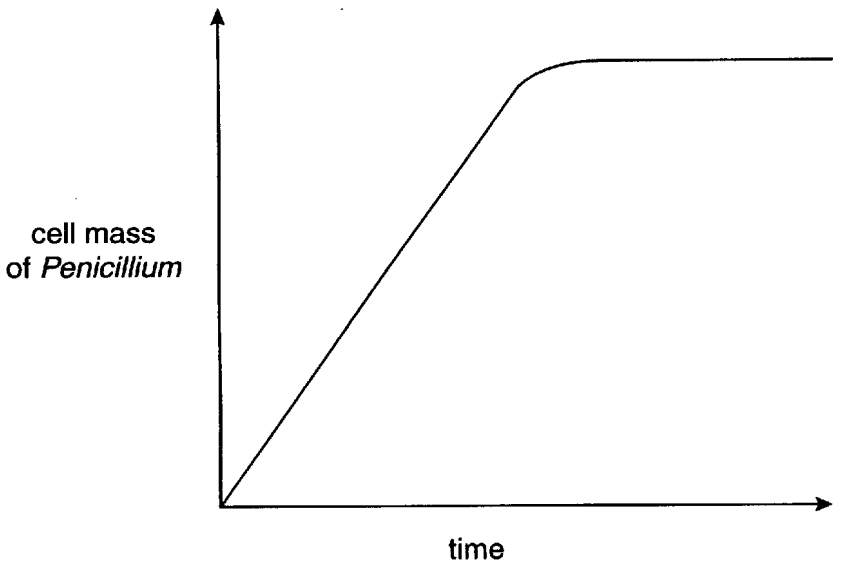

Fig. 4.2

(i) Mark an **X** on the curve of Fig. 4.2 to show when secondary metabolites are being produced by this microorganism. [1]

(ii) Explain how a culture of *Penicillium* can be treated to encourage the production of secondary metabolites.

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[Total: 15]

5 **(a)** Fig. 5.1 shows a section through part of a filament of *Penicillium roquefortii* isolated from blue cheese.

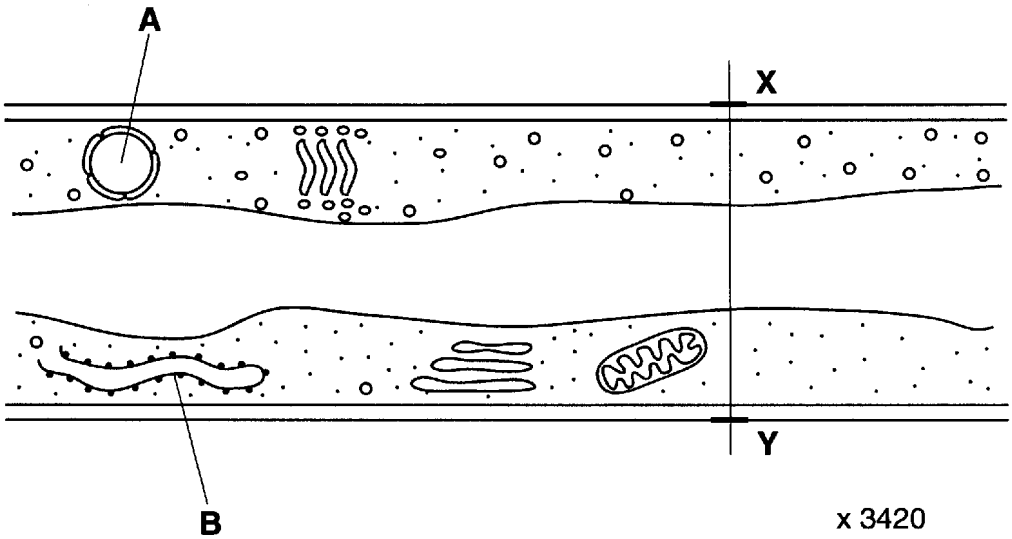

Fig. 5.1

(i) Name the features labelled **A** and **B** in Fig. 5.1.

A .....

B ..... [1]

(ii) Name **two** features **visible in Fig. 5.1** which show that this organism is eukaryotic. Do not include those features labelled **A** and **B**.

1 .....

2 ..... [2]

(iii) Calculate the diameter of the filament at **XY** to the nearest micrometre (μm). Show your working.

Answer ..... μm [3]

(b) A student found two different microorganisms, **S** and **T**, in a culture solution and wrote the following descriptions of each.

Microorganism S

The microorganism is 1.0 μm in diameter and is a single cell surrounded by a cell wall. It has a number of flagella and is motile. Internally there are many small circular rings of DNA and free ribosomes.

Microorganism T

This microorganism is 200 nm in diameter. It has a head enclosed by a protein coat composed of a number of identical elements. The tail section has a base plate with a number of fibres, which spread out like feet.

Complete the table below.

	microorganism **S**	microorganism **T**
type of microorganism		
name of structure underlined in student's description		
another feature present in the same organism, **not** in student's description		

[6]

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

Some bacteria of different species can appear very similar. A staining method was developed to distinguish between them. This method is called Gram staining after the Danish biologist who first developed it.

Describe the basis of the Gram staining technique and explain how it distinguishes between different bacterial types.

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Quality of Written Communication [1]

[Total: 20]

6 **(a)** Microbiology involves organisms that are not easy to see due to their size. Some of these organisms are potentially dangerous.

An A-level student is planning to carry out an investigation on the bacteria growing in a mixed culture. For each of the following procedures, describe the appropriate methods that the student should use.

(i) Isolating examples of bacteria from a mixed culture.

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(ii) Safe incubation of bacteria on agar.

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(iii) Safe observation of bacterial cultures.

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(iv) Safe disposal of bacterial cultures.

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(b) Microorganisms are often used in genetic engineering, which is controlled by law.

Explain why it is necessary to control genetic engineering of microorganisms.

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(c) State **three** possible hazards of genetic engineering in crop plants.

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(d) Explain **four** ways in which genetic engineering could increase the yield of crops.

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4 .....

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[Total: 18]