OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY 2805/04

Microbiology and Biotechnology

Friday **24 JUNE 2005** 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	12	
2	13	
3	19	
4	12	
5	14	
6	20	
TOTAL	90	

This question paper consists of 18 printed pages and 2 blank pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 **(a)** Enzymes are used in many commercial processes, either in a free, soluble form or immobilised.

Immobilised enzymes are being used in a bioreactor that attaches to spacesuits. The bioreactor was developed during 'Water Recovery Tests'. This immobilised enzyme bioreactor removes the urea from an astronaut's urine. The bioreactor uses 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.*

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.....[1]

(ii) State **two** different methods of immobilising an enzyme.

1 .....

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2 .....

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(iii) Suggest **three** practical advantages of using an immobilised urease bioreactor in a space ship.

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(b) Soluble and immobilised lipases were tested for their ability to hydrolyse palm oil. When oil is hydrolysed, it produces fatty acids and glycerol.

The two forms of lipase showed **optimal** activity at the same pH and temperature (pH 7.5 and 35°C). At that pH and temperature, 100% of the oil was hydrolysed in two minutes.

If the temperature was increased to 45°C, 100% of the oil was hydrolysed using immobilised lipase but when soluble lipase was used, only 80% was hydrolysed within the two-minute period.

(i) Define the term *hydrolysis.*

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(ii) Using the information from the passage and your knowledge of the products of the reaction, explain the advantages of using an immobilised enzyme to hydrolyse palm oil.

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[Total: 12]

2 **(a)** In this question, one mark is available for the quality of spelling, punctuation and grammar.

Many different types of bacteria live on the surface of the skin. Some of them convert the proteins in sweat into ammonia, which produces unpleasant smells. Many people use deodorants; some deodorants simply mask the smell but others work by inhibiting the action of bacteria.

Describe how you would test to find out which of a pair of liquid deodorants has the most effective antibacterial properties. Include details of the aseptic techniques you would use.

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Quality of Written Communication [1]

(b) Human sweat contains some natural anti-bacterial substances.

(i) Suggest the benefits in hot weather, **other than reducing body odour**, of sweat containing anti-bacterial substances.

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(ii) Some anti-bacterial substances 'punch' holes in bacterial cell walls.

Explain why they **do not** have the same effect on plant and animal cells.

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[Total: 13]

3 Bacteria and viruses cause many common diseases. However, many people confuse viruses with bacteria.

Viruses are different from bacteria in both size and structure.

(a) Complete the table below by stating the differences between the structure of viruses and the structure of bacteria.

structural feature	virus	bacteria
outer coating		
cytoplasm		
nuclear material		

[3]

(b) Fig. 3.1 is a diagram of the human immunodeficiency virus (HIV).

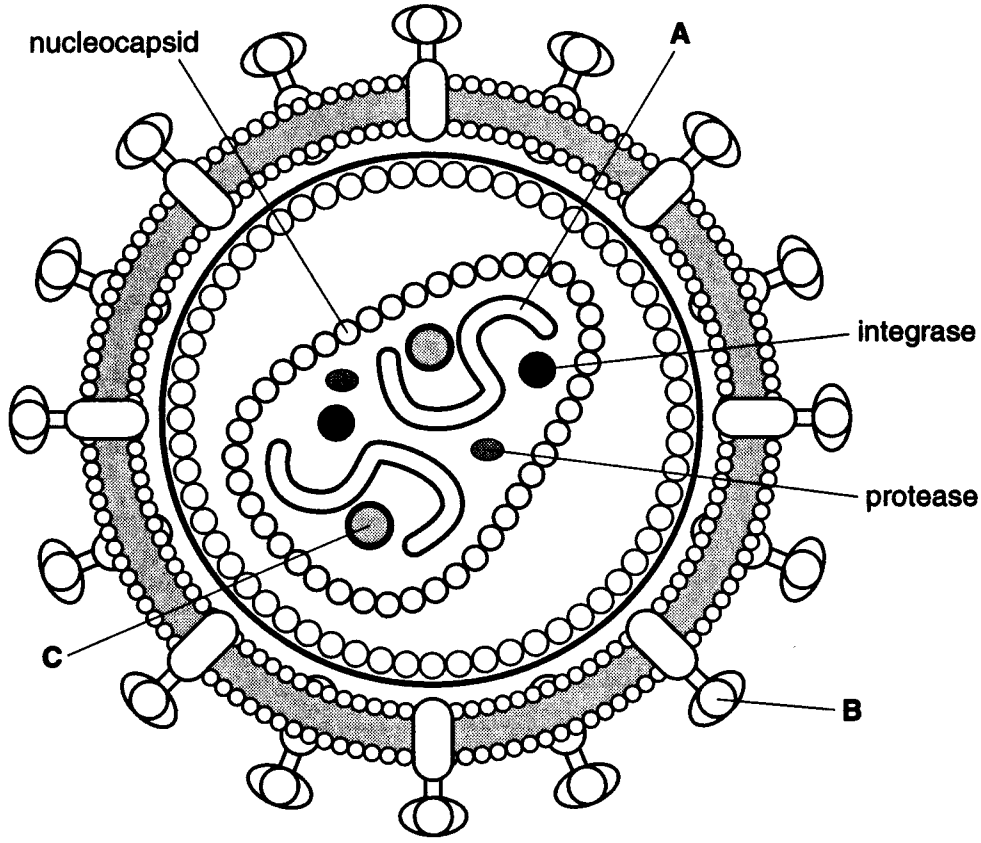

Fig. 3.1

Name structures **A** to **C**.

A .....

B .....

C .....[3]

For Examiner's Use

(c) In this question, one mark is available for the quality of use and organisation of scientific terms.

Describe the life cycle of HIV.

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Quality of Written Communication [1]

[Turn over

(d) Some viruses, known as bacteriophages, infect bacteria. The DNA of bacteriophage λ becomes incorporated into the bacterial chromosome and is known as a prophage. The host bacterial cell remains unaffected and can continue to grow and reproduce asexually.

Describe asexual reproduction in the bacterial cell **and** explain how this allows the replication of the prophage.

You may use the space below for any diagrams.

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[4]

[Total: 19]

4 Artificial selection has been used for many years to produce plants and animals with characteristics valued by breeders.

A hybrid variety of watermelon has been produced which is small, sweet and seedless. This was achieved by selectively breeding two different varieties of watermelon plant, as shown in Fig. 4.1.

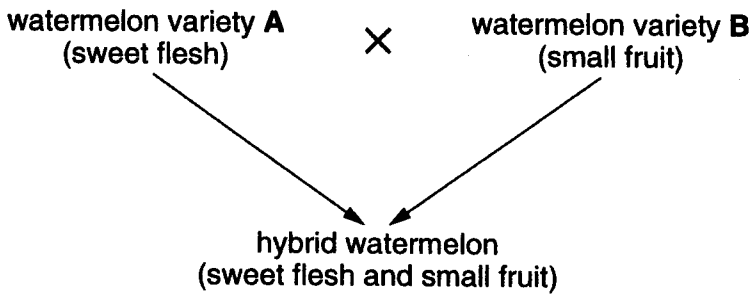

Fig. 4.1

The hybrid from this cross is sterile because it is triploid (3n). Tissue culture may be used to clone more of this hybrid variety.

(a) Explain why the hybrid is sterile.

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[Turn over

(b) Describe how plants that produce watermelons with sweet flesh and small fruits could be obtained by cloning from tissue culture.

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(c) Discuss the advantages **and** disadvantages of using the technique of tissue culture for cloning plants.

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[Total: 12]

5 A student investigated the fermentation of two sugars, glucose and maltose, by yeast cells. Two fermentation tubes were prepared containing equal volumes of a yeast suspension and the respective sugar solutions.

Each fermentation tube was placed inside a test tube, as shown in Fig. 5.1.

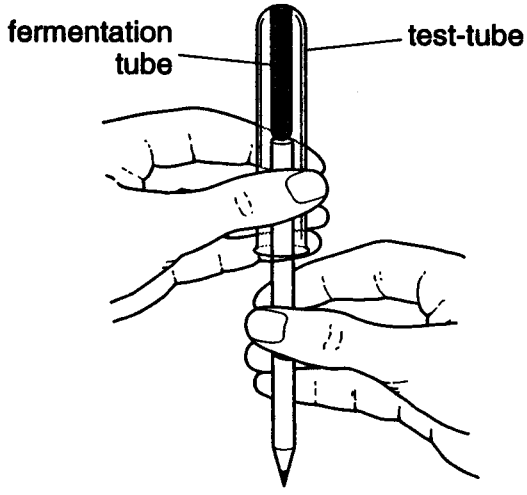

Fig. 5.1

The test-tubes were turned through 180° and placed in a test-tube rack. The yeast suspensions were left to ferment for 80 minutes. During this time, gas collected as shown in Fig. 5.2.

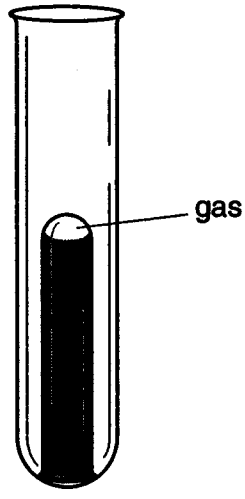

Fig. 5.2

The student determined the volume of gas collected in each tube at intervals of ten minutes. The results are shown in Fig. 5.3.

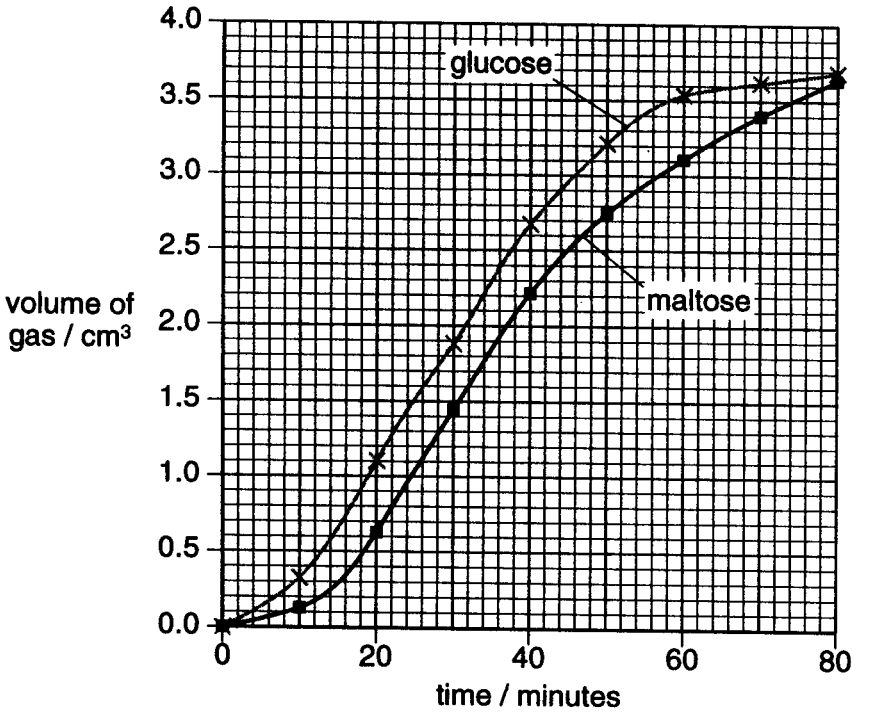

Fig. 5.3

(a) (i) Suggest **three** variables, **other than type of sugar**, that could affect the results of this investigation.

1 .....

2 .....

3 .....[3]

(ii) Name the gas that is produced by fermentation.

.....[1]

(b) (i) Using the data in Fig. 5.3, describe the results obtained with glucose.

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(ii) Suggest reasons for the results you have described in **(b) (i)**.

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(c) Suggest why there is a difference between the results for maltose and the results for glucose.

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[Total: 14]

6 Fig. 6.1 shows a batch fermenter used to produce penicillin.

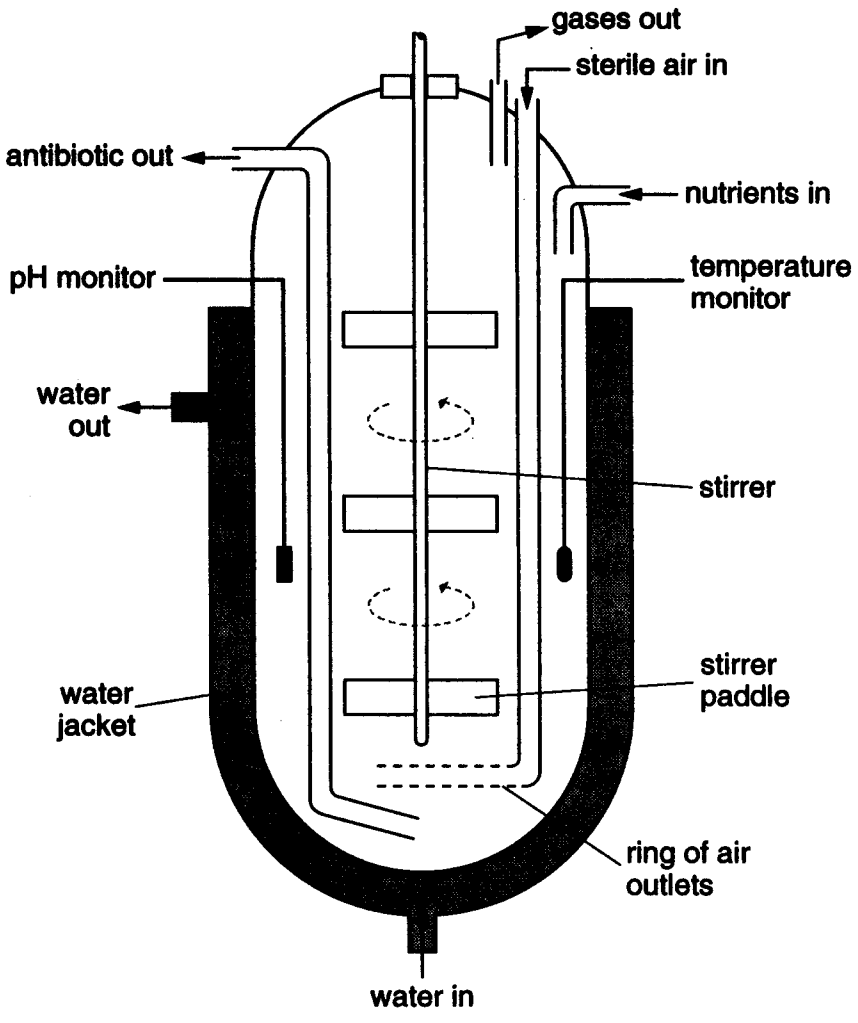

Fig. 6.1

(a) Explain why sterile air is pumped into the fermenter.

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.....[2]

(b) **(i)** The fungus that produces penicillin needs a supply of carbon and nitrogen. Give the form in which these elements are added to the culture.

carbon .....

nitrogen .....[2]

(ii) Explain why it is necessary to pump water into the jacket surrounding the culture.

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(iii) State why pH is monitored **and** describe how it is controlled.

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Question 6 continues on the next page.

For Examiner's Use

(c) Fig. 6.2 is a graph showing the production of penicillin and the growth of the fungus, *Penicillium*, in the fermenter shown in Fig. 6.1.

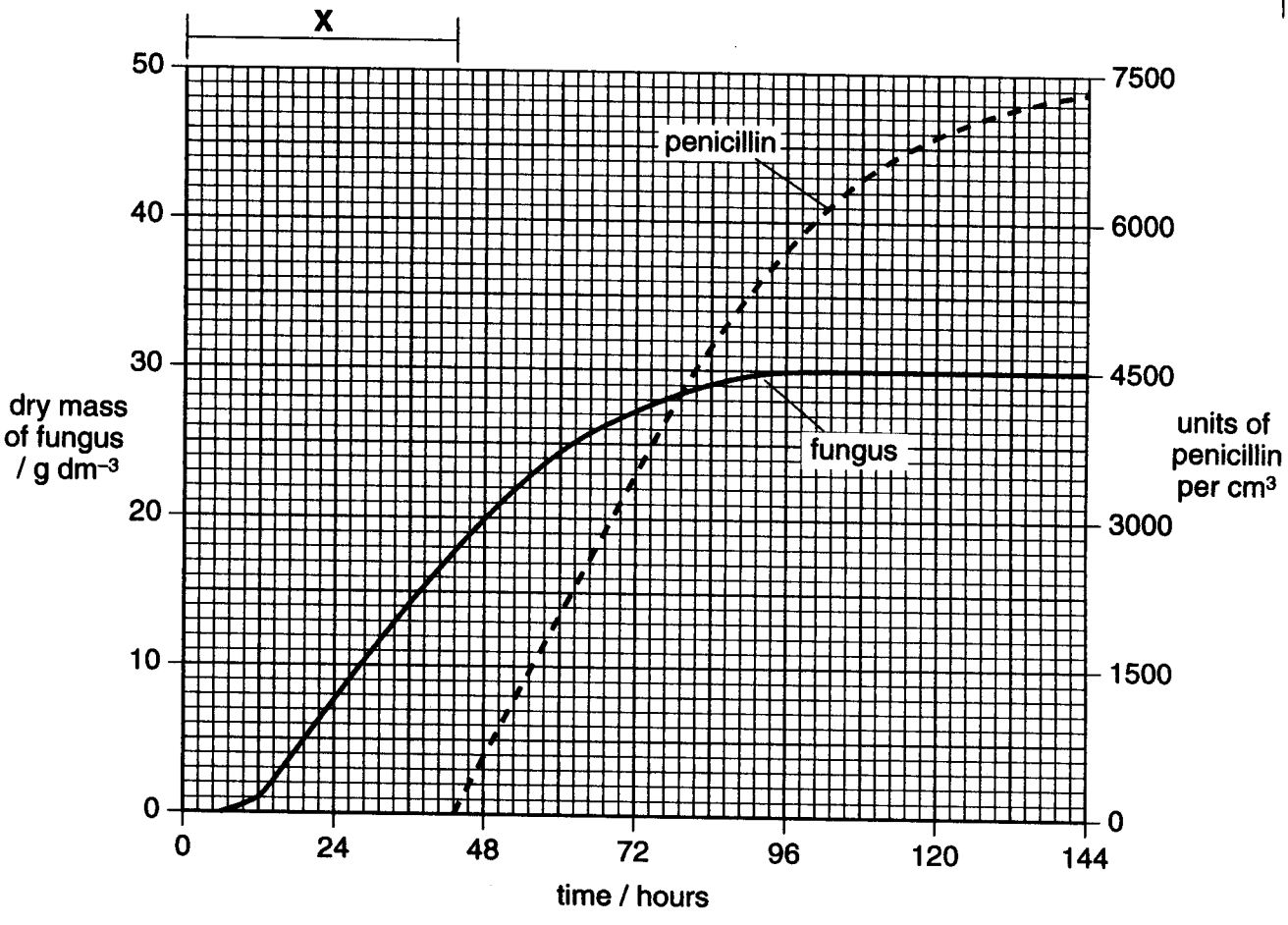

Fig. 6.2

(i) Using the data in Fig. 6.2, state the time when *Penicillium* enters its stationary phase.

.....[1]

(ii) Explain why there is no antibiotic produced during phase **X**.

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(d) Penicillin is removed from the fermenter for downstream processing.

Describe what happens during downstream processing.

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(e) Other medically important products, such as insulin and growth hormone, are produced on a large scale using microorganisms.

Give reasons for using microorganisms in the production of insulin and growth hormone.

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[Total: 20]

END OF QUESTION PAPER