OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY

2805/04

Microbiology and Biotechnology

Monday **31 JANUARY 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	19	
2	17	
3	15	
4	17	
5	11	
6	11	
TOTAL	90	

This question paper consists of 16 printed pages.

Registered Charity Number: 1066969
[Turn over

For Examiner's Use

Answer **all** the questions.

1 **(a)** Fig. 1.1 shows a biosensor that could be used to measure the concentration of glucose in a blood sample.

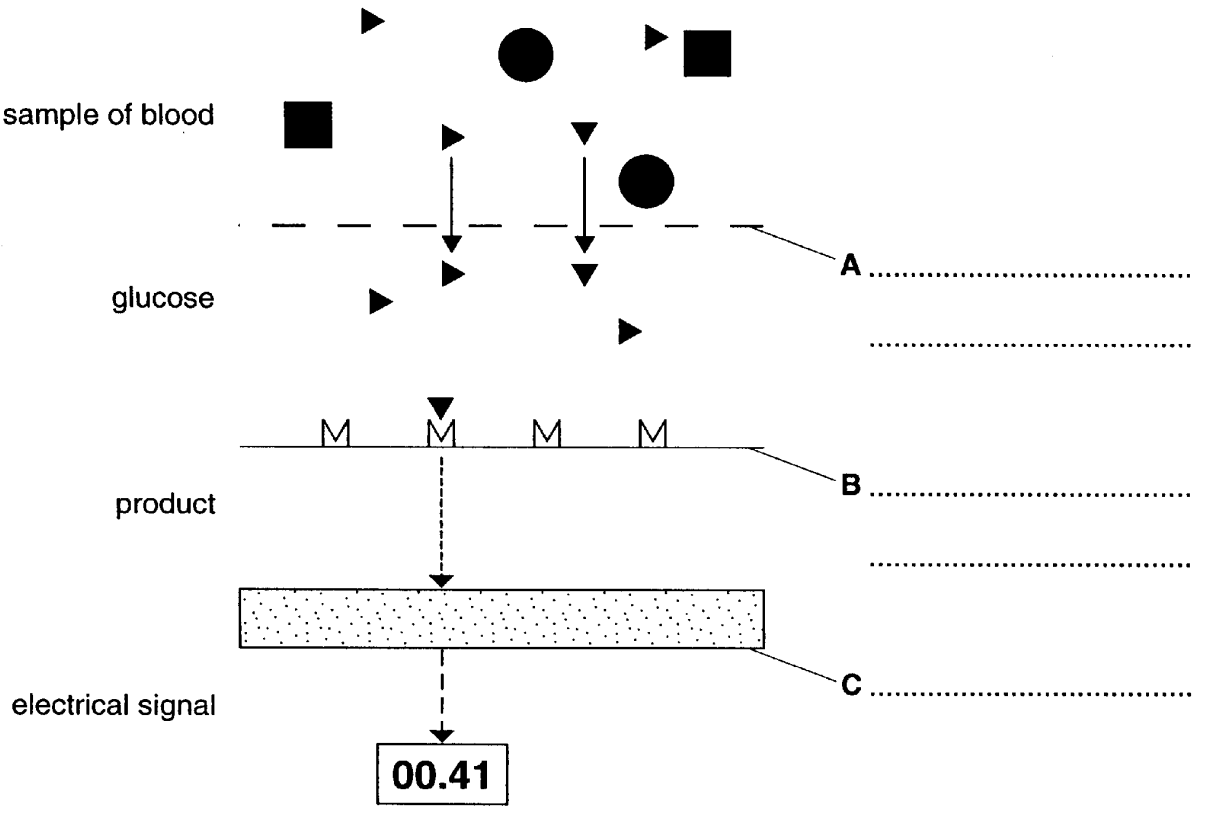

Fig. 1.1

(i) Label structures **A** to **C** on Fig. 1.1. [3]

(ii) Explain how this biosensor works.

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(iii) Suggest what advantages such a biosensor may have to someone suffering from diabetes.

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(b) Some biosensors use monoclonal antibodies.

One stage in the production of a monoclonal antibody is the fusion of a lymphocyte and a myeloma cell.

(i) Name the type of cell that results from this fusion.

.....[1]

(ii) Explain why the fusion is necessary.

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.....[3]

(c) One medical use of monoclonal antibodies is to detect the presence of viruses, such as HIV.

(i) Explain how the structure of viruses, such as HIV, allows this identification to be achieved.

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(ii) Give **one** other medical use of monoclonal antibodies.

.....[1]

[Total: 19]

[Turn over

2 Consumers are increasingly concerned about the safety of their food. People may become ill through the consumption of untreated milk and dairy products, or through processes involved in dairy farming.

These include:

- errors in pasteurisation;
- consumption of untreated milk products;
- contamination of milk products by pathogens such as *Mycobacterium* (TB) and *Salmonella* (food poisoning bacteria);
- transmission of pathogens to humans through animal contact.

Fig. 2.1 shows how milk is collected and processed in the UK.

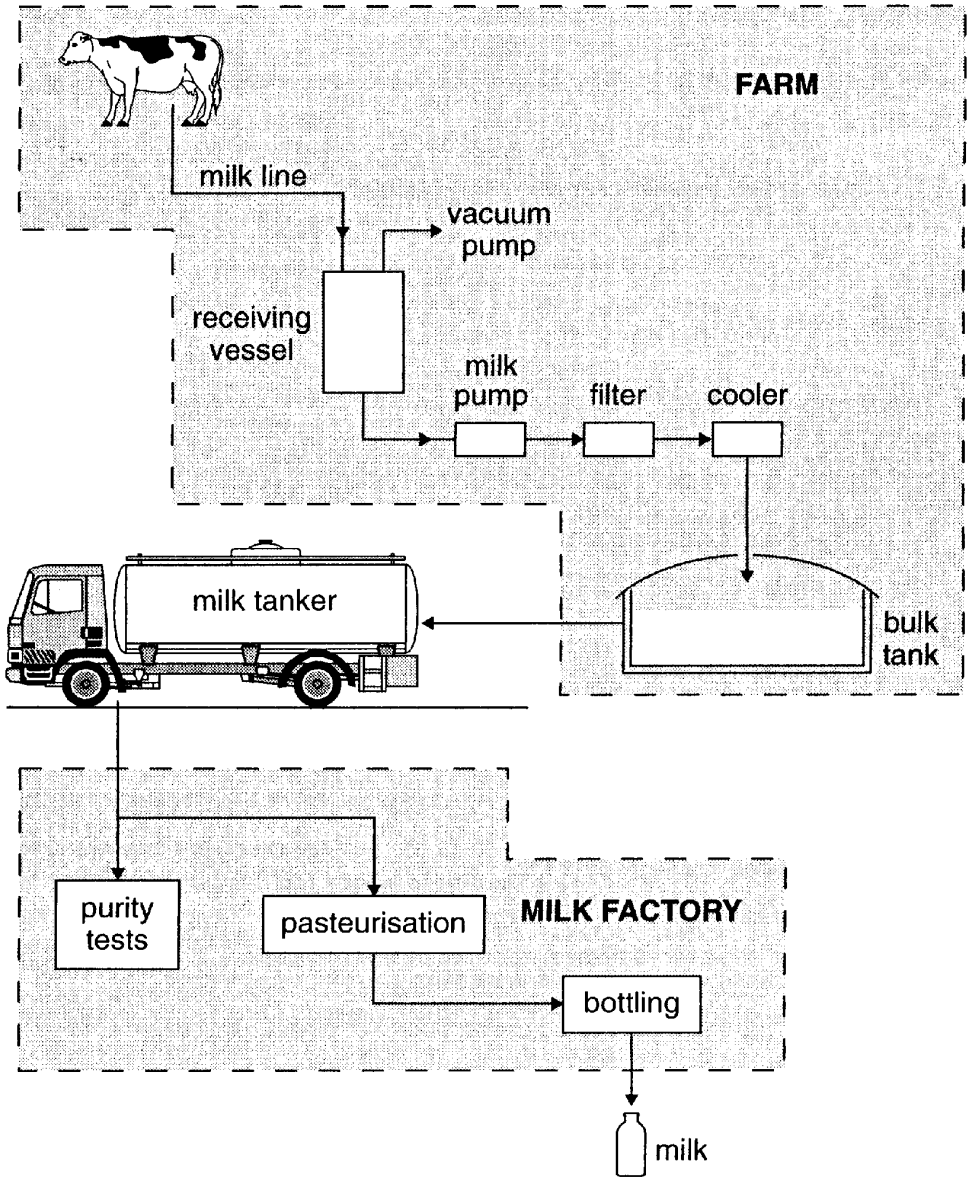

Fig. 2.1

For Examiner's Use

(a) Outline how milk is pasteurised **and** explain why the process should remove the danger of infection.

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

Pathogenic bacteria like *Salmonella* may contaminate milk. Possible origins of *Salmonella* in milk stored in bulk tanks include infected mammary glands and contamination by faeces during milking.

A student chose to use a haemocytometer to measure the bacterial population of a sample of milk from a bulk tank.

Describe the steps of this technique.

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[Turn over

For Examiner's Use

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Quality of Written Communication [1]

For Examiner's Use

(c) (i) State why dilution plating may be a better method of determining the potential danger of pathogenic bacteria like *Salmonella* in the milk sample.

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(ii) Suggest how you could distinguish *Salmonella* from other bacteria present by observation of the plate.

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.....[2]

(iii) Dilution plating is **not** used for purity tests in milk factories.

Suggest **one** reason why.

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.....[1]

[Total: 17]

[Turn over

3 **(a)** A number of organic chemicals are produced commercially using microorganisms.

Citric acid is produced by certain fungi and is a secondary metabolite.

(i) Name **one other** secondary metabolite produced commercially from a fungus.

.....[1]

(ii) State what is meant by the term *secondary metabolite*.

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.....[1]

(iii) State which method of fermentation would be used to produce a secondary metabolite and explain your answer.

method .....

explanation .....

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Fig. 3.1 shows a 'pilot plant' assembled by a student in a school laboratory.

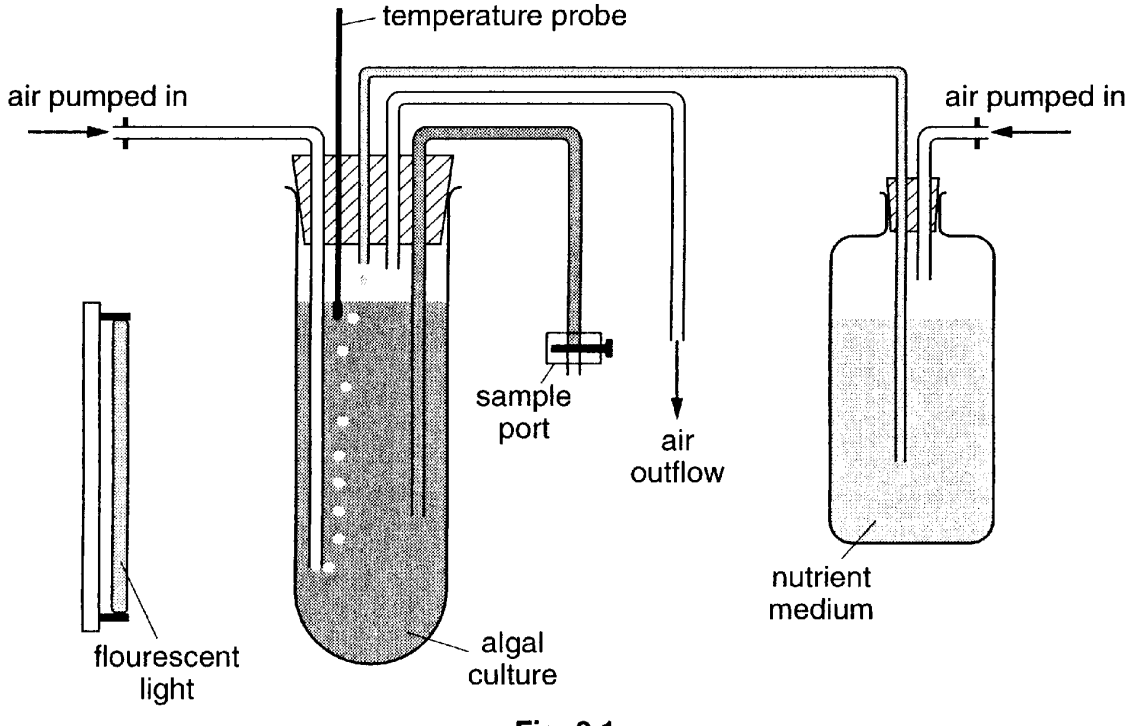

Fig. 3.1

For Examiner's Use

(b) The student has undertaken a project to culture an alga called *Chlorella* to feed brine shrimps for use as fish food. If it works, the student hopes to produce a **continuous culture** of algae.

Explain how the apparatus shown in Fig. 3.1 allows a continuous culture of *Chlorella*.

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(c) Describe the major problems of developing this project to enable the large-scale production of *Chlorella*.

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[Total: 15]

[Turn over

For Examiner's Use

4 Plants that are genetically modified to express an insecticide protein, coded for by a gene from the bacterium *Bacillus thuringiensis*, provide a safe and highly effective method of insect control. These plants are referred to as *Bt*-protected plants.

The protein is contained within plant cells and rapidly degrades when the plant dies. Organisms other than insect pests are unaffected if they are exposed to high levels of this protein. Less insecticide is used on *Bt*-protected plants than on unprotected plants.

(a) Using the information from the passage above, explain the advantages of using this method of insect control.

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

Crop plants such as cotton have been genetically modified by using the gene from *Bacillus thuringiensis*.

Describe the steps that would be taken to make *Bt*-protected cotton plants from cotton plants that are not protected.

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For Examiner's Use

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Quality of Written Communication [1]

(c) State **four** other improvements that could be made to crop plants using genetic engineering.

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4 .....

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[Total: 17]

5 The surface of a clean tooth is colonised by single bacterial cells. Other bacteria then attach to these cells, forming dental plaque. Lactic acid bacteria in dental plaque ferment sugars and produce acid that decays teeth.

Fig. 5.1 shows dental plaque, which is an example of a biofilm. A biofilm is a community of microbial cells that are attached to a surface by a special sticky gel.

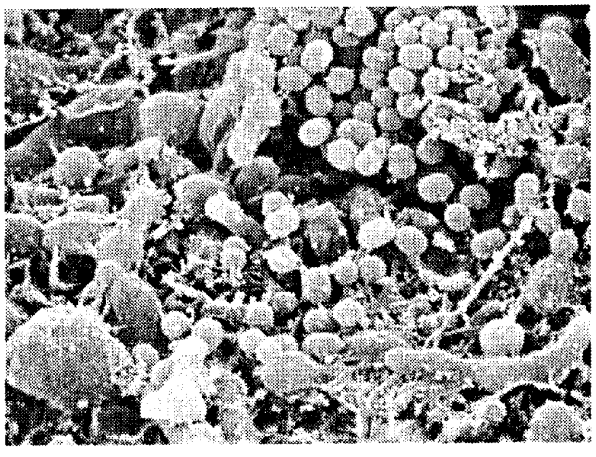

Fig. 5.1

(a) Outline how you would confirm that Gram-positive bacteria, such as lactic acid bacteria, were present in dental plaque.
Assume that you are provided with a heat-fixed smear.

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(b) **(i)** State the difference between the cell wall of Gram-positive and Gram-negative bacteria that allows bacteria to be classified in this way.

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(ii) State how the difference in structure results in a different colour.

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.....[1]

(c) Research is taking place to see if chemicals can be added to toothpaste that block the expression of the genes responsible for the synthesis of the sticky gel and therefore stop plaque forming.

RNA interference is one method used to block the expression of genes.
This uses RNA molecules that are complementary to the messenger RNA of the gene.

(i) Explain how RNA interference affects the expression of a gene.

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(ii) Unfortunately, adding complementary RNA to toothpaste has not proved successful in controlling plaque. Suggest why.

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[Total: 11]

6 Immobilised glucose isomerase is used for the production of high-fructose syrups. Starch is used as a source of glucose, which is then treated by glucose isomerase to form a mixture of glucose and fructose.

Fructose is sweeter than glucose and the syrup formed is used in sweets and soft drinks.

Fig. 6.1 shows the stages in this process.

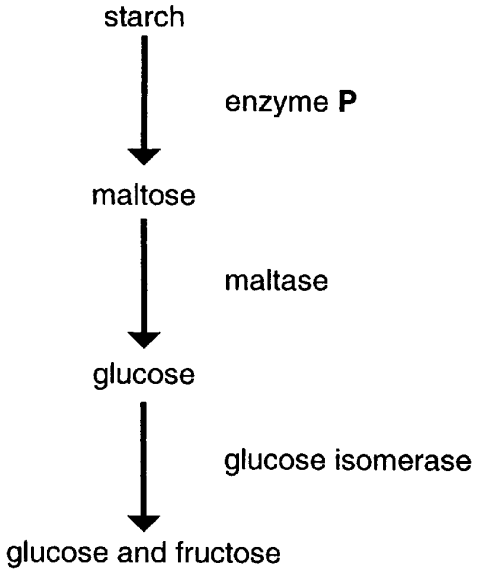

Fig. 6.1

(a) (i) Name enzyme **P**.

.....[1]

(ii) Name the type of bond that is broken when maltose is converted to glucose.

.....[1]

(iii) Name the form of glucose produced when maltose is broken down.

.....[1]

(b) The enzyme glucose isomerase is immobilised by being attached to an insoluble material.

(i) State **two** ways in which glucose isomerase could be immobilised.

1 .....

2 .....[2]

(ii) Explain **two** advantages of using immobilised glucose isomerase rather than the enzyme in solution.

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(c) Nitrogenase is an enzyme found in some bacteria that converts nitrogen gas into ammonia in a process known as nitrogen fixation. The enzyme is inactivated when exposed to oxygen. Commercial methods of fixing nitrogen are being developed but whole cells rather than the isolated enzyme are immobilised.

Suggest advantages of immobilising the whole cell rather than the enzyme.

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[Total: 11]

END OF QUESTION PAPER