OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY 2805/04

Microbiology and Biotechnology

Thursday **20 JUNE 2002** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator

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	12	
2	17	
3	20	
4	12	
5	18	
6	11	
TOTAL	90	

This question paper consists of 16 printed pages.

Registered Charity Number: 1066969

Answer **all** questions.

1 Gram staining is a technique that distinguishes between groups of bacteria.

(a) Complete the table below by stating the colour of the bacteria, when carrying out Gram staining.

	Salmonella tetani (Gram +ve)	*Escherichia coli* (Gram –ve)
add crystal violet, wash with Gram's iodine, then wash with alcohol		
add safranin		

[2]

Fig. 1.1 shows the outer surface of a Gram-negative bacterium.

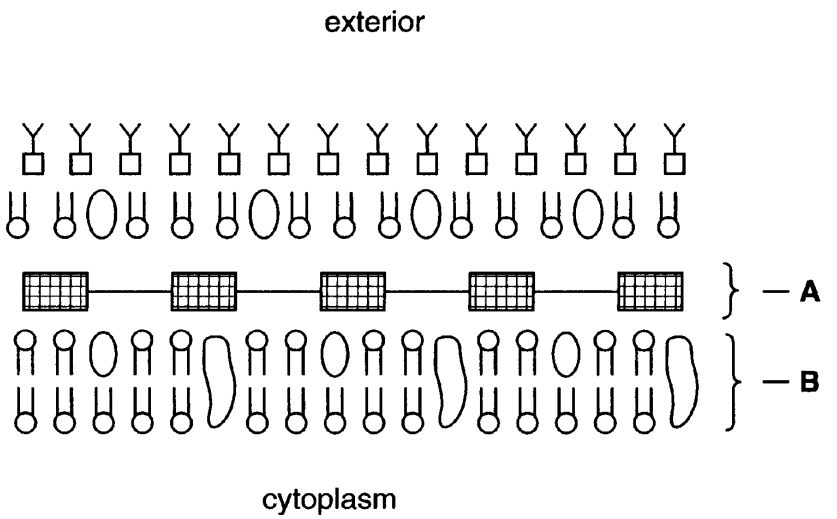

Fig. 1.1

(b) Name **A** and **B** and state a function for each.

A .....

function .....

B .....

function .....[4]

(c) Draw a simple sketch of a section through the surface of a Gram-positive bacterium. On your sketch show the relative thicknesses of the three main layers and label them.

Do **not** include details of the molecules present.

[4]

Differences in the outer surfaces of Gram-positive and Gram-negative bacteria are responsible for the fact that some antibiotics do not affect Gram-negative bacteria.

(d) Suggest why some antibiotics do not affect Gram-negative bacteria.

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.....[2]

[Total : 12]

2 Body fluids are often analysed for the presence of pathogenic microorganisms. Culture plates are prepared and samples of body fluids are inoculated onto them using aseptic techniques.

(a) State what is meant by the term *pathogenic* microorganism.

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.....[1]

(b) Describe how you would pour an agar plate and inoculate it using aseptic techniques. *(In this question, 1 mark is available for the quality of written communication.)*

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QWC [1]

Growth factors, substances that microorganisms cannot make, are added to a culture medium to ensure that the microorganisms are able to grow. Amino acids, vitamins, purines and pyrimidines are the major groups of growth factors.

(c) State the functions of the following growth factors in microorganisms.

amino acids .....

.....

vitamins .....

.....

purines **and** pyrimidines .....

.....[3]

(d) Explain why it is not possible to culture viruses on sterile agar plates.

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.....[1]

(e) Describe briefly how you would estimate the numbers of **live** bacteria in a sample of body fluid.

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.....[4]

[Total : 17]

3 Fig. 3.1 shows a pilot plant to grow a microorganism that produces a useful product.

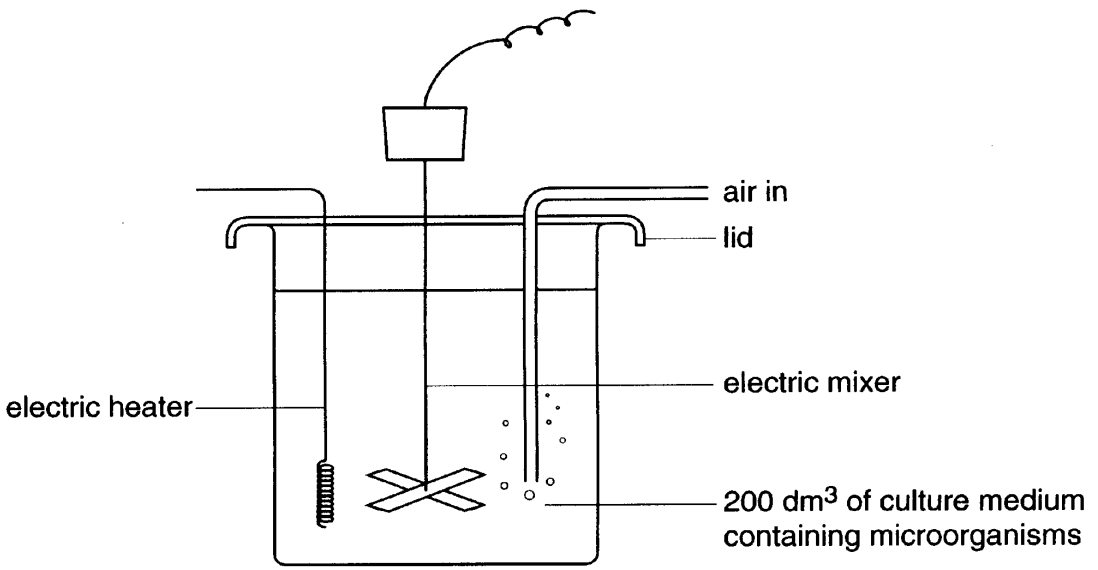

Fig. 3.1

In order to grow this microorganism in batch culture on an industrial scale, the fermenter will have to be made larger.

(a) (i) State and explain **two** other alterations that will have to be made to the fermenter if the microorganism is to be grown on an industrial scale.

1. .....

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2. .....

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.....[4]

(ii) Name **two** environmental factors that must be monitored inside the fermenter to ensure optimum rate of growth of the microorganism.

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.....[2]

Fig. 3.2 shows a growth curve of a typical microorganism in a fermenter.

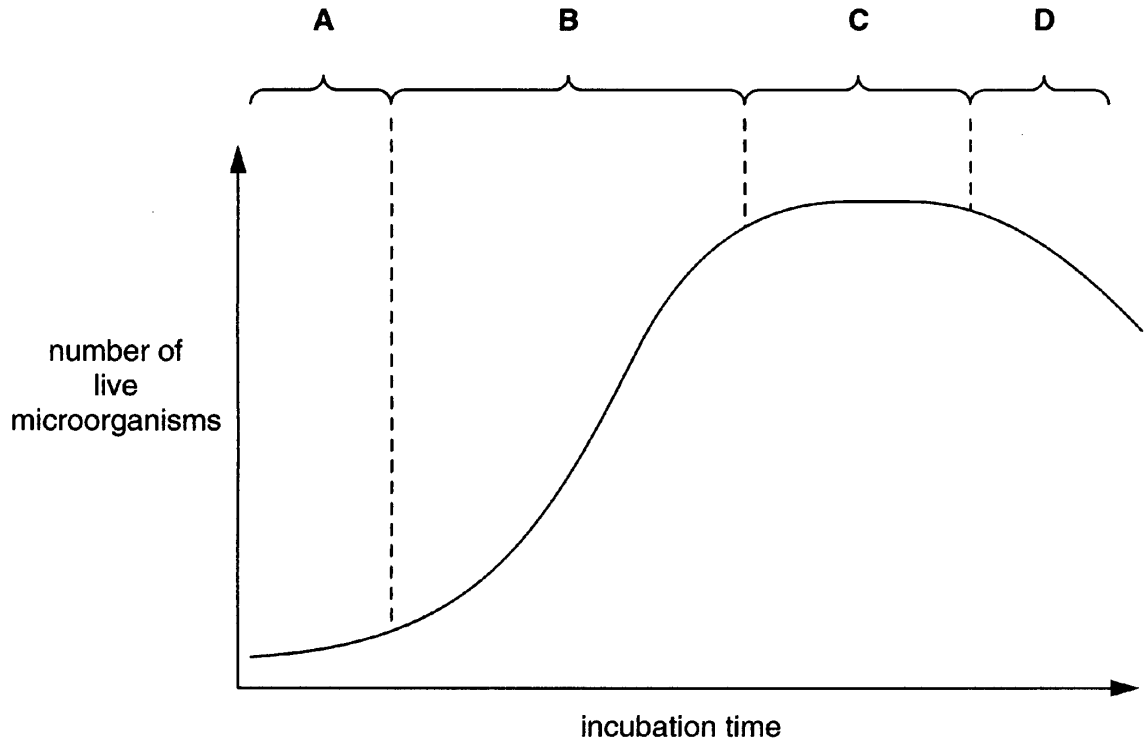

Fig. 3.2

(b) With reference to Fig. 3.2, explain what is happening during each of the stages labelled **A** to **D**.

A .....

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B .....

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C .....

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D .....

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.....[8]

Fermenters that are designed to grow microorganisms may use continuous culture or batch culture methods.

(c) (i) Explain how the maximum population growth rate may be maintained in a continuous culture.

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.....[2]

(ii) State **two** advantages and **two** disadvantages of continuous culture over batch culture.

advantages

1. .....

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2. .....

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disadvantages

1. .....

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2. .....

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[4]

[Total : 20]

4 Diabetes, which is caused by the failure of one of the body's homeostatic mechanisms, is a condition where blood glucose concentrations rise above normal. The Benedict's test may be used to test for glucose.

(a) Suggest the advantages of using a biosensor instead of the Benedict's test to measure blood glucose concentration.

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.....[4]

(b) Explain the principles of a biosensor designed to measure the concentration of blood glucose.
(In this question, 1 mark is available for the quality of written communication.)

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QWC [1]

[Total : 12]

5 **(a)** Describe the role of microorganisms in the brewing industry.

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.....[4]

(b) Explain why a microorganism, rather than a pure enzyme, is used during the brewing process.

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(c) Describe the conditions that are necessary for optimum production during fermentation in the brewing process.

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(d) **(i)** Outline the steps that would be taken by a genetic engineer to modify a microorganism used in the brewing industry.

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.....[4]

(ii) Suggest **two** properties of the microorganism that might be improved by genetic engineering.

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.....[2]

Genetic engineering is also widely used in the food industry.

(e) Suggest **two** arguments **against** this use of genetic engineering.

1. .....

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2. .....

.....[2]

[Total : 18]

6 Fig. 6.1 is a simplified diagram of part of a sewage treatment process.

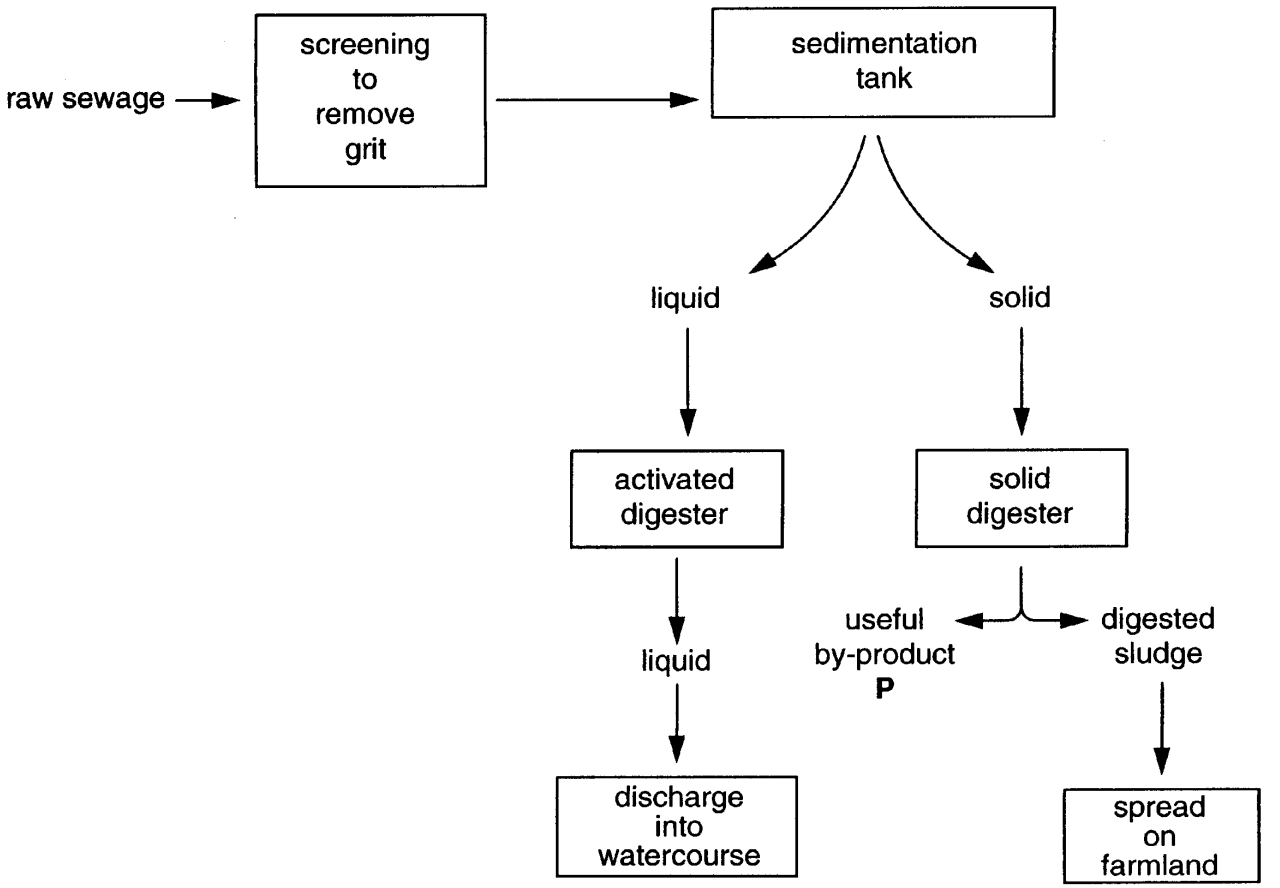

Fig. 6.1

Microorganisms found in the activated digester break down organic material in liquid sewage.

(a) Name **two** types of microorganism found in the activated digester.

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.....[1]

Fig. 6.2 shows an equation to summarise the process that occurs in the activated digester.

organic molecule + **gas X** $\xrightarrow[\textbf{process Z}]{}$ water + **molecule Y**

Fig. 6.2

(b) With reference to Fig. 6.2,

name the gas labelled **X**; .....

the molecule produced labelled **Y**; .....

the biochemical process labelled **Z**. .....[3]

(c) If gas is not bubbled through the mixture, state how this process could be activated.

.....[1]

Liquid from activated digesters may still contain some organic compounds.

(d) Explain why it is considered safe to release this liquid into watercourses.

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.....[2]

(e) With reference to Fig. 6.1, describe and explain how the process that occurs within the solid digester produces a useful by-product, **P**.

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.....[4]

[Total : 11]