OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY

2805/04

Microbiology and Biotechnology

Tuesday **29 JANUARY 2002** Morning 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	19	
2	14	
3	10	
4	15	
5	16	
6	16	
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)** **(i)** Complete the table by arranging the following groups in order of their individual sizes and then compare some of their features.

Prokaryotae **Protoctista** **Viruses**

smallest

group	type of genetic material (DNA or RNA)	presence (✔) or absence (✘) of nucleus

largest

[4]

(ii) Name the group that includes bacteriophages.

.....[1]

Fig. 1.1 is a drawing of an electron micrograph of the yeast *Saccharomyces cerevisiae*.

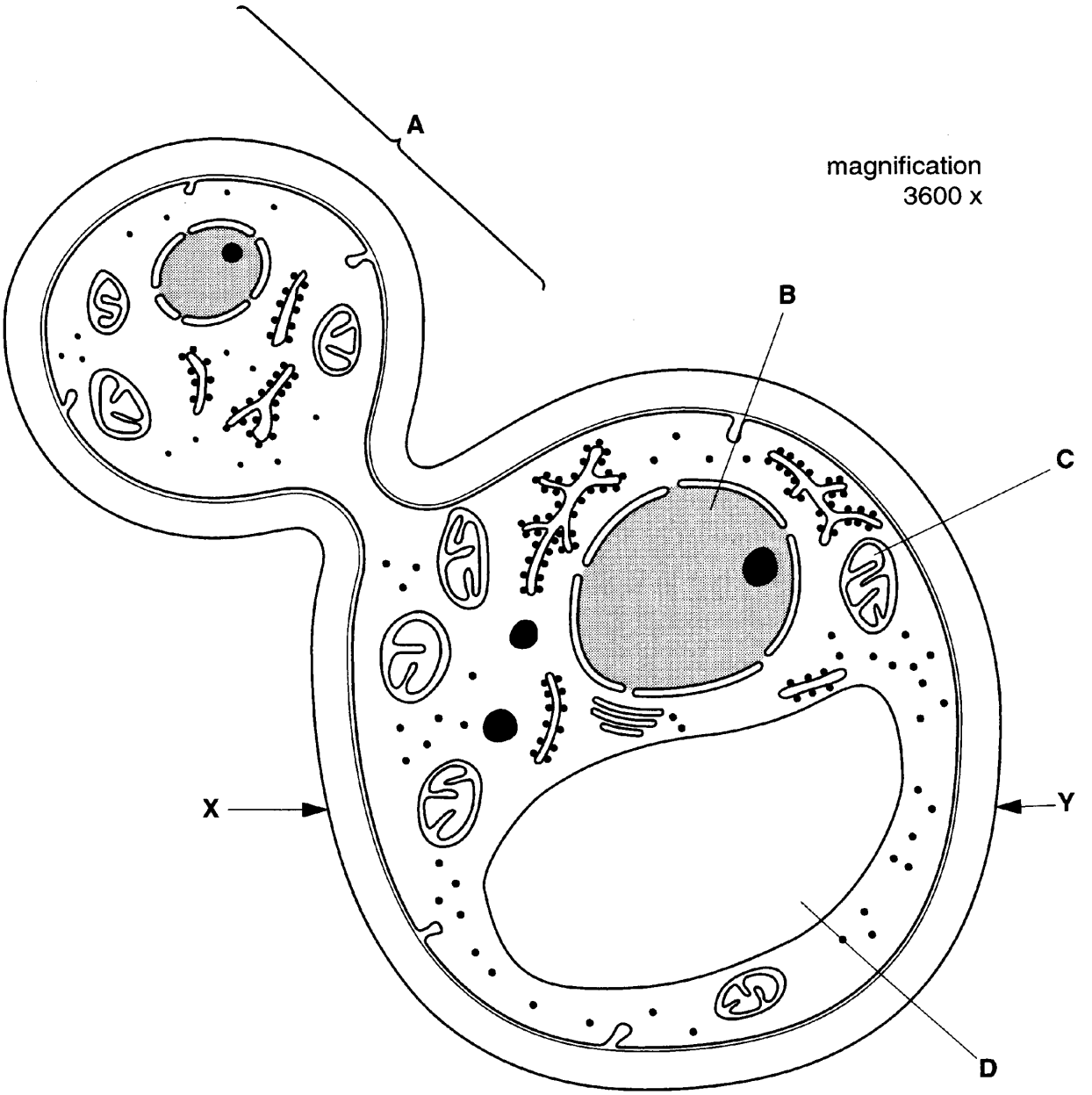

Fig. 1.1

(b) (i) Name the structures labelled **A** to **D**.

A .....

B .....

C .....

D .....[4]

[Turn over

For Examiner's Use

(ii) Calculate the actual width of this cell from **X** to **Y**. Show your working and express your answer in μm.

[2]

(c) Viruses are cellular parasites. Describe the life cycle of the human immunodeficiency virus (HIV).
(In this question, 1 mark is available for the quality of written communication.)

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[Total : 19]

For Examiner's Use

2 Penicillin is produced by batch fermentation of a microorganism, *Penicillium*, which has a filamentous growth form.

(a) Explain how batch fermentation differs from continuous fermentation.

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(b) **(i)** Name the group of microorganisms to which *Penicillium* belongs.

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(ii) Explain why the filamentous growth form of *Penicillium* could create a problem within a fermenter and how the fermenter is designed to overcome it.

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[Turn over

Fig. 2.1 shows the changes in the concentration of a carbon source and the increase in biomass of *Penicillium* during fermentation.

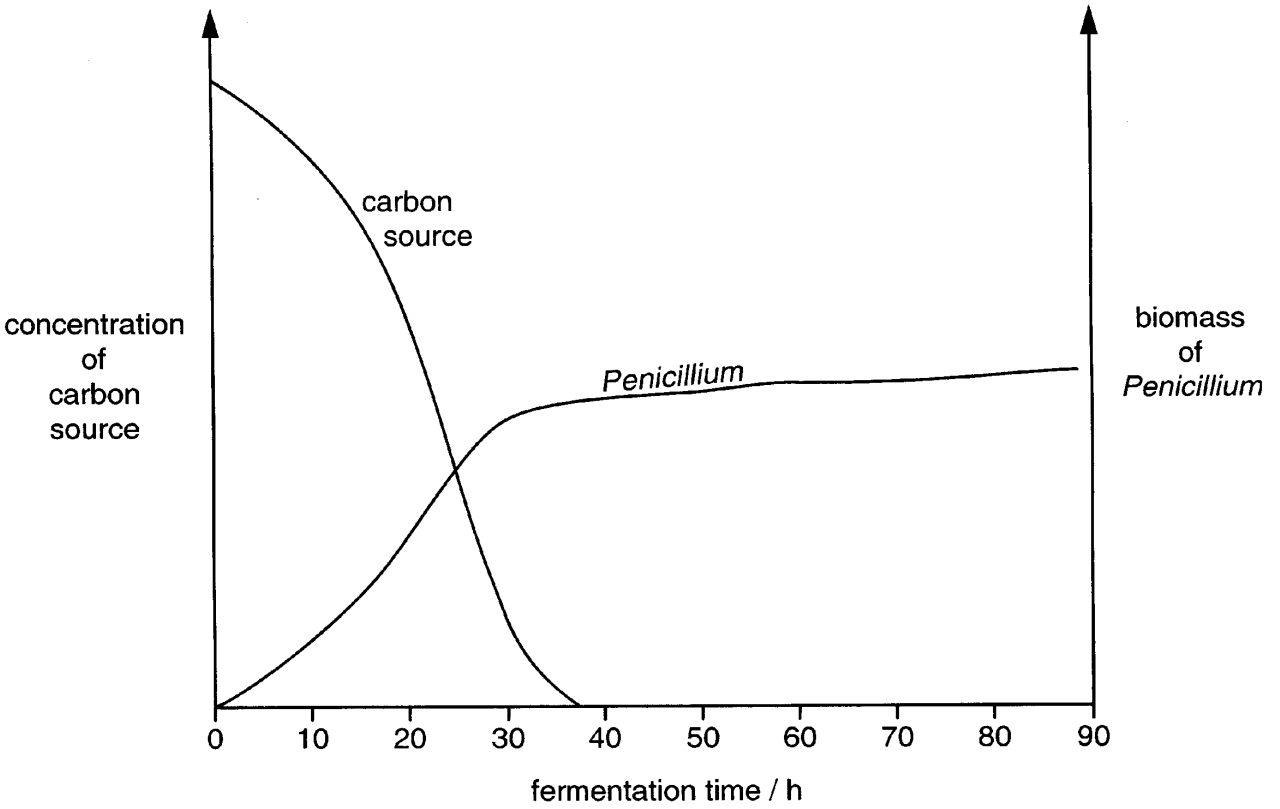

Fig. 2.1

(c) Name a suitable carbon source that is provided during fermentation.

.....[1]

Nitrogen is another essential element needed for growth.

(d) State in what form nitrogen is provided in this case.

.....[1]

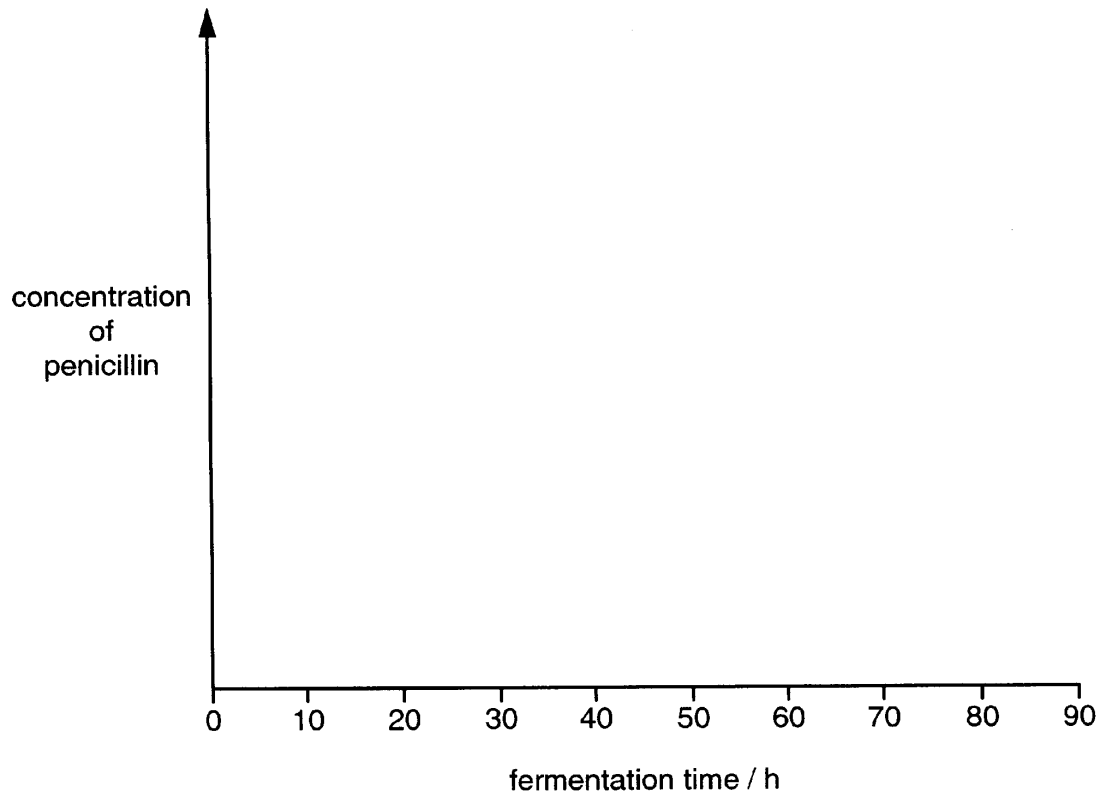

Fig. 2.2

Penicillin in not produced by the microorganism until 20 hours of fermentation.

(e) On Fig. 2.2, sketch a line to show the changes in concentration of penicillin during fermentation. [2]

(f) With reference to Fig. 2.1, explain why continuous fermentation would not be a successful method for penicillin production.

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[Total : 14]

For Examiner's Use

3 There is a concern that genetically modified microorganisms may pose a threat, should they be released into the environment. One method of detecting such organisms is to introduce a further gene that codes for an enzyme, luciferase, along with the desired gene. This enzyme occurs naturally in a number of marine bacteria and causes bioluminescence (the production of light) in the presence of oxygen and certain substrates.

(a) Describe how the gene that codes for luciferase could be isolated from the marine bacteria.

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.....[6]

The gene that codes for luciferase can be inserted into genetically modified plant cells. Plasmids are often used as gene vectors to introduce genes into bacterial cells.

(b) Suggest why plasmids by themselves cannot be used to insert genes directly into plant cells.

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(c) Suggest advantages of using the luciferase gene to detect the presence of escaped genetically modified microorganisms.

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[Total : 10]

For Examiner's Use

4 A number of cases of diarrhoea have been reported following a series of floods. Suspecting pollution of a river by sewage, a sample of river water was taken and the bacterial population estimated using haemocytometry and turbidimetry. A haemocytometer is used to estimate the **total cell count** of bacteria in a sample culture. Fig. 4.1 shows a haemocytometer grid. The depth of culture on the grid is 0.1 mm.

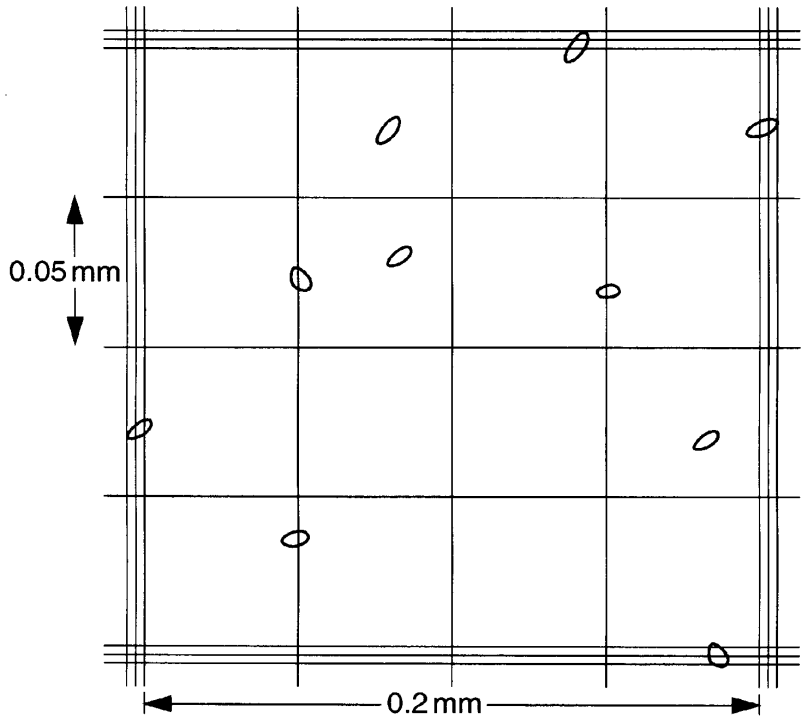

Fig. 4.1

(a) Calculate the number of cells in 1 mm^3 of the original culture. Show your working.

[4]

[Turn over

For Examiner's Use

(b) Describe how turbidimetry is used to estimate the total cell count of a culture.
(In this question, 1 mark is available for the quality of written communication.)

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(c) **(i)** State **one** limitation of using turbidimetry rather than haemocytometry when estimating total viable cell counts.

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(ii) Explain why cell counts from either of these methods are of little use in determining whether the river water might be the cause of diarrhoea.

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[Total : 15]

For Examiner's Use

5 Large numbers of antibodies are produced by the body's immune system as a defence against microorganisms. Antigens present in the membranes of invading cells may stimulate this reaction.

(a) (i) Name the type of cell in the human body that produces antibodies.

.....[1]

(ii) Explain why it is not possible to use this type of cell to produce large quantities of antibodies in a cell culture medium.

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(b) State what is meant by a *monoclonal antibody.*

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(c) Describe the large scale production of monoclonal antibodies.

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Fig. 5.1 shows a plastic strip used to test for pregnancy. The strip contains monoclonal antibodies that bind to a hormone present in the urine of pregnant women. During the pregnancy test, the bottom of the strip is placed in a sample of urine. If the pregnancy hormone is present, a blue line appears in the small window.

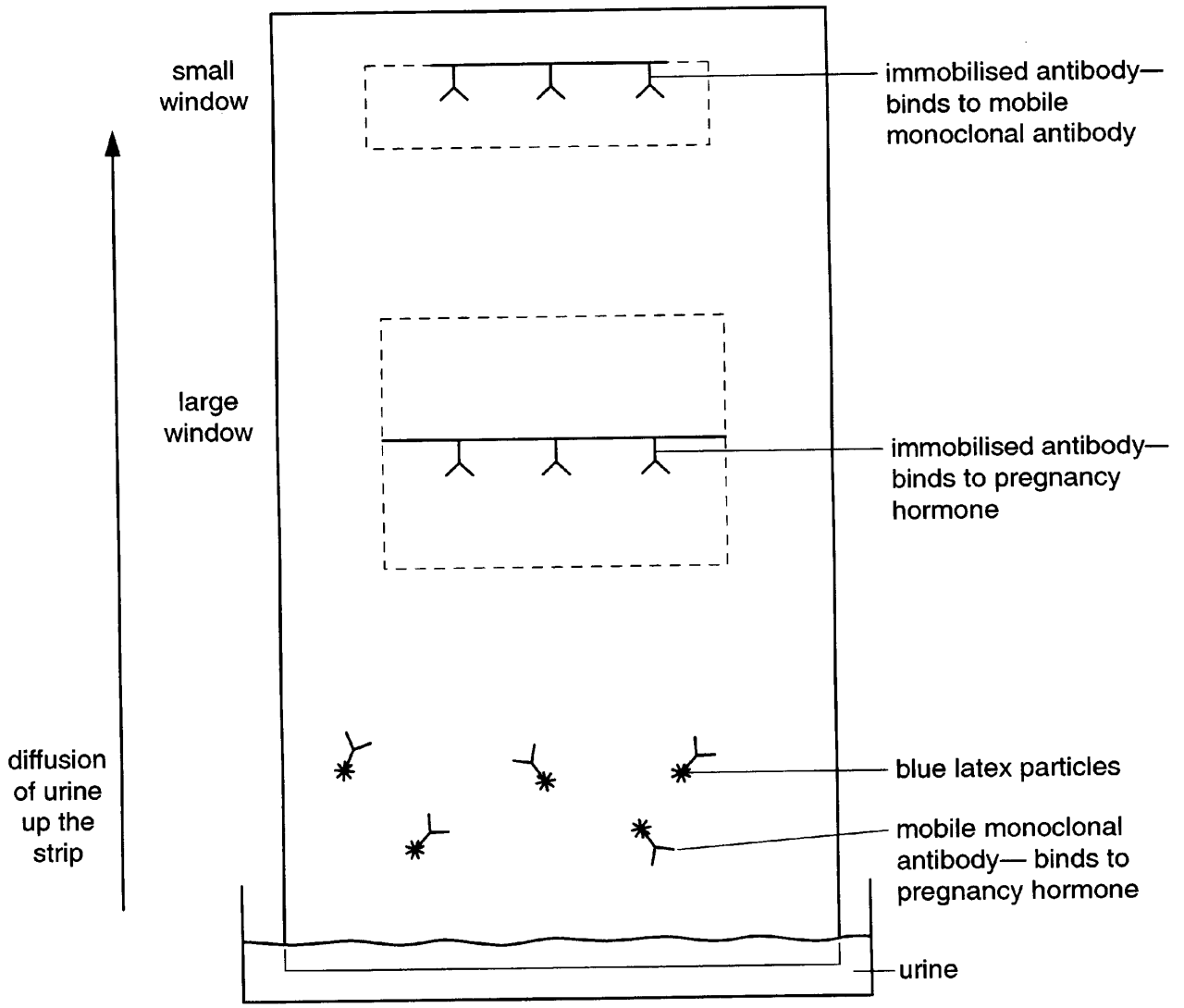

Fig. 5.1

(d) Name the hormone detected by this test.

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For Examiner's Use

(e) With reference to Fig. 5.1,

(i) explain why a blue line would appear in the large window if the urine sample contains the pregnancy hormone;

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(ii) explain why the test must continue until a blue line appears in the **small window**.

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[Total : 16]

6 Milk is an important part of the adult diet in many parts of the world. It contains lactose, a reducing sugar, which is digested by the enzyme lactase produced by the small intestine. However, many people lack this enzyme and if they eat even small amounts of lactose it causes them to develop diarrhoea and other unpleasant symptoms. Adding lactase to pasteurised milk can produce lactose-free milk. Lactose is converted to glucose and galactose, which are both reducing sugars. Fig. 6.1 is a diagram which shows this process.

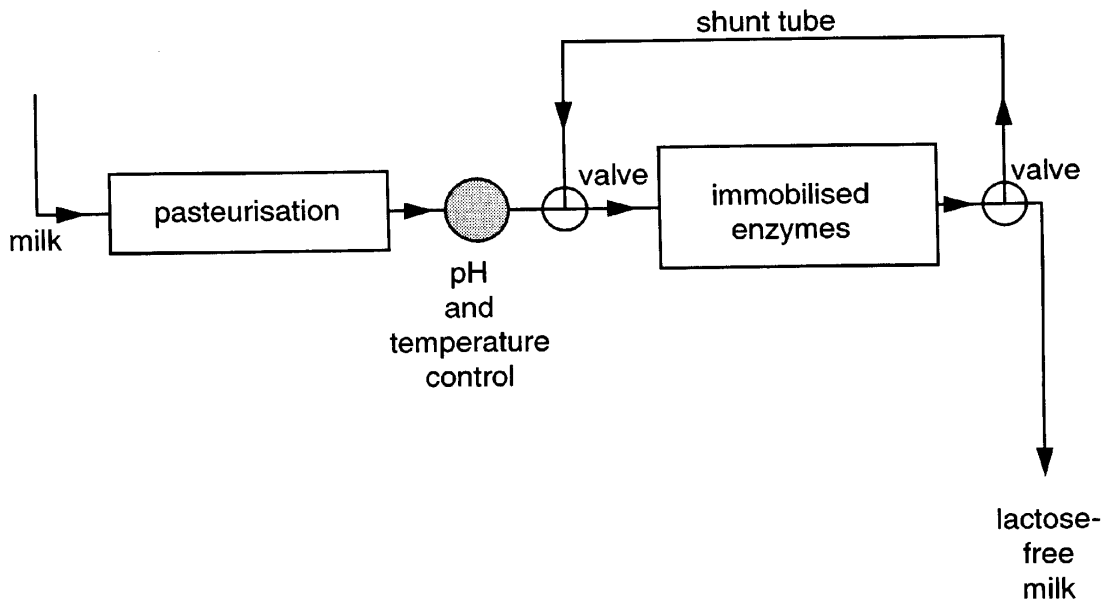

Fig. 6.1

(a) (i) State why milk is pasteurised at the beginning of the process.

.....[1]

(ii) Suggest **two** methods that could be used to immobilise the lactase.

1. .....

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2. .....

.....[2]

(iii) Explain the advantages of using immobilised enzymes.

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(iv) Suggest why the reaction vessel is fitted with a shunt tube.

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The temperature is closely controlled during this process.

(b) Explain the effect on lactase and its activity if the temperature was allowed to fluctuate.

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Biosensors are used to detect the presence of sugars.

(c) Explain what is meant by the term *biosensor*.

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[Total : 16]