1 **(a)** Microorganisms include fungi and bacteria. Fungi are eukaryotes. Bacteria are prokaryotes.

Describe **one** distinctive feature of the cell structure of each of these microorganisms.

fungal cell .....

.....

bacterial cell .....

..... **[2]**

(b) The use of microorganisms in biotechnology involves aseptic technique. Aseptic technique prevents pathogens contaminating products.

What is meant by the term pathogen?

.....

..... **[1]**

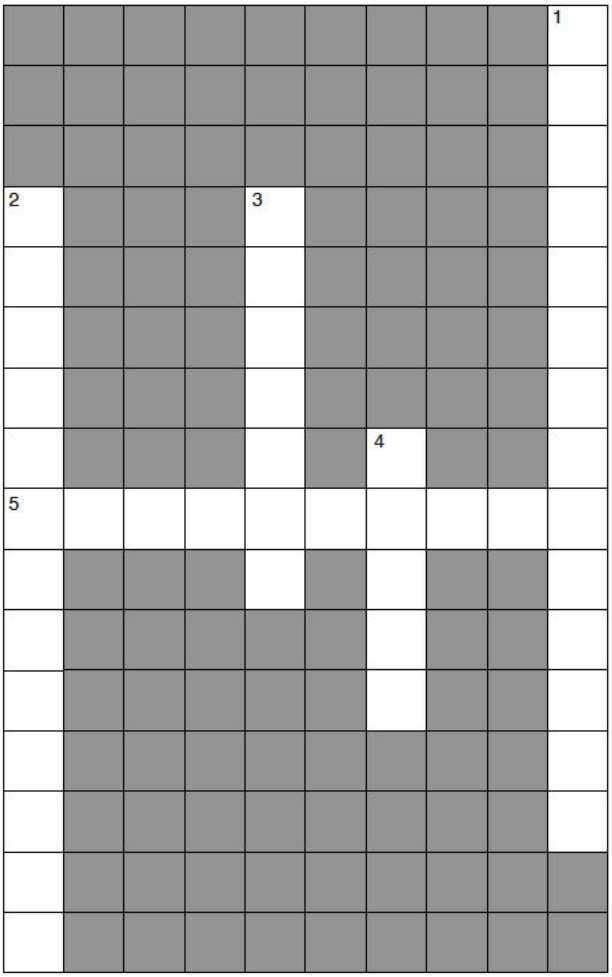
(c) State what is meant by biotechnology using suitable examples from different areas of biotechnology **and** explain why microorganisms are used in biotechnological processes.

In your answer you should give examples of products and the microorganisms used to make them, as well as the advantages of using microorganisms.

[8]

[Total: 11]

2 Fig. 5.1 is a crossword that should contain five words relating to the use of microorganisms by humans.



[5]

Fig. 5.1

Use the clues below to write the five appropriate words in the correct spaces on Fig. 5.1.

ACROSS

5 Microbial culture method in which nutrients are added and the product harvested throughout the fermentation process.

DOWN

1 Technique that makes enzymes more thermostable and allows them to be re-used.

2 The industrial use of living organisms to produce food, drugs or other products.

3 Sterile technique that prevents the growth of undesirable microorganisms.

4 Kingdom of eukaryotic microorganisms with cell walls made of chitin.

[Total: 5]

3 The antibiotic penicillin is produced by batch culture of the fungus *Penicillium chrysogenum*.

(a) Fig. 4.1 shows the concentration of penicillin, lactose and ammonia as well as the fungal biomass over time when penicillin is being produced by batch culture.

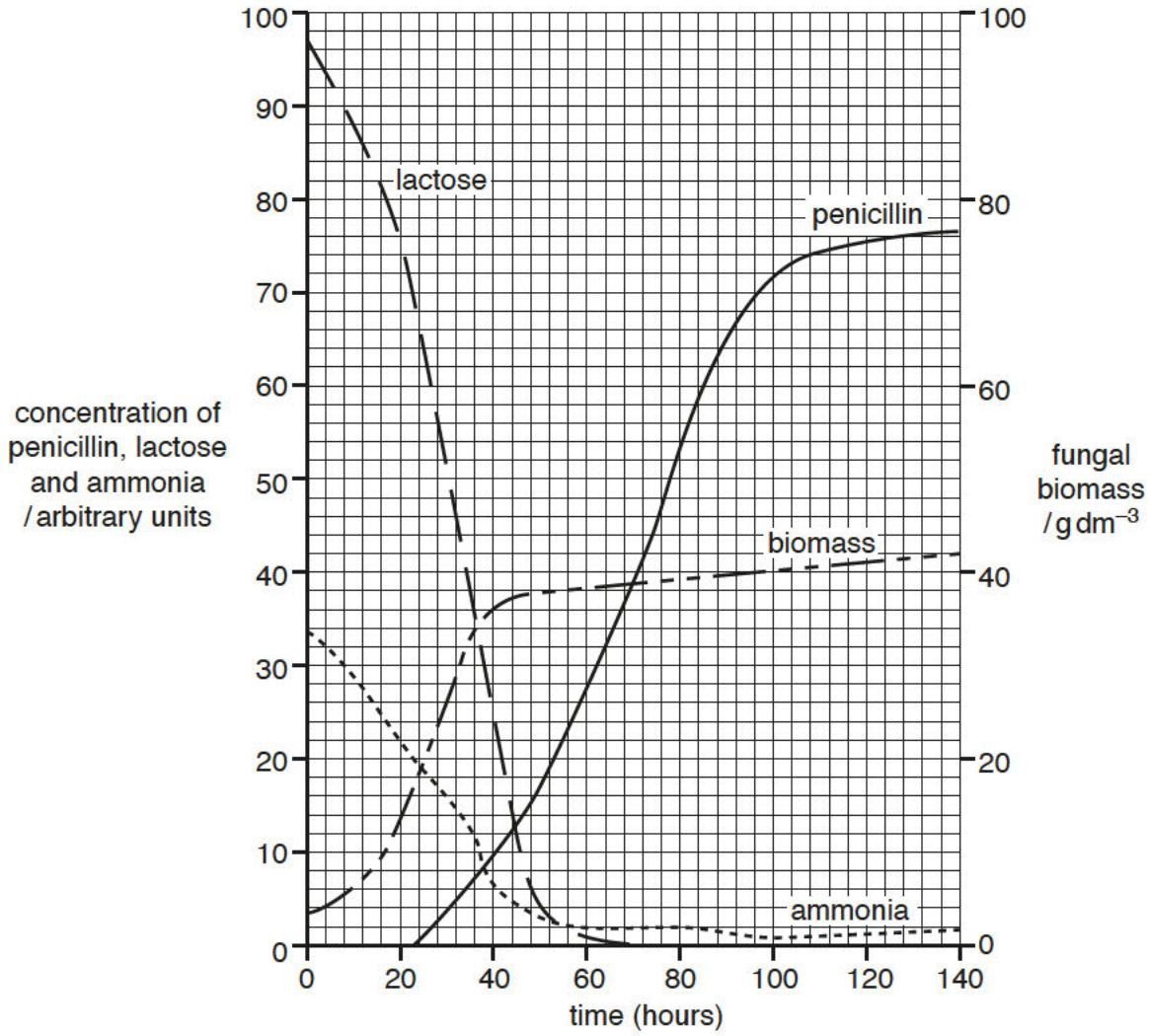


Fig. 4.1

(i) With reference to Fig. 4.1, describe and explain the changes in concentration of lactose **and** ammonia.

description .....

.....

.....

.....

.....

.....

explanation .....

.....

.....

.....

.....

..... **[4]**

(ii) A student incorrectly suggested that penicillin might be produced by continuous culture fermentation instead of by batch culture.

Suggest how the curves for lactose, ammonia and biomass on Fig. 4.1 might differ in continuous culture.

.....

.....

.....

..... **[2]**

(iii) A second student said that continuous culture would not be suitable, as penicillin is a secondary metabolite.

What evidence is there in Fig. 4.1 that penicillin is a secondary metabolite?

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..... **[2]**

(b) (i) Explain the importance of maintaining aseptic conditions in manufacturing penicillin by fermentation.

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.....

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..... **[3]**

(ii) State **three** physical or chemical factors within the fermenter, other than nutrient levels, that need to be monitored and controlled.

For each factor, explain **why** it must be controlled.

.....

.....

.....

.....

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.....

.....

..... **[3]**

[Total: 14]

4 Fig. 1.1 is a flow diagram showing the main stages involved in making cheese. The starting material is milk, which contains the protein, casein.

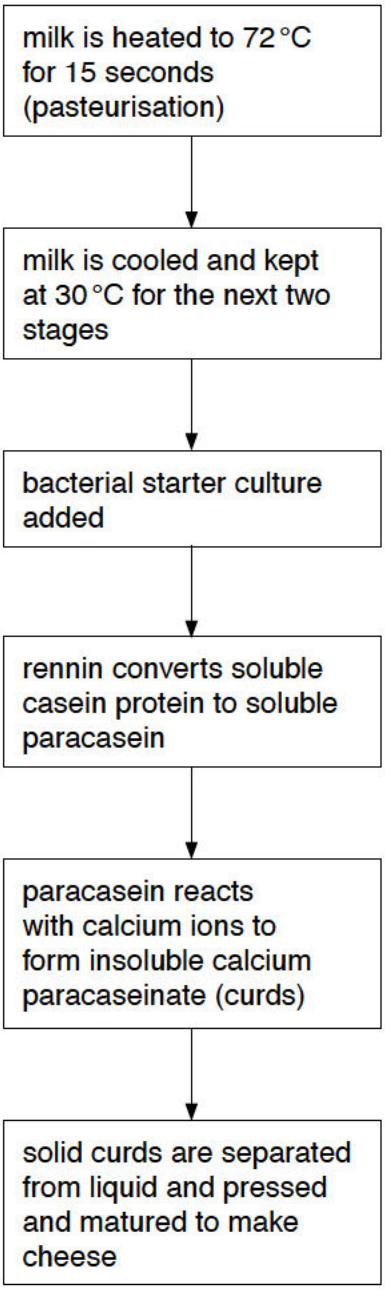


Fig. 1.1

(a) (i) Explain why making cheese can be described as a biotechnological process.

.....

.....

.....

..... **[2]**

(ii) Suggest **two** benefits of the pasteurisation stage.

.....

.....

.....

..... **[2]**

(b) (i) Rennin is a protein that can be obtained from the stomach lining of calves. It is used in the cheese-making process in the ratio one part rennin to 10 000 parts milk.

Suggest what type of protein rennin is **and** explain how a very small quantity of rennin is able to convert a large quantity of milk.

.....

.....

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.....

.....

..... **[3]**

(ii) Rennin could, in theory, be immobilised for use in cheese-making.

List **two** potential advantages of this.

1 .....

2 ..... **[2]**

(c) Rennin can now be made by genetically modified microorganisms.

Outline the process by which bacteria can be genetically modified to produce rennin.

In your answer, you should make clear how the steps in the process are sequenced.

.... [8]

[Total: 17]

5 The efficiency of energy transfer between trophic levels limits the number of organisms in a particular ecosystem.

(a) Outline how the **percentage efficiency** of energy transfer between producers and herbivores can be estimated.

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.....

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..... **[4]**

(b) One way that humans try to maximise food production is to manipulate the transfer of energy through ecosystems.

A number of methods can be used to increase energy transfer through agricultural ecosystems and other food production systems.

These methods include:

A artificial selection

B recombinant DNA technology

C growing microorganisms in a fermenter

D use of immobilised enzymes

E control of plant physiology with synthetic plant hormones

F manipulation of the nitrogen cycle.

Using the letters **A** – **F**, select the **most suitable** method that could be used to achieve each of the aims shown in the table below.

You may select each letter more than once.

Aim	**Letter**
improving soil that is low in nutrients for the growing of wheat	
preventing the spoilage of fruits after picking	
reducing the impact of a fungal disease on yields from cucumber plants	
producing strawberry plants that grow quicker and fruit earlier	
making sugar syrup from waste starch	
producing large amounts of a fungus for food	

[6]

(c) Some animal pests compete with humans for food.

Some examples of pest behaviour are described below. These include examples of innate (instinctive) and learned behaviours.

Name each **specific** type of innate or learned behaviour described in the table below.

Description	**Name of innate or learned behaviour**
Sparrows initially fly away from fruit bushes on which shiny CDs are hung, particularly when the CDs move in the wind.	
After a few days the sparrows start visiting the fruit bushes again, and do not fly away even when the CDs move.	
Carrot flies move towards chemicals released by carrot plants.	
Raccoons learn to remove lids from containers of grain in a barn.	
A line of young chicks follow their mother into a cornfield.	

[5]

[Total: 15]