Biotechnology and Genetic Engineering

Question Paper 1

Level	IGCSE
Subject	Biology
Exam Board	CIE
Topic	Biotechnology and Genetic Engineering
Paper Type	(Extended) Theory Paper
Booklet	Question Paper 1

Time Allowed: **68 minutes**

Score: **/56**

Percentage: **/100**

1 **(a)** Define the term *genetic engineering*.

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.....[2]

(b) Fig. 6.1 is a flow diagram that shows how insulin can be produced using genetic engineering.

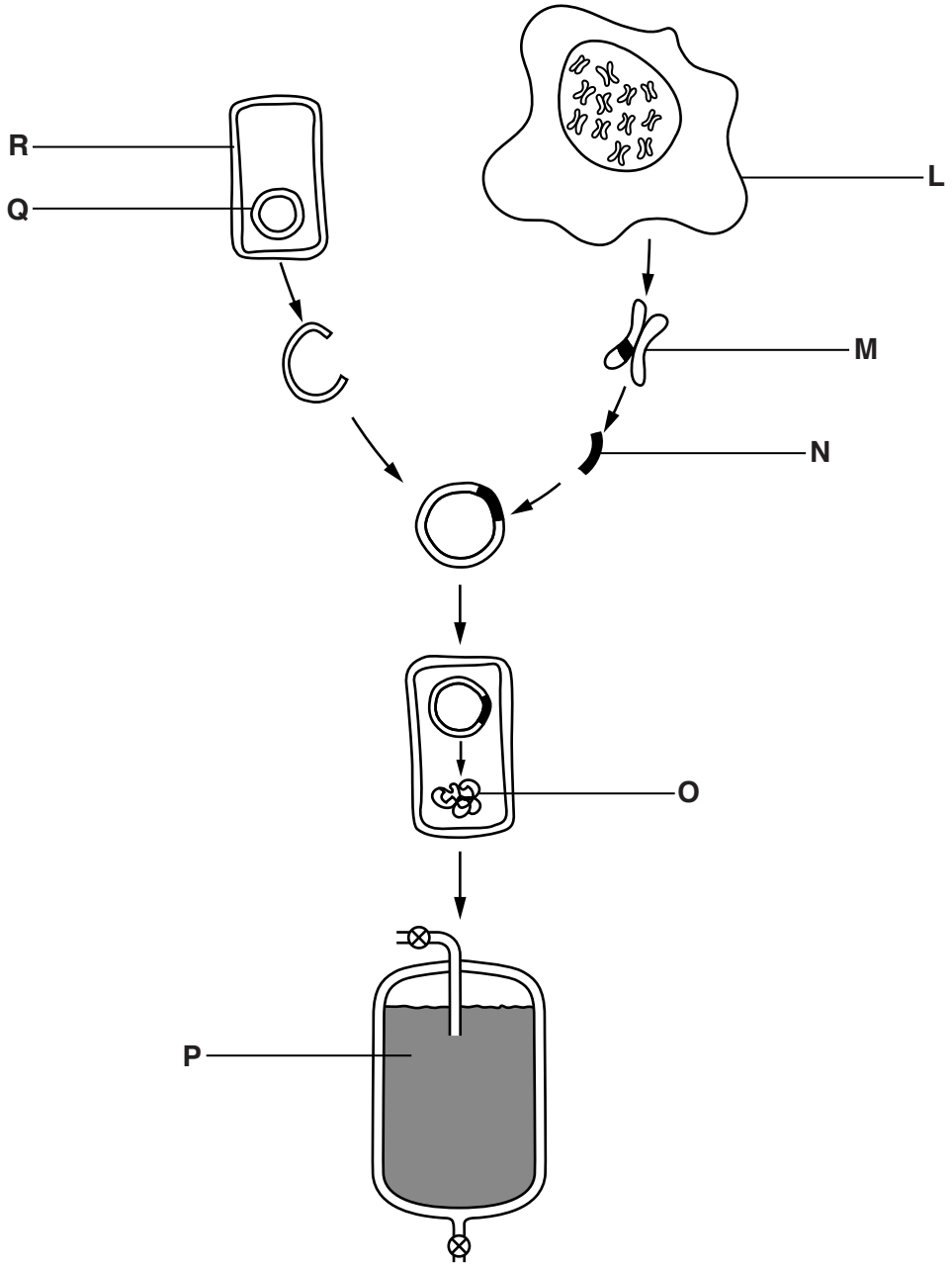

Fig. 6.1

Table 6.1 shows stages in the production of insulin by genetic engineering.

Complete Table 6.1. The first row has been done for you.

Table 6.1

letter from Fig. 6.1	name	description
M	chromosomes	threads of DNA found in the nucleus
		section of DNA removed from human cell
	plasmid	
		type of cell that is genetically engineered
		specific chain of amino acids coded by the section of DNA removed from the human cell
	fermenter	

[5]

(c) The genetically engineered cells in Fig. 6.1 reproduce asexually.

Explain the advantages of asexual reproduction for insulin production by genetic engineering.

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[Total: 10]

2 Antibiotics are used to treat human diseases.

Many bacteria have become resistant to antibiotics. Some antibiotics can no longer be used to treat certain diseases.

Samples of bacteria were taken from a person who had an infectious disease. They were spread onto four Petri dishes of agar (agar plates). Three of these agar plates contained the antibiotics **1**, **2** or **3**.

The results are shown in Fig. 2.1.

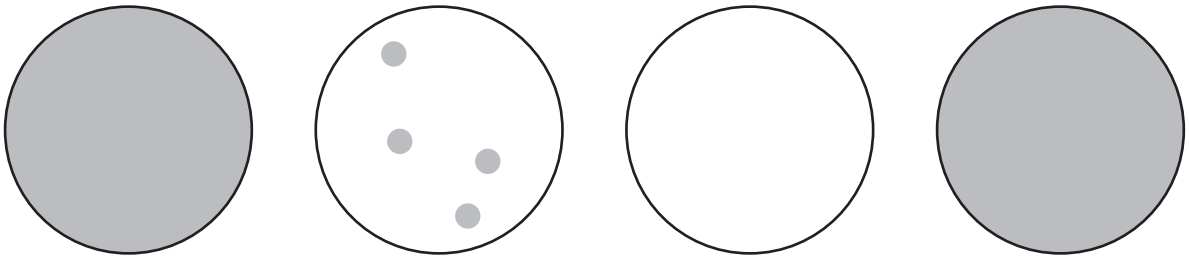

Fig. 2.1

(a) Explain why:

(i) no bacteria grew in the agar plate with antibiotic **2**;

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..... [1]

(ii) bacteria grew in the agar plate with antibiotic **3**;

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..... [1]

(iii) only a small number of bacteria grew with antibiotic **1**.

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(b) Explain why it is important to carry out a test similar to that shown in Fig. 2.1 before giving an antibiotic to a person infected with a bacterial disease.

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(c) Antibiotic resistance has become a major problem worldwide.

Suggest how the problem of antibiotic resistance can be limited.

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(d) Hormones are used to treat a variety of conditions.

The most common hormonal treatment is the use of insulin to treat diabetes. Most of the insulin is produced using cells that are grown in large fermenters. These cells have been genetically engineered to produce human insulin.

Fig. 2.2 shows the stages involved in transferring the gene for insulin from human cells to bacterial cells.

P	gene from human cell removed from chromosome 11
Q	bacterium produces human insulin
R	plasmid vector enters bacterium
S	gene for human insulin found to be on chromosome 11
T	bacterium divides by binary fission
V	gene for human insulin inserted into a plasmid vector

Fig. 2.2

(i) Put the stages into the correct sequence. Two have been done for you.

S					**Q**

[1]

(ii) Diabetes is often treated with human insulin that has been produced by genetically modified cells. In most countries this type of insulin has replaced the insulin that was prepared from animals.

Suggest the advantages of providing human insulin to people with diabetes rather than insulin obtained from animals.

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[Total: 14]

3 Bovine somatotropin (BST) is a protein hormone that stimulates growth in cows.

(a) Name the small molecules that are joined together to make proteins.

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(ii) Define the term *growth*.

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(b) Genetic engineering techniques similar to those used for producing human insulin were used to make bacteria produce BST.

Outline the way in which genetic engineering was used to produce BST.

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(c) The effects of BST on milk production and the food energy intake of cows were investigated.
The milk yield and food energy intake were recorded each day for each cow in two groups, **A** and **B**.

- Group **A** received BST treatment at week 10.
- Group **B** did not receive any BST.

The results are shown in Fig. 2.1.

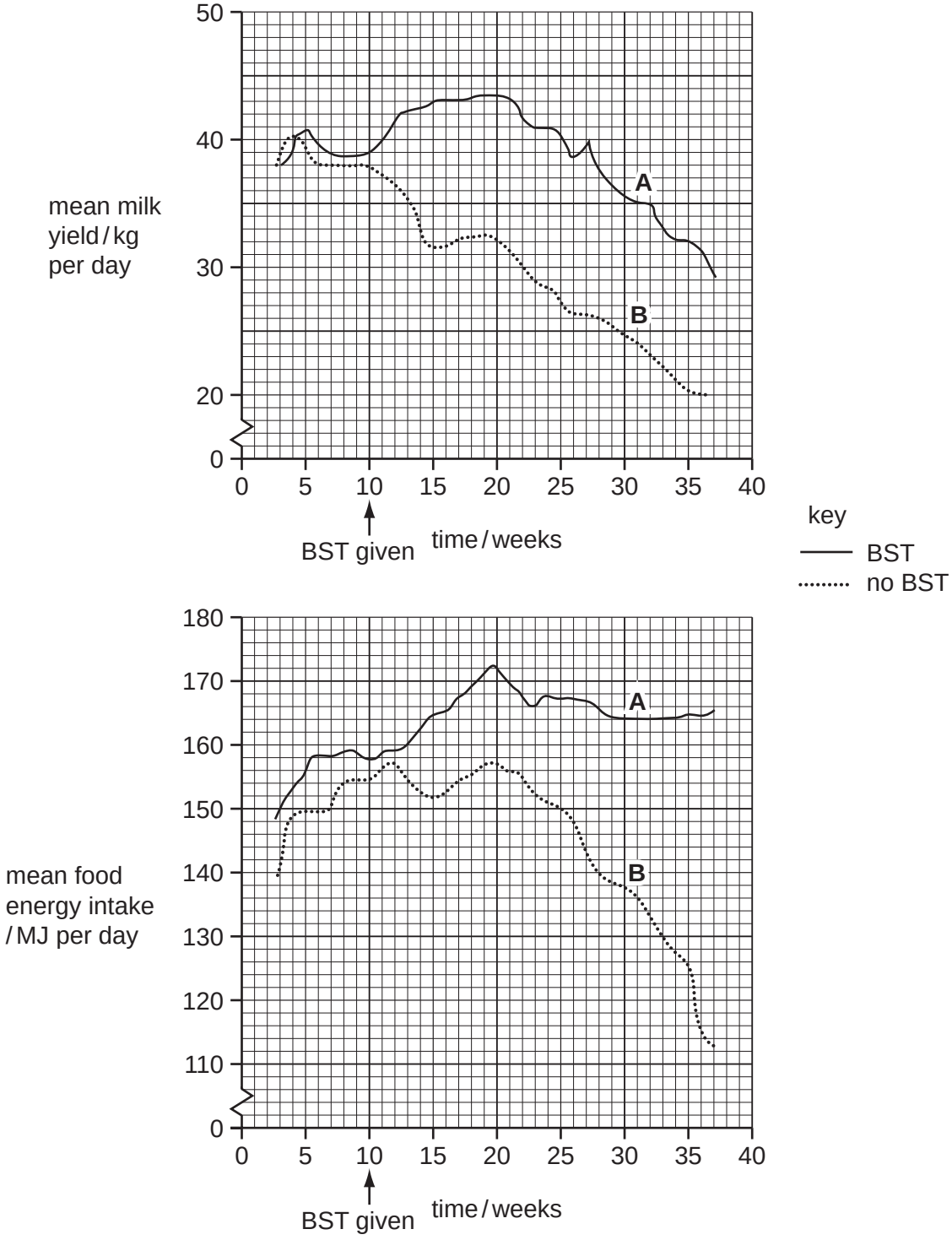

Fig. 2.1

(i) Use Fig. 2.1 to describe the effect of BST treatment on mean milk yield and mean food energy intake. You will gain credit if you use data from Fig. 2.1 in your answer.

mean milk yield .....

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mean food energy intake .....

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(ii) Various studies have shown that there is little economic benefit from using BST.

Use the results from Fig. 2.1 to explain why this might be so.

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(d) The US Food and Drug Administration certifies that milk from cows treated with BST is as safe as milk from cows not treated with the hormone.

It is impossible to test milk to detect the use of BST, but some milk producers in the US label their milk to indicate that it is BST-free.

Discuss the reasons for labelling milk to show whether it has come from cattle treated with BST or not.

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[Total: 18]

4 A small quantity of a fungus was put into a fermenter with all the nutrients required for growth and kept at an appropriate temperature.

The fungus was provided with nutrients at a suitable pH at the start.

Fig. 3.1 shows the growth of the fungus over 160 hours.

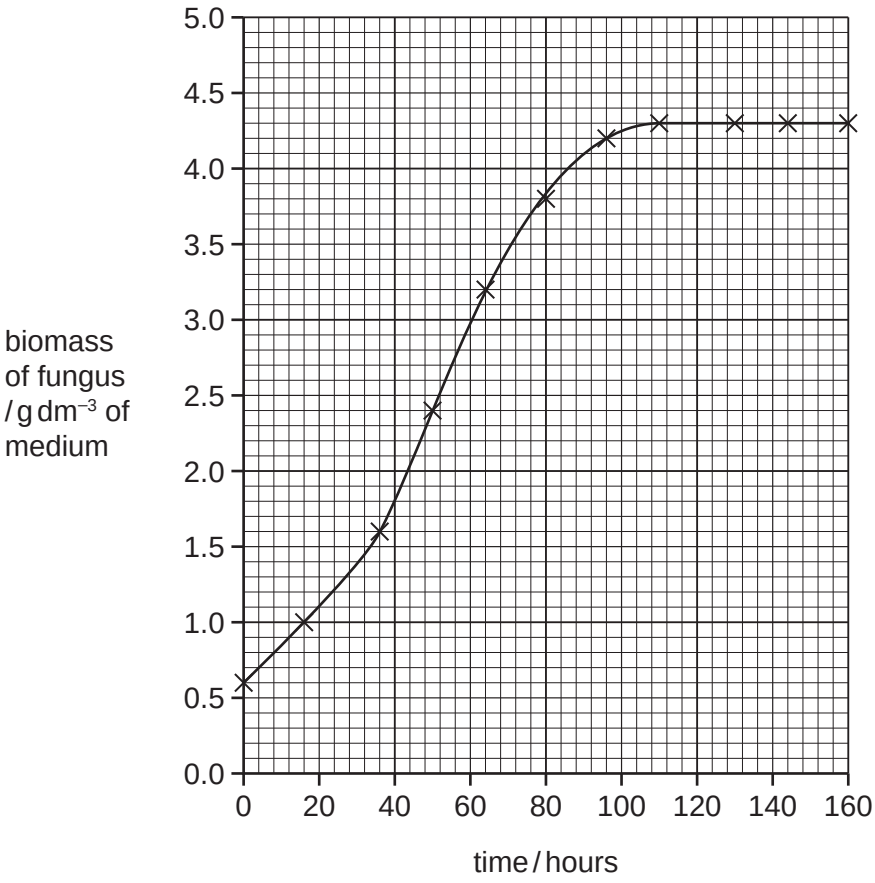

Fig. 3.1

(a) Explain why the biomass of the fungus did **not** increase during the stationary phase after 110 hours.

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Mycoprotein is a food made from the fungus, *Fusarium venenatum*. The production process for mycoprotein is shown in Fig. 3.2.

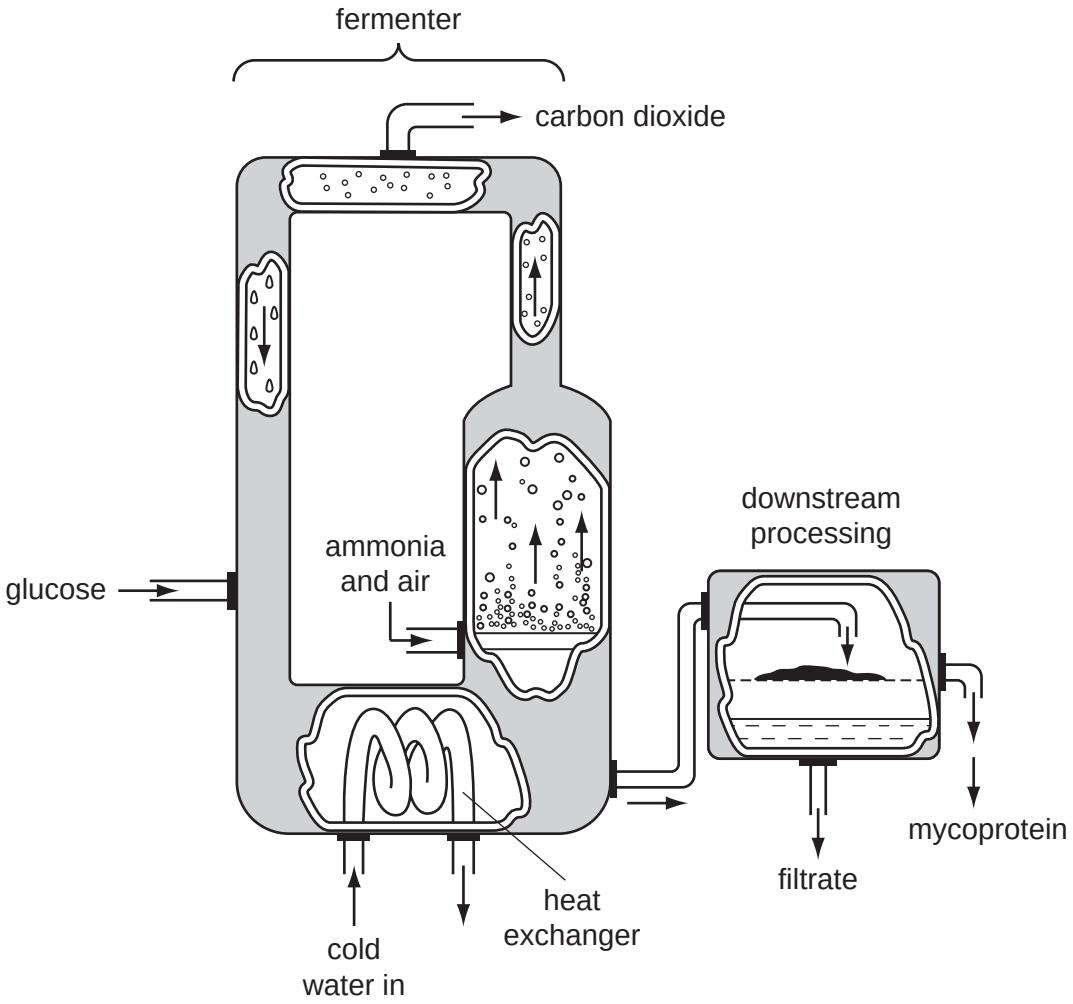

Fig. 3.2

(b) Explain why ammonia and air are pumped into the fermenter.

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(c) The growth depends on the activity of enzymes in the fungus.

Explain why the temperature in the fermenter is kept constant.

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(d) Efficient production of mycoprotein depends on keeping the fungus in the exponential phase of growth.

Explain how the production process, **shown in Fig. 3.2**, keeps the fungus in the exponential phase.

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(e) The fungus extracted from the fermenter contains nutrients and is converted into foods, such as burgers and sausages, that are suitable for vegetarians.

During processing, food additives are mixed with the fungus.

State **two** reasons for mixing food additives with the fungus that is made into foods.

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[Total: 14]