Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Biotechnology and genetic modification

Time allowed: 1 hour 35 minutes

Subject code **0610**

Biology

Questions from Paper 3 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 97

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 97 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 Complete the sentences about genetic engineering.

Use words from the list.

Each word may be used once, more than once, or not at all.

adding **bacteria** **crops** **family** **insects**

minerals **organism** **removing** **viruses**

vitamin **weeds**

In genetic engineering the genetic material of an ..... is changed by ..... , changing or inserting individual genes.

An example of this is inserting a human gene into ..... so that they produce human insulin.

Crop plants have genes inserted into them to make them resistant to herbicides.

Herbicides kill ..... .

Crop plants can also be genetically engineered by inserting a gene so that they produce a ..... which is a nutrient needed by humans in very small amounts.

[5]

Genetic modification Click for more variations

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2 The development of biological washing powders using enzymes from bacteria is an example of biotechnology.

(a) State **two** reasons why bacteria are useful in biotechnology, such as in the development of biological washing powders.

1 .....

.....

2 .....

.....

[2]

(b) Fig. 7.1 shows part of a label taken from a packet of '5 Star Bio' washing powder.

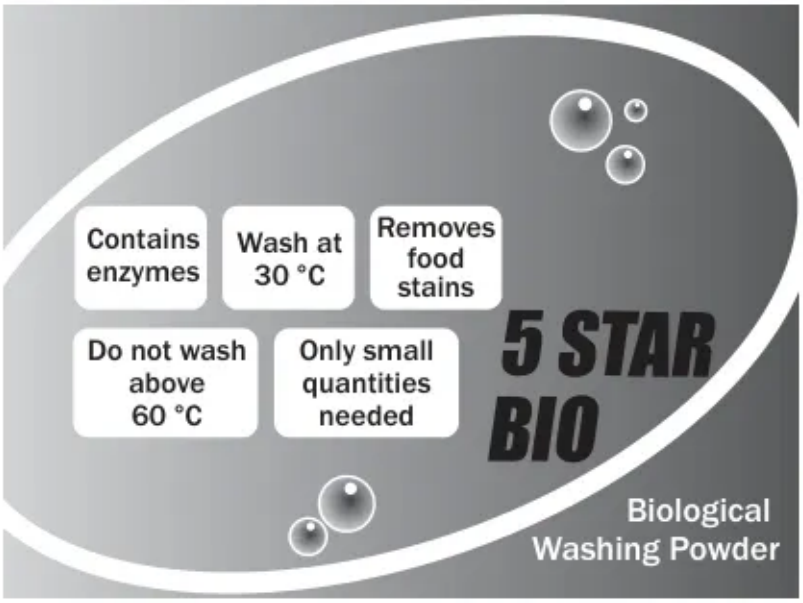


Fig. 7.1

Use the information shown in Fig. 7.1 to:

(i) explain how this washing powder removes food stains

.....

.....

.....

.....

.....[2]

(ii) explain why the manufacturer recommends washing at 30 °C and not above 60 °C

.....

.....

.....

.....

.....[2]

(iii) suggest why only small quantities of washing powder are needed to wash a large quantity of clothes.

.....

.....[1]

(c) Name an enzyme that could be used to remove fat stains from clothing.

.....[1]

[Total: 8]

Biotechnology: bacteria, yeast, enzymes and fermenters Click for more variations

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3 Biotechnology is used in the process of bread-making.

Fig. 1.1 shows some of the steps in making bread.

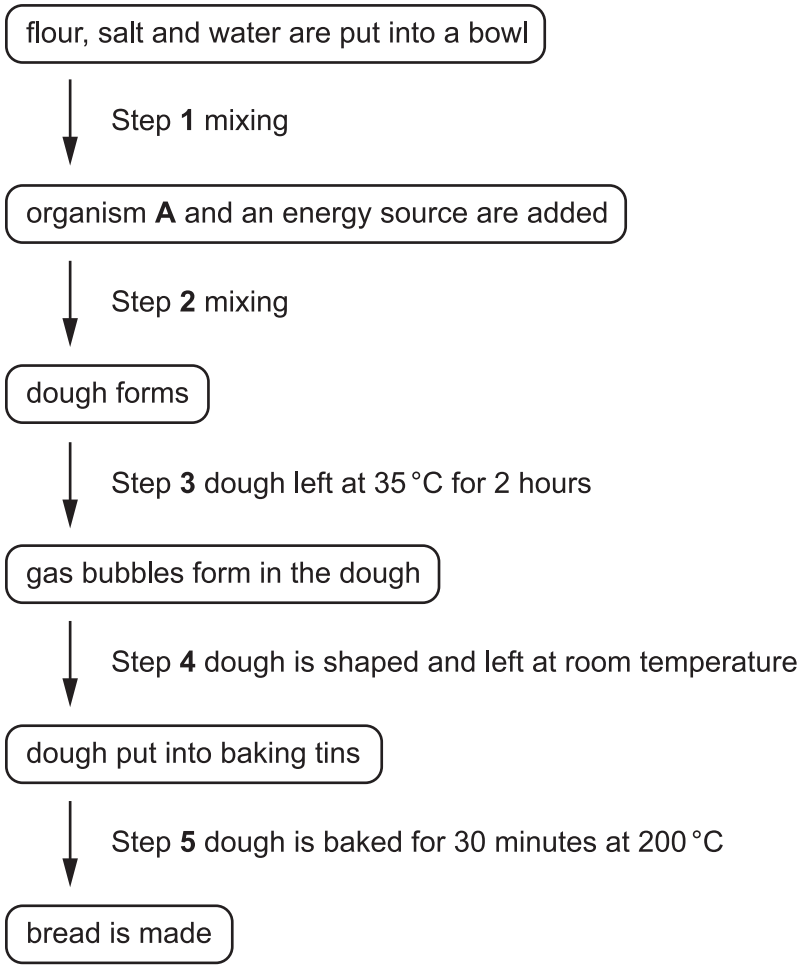


Fig. 1.1

(a) State the name of organism **A** in Fig. 1.1.

..... [1]

(b) (i) State the name of the source of energy used by organism **A**.

..... [1]

(ii) State the name of the process that occurs at step **3** that causes gas bubbles to form in the dough.

..... [1]

(iii) State the name of the gas that forms to create the gas bubbles in the dough.

..... [1]

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(c) Explain the reasons for the different temperatures used in step **3** and step **5**.

.....

.....

.....

.....

..... [2]

(d) State the name of **two** products of biotechnology, other than bread, that make use of microorganisms.

1 .....

2 .....
[2]

[Total: 8]

Biotechnology: bacteria, yeast, enzymes and fermenters Click for more variations

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4 **(a)** **(i)** State **two** reasons why bacteria are useful in genetic modification and biotechnology.

1 .....

2 .....

[2]

(ii) Describe the ways in which genetic modification can improve crop plants.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Scientists investigated two enzymes that could be used in washing powders.

The activity of each enzyme was measured at pH values between 2 and 10.

Fig. 7.1 shows the results of the investigation.

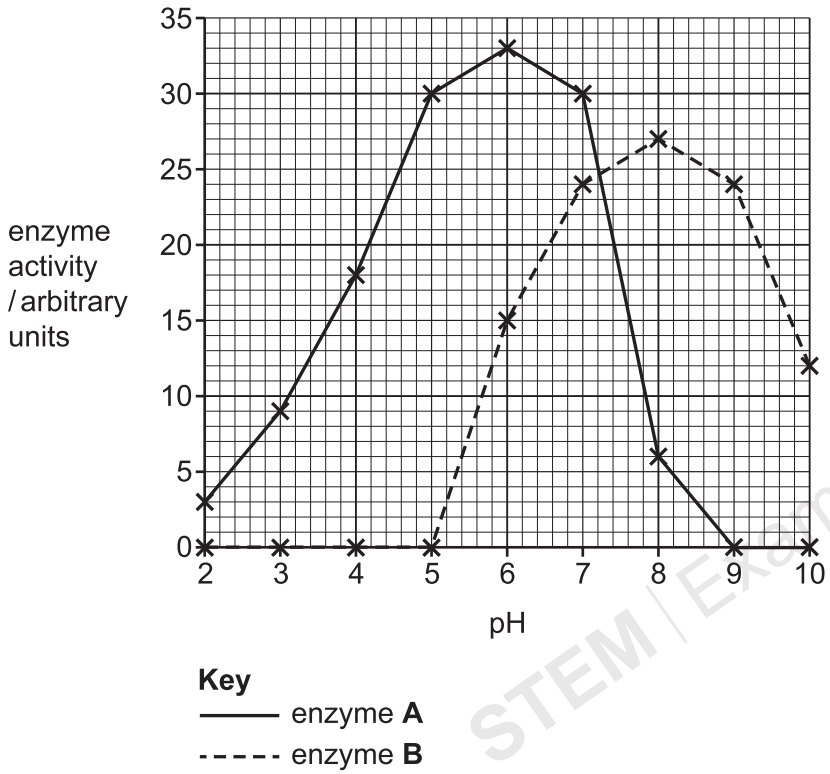


Fig. 7.1

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(i) The list shows six conclusions.

Tick (✓) the conclusions that can be made from the data shown in Fig. 7.1.

At pH 10, enzyme **B** is more active than enzyme **A**.	
Enzyme **A** and enzyme **B** are **not** active at pH 4.	
Enzyme **B** has a greater maximum activity than enzyme **A**.	
Enzyme **A** has a maximum activity of 33 arbitrary units.	
Enzyme **A** shows activity over a pH range of 6 to 10.	
The largest difference in activity between enzyme **A** and enzyme **B** is at pH 5.	

[3]

(ii) Many washing powders have a pH of approximately 9.

Identify the best enzyme, **A** or **B**, to use in these washing powders.

Give **one** reason for your choice.

enzyme .....

reason .....

.....

.....

[1]

[Total: 9]

Enzymes Click for more variations

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

.....

.....

.....

.....

.....[2]

(b) **(i)** Outline why bacteria are useful in genetic engineering.

.....

.....

.....

.....

.....[2]

(ii) Table 6.1 contains six statements about biological processes. Only **two** of these use genetic engineering. Identify these two processes. Place a tick in the box (✓) next to your choices.

Table 6.1

statement	uses genetic engineering
producing fruit juice using pectinase	
introducing genes into crop plants to provide additional vitamins	
selective breeding to produce organisms with desirable features	
placing a section of DNA into bacteria to produce human insulin	
using yeast to produce ethanol	
using a contraceptive implant as a method of birth control	

[2]

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(c) Scientists have used genetic engineering to develop crop plants which are resistant to herbicides.

(i) Explain why farmers use herbicides.

.....

.....

.....

.....

.....[2]

(ii) A field contains genetically modified crop plants which are resistant to herbicides. It also contains some weeds. The plants are sprayed with herbicides.

State how the herbicide affects:

the weeds

.....

.....

the crop plants.

.....

.....
[2]

[Total: 10]

Genetic modification Click for more variations

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6 **(a)** Starch, glucose and fructose are carbohydrates. Fructose syrup is used as a sweetening agent as an alternative to sucrose.

The flow chart in Fig. 3.1 shows how fructose is prepared from maize starch.

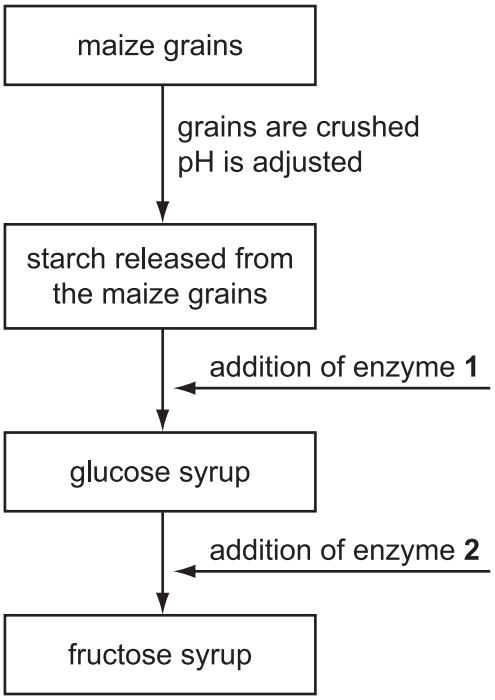


Fig. 3.1

(i) Name enzyme **1**.

.....

[1]

(ii) State why it is necessary to adjust the pH before an enzyme is added to the process.

.....

.....

[1]

(b) Maize grains contain protease enzymes. With reference to the processes shown in Fig. 3.1, suggest why it is important that these enzymes do not contaminate the glucose syrup.

.....

.....

[1]

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(c) The formation of fructose syrup from glucose syrup is carried out at a temperature of 60 °C.

Suggest an important property of enzyme **2** that allows it to be used at temperatures as high as 60 °C.

.....

.....

..... [1]

(d) Enzyme **2** is found naturally in many bacteria. Enzymes for use in washing powders are obtained from bacteria.

Describe how bacteria are used to produce enzymes for washing powders.

.....

.....

.....

.....

.....

.....

..... [3]

(e) Pectinase is an enzyme that breaks down compounds known as pectins. Cell walls of fruits, such as apples and mangoes, contain pectins.

Explain the **advantages** of using pectinase in fruit juice production.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

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Biotechnology: bacteria, yeast, enzymes and fermenters Click for more variations

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

.....

.....

.....

.....

.....[2]

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

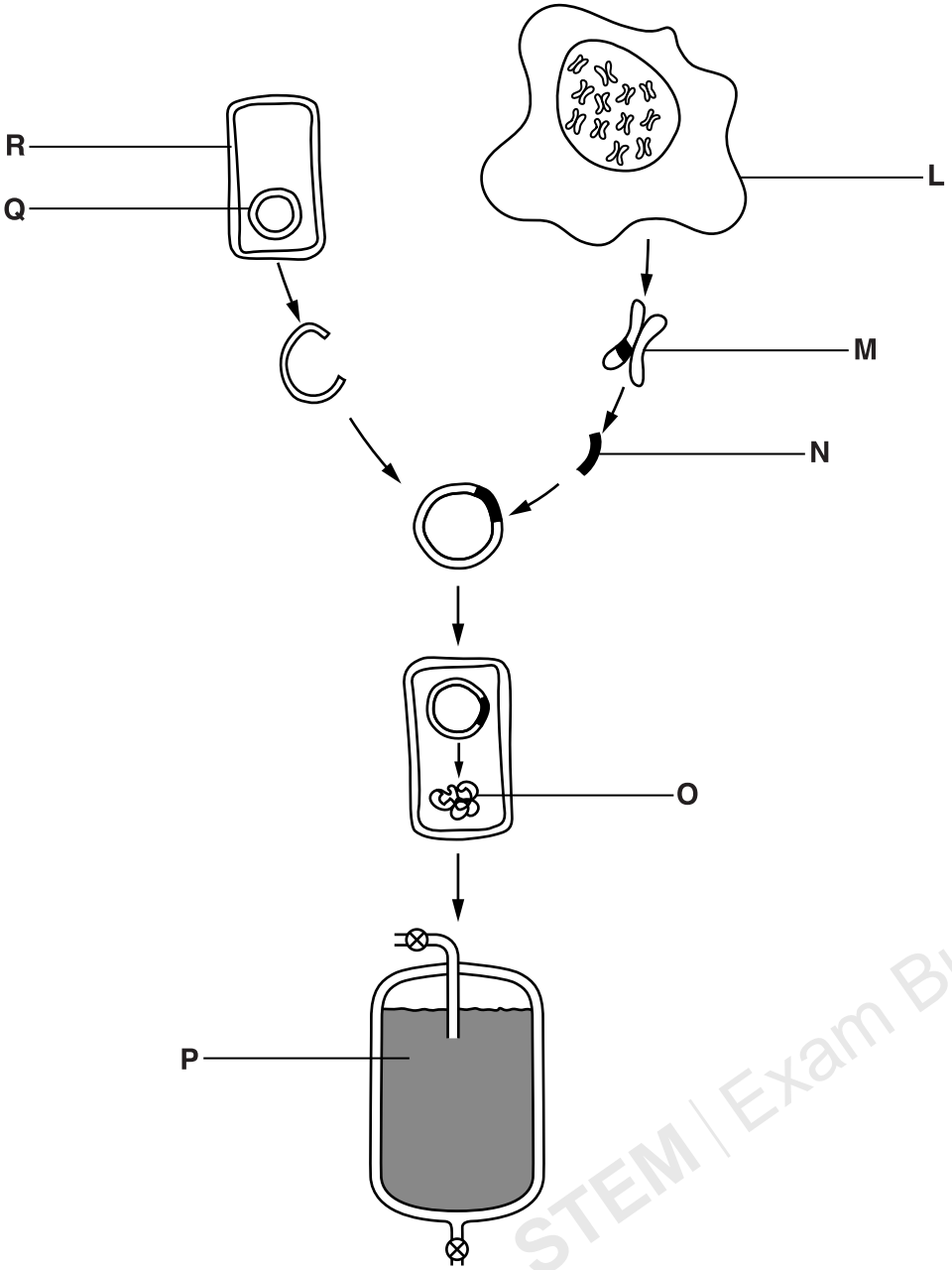


Fig. 6.1

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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.

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 10]

Asexual and sexual reproduction Click for more variations

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8 Genetic engineering is an example of an important biotechnology.

(a) Complete the passage below by filling in each space with a suitable word.

DNA is a biological molecule found in the ..... of an animal cell. The sequence of the ..... in mRNA determines the order of the amino acids that will be assembled into a ..... .

When carrying out genetic engineering, sections of human DNA called ..... are cut using restriction enzymes. Next bacterial plasmids are cut with the ..... restriction enzymes to form complementary ..... ends.

The cut section of human DNA is inserted into the cut plasmid and they are joined together to form a ..... plasmid. These plasmids are inserted into ..... and replication occurs. This process is used to produce human ..... that is used to treat people with diabetes.

[9]

(b) In addition to genetic engineering, enzymes are also useful in other biotechnologies.

State **two** examples of how enzymes are used in another biotechnology.

1 .....

2 .....

[2]

[Total: 11]

Genetic modification Click for more variations

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9 Cotton, *Gossypium hirsutum*, is grown for the fibres that form within the fruits after fertilisation, as shown in Fig. 3.1.

Fibres from the fruits of cotton plants are used in the textile industry.



Fig. 3.1

Cotton plants have been genetically engineered to produce a protein that is toxic to the caterpillars of several insect pests. This gives the cotton plants resistance to the pests.

The *cry* gene for pest resistance was isolated from the bacterium *Bacillus thuringiensis* and inserted into the cells of cotton plants as shown in Fig. 3.2.

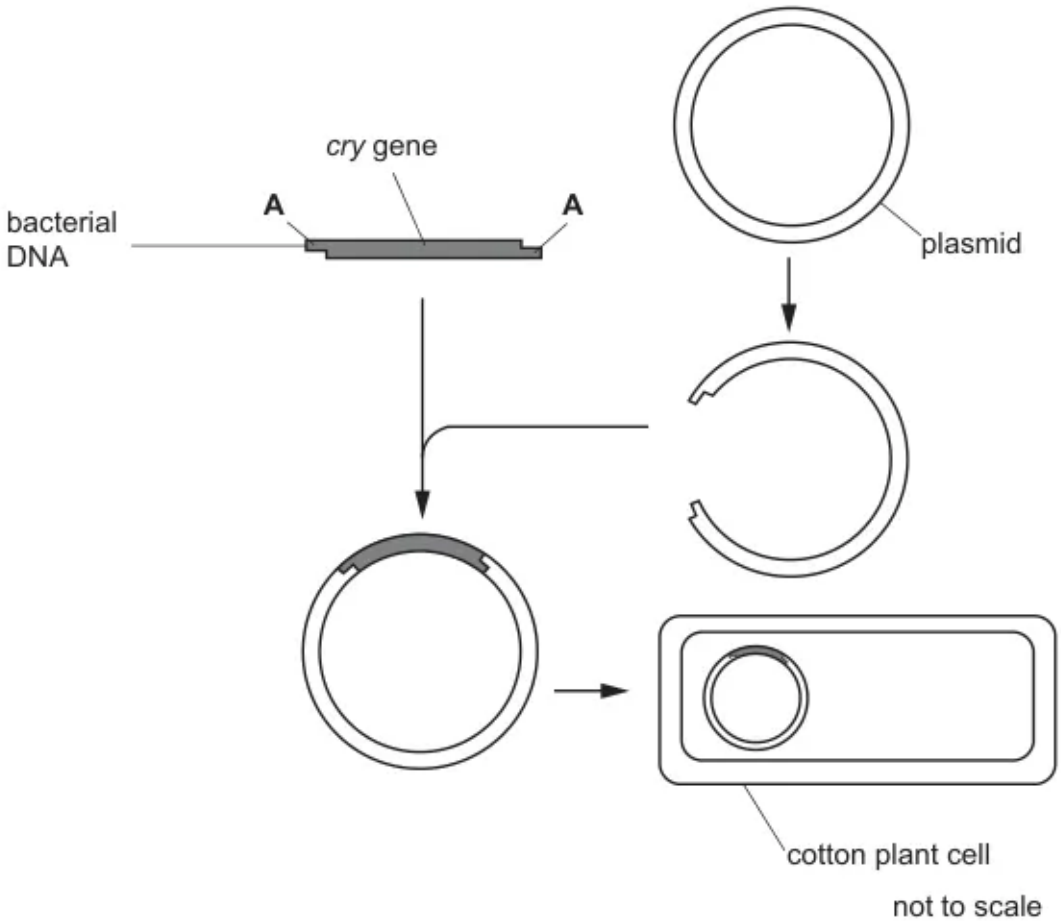


Fig. 3.2

(a) An enzyme cuts the *cry* gene from the DNA of *B. thuringiensis*.

(i) State the name of the enzyme that cuts DNA.

..... [1]

(ii) State the name of the regions labelled **A** on Fig. 3.2.

..... [1]

(iii) Explain how the DNA is inserted into the plasmid.

.....

.....

.....

.....

.....

..... [3]

(b) The plasmids containing the *cry* gene are inserted into the cells of cotton plants.

Outline how the cells of cotton plants use the *cry* gene to make the toxic protein.

.....

.....

.....

.....

.....

.....

.....

..... [4]

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(c) Outline the advantages to farmers of growing genetically engineered cotton plants that contain the toxic protein.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 12]

Genetic modification Click for more variations

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10 Penicillin is produced by biotechnology industries.

(a) (i) State the name of the type of pathogen penicillin is used to treat.

..... [1]

(ii) State the name of the group of medicinal drugs that includes penicillin.

..... [1]

(b) Fig. 1.1 is a flow diagram of some of the steps in the production of penicillin.

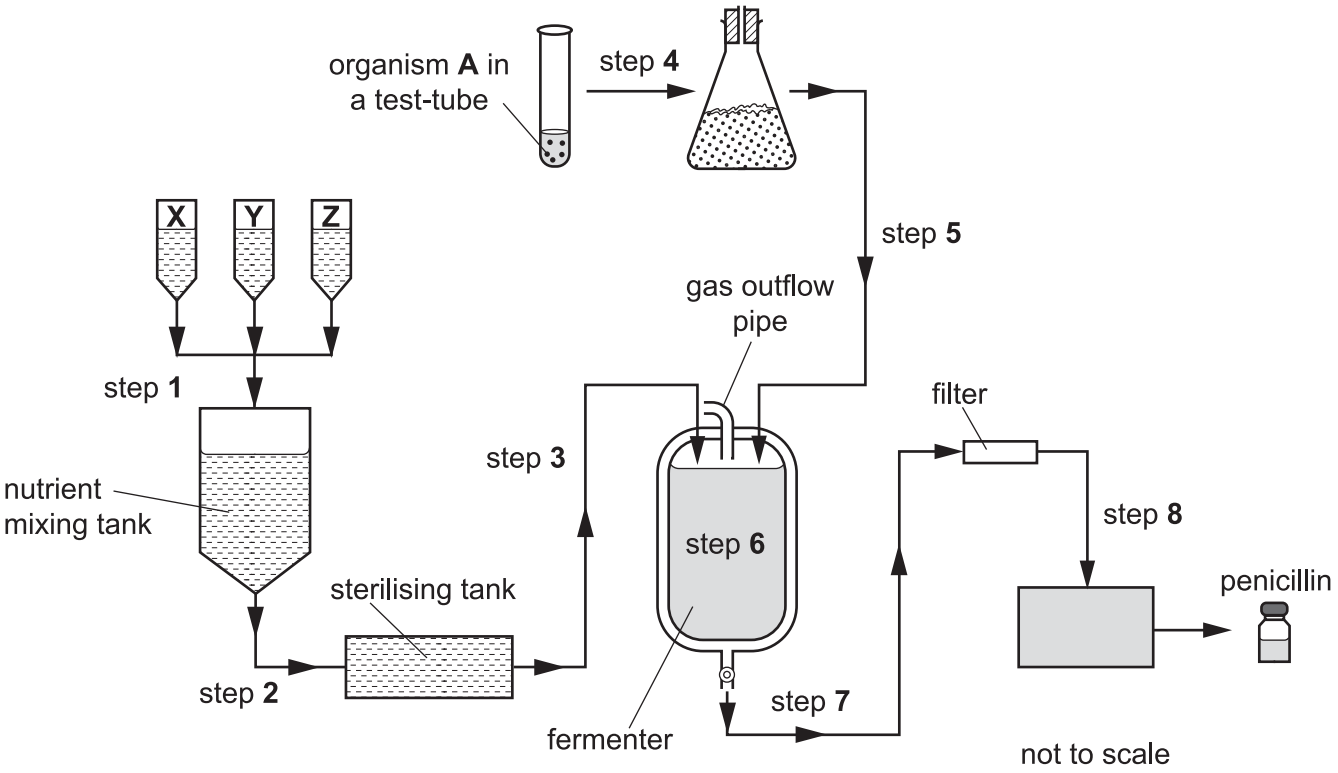


Fig. 1.1

(i) Organism **A** belongs to the fungus kingdom.

State **two** main features of fungal cells that are used to distinguish them from the cells of prokaryotes.

1 .....

2 .....

[2]

(ii) State the genus name of organism **A** in Fig. 1.1.

..... [1]

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(iii) Penicillin is produced in the fermenter shown in Fig. 1.1. A variety of nutrients, **X**, **Y** and **Z**, are mixed together and added to the fermenter in step **1**.

List **two** nutrients that need to be added to a fermenter to produce penicillin.

1 .....

2 .....

[2]

(iv) Explain why the nutrients are sterilised (step **2**) before they are added to the fermenter (step **3**).

.....

.....

..... [1]

(v) Explain why the fermenter has a gas outflow pipe.

.....

.....

.....

.....

..... [2]

(vi) Using the information in Fig. 1.1, outline the events occurring from step **4** to step **8** during the production of penicillin.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 14]

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