CAMBRIDGE IGCSE BIOLOGY · 0610

BIOLOGY



EXAM QUESTION PACK

TOPIC 21: BIOTECHNOLOGY AND GENETIC MODIFICATION

SCORE	PERCENTAGE
/	%

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Biotechnology and genetic modification – 2023 November IGCSE 0610

1. Nov/2023 /Paper_ 0610/13/No.39

Which product is made using an enzyme rather than bacteria or fungi?

A insulin

B penicillin

C lactose-free milk

D mycoprotein

2. Nov/2023 /Paper_ 0610/13/No.40

What is a reason for inserting genes into bacterial cells?

A to confer resistance to herbicides

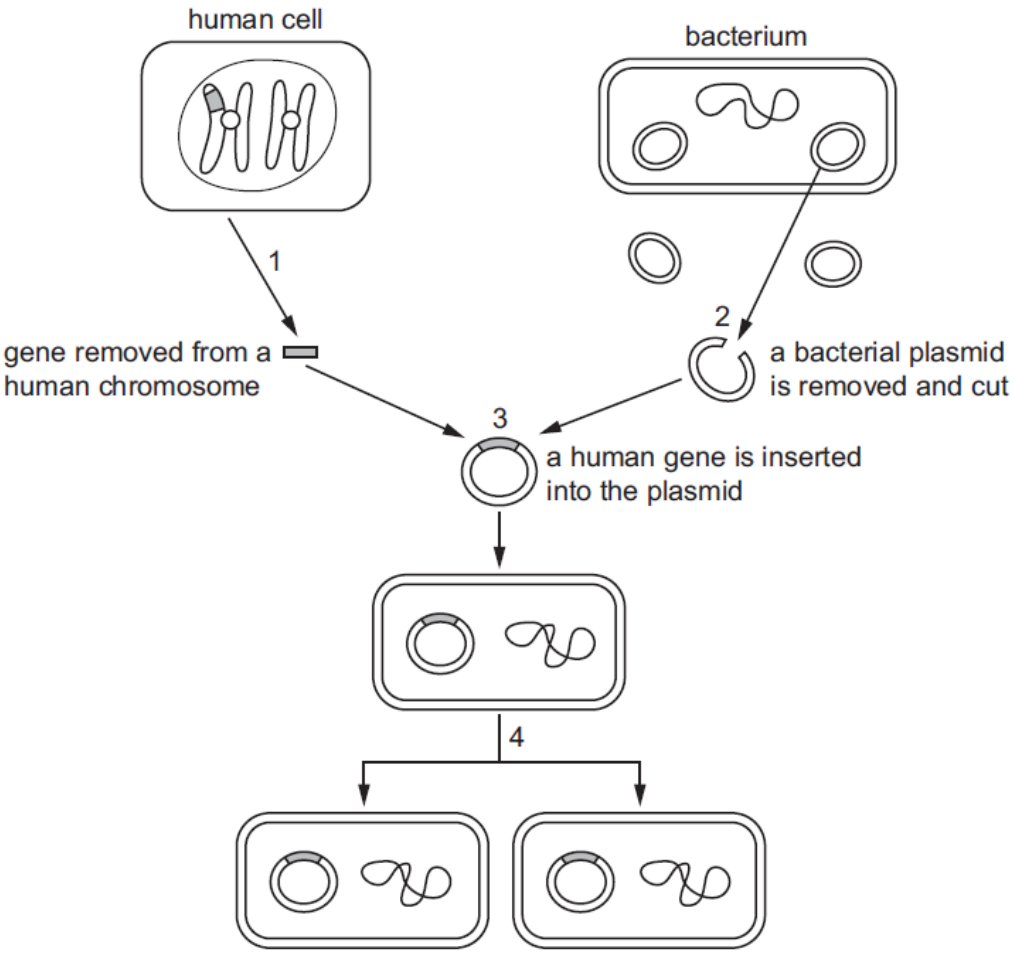
B to confer resistance to insect pests

C to improve their nutritional qualities

D to produce human proteins

3. Nov/2023 /Paper_ 0610/22/No.40

The diagram shows how a human gene can be inserted into a bacterium.



Which row shows the correct processes at 1, 2, 3 and 4?

	using restriction enzymes	using ligase enzymes	multiplication of bacteria
A	1	2	3
B	1 and 2	3	4
C	1 and 3	2	4
D	4	1 and 2	3

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4. Nov/2023 /Paper_ 0610/23/No.39

Which statement is an advantage of genetically modifying crops?

A Less pesticide is used if the genetically modified crop is resistant to pests.

B More herbicide is used if the genetically modified crop is resistant to herbicide.

C Seeds for genetically modified crops are more expensive.

D The genetically modified crop genes may be passed to other plants.

5. Nov/2023 /Paper_ 0610/23/No.40

Which statements are correct descriptions of parts of the process of protein synthesis?

1 Amino acids are made by the ribosomes.

2 mRNA is copied.

3 The gene coding for the protein moves into the nucleus.

4 The ribosome assembles the amino acids into protein molecules.

5 The sequence of amino acids is determined by the sequence of bases in the mRNA.

A 1, 2, 3, 4 and 5

B 1, 3 and 4 only

C 2, 3 and 5 only

D 4 and 5 only

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Biotechnology and genetic modification – 2022 November IGCSE 0610

1. June/2023/Paper_0610/11/No.40

Which statement about genetic modification is correct?

A It involves choosing which individual organisms are used for breeding.

B It is always done using genes from the same species.

C It produces a new combination of genes.

D It produces exact copies of individual organisms.

2. June/2023/Paper_0610/12/No.40

Bacteria are useful for manufacturing products for human use.

Which statement explains why they are useful?

A Bacteria can be grown without nutrients.

B Bacteria do not have a nucleus.

C Bacteria infect human cells.

D Bacteria reproduce very rapidly.

3. June/2023/Paper_0610/13/No.33

Which statement is correct?

A Chromosomes are made of DNA.

B Chromosomes make up a gene.

C Each chromosome is a length of DNA that codes for a protein.

D Different forms of chromosomes are called alleles.

4. June/2023/Paper_0610/13/No.40

What is a reason for using bacteria in biotechnology?

A Bacteria are found inside the human body.

B Bacteria do **not** become resistant to antibiotics.

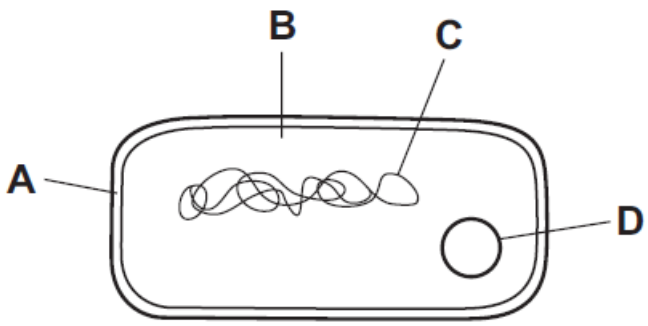
C Bacteria can make complex molecules.

D Bacteria reproduce slowly.

5. June/2023/Paper_0610/21/No.39

The diagram shows a bacterial cell.

Which part is useful in genetic modification?



6. June/2023/Paper_0610/21/No.40

Which statement about genetic modification is correct?

A It involves choosing which individual organisms are used for breeding.

B It is always done using genes from the same species.

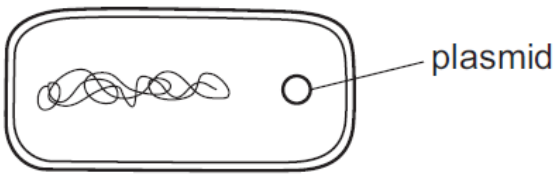
C It produces a new combination of genes.

D It produces exact copies of individual organisms.

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7. June/2023/Paper_0610/22/No.39

The diagram shows a bacterial cell containing a plasmid.



What is inserted into the plasmid if this cell is to be used for the production of insulin?

A a length of DNA from a human

B a length of DNA from another bacterium

C a molecule of insulin

D an enzyme

8. June/2023/Paper_0610/22/No.40

Yeast carries out anaerobic respiration, making carbon dioxide and ethanol as end-products.

Which end-products can be used to make biofuel and bread?

	biofuel	bread
A	carbon dioxide	carbon dioxide
B	carbon dioxide	ethanol
C	ethanol	carbon dioxide
D	ethanol	ethanol

9. June/2023/Paper_0610/23/No.39

Genetic modification has been used to produce human insulin in bacterial cells.

What is inserted into the bacterial cells to produce human insulin?

A a human nucleus

B human plasmids

C recombinant insulin

D recombinant plasmids

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10. June/2023/Paper_0610/23/No.40

Penicillin is made in a fermenter by growing organisms.

Which type of organism is used in the production of penicillin?

A bacterium

B fungus

C protoctist

D virus

11. March/2023/Paper_ 0610/12/No.24

Why is yeast used in bread-making?

A Aerobic respiration produces alcohol.

B Aerobic respiration produces lactic acid.

C Anaerobic respiration produces alcohol.

D Anaerobic respiration produces carbon dioxide.

12. March/2023/Paper_ 0610/12/No.39

Vitamin A deficiency is a big health problem in some parts of the world and can cause problems such as blindness. Rice can be genetically modified to enable people to make vitamin A when they eat it.

150 g of this rice provides 60% of the adult recommended daily intake of vitamin A.

How much rice does an adult need to get 100% of the recommended daily intake of vitamin A?

A 190 g **B** 210 g **C** 250 g **D** 375 g

13. March/2023/Paper_ 0610/12/No.40
Which feature of bacteria makes them useful in genetic modification?

A They can only make simple molecules.

B They can reproduce rapidly.

C They can cause decomposition.

D They can cause disease.

14. March/2023/Paper_ 0610/22/No.22
Why is yeast used in bread-making?

A Aerobic respiration produces alcohol.

B Aerobic respiration produces lactic acid.

C Anaerobic respiration produces alcohol.

D Anaerobic respiration produces carbon dioxide.

15. March/2023/Paper_ 0610/22/No.39
Which component of bacteria is genetically modified to produce human insulin?

A cell membrane

B cell wall

C plasmids

D single circular DNA strand

16. March/2023/Paper_ 0610/22/No.40
Fermenters must have carefully controlled conditions.

Which condition has the correct reason for controlling it?

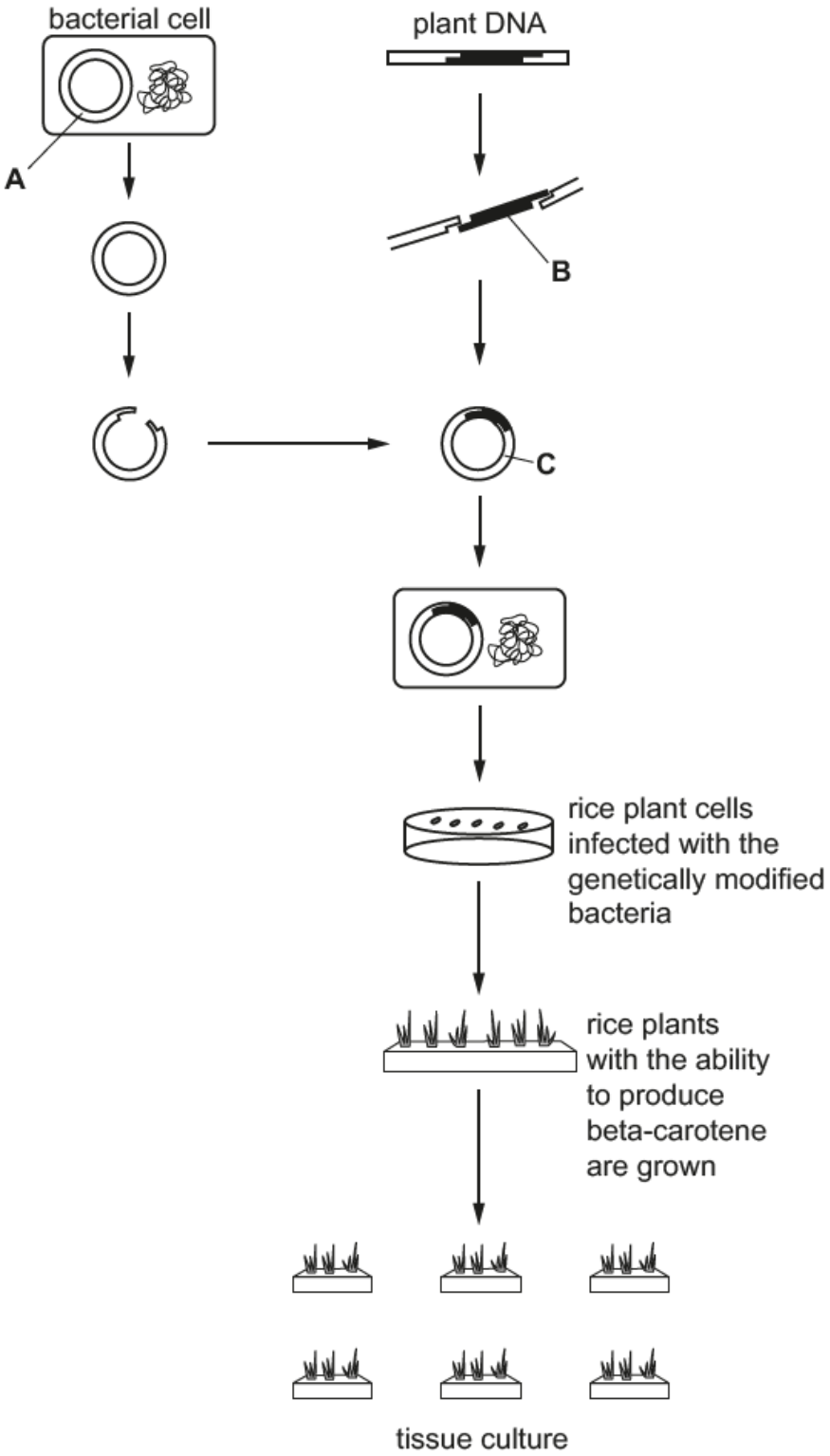
	condition to be controlled	reason for controlling condition
A	supply of amino acids	for carbohydrate synthesis
B	supply of glucose	waste product to be removed
C	supply of oxygen	for anaerobic respiration
D	pH	to be optimum for enzyme activity

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17. March/2023/Paper_ 0610/41/No.6

Golden rice is a type of rice that has been genetically modified to contain a nutrient called beta-carotene.

Fig. 6.1 shows the genetic modification process used to produce golden rice.



not to scale

Fig. 6.1

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(a) Using the information in Fig. 6.1, complete the sentences to describe how rice is genetically modified to contain beta-carotene.

The part labelled **A** in the bacterial cell is a ..... .

Part **A** is extracted and cut using a ..... enzyme forming ..... ends.

The part labelled **B** is the ..... that codes for the production of beta-carotene.

The enzyme used to cut part **A** is also used to cut part **B** from the plant DNA.

Part **B** is inserted into the part labelled **A** using the enzyme ..... .

This forms the part labelled **C**, which is called a ..... .

Part **C** is put into a bacterium. The bacterium is taken up by rice plant cells, giving them the ability to produce beta-carotene.

Tissue culture is a form of ..... reproduction that is used to produce many identical rice plants producing beta-carotene for commercial use.

[7]

(b) Apart from structural features, state **two** reasons why bacteria are useful for genetic modification.

1 .....

2 .....

[2]

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(c) Discuss the disadvantages of genetically modifying rice plants to produce beta-carotene.

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..... [3]

(d) Beta-carotene is required to produce vitamin A, which is essential for eye function.

State the nutrient required to prevent:

scurvy .....

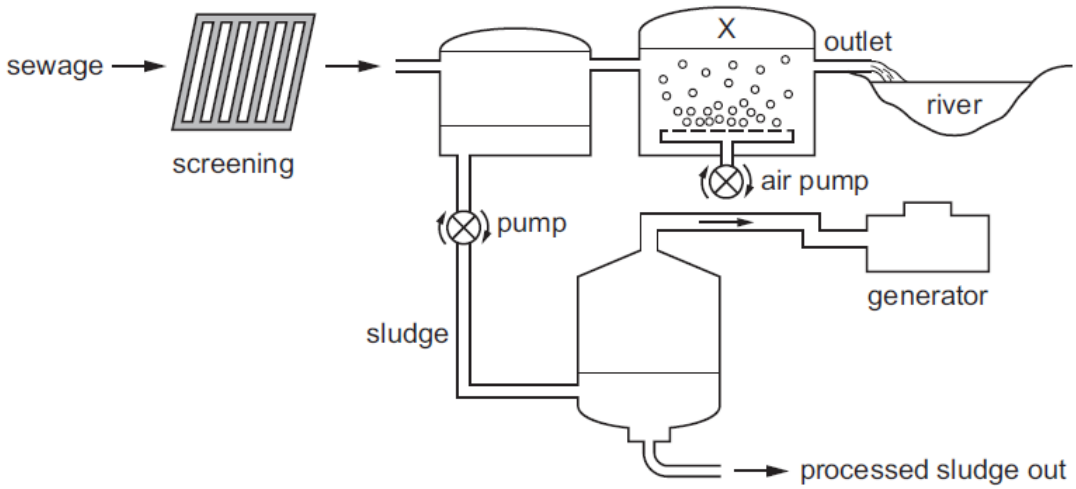
rickets. .....
[2]

[Total: 14]

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1. Nov/2022/Paper_11/No.40

The diagram shows a sewage treatment process.



What is structure X?

A aeration tank

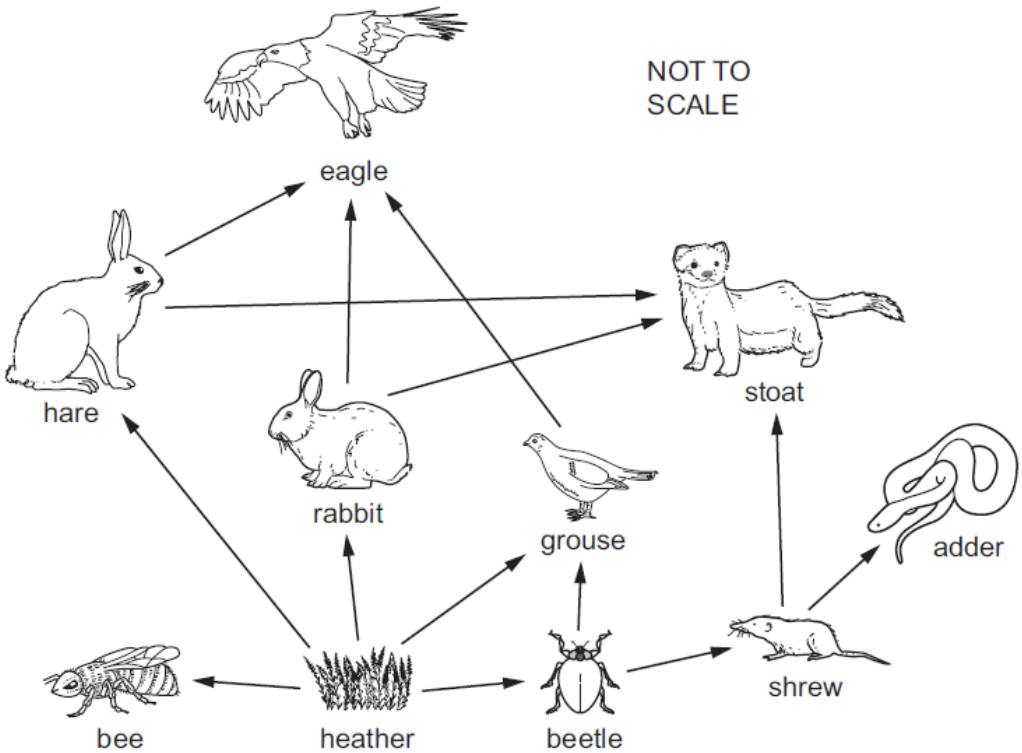
B anaerobic tank

C settlement tank

D storage tank

2. Nov/2022/Paper_21/No.35

The diagram shows a food web.



How many organisms are feeding at more than one trophic level?

A 0 **B** 1 **C** 2 **D** 3

3. Nov/2022/Paper_23/No.37

Bacteria are useful in genetic engineering because they possess plasmids.

Which statement describes the importance of a plasmid?

A It is a circle of DNA and human genes can be inserted into it.

B It is the nucleus of the bacterium and human genes can be inserted into it.

C It can be destroyed and replaced with human insulin.

D It is a circle of DNA and human insulin can be inserted into it.

4. Nov/2022/Paper_23/No.38

Which statement is correct?

A DNA ligase is used to cut DNA.

B DNA ligase is used to make proteins.

C Restriction enzymes are used to cut DNA.

D Restriction enzymes are used to make proteins.

5. Nov/2022/Paper_42/No.4

(a) Fig. 4.1 is a flow chart showing some of the processes that occur in a biofuels power plant.

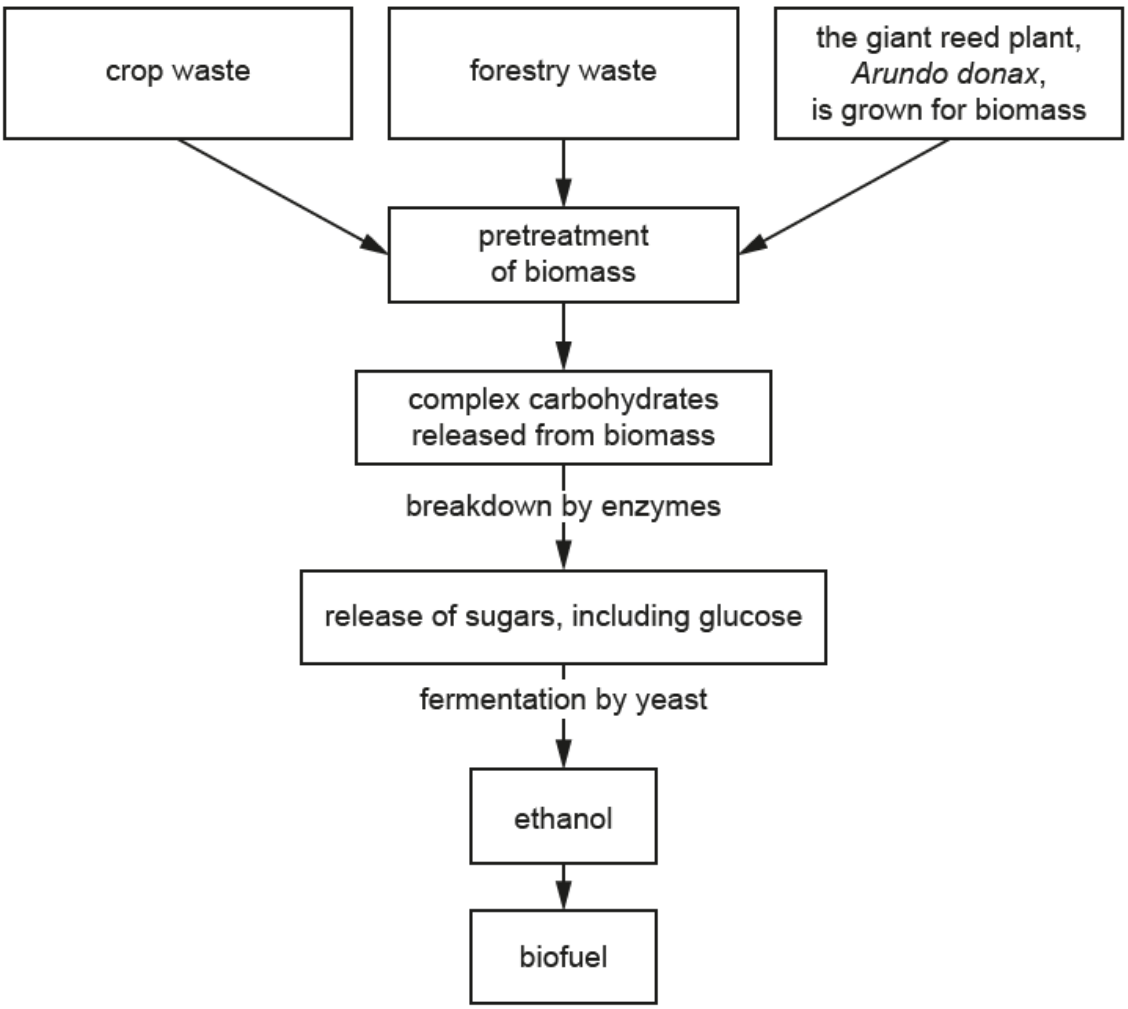


Fig. 4.1

(i) The fermentation stage shown in Fig. 4.1 requires yeast.

Complete the balanced chemical equation to show how ethanol is produced by yeast respiration.

..... ⟶ ..... + ...

[2]

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(ii) Using the information in Fig. 4.1, suggest the environmental advantages of using ethanol as a fuel.

.....

.....

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.....

.....

..... [3]

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(iii) Farmers grow giant reed plants as monocultures.

Describe the disadvantages of growing giant reed plants to provide biomass for the production of biofuels.

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.....

.....

..... [2]

(b) One problem with using biomass in the process shown in Fig. 4.1 is that the breakdown stage produces a sugar called xylose and ethanoic acid. Yeast cannot use xylose, and ethanoic acid is toxic to yeast.

Scientists genetically engineered a type of yeast that can use xylose and ethanoic acid.

Fig. 4.2 shows the results of one of the trial experiments done by the scientists using their new genetically engineered yeast.

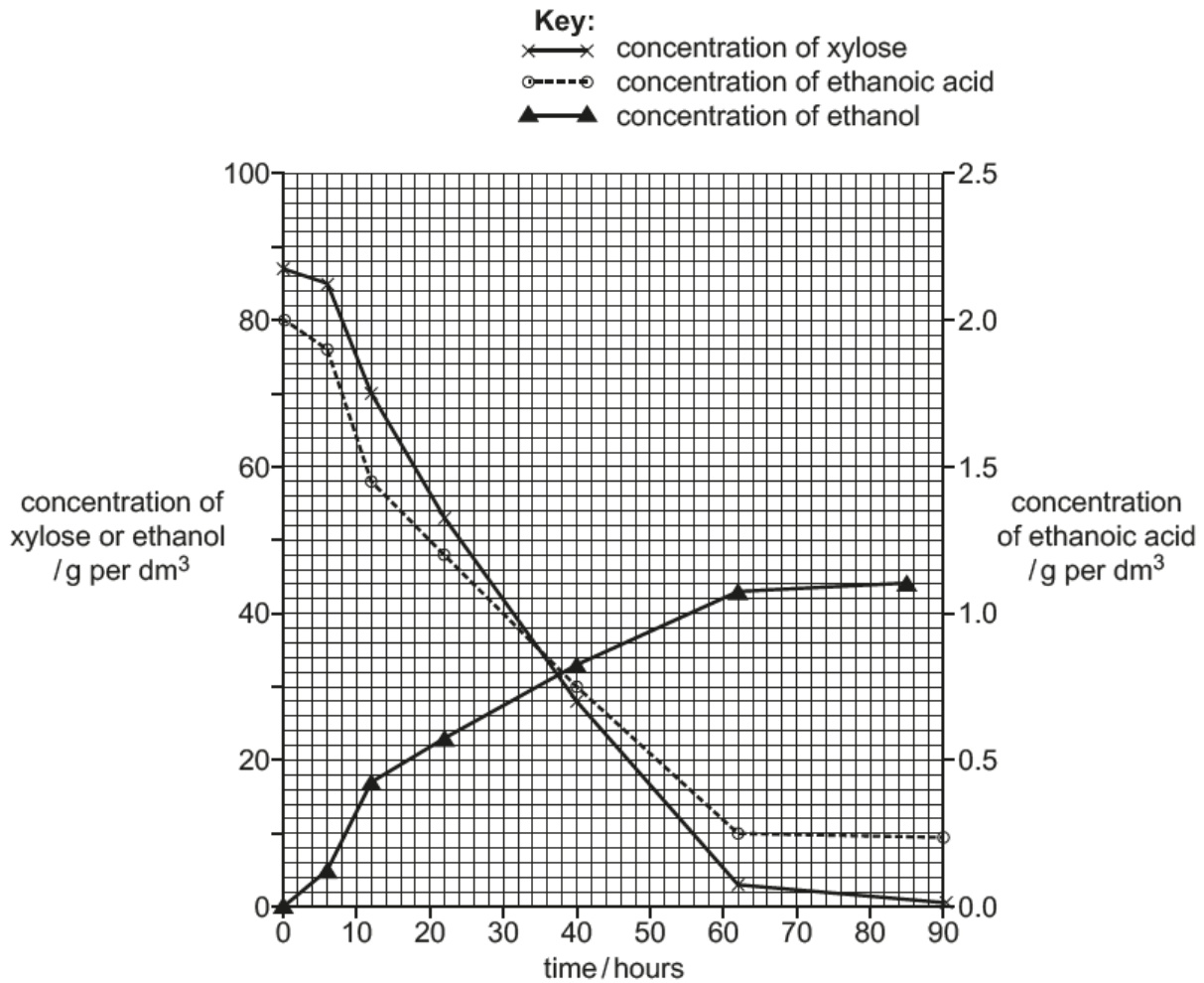


Fig. 4.2

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(i) Describe the results shown in Fig. 4.2.

.....

.....

.....

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.....

.....

..... [3]

(ii) The experiment was done at 30 °C.

The scientists repeated the experiment at 20 °C.

Predict the results that you would expect for the concentration of ethanol.

.....

.....

..... [1]

[Total: 11]

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Biotechnology and genetic modification – 2022 June IGCSE 0610

1. June/2022/Paper_ 11/No.39
Which process makes use of a genetically engineered organism?

A using bacteria to produce insulin

B using enzymes in biological washing powders

C using pectinase in fruit juice production

D using yeast to produce ethanol

2. June/2022/Paper_ 12/No.39
Which process makes use of a genetically engineered organism?

A using bacteria to produce insulin

B using enzymes in biological washing powders

C using pectinase in fruit juice production

D using yeast to produce ethanol

3. June/2022/Paper_ 13/No.39
Which process makes use of a genetically engineered organism?

A using bacteria to produce insulin

B using enzymes in biological washing powders

C using pectinase in fruit juice production

D using yeast to produce ethanol

4. June/2022/Paper_ 23/No.38
Which process makes use of a genetically engineered organism?

A using bacteria to produce insulin

B using enzymes in biological washing powders

C using pectinase in fruit juice production

D using yeast to produce ethanol

5. June/2022/Paper_ 43/No.1(a_ b)

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.

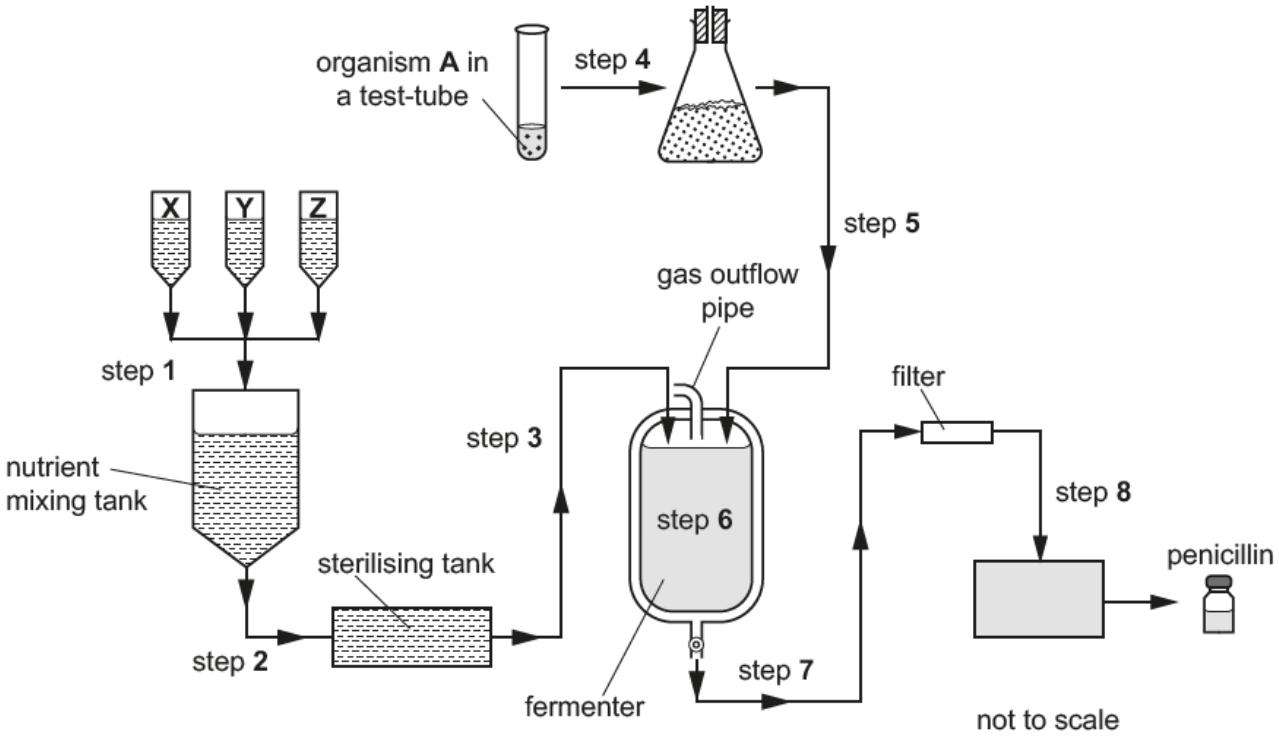


Fig. 1.1

(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.

.....

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..... [2]

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

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..... [4]

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Biotechnology and genetic modification – 2021 IGCSE 0610

1. Nov/2021/Paper_12/No.39

What is the useful product of anaerobic respiration in the manufacture of bread?

A carbon dioxide

B ethanol

C lactic acid

D oxygen

2. Nov/2021/Paper_13/No.39

Three statements about the bacteria that are used in biotechnology and genetic engineering are listed.

1 They can convert simple molecules into more complex ones.

2 They can only reproduce very slowly.

3 Their genetic material can be changed.

Which statements are correct?

A 1 and 2 **B** 2 only **C** 1 and 3 **D** 3 only

3. Nov/2021/Paper_21/No.37

Bacteria can be genetically engineered to produce human protein.

What happens during this process?

A The human plasmids are isolated using restriction enzymes.

B Ligase is used to create sticky ends in bacterial plasmids.

C Restriction enzymes are used to create sticky ends in human DNA.

D Human DNA is isolated using ligase.

4. Nov/2021/Paper_22/No.37

What is a characteristic of bacteria that makes them useful in genetic engineering?

A The genetic code of bacteria is different to plants and animals.

B Their nucleus contains DNA.

C Plasmids can be transferred between cells.

D They have large numbers of mitochondria.

5. Nov/2021/Paper_23/No.38

Reasons why bacteria might be used in biotechnology and genetic engineering are listed.

1 All bacteria are harmless organisms.

2 Bacteria contain plasmids.

3 Bacteria share the same genetic code as other organisms.

4 There is a lack of ethical concerns about using bacteria.

Which reasons make bacteria useful in biotechnology and genetic engineering?

A 1, 2 and 3 **B** 2, 3 and 4 **C** 1 and 4 **D** 2 and 3 only

6. Nov/2021/Paper_23/No.40

Bacteria can be genetically engineered to produce human proteins, such as human insulin.

Which enzyme is used to join the human gene and the bacterial plasmid together to create a recombinant plasmid?

A lipase

B recombinant enzyme

C DNA ligase

D restriction enzyme

Biotechnology and genetic modification – 2021 IGCSE 0610

1. March/2021/Paper_12/No.39

Rice has been modified by adding genes from bacteria and another plant so that it can produce the nutrient beta carotene.

What is this process called?

A evolution

B genetic engineering

C mutation

D selective breeding

2. June/2021/Paper_12/No.39

Bacteria are useful in ……X…… because of their rapid ……Y…… rate and their ability to make complex ……Z…… .

Which row completes the sentence?

	X	Y	Z
A	bread making	competition	chemicals
B	biotechnology	reproduction	molecules
C	ethanol production	competition	enzymes
D	genetic engineering	production	pectinase

3. June/2021/Paper_13/No.39

What is an example of genetic engineering?

A the addition of vitamins to food to increase the nutritional benefits

B the breeding of sheep with thick wool by choosing animals with desired characteristics

C the insertion of genes into crop plants to make them resistant to insect pests

D the production of biofuels by yeast cells

4. June/2021/Paper_21/No.39

Why are bacteria useful in genetic engineering?

A Their genetic code is different to other organisms.

B They have cell walls.

C They have plasmids.

D They reproduce sexually.

5. June/2021/Paper_22/No.39

Bacteria can be used to make human proteins.

Which statement explains why this is possible when a human gene is placed in a bacterial cell?

A Bacteria are able to reproduce rapidly.

B Bacteria are very small organisms.

C Bacteria contain genetic material in plasmids.

D Bacteria have the same genetic code as humans.

6. June2021/Paper_41/No.3

Bacteria are used in many biotechnological processes.

(a) Explain why bacteria are useful in biotechnology.

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..... [3]

(b) Insulin is one of many human proteins that are made by genetically engineered bacteria.

Some people cannot produce insulin because their immune system has destroyed the cells that make insulin.

(i) State the organ that contains the cells that have been destroyed.

..... [1]

(ii) State the name of the disease caused by the destruction of these cells.

..... [1]

(iii) State the function of insulin in the body.

..... [1]

(c) Genetically engineered bacteria that are used to make insulin were grown in a fermenter for five days.

Samples were taken from the fermenter every six hours and the number of bacteria in 1.0 mm^3 of the nutrient solution were counted.

Changes in the numbers of living bacteria in the samples taken from the fermenter are shown in Fig. 3.1.

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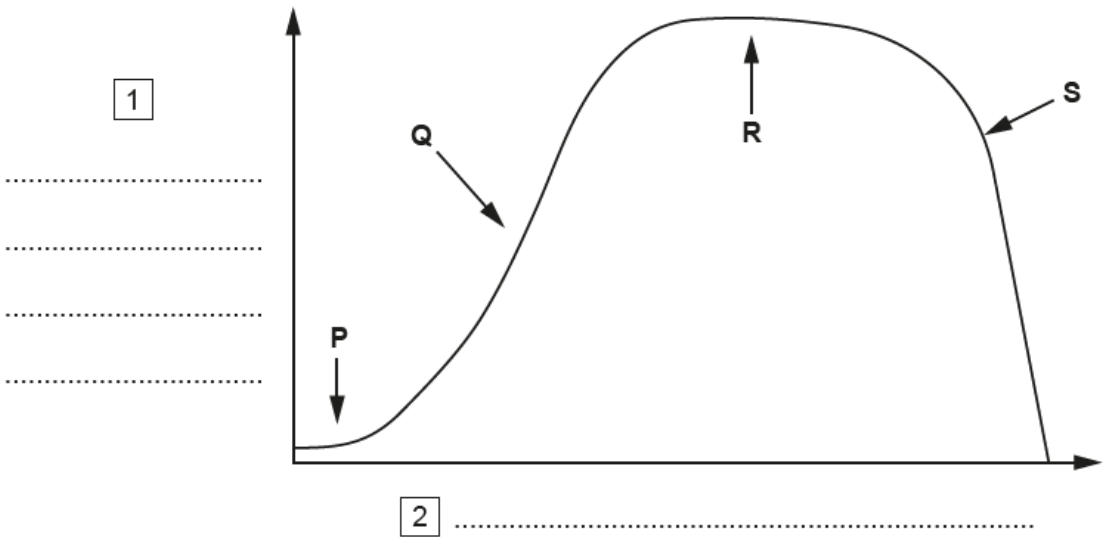


Fig. 3.1

(i) Complete Fig. 3.1 by adding labels for the axes at 1 and 2. [1]

(ii) State the names of the stages of population growth of the bacteria labelled **P** to **S**.

P .....

Q .....

R .....

S .....

[2]

(iii) Explain, with reference to Fig. 3.1, why the bacteria did not grow in the fermenter for longer than five days.

.....

.....

.....

.....

.....

.....

..... [3]

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(d) Mineral salts are important in the human diet. One of the most important is iron.

Explain:

- the importance of iron in the human diet
- the effects of an iron deficiency.

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.....

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.....

.....

..... [3]

(e) Fig. 3.2 shows a field of cassava, *Manihot esculenta*, which is a crop plant grown in parts of Africa and Asia.



Fig. 3.2

The plants store starch in their roots, which form a large part of the diet for many people. Cassava does not provide many vitamins or mineral ions.

Genetic engineers have modified cassava to increase its iron content. They have done this by incorporating a gene for a membrane protein from the plant *Arabidopsis thaliana*.

(i) State the name of the enzyme that is used to cut out the gene from the DNA of *A. thaliana*.

..... [1]

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(ii) Describe how the gene from *A. thaliana* and the DNA from cassava form recombinant DNA.

.....

.....

.....

.....

..... [2]

(iii) Scientists who develop genetically engineered varieties of crop plants often breed them for several generations before releasing them for farmers to use.

Suggest why the scientists do this.

.....

.....

.....

.....

..... [2]

[Total: 20]

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Biotechnology and genetic modification – 2020 IGCSE 0610

1. Nov/2020/Paper_13/No.38

Genes can be inserted into crop plants to make them resistant to herbicides.

Which process is this an example of?

A antibiotic resistance

B genetic engineering

C natural selection

D selective breeding

2. Nov/2020/Paper_21/No.38

Which are reasons why bacteria are often useful in biotechnology?

1 lack of ethical concerns over their manipulation and growth

2 they have the same genetic code as all other organisms

3 their DNA is located in a nucleus that can easily be altered with enzymes

A 1 and 2 only **B** 1 and 3 only **C** 1, 2 and 3 **D** 2 and 3 only

3. Nov/2020/Paper_22/No.38

The stages describe how genetic engineering can be used to produce human insulin from bacteria.

1 cut bacterial plasmid DNA with restriction enzymes

2 extract gene for insulin from human DNA with restriction enzymes

3 insert recombinant plasmid into bacteria

4 join human DNA to bacterial plasmid DNA using DNA ligase

5 replicate bacteria containing recombinant plasmid

Which sequence will lead to the production of human insulin by bacteria?

A $2 \rightarrow 1 \rightarrow 4 \rightarrow 3 \rightarrow 5$

B $2 \rightarrow 5 \rightarrow 1 \rightarrow 3 \rightarrow 4$

C $4 \rightarrow 2 \rightarrow 3 \rightarrow 1 \rightarrow 5$

D $4 \rightarrow 3 \rightarrow 5 \rightarrow 1 \rightarrow 2$

4. Nov/2020/Paper_23/No.38

Bacteria are used to make insulin.

This happens in several stages.

1 bacteria synthesise insulin in fermenters

2 the insulin gene is inserted into a bacterial plasmid

3 removal of the insulin gene from a human chromosome

4 a section of a plasmid is removed

In which order do these stages occur?

A $1 \rightarrow 3 \rightarrow 2 \rightarrow 4$

B $1 \rightarrow 4 \rightarrow 3 \rightarrow 2$

C $4 \rightarrow 2 \rightarrow 3 \rightarrow 1$

D $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

Biotechnology and genetic modification – 2020 IGCSE 0610

1. June/2020/Paper_11/No.38

A crop plant has been genetically modified to make it resistant to herbicides.

Which is a possible disadvantage of introducing this new crop plant?

A Loss of weeds reduces competition.

B Some weeds might become resistant to the herbicide.

C The crop plant is unharmed and produces a higher yield.

D The new gene will appear in new generations of the crop.

2. June/2020/Paper_11/No.39

Which is an example of an undesirable effect of deforestation?

A decreased carbon dioxide concentration in the atmosphere

B decreased soil erosion

C increased flooding

D the variety of organisms is maintained

3. June/2020/Paper_12/No.38

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A Loss of weeds reduces competition.

B Some weeds might become resistant to the herbicide.

C The crop plant is unharmed and produces a higher yield.

D The new gene will appear in new generations of the crop.

5. June/2020/Paper_22/No.37

What is the role of anaerobic respiration in bread-making?

A to produce alcohol to flavour the bread

B to produce gas to make the bread rise

C to release enough energy to bake the bread

D to release enough lactic acid to kill the yeast

6. June/2020/Paper_22/No.38

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Which is a possible disadvantage of introducing this new crop plant?

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B Some weeds might become resistant to the herbicide.

C The crop plant is unharmed and produces a higher yield.

D The new gene will appear in new generations of the crop.

7. June/2020/Paper_22/No.39

Which is a reason for using bacteria in biotechnology?

A Bacteria are found inside the human body.

B Bacteria do not become resistant to antibiotics.

C Bacteria can make complex molecules.

D Bacteria reproduce slowly.

8. June/2020/Paper_23/No.37

What is the role of anaerobic respiration in bread-making?

A to produce alcohol to flavour the bread

B to produce gas to make the bread rise

C to release enough energy to bake the bread

D to release enough lactic acid to kill the yeast

9. June/2020/Paper_23/No.38

A crop plant has been genetically modified to make it resistant to herbicides.

Which is a possible disadvantage of introducing this new crop plant?

A Loss of weeds reduces competition.

B Some weeds might become resistant to the herbicide.

C The crop plant is unharmed and produces a higher yield.

D The new gene will appear in new generations of the crop.

Microorganisms and Biotechnology P2 Questions

Microorganisms and biotechnology

Content

14.1 Microorganisms

14.2 Food biotechnology

14.3 Industrial biotechnology

Learning outcomes

Candidates should be able to:

(a) **list the main characteristics of the following groups: viruses, bacteria and fungi**

(b) **outline the role of microorganisms in decomposition**

(c) **explain the role of yeast in the production of bread and alcohol**

(d) **outline the role of bacteria in yoghurt and cheese production**

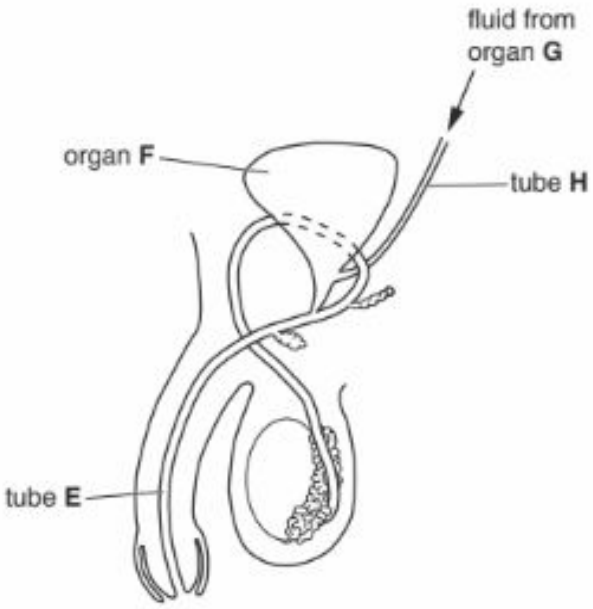
(e) **describe the use of fermenters for large-scale production of antibiotics and single cell protein**

(f) **describe the role of the fungus *Penicillium* in the production of penicillin.**

Microorganisms and Biotechnology P2 Questions

0/N18/22/Q2

The diagram shows the human male reproductive organs and associated structures.



(a) (i) Identify each of the following:

tube **E** .....

organ **F** .....

organ **G** .....

tube **H** ..... [4]

(ii) State **one** difference between the fluids carried by tube **E** and tube **H**.

.....

.....[1]

(b) (i) State **one** way in which the fluid from organ **G** may be different in a person with diabetes compared to a person without diabetes.

.....

.....[1]

(ii) A person with diabetes may be treated with insulin produced by genetically modified bacteria.

Outline how such genetically modified bacteria may be produced and used to manufacture human insulin on a commercial scale.

.....

.....

.....

.....

.....

.....[4]

[Total: 10]

Microorganisms and Biotechnology P2 Questions

M/J18/22/Q8

(a) Outline the role of a **named type** of microorganism in the production of each of the following products:

yoghurt .....

.....

.....

.....

.....

bread .....

.....

.....

.....

.....

[6]

(b) Describe how a **named type** of microorganism can be used to produce human insulin on a commercial scale.

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 10]

O/N17/21/Q7

Fig. 7.1 shows a fermenter used for the production of an antibiotic.

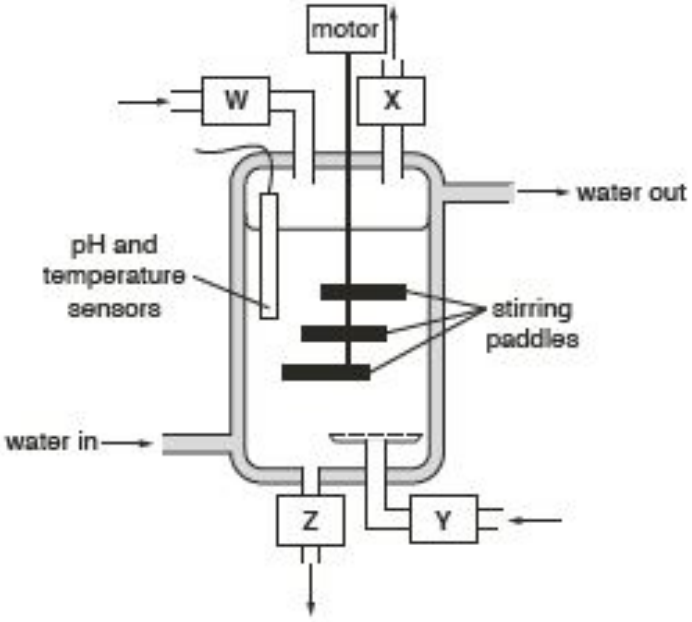


Fig. 7.1

(a) (i) Identify what enters or leaves through each of W, X, Y and Z in Fig. 7.1.

W .....

X .....

Y .....

Z ..... [4]

(ii) Explain the importance of the substance entering through Y in the production of the antibiotic.

.....

.....

.....[2]

(b) Explain why it is important to detect and to control the pH and temperature of the contents of the fermenter.

.....

.....

.....

.....

.....[3]

(c) Suggest one advantage of the motor being located outside, rather than inside, the reaction vessel of the fermenter.

.....

.....

.....[1]

[Total: 10]

Microorganisms and Biotechnology P2 Questions

M/J17/21/Q1

Spirulina is classified in the group bacteria. *Spirulina* is green in colour and is able to synthesise its own food.

(a) List **three** characteristics of bacteria.

1 .....

2 .....

3 ..... [3]

(b) **(i)** Suggest the name of the chemical that gives *Spirulina* its green colour.

..... [1]

(ii) Write, in words or symbols, the equation for the process by which *Spirulina* synthesises its own food.

..... → ..... [2]

(c) *Spirulina* can be eaten by humans.

The United Nations World Health Organization (WHO) made the following statement about *Spirulina*:

'For WHO Spirulina represents an interesting food for multiple reasons. Rich in iron and protein, it can be given to children without any risk. We at WHO consider it to be a very suitable food.'

Use your knowledge of animal nutrition to suggest and explain why WHO considers *Spirulina* to be a 'very suitable food'.

.....

.....

.....

.....

.....

.....[4]

[Total: 10]

Microorganisms and Biotechnology P2 Questions

0/N16/22/Q1

Two separate strains, **A** and **B**, of the same species of microorganism are used in the making of bread and beer (a drink that contains alcohol).

(a) **(I)** Name this type of microorganism .....[1]

(II) Name the gas released by this microorganism during the production of bread and beer.

.....[1]

(b) Fig. 1.1 shows the volume of gas released by the strains while they are being used.

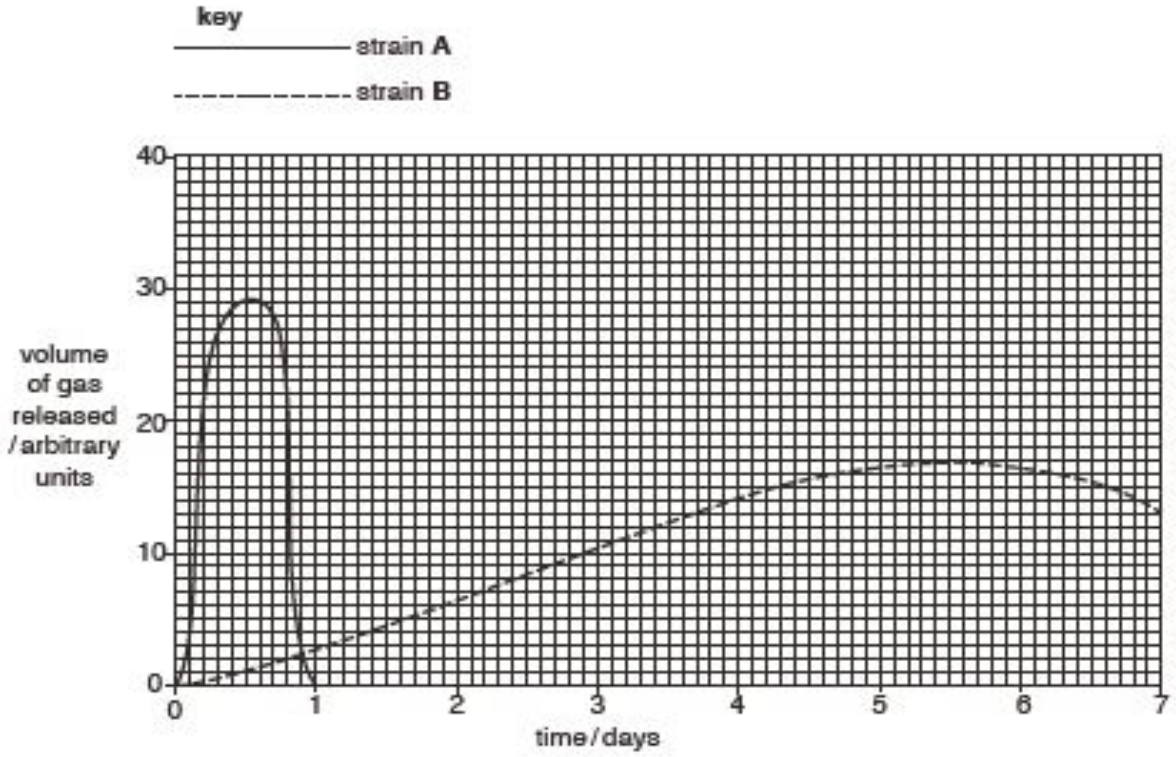


Fig. 1.1

(I) Fig. 1.1 shows the gas released by strain **B** at a temperature of 18°C.
Draw a curve on Fig. 1.1 to show the effect on strain **B** of increasing the temperature by 10°C. [3]

(II) Name **two** other external factors that would change the shape of the curves shown in Fig. 1.1.

1 .....

2 .....
[2]

(c) Strain **A** has a sweet taste and strain **B** has a bitter taste.
Suggest which strain is used for making bread. Give reasons for your answer.

strain used in making bread .....

reasons .....

.....

.....

.....

.....

.....

.....[3]

[Total: 10]

M/J16/21/Q4

Fig. 4.1 shows the stages in the process of genetic engineering to produce the hormone insulin.

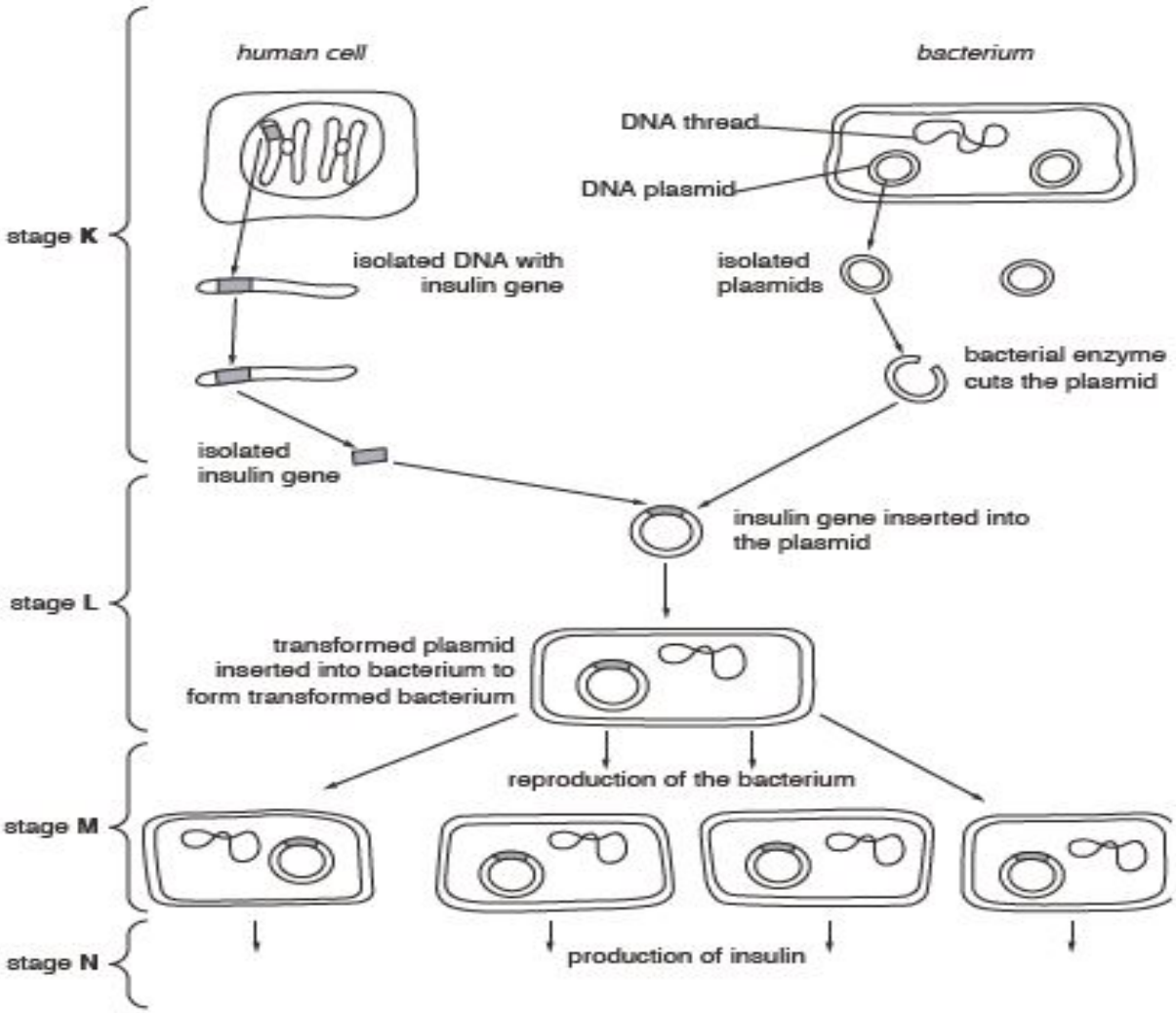


Fig. 4.1

(a) (i) Describe how the location and organisation of genetic material in the human cell shown in stage **K** of Fig. 4.1 is different from that in the bacterial cell shown.

.....

.....

.....

..... [3]

(II) Use your knowledge of bacterial cells to name **two** structures that the transformed plasmid must pass through to form a transformed bacterium in stage **L** of Fig. 4.1.

..... and ..... [2]

(III) State the type of reproduction that takes place in stage **M** of Fig. 4.1. Use your knowledge of the process of cell division to explain why it is important that this type of reproduction occurs.

type of reproduction .....

explanation .....

.....

.....

..... [3]

(IV) Name the condition in humans that is treated using insulin produced by the bacteria in stage **N** of Fig. 4.1.

..... [1]

(V) Stage **N** of Fig. 4.1 may take place in a container similar to that used in the large-scale production of antibiotics.

State the name of this type of container.

..... [1]

(b) Genetic engineering can also be used to produce crop plants for humans to eat.

Discuss the potential advantages and dangers of using genetic engineering to produce crop plants for humans to eat.

advantages .....

.....

.....

.....

dangers .....

.....

.....

..... [4]

[Total: 14]

Microorganisms and Biotechnology P2 Questions

M/J16/22/Q8

(a) Describe the industrial manufacture of single cell protein.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[8]

(b) Suggest problems of using viruses in biotechnology.

.....

.....

.....

.....[2]

[Total: 10]

Microorganisms and Biotechnology P2 Questions

0/N15/22/Q8

(a) Describe how a bacterial cell differs from a typical animal cell.

.....

.....

.....

.....

.....

.....[3]

(b) Describe the role of bacteria in nitrogen fixation.

.....

.....

.....

.....

.....

.....[3]

(c) Describe the part played by bacteria after a river has been polluted by sewage.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 10]

Microorganisms and Biotechnology P2 Questions

M/J15/22/Q8

(a) Outline the role of microorganisms in the production of yoghurt.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

(b) Explain how a slice of bread, if left exposed to the air, decomposes due to the growth of fungi.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 10]

O/N14/22/Q4

Fig. 4.1 is an incomplete flow chart of the process of anaerobic respiration in yeast and in muscles.

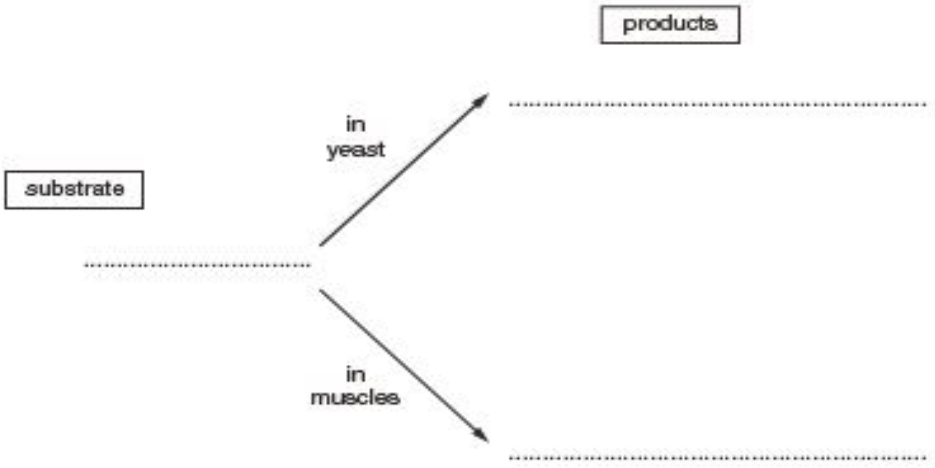


Fig. 4.1

(a) Complete Fig. 4.1 to show the substrate and products for anaerobic respiration in yeast and in muscles. [4]

(b) Yeast cells may be killed by their use in food biotechnology. Explain what causes the death of the yeast in each of the following.

(i) brewing

.....

.....

.....

..... [2]

(ii) making bread

.....

..... [1]

(c) Explain why muscle cells are not killed by anaerobic respiration in a healthy person.

.....

.....

.....

..... [2]

(d) Suggest why anaerobic respiration does not release as much energy as aerobic respiration for each molecule of the same substrate.

.....

.....

.....

..... [2]

[Total: 11]

Microorganisms and Biotechnology P2 Questions

M/J14/21/Q9

(a) Outline the role of a **named** type of microorganism in the production of each of the following products.

bread

type of microorganism .....

role .....

.....

.....

.....

yoghurt

type of microorganism .....

role .....

.....

.....

.....

[4]

(b) Describe and explain how a fermenter is used to produce the antibiotic penicillin from a **named** microorganism.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[6]

[Total: 10]

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Microorganisms and Biotechnology P2 Questions

M/J14/22/Q7

(a) Describe how a virus differs from a bacterium.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[6]

(b) Explain how microorganisms are involved in the recycling of materials in dead organic matter.

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 10]

O/N13/22/Q2

2 Fig. 2.1 shows how an alcoholic drink is produced in some countries.

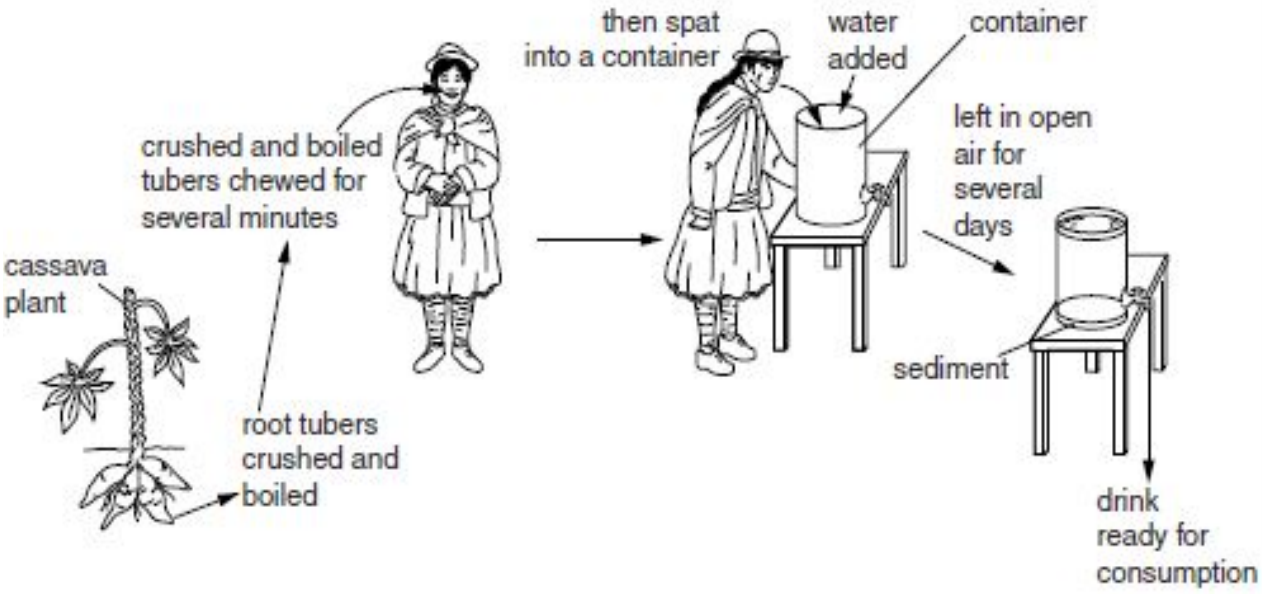


Fig. 2.1

(a) The root tubers of the cassava plant store starch. After removal from the plant, the tubers are crushed and boiled.

Suggest the effect that crushing and boiling will have on the cells of the tubers.

.....

..... [2]

(b) After they have been crushed and boiled, the cassava tubers are chewed for several minutes.

Explain what happens to the starch during this time.

.....

.....

.....

..... [3]

(c) **(i)** Name the process that must occur in the container to produce alcohol and, in the space below, give an equation for this process.

process.....

equation

[3]

(ii) Name the type of organism, whose spores are found in soil and floating in the air, that will bring about the production of alcohol.

.....[1]

(d) Suggest why the sediment in the bottom of the container increases in quantity as the container is left to stand for several days.

.....

.....

.....

.....[2]

[Total: 11]

Microorganisms and Biotechnology P2 Questions

M/J13/22/Q5

Fig. 5.1 shows a fermenter used for the large-scale production of antibiotics by microorganisms.

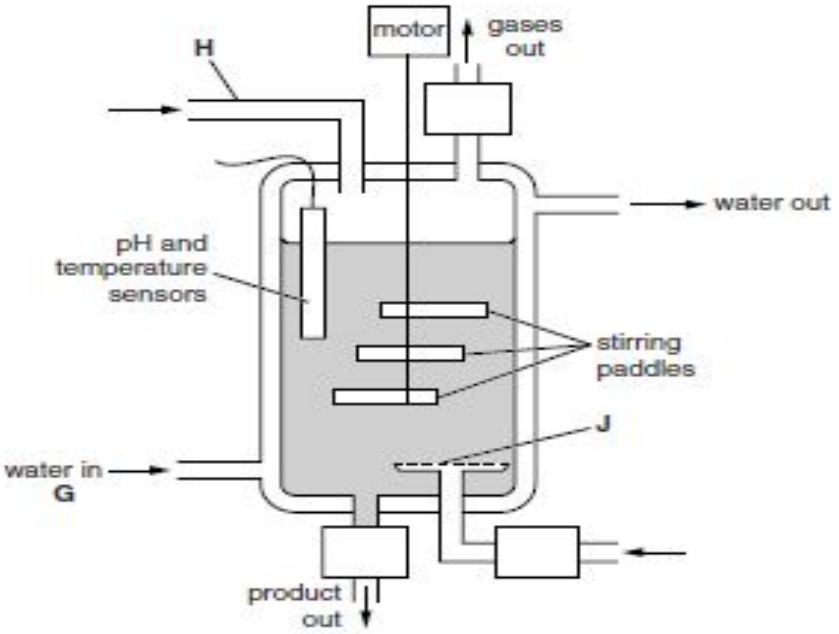


FIg. 5.1

(a) State the term for the manufacture of antibiotics using a fermenter.

.....[1]

(b) State the purpose of the water which enters the fermenter at **G**.

.....[1]

(c) Explain the importance of controlling the pH and temperature of the contents of the fermenter.

.....

.....

.....

.....

..... [2]

(d) Describe the function of part **H** and part **J**.

part **H** .....

.....

.....

.....

part **J** .....

.....

.....

.....[5]

[Total: 9]

O/N12/21/Q5

Fig. 5.1 shows a palisade cell from the leaf of a flowering plant.

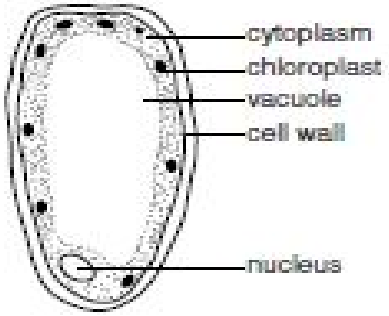


Fig. 5.1

(a) State **three** ways in which this cell differs from a fungal hypha.

palisade cell	fungal hypha
1.	.....
2.	.....
3.	.....

[3]

Fig. 5.2 shows the apparatus used to produce 5 dm^3 of red wine from grape juice.

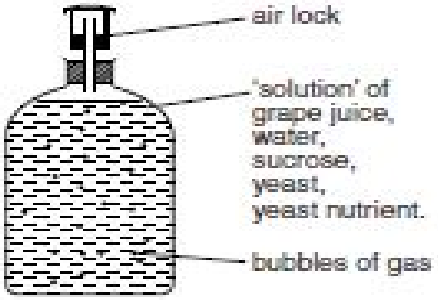


Fig. 5.2

(b) State an equation for the chemical process by which the alcohol is produced.

..... [2]

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(c) Suggest a suitable temperature to ensure a good yield of alcohol.

..... [1]

Table 5.1 shows the rate of bubble release and the concentrations of sugar and alcohol in the grape juice over the first 10 days.

Table 5.1

time /days	number of bubbles per hour	concentration of sugar/grams per dm^3	concentration of alcohol/ %
1	60	200	0.0
2	40	150	0.0
3	20	100	0.0
7	2	50	0.5
10	1	30	2.0

(d) (i) State the process that was occurring from day 1–3 to produce the bubbles of gas.

..... [1]

(ii) Explain why alcohol started to be produced only after several days.

.....

.....

..... [2]

(iii) When the alcohol content reached 15%, no further bubbles were produced. Suggest why the alcohol content could not increase further.

.....

..... [1]

[Total: 10]

M/J12/21/Q2

Fig. 2.1 shows a fresh fruit and the same fruit after being left at a temperature of 25 °C for 14 days.



fresh fruit | fruit after 14 days

Fig. 2.1

Bacteria and fungi are two groups of microorganism which cause the fruit to change appearance during the 14 days.

(a) Complete Table 2.1 to show three **differences** between the characteristics of bacteria and fungi.

Table 2.1

	bacteria	fungi
1		
2		
3		

[3]

(b) Name the process that is responsible for the appearance of the fruit after 14 days.

.....

[1]

(c) Fungi reproduce by asexual reproduction.

(i) Name the type of cell division that occurs during asexual reproduction.

.....

[1]

(ii) Explain how asexual reproduction results in genetically identical offspring.

.....

.....

..... [2]

(d) Microorganisms use glucose ($C_6H_{12}O_6$) found in the fruit to carry out aerobic respiration. Complete the equation for aerobic respiration.

Glucose ($C_6H_{12}O_6$) + ... → ..... + ...

[1]

(e) **(i)** Explain why increasing the temperature surrounding the fruit would speed up the changes shown in Fig. 2.1.

.....

.....

..... [2]

(ii) Suggest **two** ways in which the fruit may be preserved to prevent the changes shown in Fig. 2.1 from occurring.

1. .....

2. .....

[2]

[Total: 12]

Microorganisms and Biotechnology P2 Questions

O/N11/21/Q6

(a) Describe and explain how microorganisms are used to produce a hormone commercially.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[7]

(b) State the advantages of obtaining hormones by this method.

.....

.....

.....

.....

.....

.....[3]

[Total:10]

Microorganisms and Biotechnology P2 Questions

M/J11/22/Q1

Fig. 1.1 shows three types of organism (not drawn to the same scale).

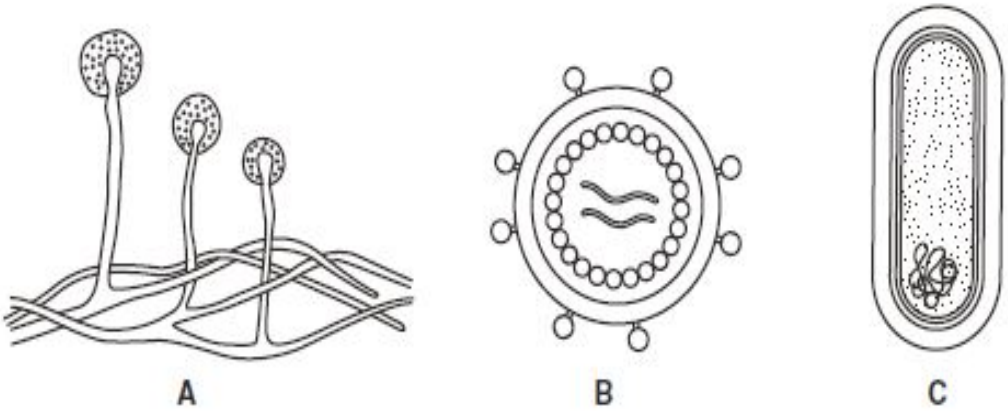


Fig. 1.1

(a) Identify the three types of organism shown in Fig. 1.1.

A .....

B .....

C ..... [3]

(b) (i) List the organisms in Fig. 1.1 in order of their actual size, starting with the largest.

.....[1]

(ii) State which of these organisms might bring about decay of organic matter.

.....[2]

(c) On Fig. 1.1, label

- a structure (**N**) that is always made mostly of DNA,
- a structure (**P**) that is made only of protein. [2]

(d) A microorganism, similar to one shown in Fig. 1.1, is used commercially to make human insulin. Name the microorganism and suggest why this process is referred to as *genetic engineering*.

microorganism name .....

why the process is called genetic engineering

.....

.....

.....

.....[3]

[Total: 11]

Microorganisms and Biotechnology P2 Questions

MARK SCHEME

Mark schemes will use these abbreviations:
; separates marking points
/ alternatives
() contents of brackets are not required but should be implied
R reject
A accept (for answers correctly cued by the question, or guidance for examiners)
Ig ignore (for incorrect but irrelevant responses)
AW alternative wording (where responses vary more than usual)
AVP alternative valid point (where a greater than usual variety of responses is expected)
ORA or reverse argument
underline actual word underlined must be used by candidate
+ statements on both sides of the + are needed for that mark

O/N18/22/Q2

2(a)(i) (E) urethra ;

(F) bladder ;

(G) kidney ;

(H) ureter ;

R gall (bladder)

2(a)(ii) semen / seminal fluid / sperm / gametes + carried by

E / not carried by

H ; 1

2(b)(i) (contains) glucose ;

2(b)(ii) insulin gene ;

from + human

+ DNA / chromosome / genome ;to

+ bacterial

+ DNA / chromosome / genome / plasmid ;

fermenter ;

reproduce / multiply / divide / mitosis / binary fission

Microorganisms and Biotechnology P2 Questions

M/J18/22/Q8

8(a) **1** enzymes **;**
(yoghurt)
2 bacteria / *Lactobacillus* / *Streptococcus* **;**
3 sugar / lactose **+** milk **;**
4 production **AW +** of acid **or** reduction in pH **;**
5 thickens / curdles / coagulates / reference to taste **;**
(bread)
6 fungus/ yeast / *Saccharomyces* **;**
7 anaerobic **+** respiration **or** fermentation **;**
8 production **AW +** carbon dioxide **;**
9 rising **;**
6 A once for **either** *yoghurt* **or** *bread*
8(b) **1** genetic **+** engineering / modification **;**
2 bacteria / fungus / named bacteria / named fungus **;**
3 reference to insulin gene **;**
4 from human **+** DNA / chromosome / genome **;**
5 to bacterial / fungal **+** DNA / chromosome / genome / plasmid **;**
6 fermenter **;**
7 reproduce / multiply / divide / mitosis / binary fission **;**

O/N17/21/Q7

7(a)(i) ***(W)***
fungus / microorganism / bacteria / nutrient /
yeast / water **;**
(X)
carbon dioxide **;**
(Y)
oxygen **;**
(Z)
antibiotic / named antibiotic **;**
7(a)(ii) respiration **;**
aerobic **;**
reference to increased yield **;**
sparger / bubbles / more surface area **;**
growth **;**
7(b) detect changes **;**
enzymes **;**
denature **;**
reduce rate of reaction / product formed **;**
kill microorganisms or named **;**
maintain optimum / best conditions **;**
7(c) heat production / temperature **;**
ease of maintenance **;**
prevents water damage to motor **;**
doesn't take up space (in fermentation vessel) **AW ;**

Microorganisms and Biotechnology P2 Questions

M/J17/21/Q1

1(a) single-celled **;**
no nucleus / nucleus not membrane bound **;**
no organelles **;**
cell wall **;**
(cell wall) not cellulose **;**
cell membrane / cytoplasm **;**
flagella / flagellum **;**
DNA circular / loop **OR** plasmid / single chromosome **;**
smaller than animal / plant cells **OR** 1–2 μm **;**
1(b)(i) chlorophyll **;**
1(b)(ii) carbon dioxide / $6CO_2$ **+** water / $6H_2O$ **;**
glucose / $C_6H_{12}O_6$ **+** oxygen / $6O_2$ **;**
1(c) iron **+** haemoglobin / red blood cells **;**
prevent anaemia **;**
protein **+** growth / repair **;**
protein **+** (production of) enzymes / antibodies **;**
carbohydrates / glucose / starch / vitamins / ions **;**
reference to a component of balanced diet / dietary supplement
OR to alleviate malnutrition / famine **;**

O/N16/22/Q1

1(a)(i) yeast / fungus / *Saccharomyces* **;**
1(a)(ii) carbon dioxide / CO_2 **;**
1(b)(i) starting at zero **;**
line above that on graph at least up to (the drawn line's) peak **;**
peaking earlier (than dotted line on graph) **;**
reaches same height as dotted line **;**
1(b)(ii) pH **;**
substrate (or named carbohydrate) concentration / amount **;**
toxins / named toxin **;**
amount of yeast / microorganism / strain A / strain B **;**
competing microorganism **AW ;**
pressure / (presence of) oxygen **;**

M/J16/21/Q4

4 (a) (i) in nucleus (human) / within
nuclear membrane ORA ;
in cytoplasm (bacteria) ;
thread + plasmid(s) (bacteria) ;
correct reference to
chromosomes AW ;
genes / chromosomes paired
(human) ;
(ii) (cell) wall ;
(cell) membrane ;
(iii) type:
asexual / binary fission / mitosis ;

explanation:
genetically + identical (cells
produced)
OR clones ;
all capable of producing
insulin / same product ;
A to produce insulin in large
quantities / to produce a large number of
bacteria / produce bacteria quickly
(iv) diabetes ;
(v) fermenter ;

M/J16/22/Q8

8 (a) 1. sterilised / aseptic technique ;
2. fermenter ;
3. bacterium / fungus / algae /
named example ;
4. substrate / cultured medium or
named / broth / any two
chemicals in the medium ;
5. oxygen / air ;
6. bubbles / sparger / aerator /
paddle / stirrer AW ;
7. temperature
regulation / control / cooling
jacket ;
8. pH ref ;
9. optimum or best for growth or
reproduction of organism ;
10. filtration / collection / harvesting /
separating (the product) ;
11. name / use of product e.g.
mycoprotein / meat
substitute / cattle feed ;
(b) 1. size reference / extremely small
AW ;
2. reproduce only in living
cells / pathogenic AW / parasitic ;
3. specific ;
4. may need to separate them from
living tissue / difficult to isolate

Microorganisms and Biotechnology P2 Questions

O/N15/221/Q8

8 (a) bacterial cell has cell wall ;
no (true) nucleus ;
ref. different arrangement of DNA eg plasmid ;
(may) have flagella ;
capable of independent existence ;
size reference e.g. bacterial cells smaller ;
bacteria produce spores ;
bacteria have slime capsules / no mitochondria / smaller ribosomes ;
A reverse argument throughout
I tail
(b) conversion of nitrogen ;
to ammonium / amino acids ;
free-living (bacteria) or named (Azotobacter) ;
in root nodules / named bacteria (Rhizobium) ;
leguminous plant / named plant ;]
I fixation of nitrogen as mentioned
in question
(c) decomposition / breakdown / decay ;
of organic matter / faeces / urea ;
using up O_2 / aerobic / dissolved oxygen decreases ;
for respiration ;
resulting in lack of O_2 / anaerobic conditions ;
ref. eutrophication ;

M/J15/22/Q8

8 (a) 1. bacteria (or named e.g.
Lactobacillus) ;
2. milk ;
3. incubation / 32 – 50 °C ;
4. reproduction of bacteria ;
5. ref. to enzymes / lactase ;
6. sugar / lactose ;
7. to lactic acid ;
8. coagulation / curdling of + milk /
protein / casein ;
9. imparts texture / flavour ;]
(b) 1. spores ;
2. produce hyphae / mycelium ;
3. enzymes ;
4. ref. suitable temperature ;
5. external digestion / description of ;
6. of starch ;
7. of protein ;
8. soluble / diffusible OR named ;
9. ref. (fungal) respiration ;

Microorganisms and Biotechnology P2 Questions

O/N14/22/Q4

4 (a) glucose / $C_6H_{12}O_6$ (substrate) ;
(yeast) alcohol / ethanol / C_2H_5OH ;
(yeast) carbon dioxide / CO_2 ;
(muscles) lactic acid / lactate / $C_3H_6O_3$;
(b) (i) food / glucose deficiency / AW ;
(killed) by alcohol ;
poisoned by competing organisms (e.g. bacteria) ;
(ii) (killed) by heat / baking / high temperature ;
(c) lactic acid removed / broken down / converted ;
by circulation / blood / AW ;
lactic acid not toxic (at concentrations experienced) ;
(d) substrate / glucose not completely broken down ;
chemical energy ;
still contained within product / lactic acid / alcohol ;

M/J14/21/Q9

9 (a) bread:
fungus / yeast ;
fermentation / (anaerobic) respiration ;
CO_2 production + dough rises / improves texture of bread ;
yoghurt:
bacteria/bacterium / Lactobacillus ;
(milk sugar / lactose) to lactic acid ;
(lactic acid) thickens / clots milk / gives sour taste ;

b) Penicillium;
sterilised + prevent contamination AW ;
substrate / nutrient medium / culture medium ;
protein / amino acids provided ;
for growth ;
carbohydrate / glucose provided ;
for respiration / ref. energy ;
supply of oxygen / air ;
ref. sparger + bubbles or ref. surface area / paddles + stirring ;
ref. control of temp ;
ref. control of pH ;
extraction / filtration / purification / crystallisation ;

M/J14/22/Q7

7 (a) Viruses
DNA or RNA both must be noted for mark and as possibilities;
parasitic / disease causing AW / reproduce only in host cell ;
Bacteria
contain DNA ;
saprotrophic / decomposers AW ;
ref. binary fission / asexual reproduction / mitosis ;
Comparative points
protein coat / no protein coat ;
not truly living / living ;
no (cell) wall / (cell) wall ;
no spores / forms spores ;
no cytoplasm* / cytoplasm ;
not affected by / affected by antibiotics ;
size comparison ;
GUIDANCE:
Accept points on labelled diagrams
A harmful / active only in host cell
Ig loop / strand / RNA
R protein wall
A acellular
Ig composition of the wall
*A no ribosomes / protoplasm / flagella / plasmid / cell membrane ORA R nucleus / mitochondria
viruses less than 300 nm – bacteria c. × 50 larger
A viruses small(er) than bacteria

(b)
decomposition / decay / putrefaction ;
saprotrophic ;
release enzymes / ref. external digestion ;
insoluble to soluble ;
example of macromolecule and breakdown product, e.g. protein to amino acids ;
respiration ;
CO_2 released N photosynthesis ;
water released N later use ;
nitrification ;
NH_4^+ / NO_2^- / NO_3^{2-} ;
salts for plant uptake ;

Microorganisms and Biotechnology P2 Questions

O/N13/22/Q2

(a) damage / breaks AW (cells / tuber);
ref. cell wall / membrane;
releasing (cell) contents / starch;
kills cells / denatures enzymes / stops metabolic reactions; [max 2]
(b) amylase / carbohydrase;
digests / breaks down / hydrolyses + starch;
(to) maltose; [3]
(c) (i) fermentation / anaerobic respiration; [1]
left hand side of equation
glucose / $C_6H_{12}O_6$;
right hand side of equation
$2C_2H_5OH + 2CO_2$ / alcohol/ethanol + carbon dioxide; [2]
(ii) fungus / yeast ; [1]
(d) yeast (cells) + reproduce / increase in number / multiply;
(sediment contains) yeast (cells) / bacteria / chewed tuber AW
yeast (cells) dead + sugar / food used up / alcohol is toxic AW; [max 2]
[Total 11]

M/J13/22/Q5

5 (a) biotechnology / fermentation / culturing;
(b) to control / lower / the temperature;
(c) enzymes;
prevention of denaturation / destruction / prevents death of fungus / microorganism / bacterium;
optimum / best / better / + for growth / reproduction;
high(er) yield;
(d) any ref. sterile;
(H) for introduction of microorganism or named;
and food / nutrients / culture medium;
e.g. amino acids / protein / carbohydrates or named;
(J) for introduction of air / oxygen;
bubbles / large surface area (as O_2 passes through grille) / sparger;
for respiration;

O/N12/21/Q5

5 (a) one nucleus per cell in palisade v hypha – coenocytic / several nuclei;
separate cells each with wall v not separate cells;
large central vacuole v several small vacuoles;
stores starch v stores glycogen;
chloroplasts / chlorophyll present v absent;
walls are made of different materials (chitin for hypha); [max 3]
(b) $C_6H_{12}0_6 \rightarrow 2\ C_2H_5OH + 2C0_2$;
glucose / sucrose; → alcohol / ethanol + carbon dioxide;
A a word or chemical equation, 1 mark each side, but if chemical, must balance. [2]
(c) 25 – 40 °C; [1]

(d) (i) respiration;
R anaerobic / fermentation [1]
(ii) the oxygen has been used (up);
and no more can enter ;
the yeast starts to respire anaerobically; [max 2]
(iii) yeast has died;
depletion of substrate or named;
respiration / fermentation ceases; [max 1]
[Total: 10]

M/J12/21/Q2

2 (a) ref. presence / absence hyphae / mycelium;
ref. reproduction by spores / sporangia / absence of spores / sporangia;
ref. cell wall composition;
ref prokaryote / eukaryote OR no true nucleus / true nuclei AW;
unicellular / multicellular;
reasonable size ref.;
vacuole / no vacuole; [3]
(b) decay / decomposition / rot(ting) / putrefaction; [1]
(c) (i) mitosis / mitotic /; [1]
(ii) one parent;
same / no new combination of genes / alleles; [2]
(d) oxygen / $6O_2$ + carbon dioxide / $6CO_2$ + water / $6H_2O$; [1]

(e) (i) digestion / chemical breakdown qualified (increases);
correct ref. enzymes;
rate of reaction/respiration increases;
more / faster reproduction microorganism(s); [2]
(ii) (any two from)
drying, freezing, cooling, pickling, jamming, vacuum packing, chemical (preservatives) or any named, canning, radiation,;; [2]
[Total: 12]

O/N11/21/Q6

6 (a) human/named donor animal/named cell;
gene or DNA for hormone/insulin;
cut/removed from chromosome;
ref. use of enzymes;
inserted into plasmid/DNA;
of bacterium;
culture medium AW (R agar plate);
oxygen supplied/aeration;
suitable temperature/pH/sterility;
bacteria divide/reproduce;
the gene makes insulin/hormone;
separated from infusion;
(b) conditions (or named) can be controlled;
for maximum yield/large amounts;
no harm to human;

no harm to animal/sheep AW;
insulin is (exact) match of human insulin– not of another animal AW;
cheaper AW/higher profits/safer/no transmission of disease;
[Total: 10]