AQA GCSE Biology | 8461

SPECIFICATION POINT 4.7.5.4

Role of biotechnology

Past-paper questions

Tier	**Foundation**
Question groups	**9**
Available paper years	**2008–2020**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.7.5.4 Role of biotechnology

Question 01

June 2008 | BLY3F | Original Q5 | Legacy

5 (a) Microorganisms can be grown in Petri dishes containing nutrient agar.
The Petri dish and nutrient agar must be sterilised before use.

Which method is used to sterilise the Petri dish and nutrient agar?

Tick (✓) **one** box.

- Heat at 120 °C for 30 minutes ☐
- Pass through a Bunsen burner flame ☐
- Place in an incubator at 25 °C for one day ☐

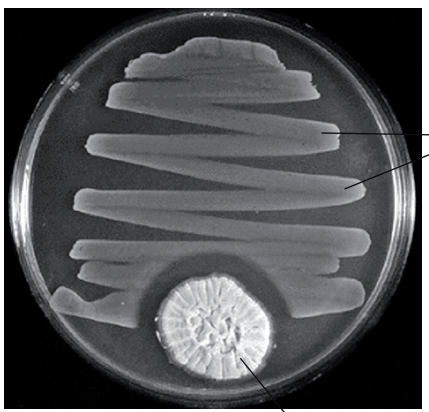
(1 mark)

Question 5 continues on the next page

Question 01 · continued

for mark

5 (b) The photograph shows *Penicillium* mould and one species of bacterium growing together on nutrient agar in a Petri dish.



The *Penicillium* mould produces an antibiotic.

How can you tell this from the photograph?

.....

.....

(1 mark)

5 (c) A student investigated the effect of pH on the growth of *Penicillium*.

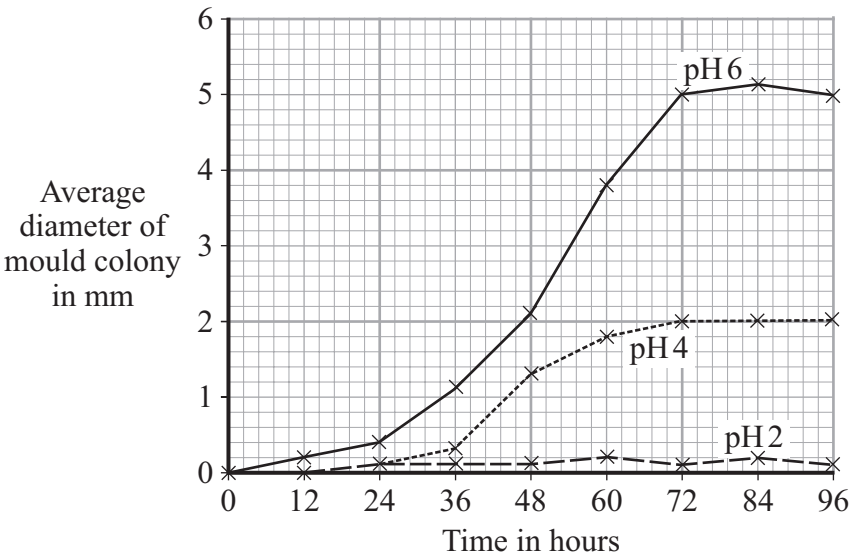
- He used three Petri dishes containing nutrient agar.
- The pH of the nutrient agar in the three Petri dishes was 2, 4 and 6 respectively.
- He inoculated each Petri dish with the same amount of *Penicillium* mould.
- Every 12 hours, he measured the diameter of five *Penicillium* colonies in each dish.
- From these measurements, he calculated the average diameter of the five colonies in each dish.

The graph on the opposite page shows the results.

4.7.5.4 Role of biotechnology

Question 01 · continued

for mark



5 (c) (i) Complete the sentence.

Calculating the average diameter of five colonies from each dish made the results more ..... .

(1 mark)

5 (c) (ii) At which pH did the mould grow best? .....

(1 mark)

5 (c) (iii) What was the maximum average diameter of the mould colony at pH 4?

..... mm

(1 mark)

5 (c) (iv) During which 12-hour period was growth fastest at pH 6?

From ..... to ..... hours.

(1 mark)

5 (d) pH is only one factor which affects the growth of *Penicillium* mould.

When *Penicillium* is grown in an industrial fermenter, other factors also need to be controlled.

Give **two** of these other factors.

1 .....

2 .....

(2 marks)

8

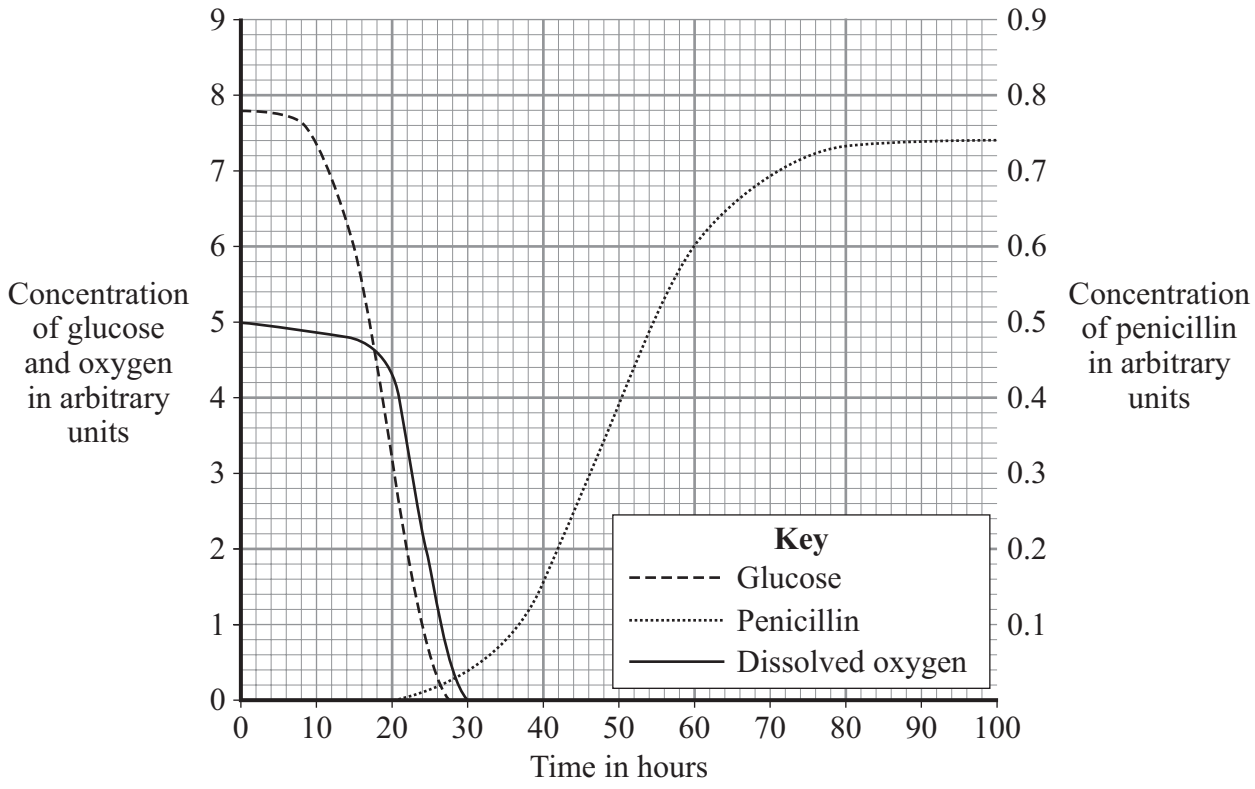
4.7.5.4 Role of biotechnology

Question 02

January 2009 | BLY3F | Original Q5 | Legacy

5 The mould *Penicillium* can be grown in a fermenter. It produces the antibiotic penicillin.

The graph shows changes that occurred in the fermenter during the production of penicillin.



5 (a) During which time period was penicillin produced most quickly?

Draw a ring around **one** answer.

0 – 20 hours **40 – 60 hours** **80 – 100 hours**

(1 mark)

5 (b) (i) Describe how the concentration of glucose in the fermenter changes between 0 and 30 hours.

.....

.....

.....

.....

(2 marks)

4.7.5.4 Role of biotechnology

Question 02 · continued

for mark

5 (b) (ii) How does the change in the concentration of oxygen in the fermenter compare with that of glucose between 0 and 30 hours?

Put a tick (✓) in **two** boxes next to your choices.

The oxygen concentration changes after the glucose concentration. ☐

The oxygen concentration changes before the glucose concentration. ☐

The oxygen concentration changes less than the glucose concentration. ☐

The oxygen concentration changes more than the glucose concentration. ☐

(2 marks)

5 (b) (iii) What is the name of the process that uses both glucose and oxygen?

Draw a ring around **one** answer.

aerobic respiration **distillation** **filtration**

(1 mark)

6

4.7.5.4 Role of biotechnology

Question 03

March 2009 | BLY1BP | Original Q4 | Legacy

QUESTION FOUR

Insulin is a drug needed by some people suffering from diabetes.

Bacteria can be genetically engineered to produce insulin.

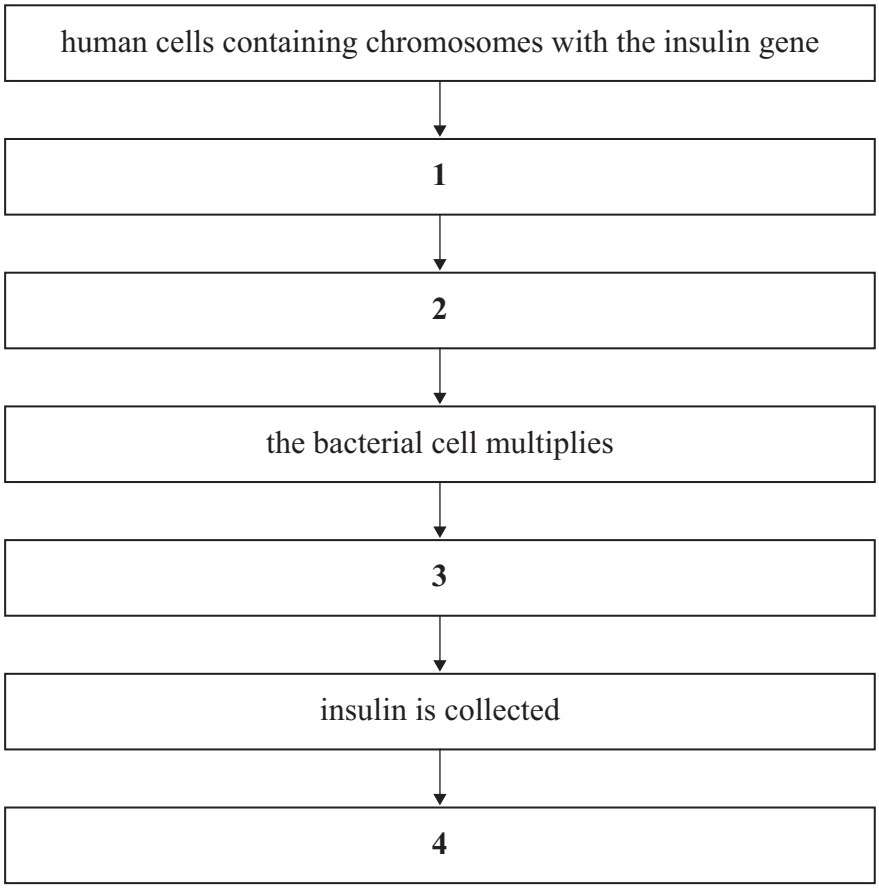
Match statements, **A**, **B**, **C** and **D**, with the labels **1–4** on the flow chart.

A insulin is produced by genetically engineered bacteria

B diabetics inject insulin to control diabetes

C the insulin gene is 'cut out' using enzymes

D the insulin gene is transferred into a bacterium



4.7.5.4 Role of biotechnology

Question 04

June 2009 | BLY3F | Original Q5 | Legacy

5 The table gives information about the growth of different types of organism.
The figures were obtained during the period of fastest growth for each organism.

Organism	Time taken to double in mass
Bacteria	40 minutes
Yeasts	2 hours
Fusarium	4 hours
Algae	5 hours
Soybeans	1 week
Cattle	8 weeks

5 (a) (i) Which type of organism grows the fastest? .....

(1 mark)

5 (a) (ii) How many times faster than cattle do soybeans double in mass?

.....

(1 mark)

5 (a) (iii) *Fusarium* grows at its fastest rate in a fermenter.
Some scientists put **one tonne** of *Fusarium* into a fermenter.

Use data from the table to calculate how much *Fusarium* there would be in the fermenter after 8 hours.

Draw a ring around **one** answer.

2 tonnes **4 tonnes** **8 tonnes**

(1 mark)

Question 04 · continued

for mark

5 (b) *Fusarium* is used to make mycoprotein.

Read the information about substances found in mycoprotein.

- Protein – can be used for making cells, enzymes and antibodies.
- Fats – are rich in energy but large amounts in the diet can cause circulatory problems.
- Dietary fibre – helps to reduce the risk of colon cancer.

The table compares the composition of mycoprotein and beef.

Substance	Percentage of dry mass	
	Mycoprotein	Beef
Protein	47.2	68.3
Fat	13.5	30.1
Dietary fibre	19.2	0.0

Use the information above to answer the questions.

5 (b) (i) Give **two** reasons why it would be better to eat mycoprotein instead of beef.

1 .....

.....

2 .....

.....

(2 marks)

(Extra space) .....

5 (b) (ii) Give **one** reason why it would be better to eat beef instead of mycoprotein.

.....

.....

(1 mark)

(Extra space) .....

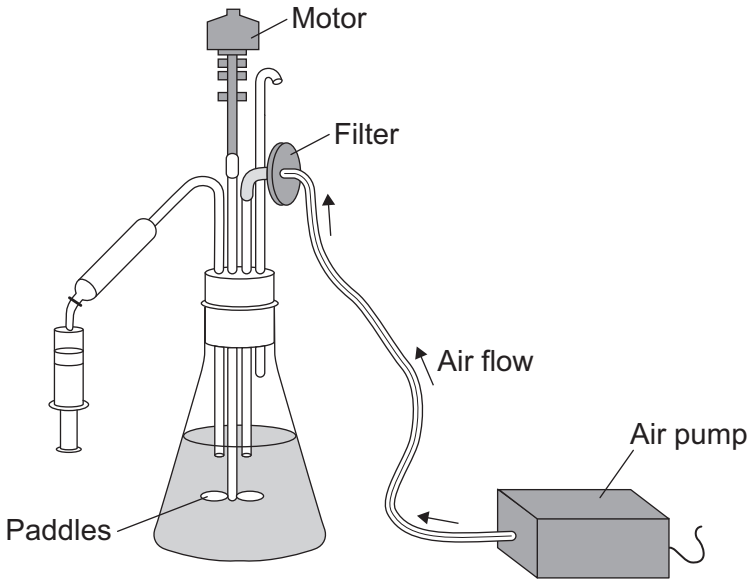
6

4.7.5.4 Role of biotechnology

Question 05

January 2011 | BLY3F | Original Q6 | Legacy

6 The diagram shows a simple laboratory fermenter.



Some students grew the fungus *Fusarium* in this fermenter.
After 5 days the students measured the dry mass of the *Fusarium*.

6 (a) **List A** gives the names of three pieces of apparatus in the diagram.
List B gives four possible functions of these pieces of apparatus.

Draw **one** line from each piece of apparatus in **List A** to its correct function in **List B**.

List A Apparatus	List B Function
Air pump	To stop microorganisms entering the flask
Filter	To allow gases to escape from the flask
Paddles	To supply oxygen to the fungus
	To keep the contents well mixed

(3 marks)

Question 6 continues on the next page

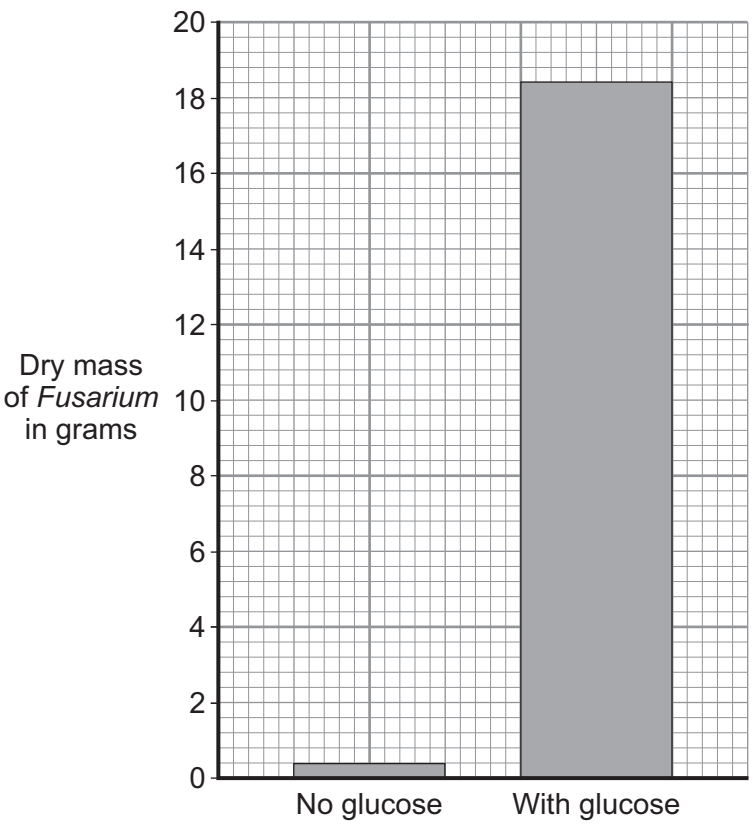
4.7.5.4 Role of biotechnology

Question 05 · continued

6 (b) The students grew the *Fusarium* in a culture solution of minerals dissolved in water.

The students repeated the experiment with the same concentration of minerals, but this time they also added glucose.

The bar chart shows the effect of adding glucose to the culture solution.



6 (b) (i) Describe, in detail, the effect of adding glucose to the culture solution.

.....

.....

.....

.....

(2 marks)

6 (b) (ii) Suggest an explanation for the effect of adding glucose.

.....

.....

(1 mark)

4.7.5.4 Role of biotechnology

Question 05 · continued

6 (c) The students repeated the investigation four more times. They used the culture solution with added glucose but each time they left out one of the minerals.

Their results are given in the table.

Mineral left out of the culture solution	Dry mass of *Fusarium* in grams
Calcium	18.50
Iron	16.80
Magnesium	1.90
Potassium	10.80

Which mineral is most important for the growth of *Fusarium*?

Draw a ring around **one** answer.

calcium **iron** **magnesium** **potassium**

(1 mark)

6 (d) Draw a ring around the correct answer to complete the sentence.

In industry, *Fusarium* is usually grown to make

alcohol.

biogas.

mycoprotein.

(1 mark)

8

4.7.5.4 Role of biotechnology

Question 06

June 2011 | BLY3F | Original Q3 | Legacy

3 Mycoprotein is produced from the fungus *Fusarium*. Mycoprotein is sometimes used instead of meat in foods for vegetarians.

3 (a) The table shows the amounts of some substances in mycoprotein and in chicken.

Substance	Mass in grams per 100 grams	
	Mycoprotein	Chicken
Protein	11.8	22.0
Dietary fibre	4.8	0.0
Fat	3.5	6.2
Carbohydrate	2.0	0.0
Cholesterol	0.0	0.1

3 (a) (i) Draw a ring around the correct answers to complete the sentence.

Eating mycoprotein instead of chicken helps to lower the risk of heart disease because

mycoprotein contains no [fat / carbohydrate / cholesterol] and

mycoprotein contains less [dietary fibre. / fat. / carbohydrate.]

(2 marks)

3 (a) (ii) A body-builder ate 4 kilograms of chicken each week to help him build up his muscles.

If he ate mycoprotein instead of chicken, he would need to eat about twice as much to have the same effect.

Use information from the table to give **one** reason why.

.....

.....

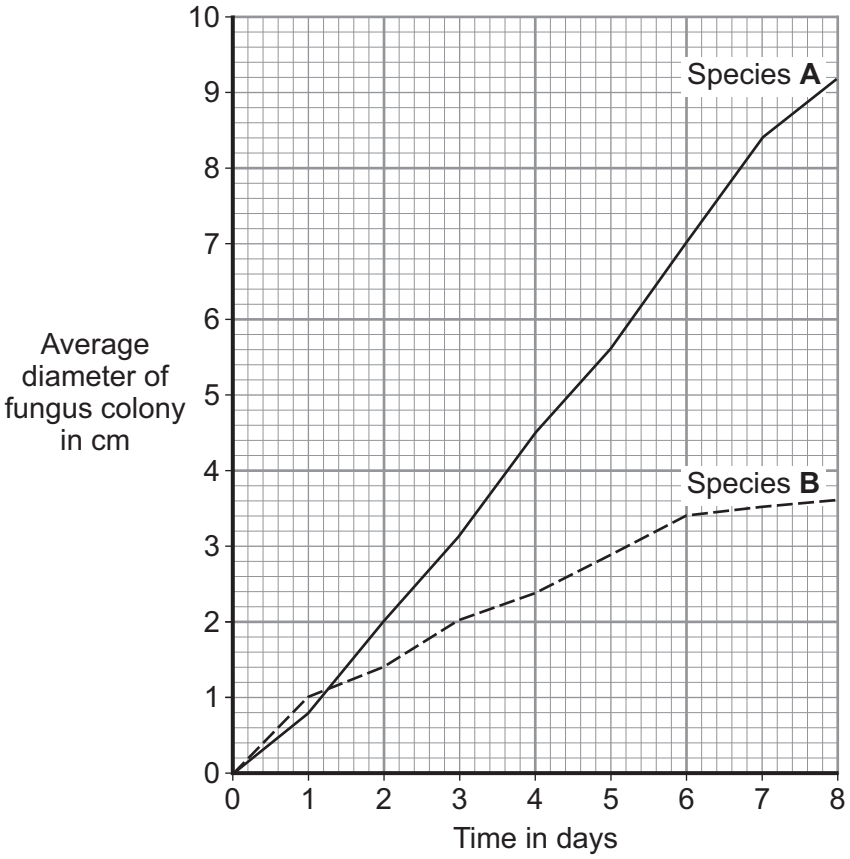
(1 mark)

4.7.5.4 Role of biotechnology

Question 06 · continued

3 (b) Scientists investigated the growth of two species, **A** and **B**, of the fungus *Fusarium.*
The scientists grew the fungus on agar jelly in Petri dishes.
They measured the diameter of a colony of each fungus every day for 8 days.

The graph shows the results.



3 (b) (i) Describe how the diameter of the colony of species **A** changed between day 0 and day 8.

.....

.....

.....

.....

(2 marks)

3 (b) (ii) Give **one** difference between the results for species **A** and the results for species **B**.

.....

.....

(1 mark)

Question 3 continues on the next page

4.7.5.4 Role of biotechnology

Question 06 · continued

3 (c) Both Petri dishes contained the same nutrients.
Both Petri dishes were kept at 25 °C.

When *Fusarium* is grown in an industrial fermenter, other factors also need to be controlled.

Give **two** of these other factors.

1 .....

2 .....

(2 marks)

8

4.7.5.4 Role of biotechnology

Question 07

June 2015 | BL3FP | Original Q7 | Legacy

7 The world population is increasing and the need for food is increasing.

Mycoprotein is a high-protein food made in fermenters using the organism *Fusarium*.

The process takes only a few weeks to produce a large amount of food.

7 (a) (i) What type of organism is *Fusarium*?

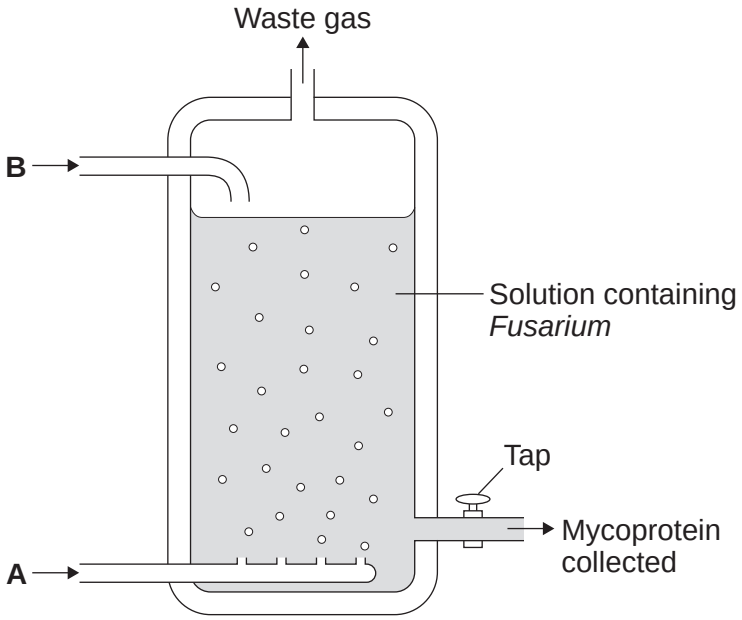
Draw a ring around the correct answer.

[1 mark]

bacterium **fungus** **virus**

Figure 8 shows a fermenter used in mycoprotein production.

Figure 8



7 (a) (ii) *Fusarium* makes mycoprotein. *Fusarium* respires aerobically.

Suggest which gas is added to the fermenter at point **A**.

[1 mark]

.....

7 (a) (iii) Another substance is added to the fermenter at point **B**. This substance is used in aerobic respiration.

Name this substance.

[1 mark]

.....

4.7.5.4 Role of biotechnology

Question 07 · continued

7 (b) People need to eat protein to grow and to be healthy.

Some people think that it would be an advantage to get more food from mycoprotein and less from farming animals.

Suggest **two** possible advantages of getting more food from mycoprotein.

[2 marks]

1 .....

.....

2 .....

.....

5

Turn over for the next question

4.7.5.4 Role of biotechnology

Question 08

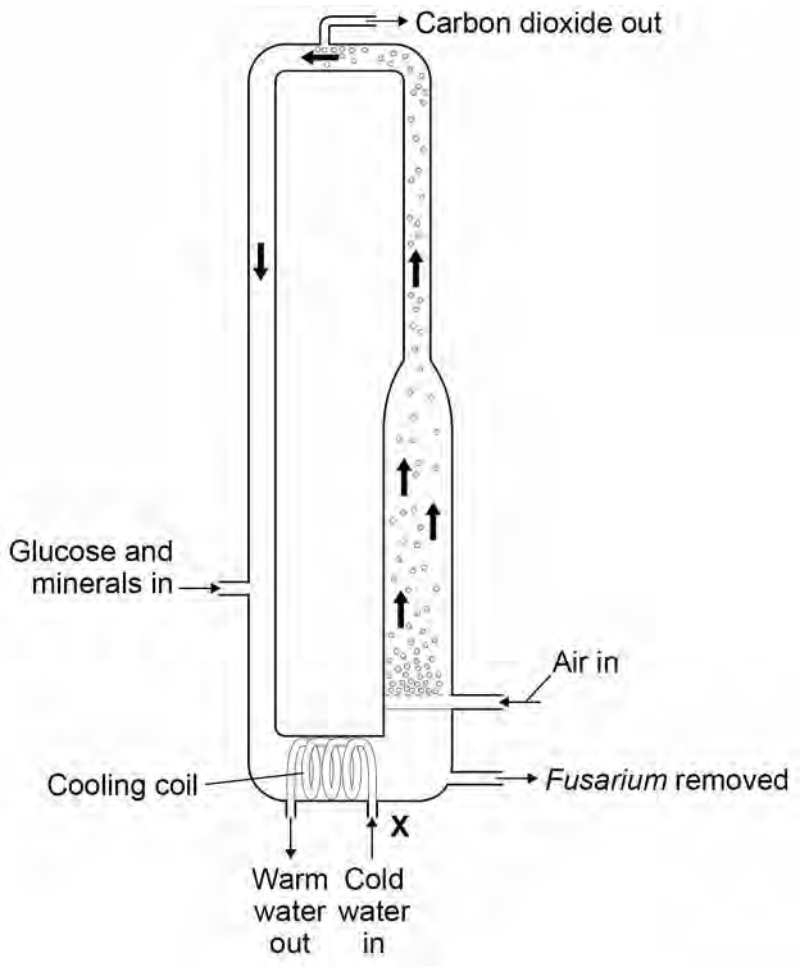
June 2018 | 8461/2F | Original Q7

0 7 Mycoprotein is a protein-rich food.

Mycoprotein is made from the fungus *Fusarium*.

Figure 9 shows a fermenter used for growing *Fusarium*.

Figure 9



0 7 . 1 Explain why the fermenter is sterilised before use.

[2 marks]

4.7.5.4 Role of biotechnology

Question 08 · continued

0 7 . 2 Cold water is pumped through the cooling coil at point **X**.

This maintains a constant temperature inside the fermenter.

Suggest the temperature at which *Fusarium* grows fastest.

[1 mark]

Tick **one** box.

5 °C ☐

20 °C ☐

30 °C ☐

85 °C ☐

0 7 . 3 Glucose and bubbles of air enter the fermenter.

The bubbles of air supply oxygen.

Explain why *Fusarium* needs glucose and oxygen.

[2 marks]

0 7 . 4 The bubbles of air also move materials around the fermenter.

Suggest why it is useful for bubbles of air and materials to move around inside the fermenter.

[2 marks]

4.7.5.4 Role of biotechnology

Question 08 · continued

0 7 . 5 100 grams of chicken meat contains 22 grams of protein.

100 grams of mycoprotein contains 11 grams of protein.

A man ate 100 grams of chicken in one meal.

How many grams of mycoprotein would the man need to eat to get the same mass of protein as in 100 grams of chicken?

[1 mark]

Tick **one** box.

- 100 grams ☐
- 110 grams ☐
- 200 grams ☐
- 220 grams ☐

8

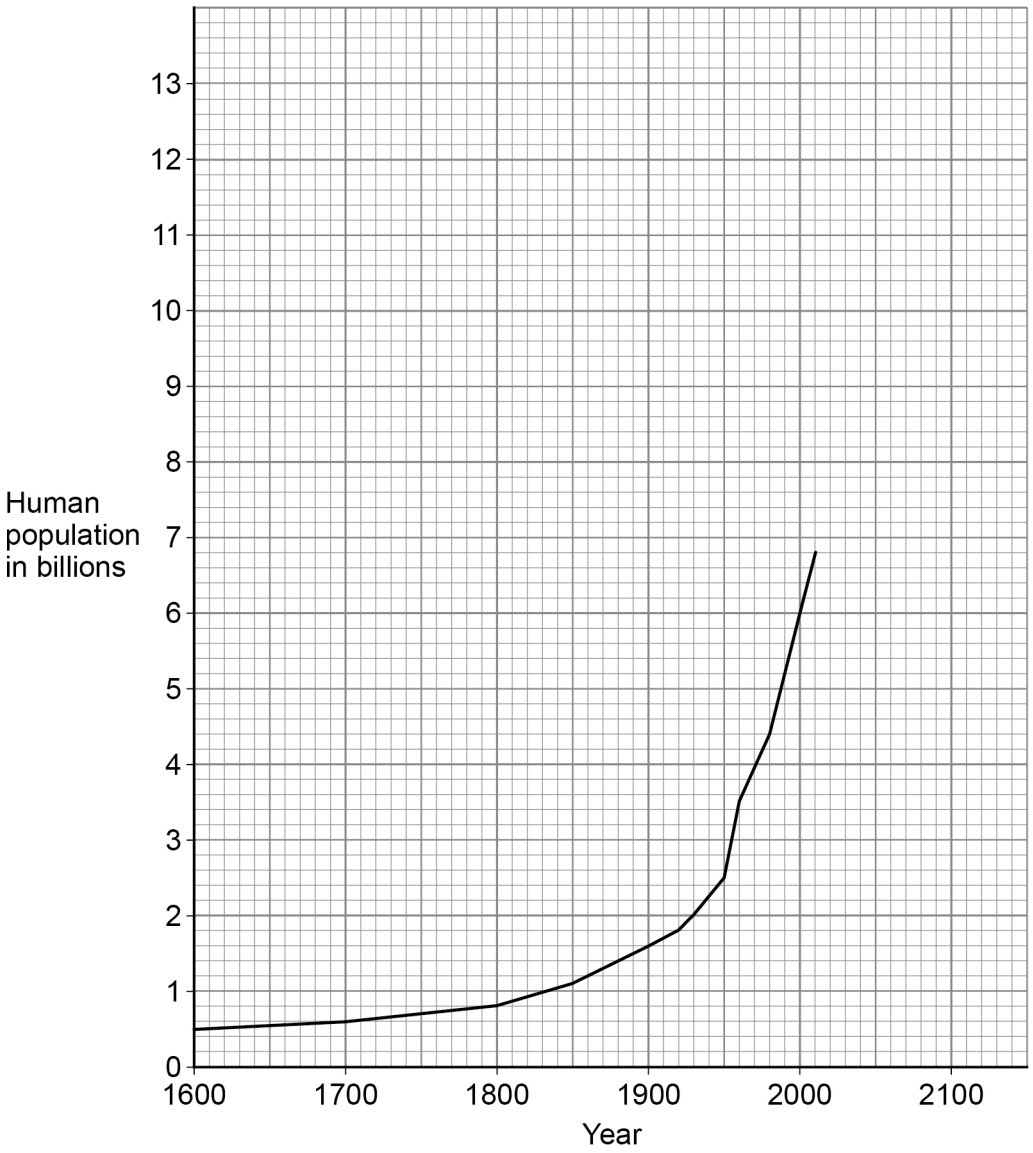
4.7.5.4 Role of biotechnology

Question 09

November 2020 | 8461/2F | Original Q9

0 9 **Figure 12** shows the human population from 1600 to 2010.

Figure 12



In 1900 the human population was 1.6 billion.

0 9 . 1 Calculate how many times greater the human population was in the year 2000 compared with the year 1900.

[2 marks]

Number of times greater = _____

4.7.5.4 Role of biotechnology

Question 09 · continued

0 9 . 2 In 1950 the human population was 2.5 billion.

Calculate the mean annual increase in the human population between 1900 and 1950.

[2 marks]

Mean annual increase = _____ billion per year

0 9 . 3 Predict the human population in 2050 if the current rate of population increase continues.

You should draw an extrapolation line on **Figure 12**.

[2 marks]

Predicted human population = _____

0 9 . 4 The increasing human population has caused a decline in fish stocks.

Describe how fishing quotas can help to return fish stocks to a sustainable level.

[2 marks]

Question 9 continues on the next page

4.7.5.4 Role of biotechnology

Question 09 · continued

0 9 . 5 Farming techniques have changed in recent years.

Describe:

- why more land is being used for farming
- how increased farming has decreased biodiversity.

[6 marks]

4.7.5.4 Role of biotechnology

Question 09 · continued

0 9 . 6 Genetic modification of crop plants can help meet the demands of the increasing human population.

Golden rice is a genetically modified (GM) crop.

What is the advantage of golden rice compared with non-GM rice?

[1 mark]

Tick (✓) **one** box.

Golden rice contains protein-rich mycoprotein ☐

Golden rice has improved nutritional value ☐

Golden rice produces human insulin ☐

0 9 . 7 Suggest **one** reason why some people are concerned about the use of golden rice.

[1 mark]

_____

_____

16