

FOR OFFICIAL USE

Centre No.	Subject No.	Level	Paper No.	Group No.	Marker's No.
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[C008/SQP043]

Total

Intermediate 2 Time: 2 hours  
Biotechnology  
Specimen Question Paper

NATIONAL  
QUALIFICATIONS

Fill in these boxes and read what is printed below.

Full name of centre

Town

First name and initials

Surname

Date of birth

Day Month Year

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Candidate number

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Number of seat

**SECTION A (25 marks)**

Instructions for completion of Section A are given on page two.

**SECTION B AND C (75 marks)**

- (a) All questions should be attempted.  
(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.
- The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.
- Additional space for answers and rough work will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the invigilator and should be inserted inside the front cover of this book.
- The numbers of questions must be clearly inserted with any answers written in the additional space.
- Rough work, if any should be necessary, should be written in this book and then scored through when the fair copy has been written.
- Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

**Read carefully**

- 1 Check that the answer sheet provided is for Intermediate 2 Biotechnology (Section A).
- 2 Fill in the details required on the answer sheet.
- 3 In this paper a question is answered by indicating the choice A, B, C or D by a stroke made in **ink** in the appropriate place in the answer sheet—see the sample question below.
- 4 For each question there is only **one** correct answer.
- 5 Rough working, if required, should be done only on this question paper—or on the rough working sheet provided—**not** on the answer sheet.
- 6 At the end of the examination the answer sheet for Section A **must not** be placed inside the answer book, but should be handed separately to the invigilator.

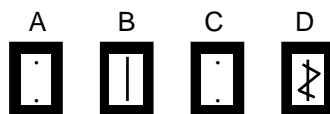
**Sample Question**

Which of the following foods contains a high proportion of fat?

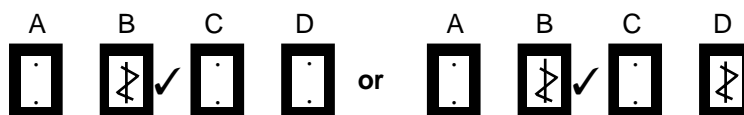
- A Bread
- B Butter
- C Sugar
- D Apple

The correct answer is **B**—Butter. A **heavy** vertical line should be drawn joining the two dots in the appropriate box in the column headed **B** as shown in the example on the answer sheet.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus, if you want to change an answer D to an answer B, your answer sheet would look like this:



If you want to change back to an answer which has already been scored out, you should enter a tick (✓) to the **right** of the box of your choice, thus:



## SECTION A

All questions in this Section should be attempted.

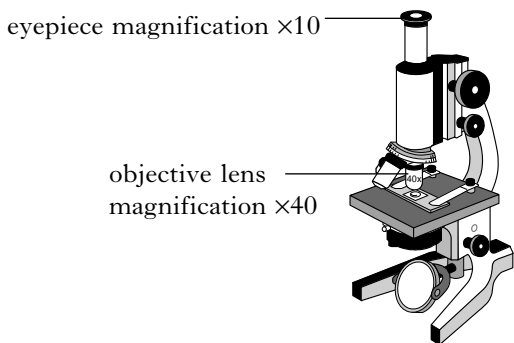
Answers should be given on the separate answer sheet provided.

1. The normal control of bacterial activity depends on its
  - A cytoplasm
  - B plasma membrane
  - C circular DNA
  - D cell wall.

2. Bacteria which are rod-shaped are described as
  - A vibrio
  - B bacilli
  - C cocci
  - D spirilla.

3. Asexual reproduction in yeast occurs by
  - A budding
  - B zygospore production
  - C binary fission
  - D conjugation.

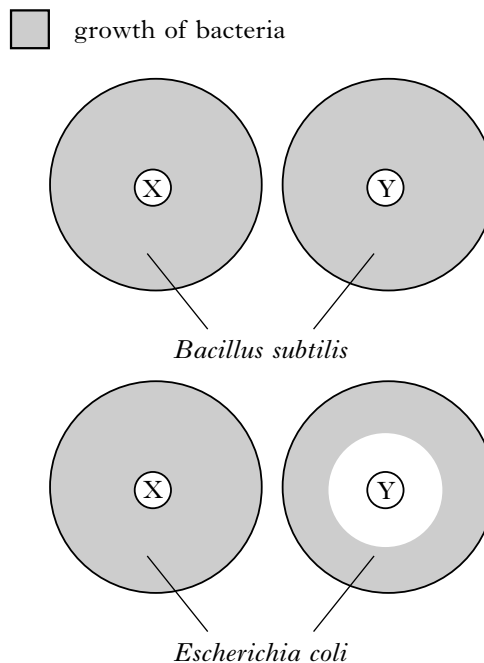
4. The diagram below shows a microscope being used to view a slide of *Chlorella*.



What is the total magnification being used to view the slide?

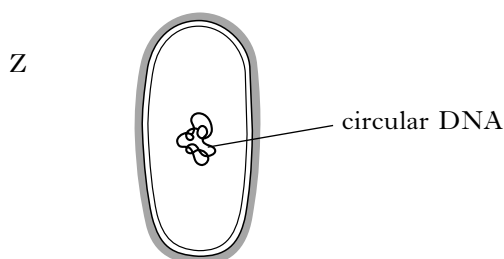
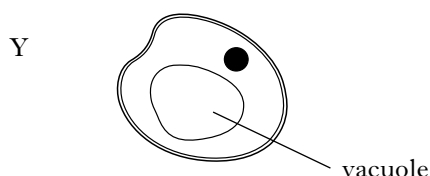
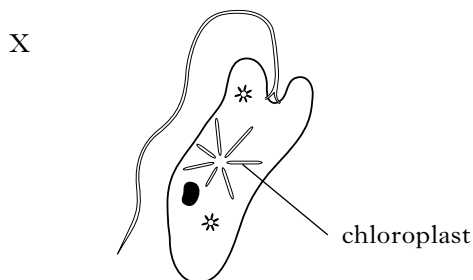
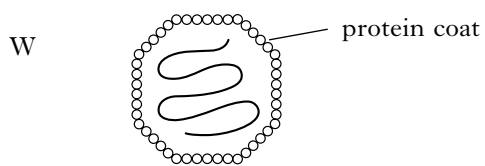
- A  $\times 10$
  - B  $\times 40$
  - C  $\times 50$
  - D  $\times 400$
5. The synthesis of chlorophyll in photosynthetic micro-organisms requires
    - A potassium
    - B iron
    - C magnesium
    - D calcium.

Questions 6 and 7 refer to the diagram below, which shows the results of growing two different bacteria, *Bacillus subtilis* and *Escherichia coli*, in the presence of two antibiotics X and Y.



6. The results of **this experiment** show that
  - A antibiotic X prevents the growth of *Bacillus subtilis*
  - B antibiotic Y prevents the growth of *Bacillus subtilis*
  - C antibiotic X prevents the growth of *Escherichia coli*
  - D antibiotic Y prevents the growth of *Escherichia coli*.
7. It can be concluded from **these results** that
  - A certain antibiotics prevent the growth of all bacteria
  - B certain antibiotics prevent the growth of some bacteria
  - C all antibiotics prevent the growth of some bacteria
  - D all antibiotics prevent the growth of all bacteria.
8. Which of the following bacteria fix nitrogen in the root nodules of legumes?
  - A *Rhizobium*
  - B *Pseudomonas*
  - C *Clostridium*
  - D *Azotobacter*

9. The diagram below shows four different micro-organisms, each with a single part labelled.



**NOT TO SCALE**

Which response correctly identifies the micro-organisms?

<i>Micro-organism</i>				
	W	X	Y	Z
A	bacterium	virus	fungus	protozoan
B	virus	protozoan	fungus	bacterium
C	fungus	protozoan	virus	bacterium
D	virus	bacterium	fungus	protozoan

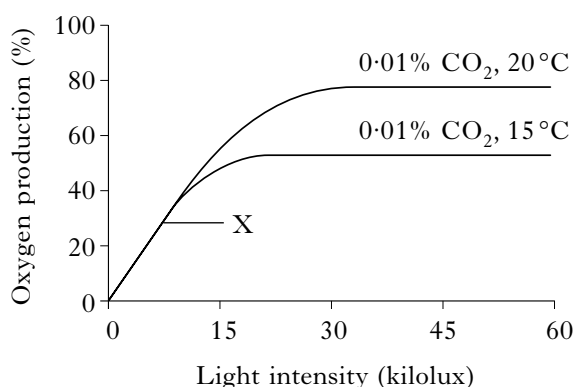
10. Energy is released in the recycling of carbon through the process of

- A photosynthesis
- B respiration
- C digestion
- D absorption.

11. *In vitro* fertilisation can be used to produce sheep. This means that an ovum from a ewe is fertilised

- A inside her body in the oviduct (egg tube)
- B outside her body by several sperms
- C outside her body in a culture fluid
- D inside her body in the uterus (womb).

12. The graph below shows the effect of increasing light intensity on the rate of photosynthesis of a culture of *Chlamydomonas* at two different temperatures. All other conditions were kept constant.



At point X, the factor limiting photosynthesis is

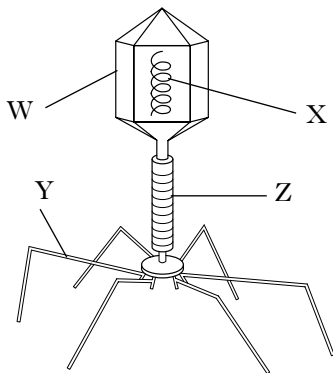
- A CO<sub>2</sub> concentration
- B temperature
- C oxygen concentration
- D light intensity.

13. *Pythium debaryanum* is a fungus which is a facultative parasite. This means that it can

- A grow only on living host material
- B grow only on dead host material
- C grow on dead and living material
- D grow only on artificial material.

14. The diagram below shows a virus which attacks bacteria.

Which of the labelled structures correctly identifies viral DNA?



- A W
- B X
- C Y
- D Z

15. The following steps describe the process of preparing and staining a smear of micro-organisms for microscopic examination.

W Fix the smear by passing the slide through a Bunsen flame several times.

X Using aseptic techniques, transfer a small part of a colony to the slide.

Y Carefully blot the slide dry with blotting paper.

Z Flood the slide with methylene blue stain for 3 minutes.

Which response shows the correct order in which these steps would be carried out?

- A Y → Z → W → X
- B X → W → Z → Y
- C W → Y → Z → X
- D X → Z → Y → W

16. A mycorrhiza is an association between the roots of a higher plant and

- A a virus
- B a fungus
- C a bacterium
- D an alga.

17. Which of the following occurs when silage is being made?

	Temperature	pH
A	increases	increases
B	decreases	increases
C	increases	decreases
D	decreases	decreases

18. Anaerobic respiration in micro-organisms can produce

- A ethanol and lactic acid
- B ethanol and acetic acid
- C ethanol and citric acid
- D only ethanol.

19. Which of the following statements describes the loop transfer of micro-organisms from liquid to solid medium?

- A Transfer of bacteria from an agar plate to broth culture
- B Transfer of bacteria from a broth culture to broth culture
- C Transfer of bacteria from a broth culture to an agar plate
- D Transfer of bacteria from an agar plate to an agar plate.

20. A 10 cm<sup>3</sup> sample of yoghurt contains 2000 *Lactobacillus bulgaris* organisms. The bacteria divide asexually once every 30 minutes.

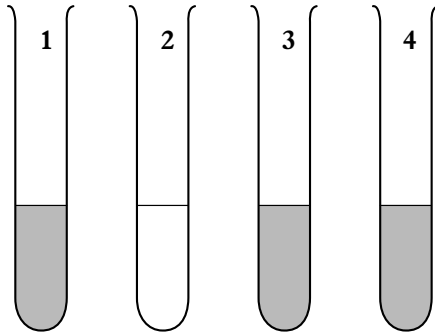
Calculate the total number of *Lactobacillus bulgaris* in a 250 cm<sup>3</sup> yoghurt sample after 1 hour.

- A 4000
- B 8000
- C 100 000
- D 200 000

21. In fungi like *Mucor*, the network of branched threads (or hyphae) is called a

- A mycelium
- B zygosporangium
- C bud
- D spore.

22. The diagram below shows the results of an experiment on the action of the enzyme pectinase on different cloudy substrates. If the pectinase works then the solution becomes clear.



Tube	1	2	3	4
Enzyme	Pectinase	Pectinase	Pectinase	Pectinase
Substrate	Protein	Pectin	Cellulose	Lipid

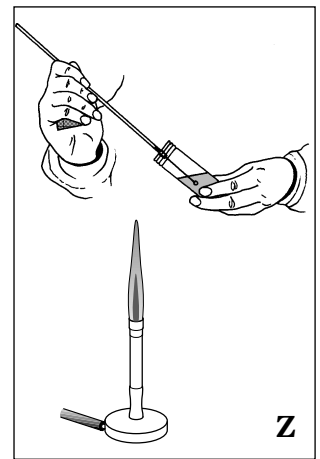
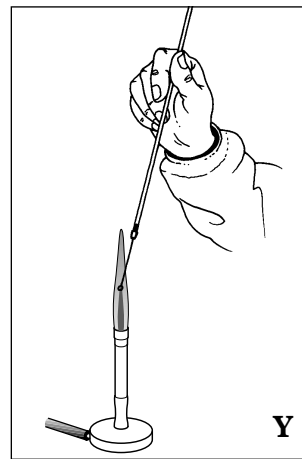
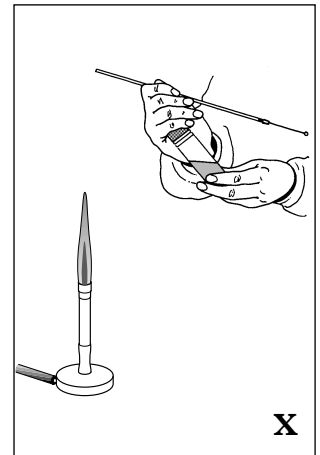
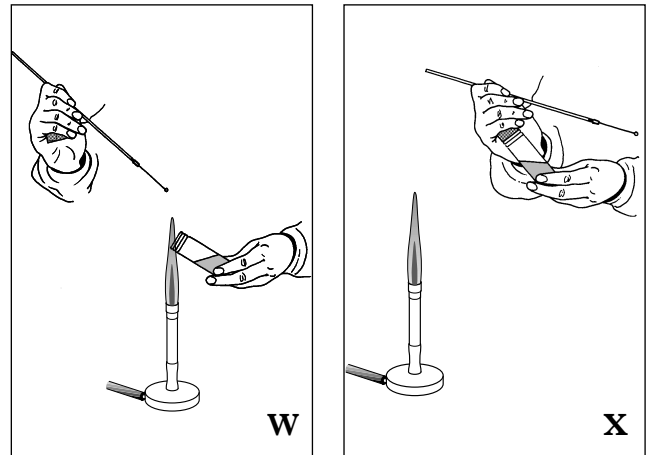
The results of this experiment shows that pectinase is

- A stable
- B specific
- C unstable
- D not specific.

23. The micro-organism responsible for the conversion of ethanol into vinegar is called

- A *Lactobacillus*
- B *Penicillium*
- C *Streptococcus*
- D *Acetobacter*.

24. The diagram below shows some of the steps involved in the loop transfer of bacteria from liquid medium.



The correct order in which these steps would take place is

- A W → X → Y → Z
- B X → Y → W → Z
- C Y → X → W → Z
- D W → Y → Z → X.

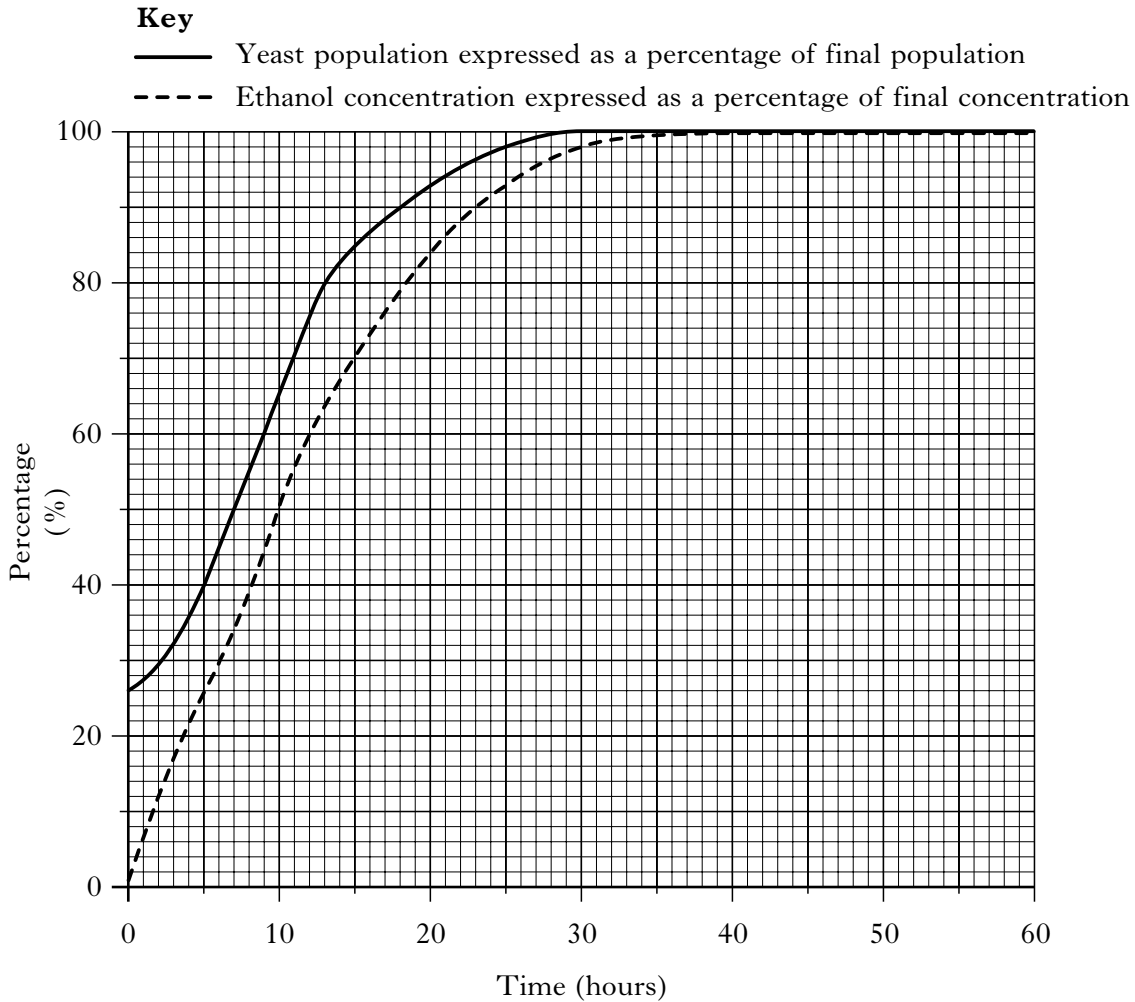
25. Silage is made in

- A a fermenter
- B a silo
- C a bio-reactor
- D an activated tank.

**SECTION B**

All questions in this Section should be attempted.

1. The graph below shows some changes which occur during fermentation of glucose solution by yeast cells.



- (a) How long does it take for the yeast to reach 70% of its final population?

Number of hours \_\_\_\_\_

(1)

- (b) During which period does the yeast population show the greatest **increase**?

Tick (✓) the correct box.

- 0–5 hours
- 5–10 hours
- 10–15 hours
- 15–20 hours

(1)

Marks

**1. (continued)**

(c) What evidence is there to suggest that the yeast is respiring anaerobically?

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**(1)**

(d) Complete the table below to compare the processes of aerobic and anaerobic respiration in yeast cells.

Write the letters of the phrases from the list into the correct columns.

- A** No oxygen used
- B** Oxygen essential
- C** Ethanol produced
- D** Maximum energy release from each glucose molecule

<i>Aerobic respiration</i>	<i>Anaerobic respiration</i>

**(2)**



Marks

2. (a) A rare breed centre decides to collect and breed as many varieties of sheep as it can. The table below provides information on the characteristics of four breeds of sheep.

<i>Breed</i>	<i>Meat yield</i>	<i>Wool quality</i>	<i>Incidence of twins</i>
A	high	poor	1 in 10
B	low	excellent	1 in 2
C	medium	excellent	1 in 5
D	high	poor	1 in 2

A local farmer wants to increase the size of his flock and improve the wool quality. The rare breed centre is willing to let him have a ram of his choice to breed with his sheep.

State the breed he should pick and explain his choice.

Breed \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_ (2)

- (b) Selective breeding can also be used to introduce desirable features into **crop plants**. State **one** example of such a desirable feature.

\_\_\_\_\_

\_\_\_\_\_ (1)

- (c) Plant tissue culture is a technique used by horticulturists to produce young plants. The following statements describe the stages which are involved in the technique.

- A** A mass of cells formed
- B** Shoot tips are transferred to a growth medium
- C** Small plants are transferred to soil
- D** Shoot tips are removed from the parent plant
- E** The shoots are transferred to a rooting medium

- (i) Use the **letters** from the list above to show the **correct order** in which these stages take place.

\_\_\_\_\_ → \_\_\_\_\_ → \_\_\_\_\_ → \_\_\_\_\_ (1)

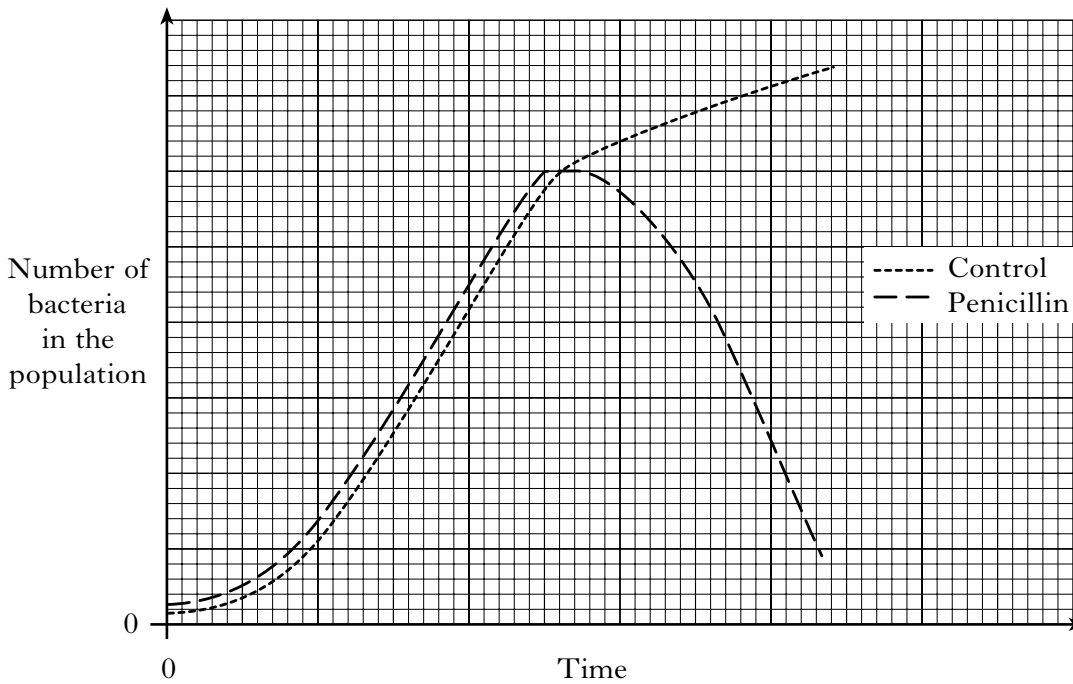
- (ii) State **one** advantage to the horticulturist of using this technique.

\_\_\_\_\_

\_\_\_\_\_ (1)

Marks

3. The graph below shows the effect of the antibiotic Penicillin on the growth of a population of bacteria.



(a) Describe the effects of penicillin on the number of bacteria in the population.

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(2)

(b) Describe the purpose of the control.

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(1)

(c) Antibiotics can be described as broad-spectrum or narrow-spectrum in action. State **one** difference between these types of antibiotics.

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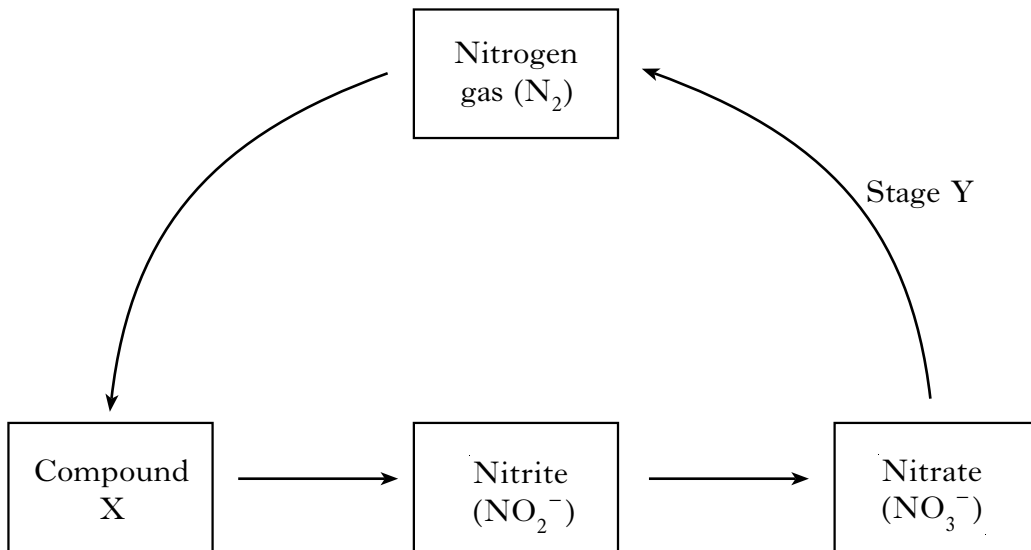


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(1)

Marks

4. The following diagram shows some of the stages of the nitrogen cycle.



- (a) Identify Stage Y of the nitrogen cycle.

Stage Y \_\_\_\_\_

(1)

- (b) Name the type of micro-organism which carries out the conversion of nitrate to nitrogen gas.

\_\_\_\_\_

(1)

- (c) Identify Compound X in the nitrogen cycle.

Compound X \_\_\_\_\_

(1)

- (d) The statements below refer to the process of biochemical synthesis by micro-organisms.

Underline one word or phrase in **bold** to make the statements correct.

The chemical element nitrogen is part of { **glucose**  
**amino acid** } molecules. During

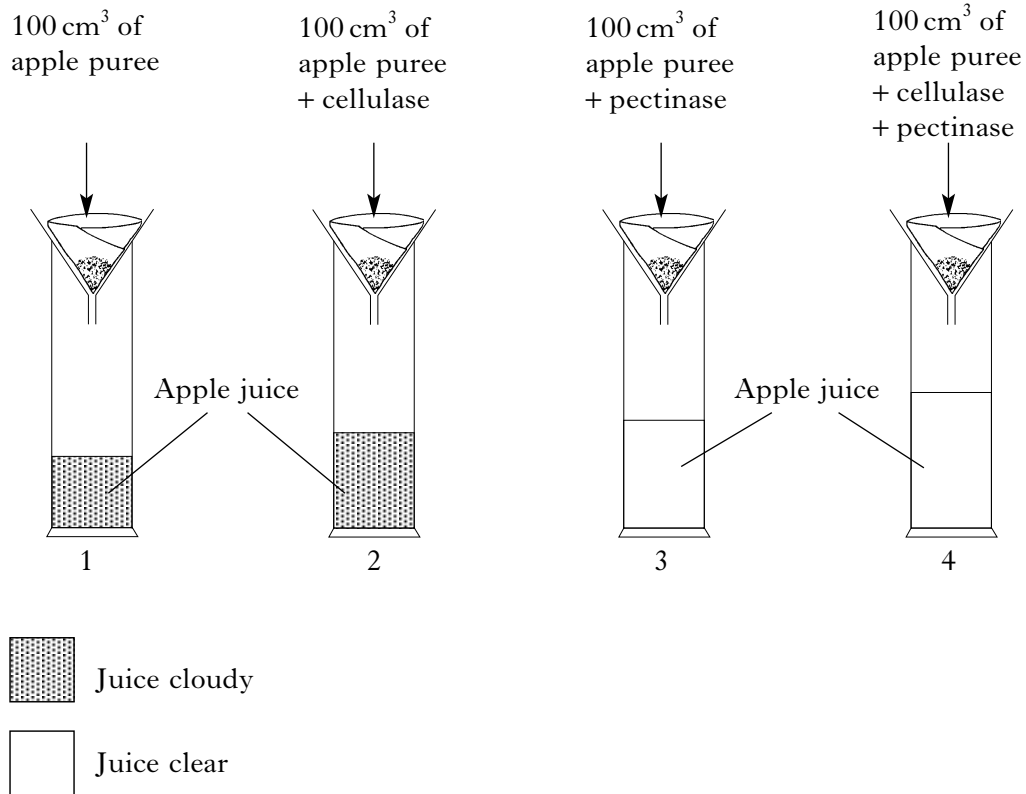
biochemical synthesis, these { **small**  
**large** } molecules are joined together to form

molecules called { **proteins**  
**fats** }.

(1)

5. (a) Cellulase and pectinase are enzymes produced by micro-organisms which break down different parts of plant cell walls. These enzymes are used in the commercial production of apple juice.

A group of students carried out an investigation into the effect of these enzymes on apple tissue at room temperature (22°C). The diagram below shows the apparatus used.



The investigation was left for 30 minutes and then the volume of apple juice in each cylinder was measured.

The results are shown in the table below.

Cylinder	1	2	3	4
Volume of apple juice extracted (cm <sup>3</sup> )	10	14	16	20

Marks

5. (a) (continued)

- (i) Calculate the volume of apple puree required to produce  $1000 \text{ cm}^3$  of apple juice, if **both enzymes** were used in the extraction.

*Space for calculation*

\_\_\_\_\_ (1)

- (ii) Predict the effect on the volume of apple juice which would be extracted if the cylinders were placed in a refrigerator at  $4^\circ\text{C}$  for 30 minutes, instead of being kept at room temperature.

\_\_\_\_\_  
\_\_\_\_\_ (1)

- (iii) The apple juice in cylinders 1 and 2 was tested for the presence of sugar. A higher concentration of sugar was found in cylinder 2. Suggest an explanation for the presence of the additional sugar in cylinder 2.

\_\_\_\_\_  
\_\_\_\_\_ (1)

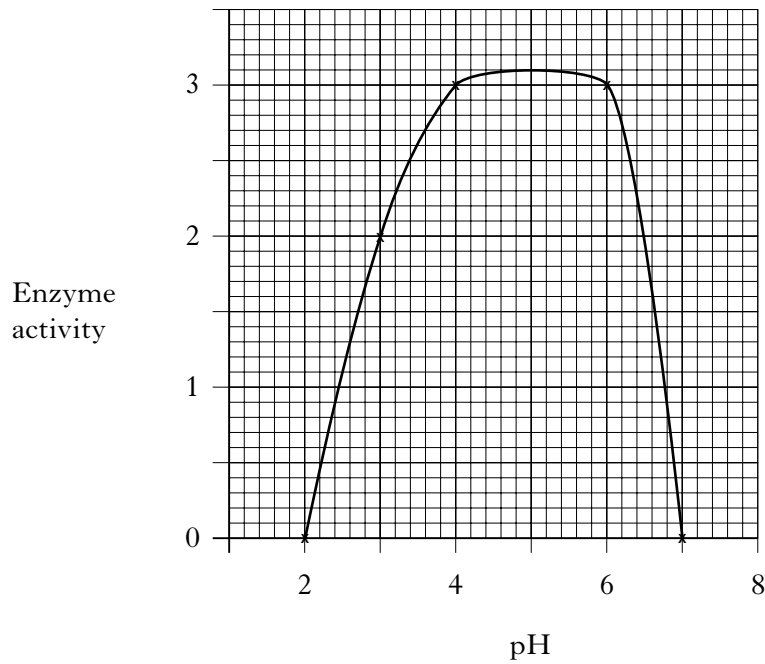
- (iv) State **two** effects of the addition of pectinase on the extraction of apple juice.

\_\_\_\_\_  
\_\_\_\_\_ (1)

Marks

5. (continued)

(b) The graph below shows the effect of pH on the activity of the enzyme pectinase.



(i) At which pH value is pectinase **most active** in this experiment?

pH \_\_\_\_\_

(1)

(ii) What term is used to describe the pH at which an enzyme is most active?

\_\_\_\_\_

(1)

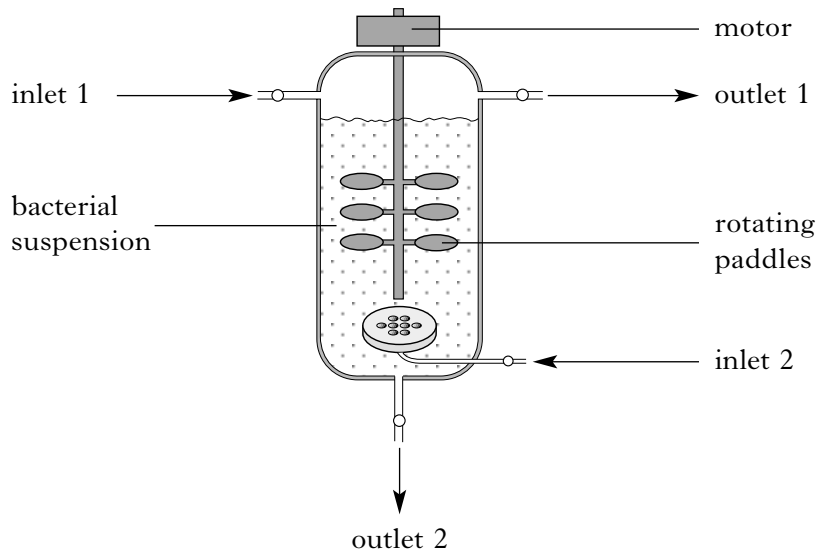
(c) Pectinase only breaks down pectin, it has no effect on cellulose. What term is used to describe this characteristic of an enzyme?

\_\_\_\_\_

(1)

Marks

6. The diagram below shows a fermenter used in the food industry to produce vinegar. The process depends on the activity of bacteria.



- (a) Describe **two** conditions, **not shown** in this diagram, that the manufacturer will have to provide in the fermenter to encourage vinegar production.

1 \_\_\_\_\_

2 \_\_\_\_\_

(2)

- (b) State **one** reason why the manufacturer regularly needs to sterilise all the equipment used in the manufacturing process.

\_\_\_\_\_

\_\_\_\_\_

(1)

- (c) Vinegar can be made by either batch or continuous flow processing methods. Examine each of the statements below and complete the table by using the letter:

**B** if the statement is true for batch processing, or

**C** if the statement is true for continuous processing.

<i>Statement</i>	<i>Letter</i>
Raw materials are added in a steady stream throughout the process.	
The process is stopped at regular intervals to remove the product.	
The concentration of raw materials decreases.	

(2)

Marks

7. A student carried out an experiment to find out the effects of inoculating soil with bacteria on the growth and yield of clover plants, which are legumes. Some clover seeds were sown in soils which had been treated as shown below. After three weeks the clover plants were harvested and their dry mass found.

	<i>Treatment of soil</i>		
	<i>Soil inoculated with bacterium X</i>	<i>Soil inoculated with bacterium Y</i>	<i>Control soil</i>
Dry mass of 100 plants (g)	35	42	35

- (a) Describe a suitable control for this experiment.

\_\_\_\_\_

\_\_\_\_\_

(1)

- (b) State **two** valid conclusions from these results.

Conclusion 1 \_\_\_\_\_

\_\_\_\_\_

Conclusion 2 \_\_\_\_\_

\_\_\_\_\_

(2)

- (c) Name **two** factors which should be kept constant to make this a controlled experiment.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)



Marks

**7. (continued)**

(d) Why was such a large sample of plants (100) used in this experiment?

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**(1)**

(e) Calculate the **percentage change** of dry mass in plants in the soil inoculated with bacteria **Y** compared with the control group.

*Space for calculation*

\_\_\_\_\_ % **(1)**

Marks

8. The enzyme rennin, which is used in the manufacture of cheese, can be obtained by natural methods, from cows' stomachs, or produced by biotechnological methods. The table below shows the combined output of rennin, expressed in kilograms, from these two sources.

	<i>Output (kg)</i>	
<i>Year</i>	<i>Natural methods</i>	<i>Biotechnological methods</i>
1988	7600	700
1989	6000	1400
1990	5300	1800
1991	4700	1900
1992	4400	3200
1993	2000	6000

- (a) Calculate the average yearly production of rennin between 1988 and 1993 by natural methods.

*Space for calculation*

\_\_\_\_\_

(1)

- (b) Calculate the simple whole number ratio of the total output from the natural methods to the total output by biotechnological methods.

*Space for calculation*

Ratio \_\_\_\_\_ : \_\_\_\_\_  
*natural methods      biotechnological methods*

(1)

Marks

**8. (continued)**

(c) Calculate the percentage of rennin produced by biotechnological methods in 1993.

*Space for calculation*

\_\_\_\_\_ %

**(1)**

(d) During cheese manufacture, waste material is produced which can be used to make single cell protein.

(i) Name the waste material from cheese manufacture which is used in the production of single cell protein.

\_\_\_\_\_

**(1)**

(ii) State **one** advantage of using this waste material for single cell protein production.

\_\_\_\_\_

**(1)**

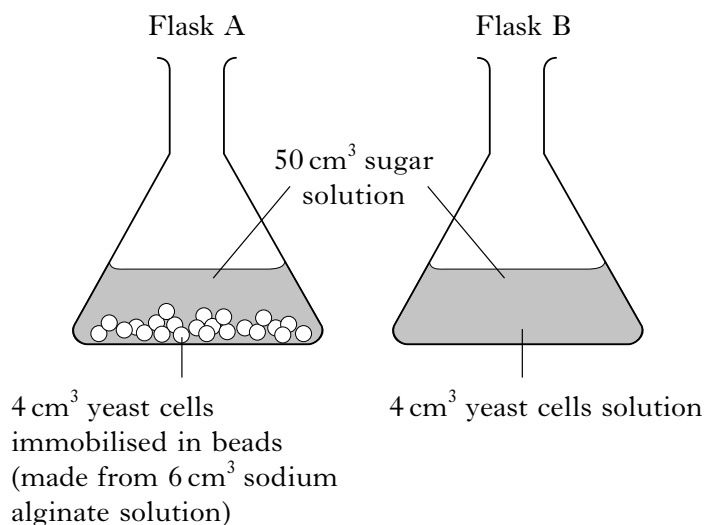
(iii) State **one** example of a use of single cell protein.

\_\_\_\_\_

**(1)**

Marks

9. (a) The diagram below shows the apparatus set up to compare the activity of free and immobilised yeast cells.



Samples were removed from each flask at one hour intervals and tested for the presence of sugar and ethanol (alcohol). After 24 hours, the contents of the flasks were filtered. The solutions collected were tested for sugar and ethanol.

The results of the investigation are shown in the table below.

	<i>Time taken for disappearance of sugar (hours)</i>	<i>Test for ethanol in filtered solution</i>
<i>Flask A</i>	20	positive
<i>Flask B</i>	4	positive

- (i) What is the effect of yeast immobilisation on the rate of the reaction?

\_\_\_\_\_ (1)

- (ii) Suggest a reason for the change in the rate of the reaction when the yeast is immobilised.

\_\_\_\_\_  
\_\_\_\_\_ (1)

Marks

9. (a) (continued)

- (iii) Suggest, with a reason, what should be added to Flask B to increase the validity of the experiment.

Addition \_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_ (1)

- (iv) State **one** advantage in using immobilised yeast cells rather than free yeast cells in this experiment.

\_\_\_\_\_

\_\_\_\_\_ (1)

- (b) The process shown in Flask A is used commercially to produce ethanol which can be processed and used as a petrol substitute called gasohol.

State **one** advantage of using gasohol, instead of petrol, as a fuel source.

\_\_\_\_\_

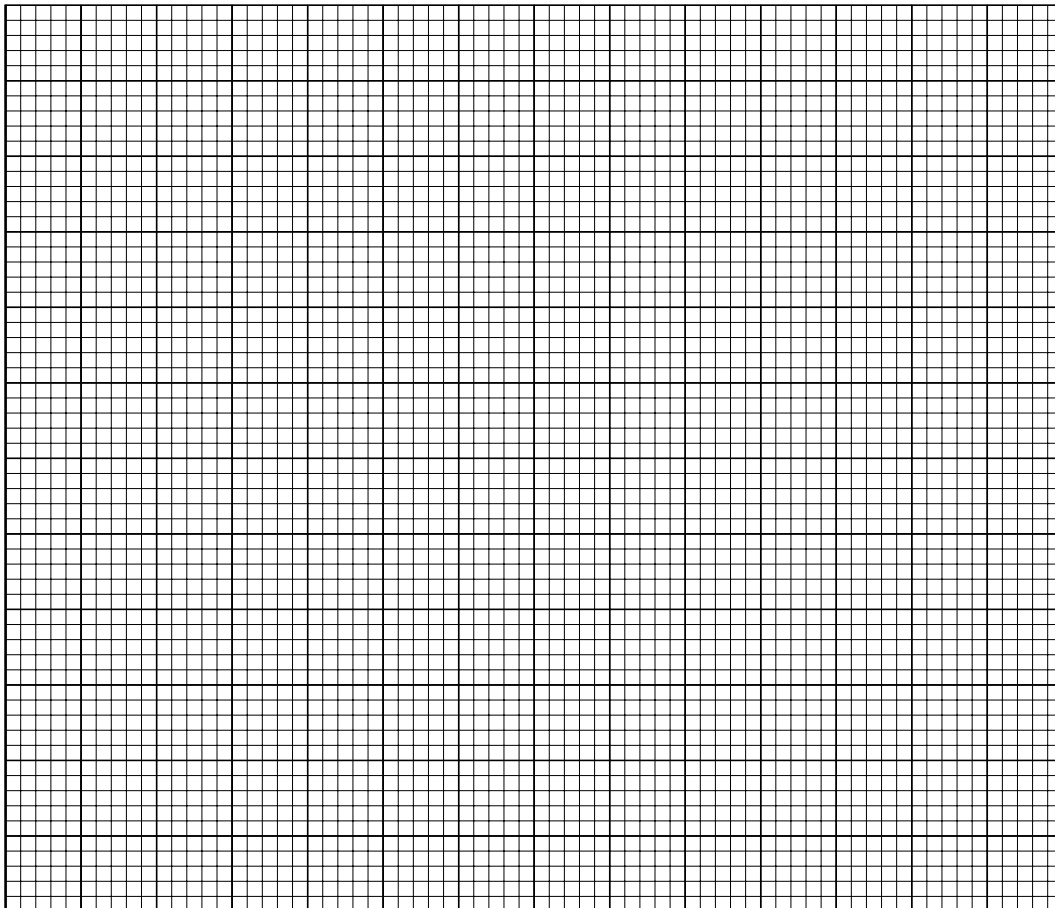
\_\_\_\_\_ (1)

Marks

10. When rabbit dung pellets are left for several weeks at room temperature in a moist chamber, different fungi appear at different times. This is shown in the table below.

<i>Fungus</i>	<i>Time taken to appear (days)</i>	<i>Role of fungus</i>
A	3	breakdown of sugars
B	5	breakdown of cellulose
C	10	breakdown of lignin

- (a) Use the information in the table to draw a **bar chart** to show the time taken for the fungi to appear.  
(Additional graph paper, if required, will be found on *Page thirty*.)



(3)

Marks

**10. (continued)**

(b) The fungi are described as saprophytic. Describe what is meant by this term.

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**(1)**

(c) Name the substance produced when cellulose is digested by the enzyme **cellulase**.

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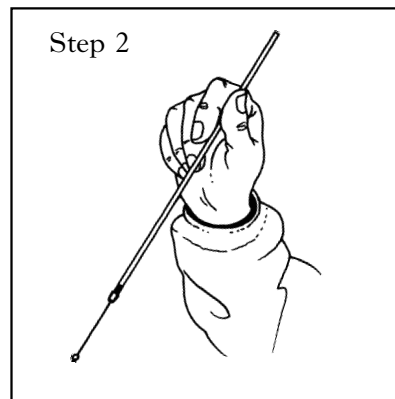
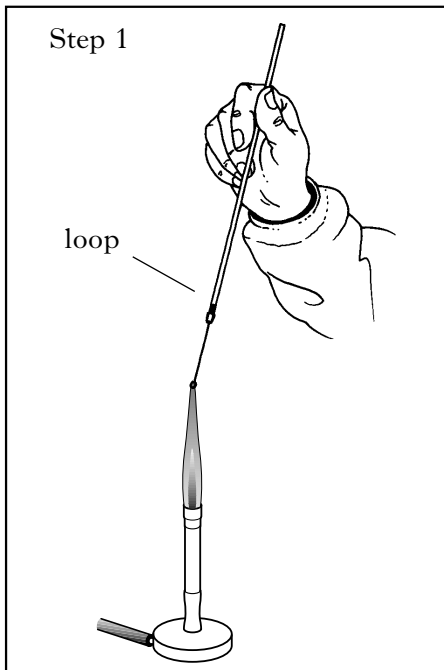
**(1)**

(d) The enzyme cellulase is synthesised by the fungi and released from the fungal cells into the dung pellets.  
What term describes enzymes, like cellulase, which have their activity **outside** micro-organisms?

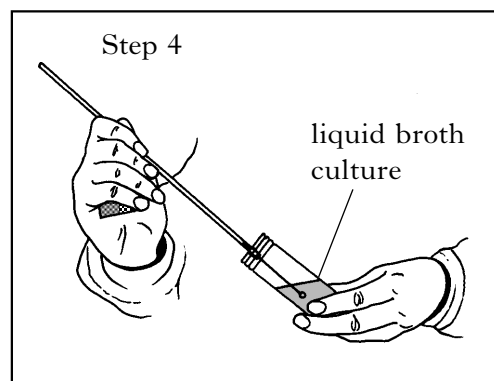
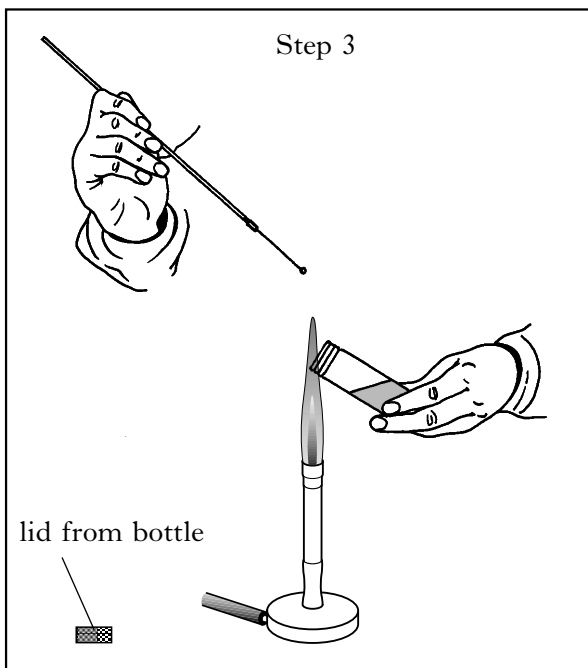
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**(1)**

11. A student was asked to sub-culture bacteria from a universal bottle of liquid broth culture using aseptic technique. The diagram below shows the steps undertaken in carrying out this procedure.



loop allowed briefly to cool



There are two errors in her aseptic technique.

**Identify** these errors, **state** the correct procedure and **explain** the reason(s) for the correct procedure.



*Marks*

**11. (continued)**

- |  |     |  |
|--|-----|--|
| (a) (i) Error 1 _____<br>_____                             | (1) |  |
| (ii) Correct procedure _____<br>_____                      | (1) |  |
| (iii) Reason for correct procedure _____<br>_____<br>_____ | (1) |  |
| (b) (i) Error 2 _____<br>_____                             | (1) |  |
| (ii) Correct procedure _____<br>_____                      | (1) |  |
| (iii) Reason for correct procedure _____<br>_____<br>_____ | (1) |  |

Marks

12. In preparation for observing bacteria under a microscope, a student fixed and stained a smear from a yoghurt sample on a slide.  
The slide was examined at a total magnification of  $\times 600$ , using an objective lens and a  $\times 15$  eyepiece lens.

(a) Calculate the magnification of the objective lens used.

*Space for calculation*

\_\_\_\_\_ (1)

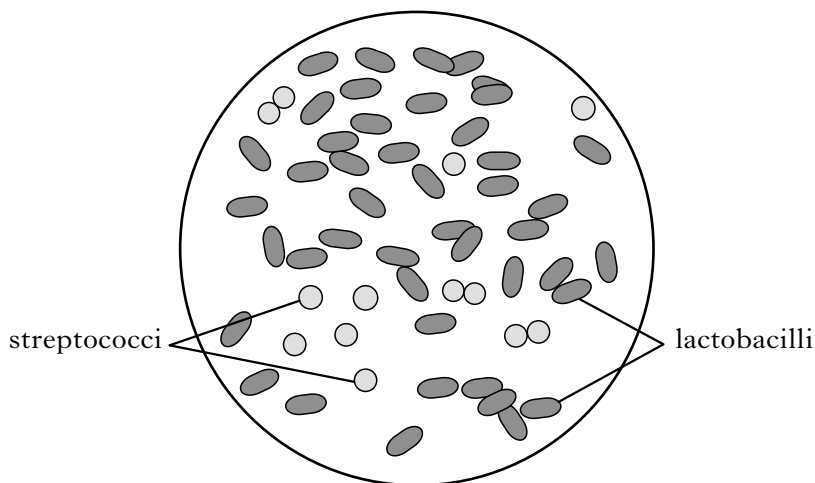
(b) (i) Explain the reason for **fixing** the smear.

\_\_\_\_\_  
\_\_\_\_\_ (1)

(ii) Explain the reason for **staining** the smear.

\_\_\_\_\_  
\_\_\_\_\_ (1)

(c) The diagram below shows the field of view observed by the student at  $\times 600$  total magnification.



*Marks*

**12. (c) (continued)**

State **two** valid conclusions that can be made from this information about the bacteria found in the yoghurt sample.

Conclusion 1 \_\_\_\_\_

\_\_\_\_\_ **(1)**

Conclusion 2 \_\_\_\_\_

\_\_\_\_\_ **(1)**

SECTION C

Both questions in this section should be attempted.

Note that each question contains a choice.

Questions 1 and 2 should be attempted on the blank pages which follow.

Supplementary sheets, if required, may be obtained from the invigilator.

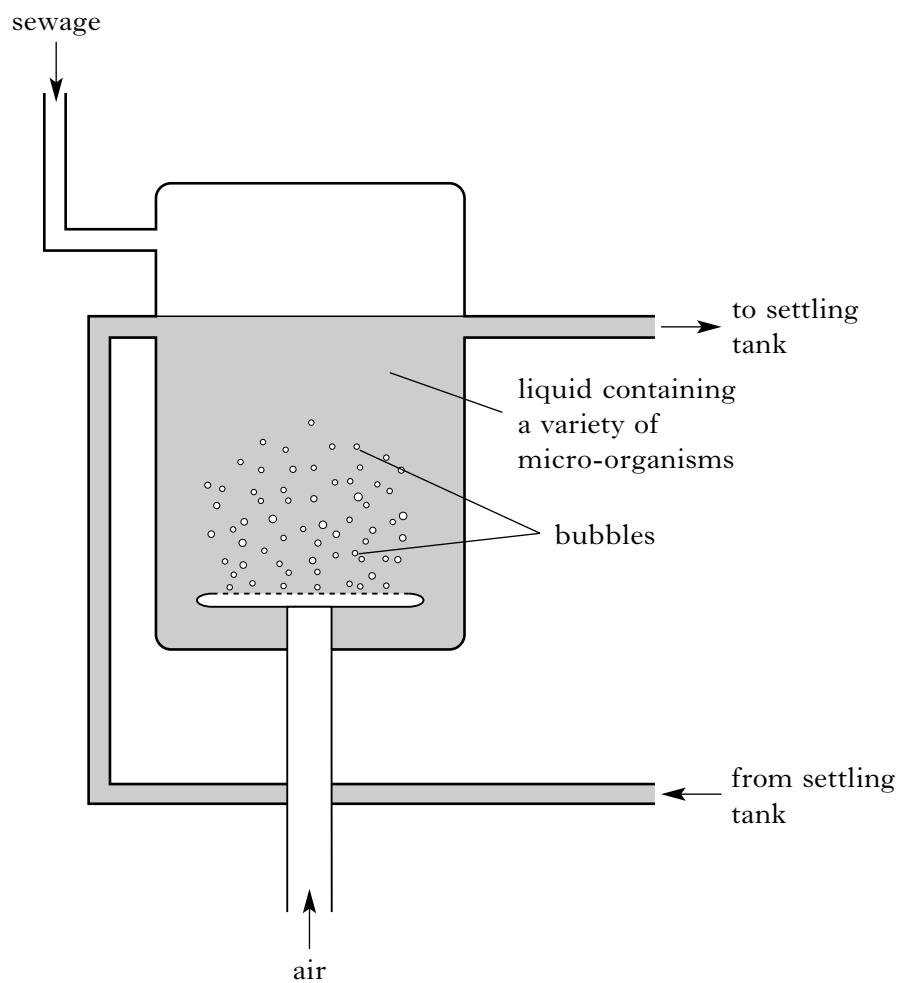
Labelled diagrams may be used where appropriate.

Marks

1. Answer **either** A **or** B.

A. Describe how the variety of micro-organisms breaks down the organic waste in sewage in the treatment plant shown in the diagram below. State **one** benefit of this process to humans.

(5)



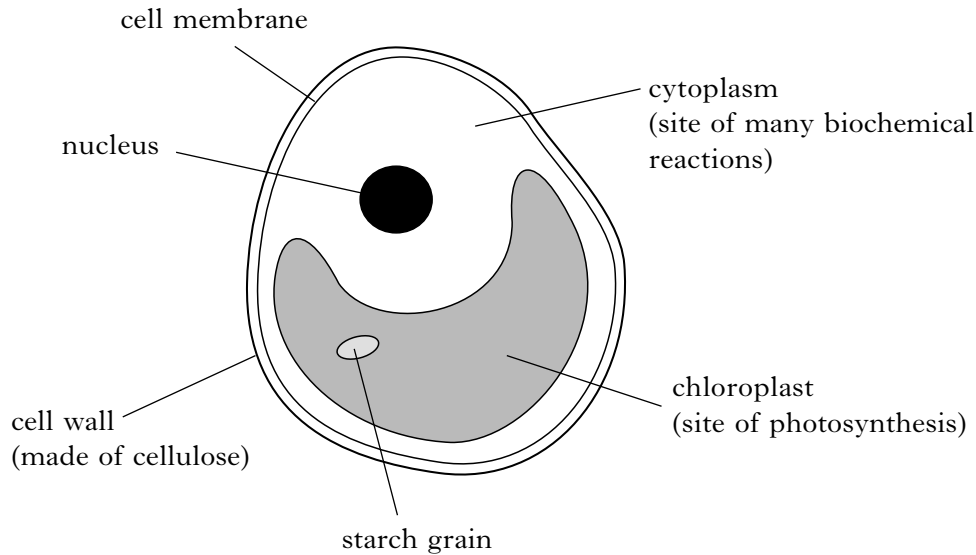
Marks

1. (continued)

OR

- B. Describe how *Chlorella* (algae) produces carbohydrates by photosynthesis and state **two** uses of these carbohydrates within *Chlorella*.

(5)



2. Answer **either A or B**.

- A. Describe the production, by a named fungus, of citric acid and state the use of this substance in the food industry.

(5)

OR

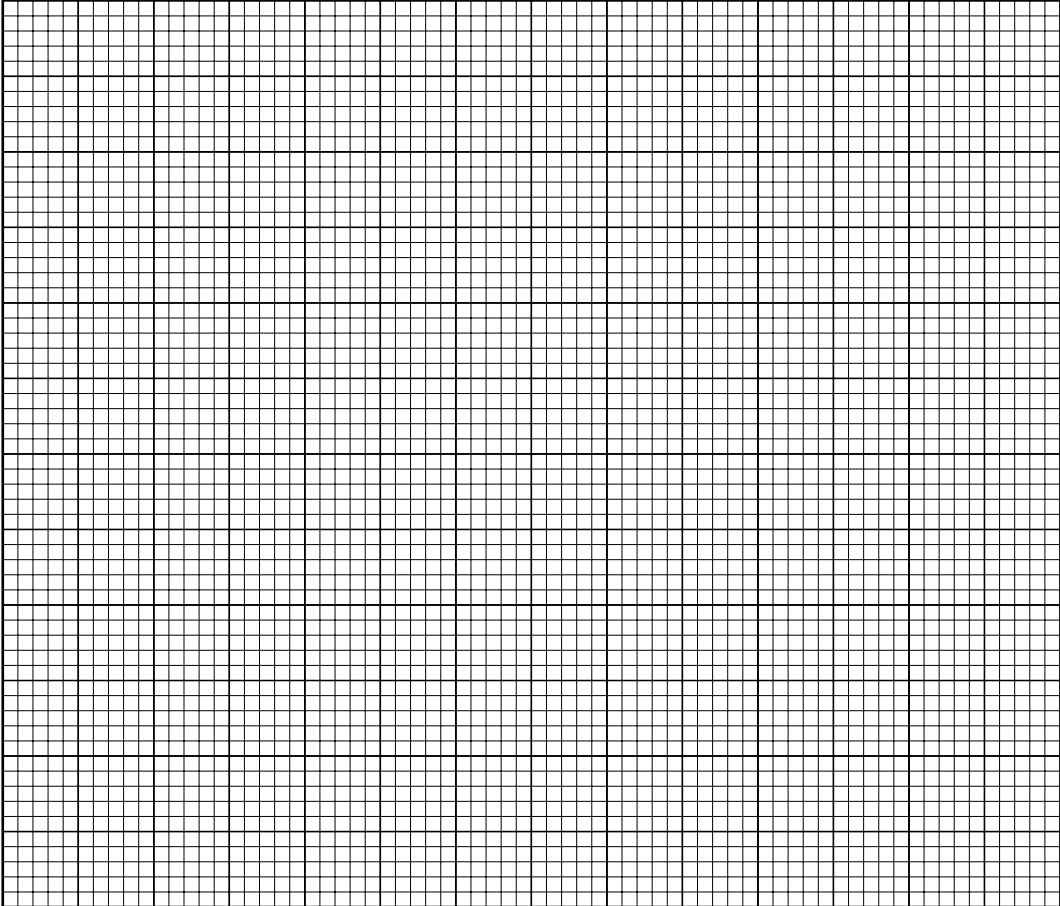
- B. Describe the stages involved in the transfer of the human gene for insulin into bacterial cells.

(5)

[END OF QUESTION PAPER]

**SPACE FOR ANSWERS**

ADDITIONAL GRAPH FOR QUESTION 10(a)



**SPACE FOR ANSWERS**

DO NOT  
WRITE IN  
THIS  
MARGIN

--

**SPACE FOR ANSWERS**

DO NOT  
WRITE IN  
THIS  
MARGIN

--	--



**SPACE FOR ANSWERS**

DO NOT  
WRITE IN  
THIS  
MARGIN

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**[C008/SQP043]**

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Intermediate 2  
Biotechnology  
Specimen Marking Instructions

NATIONAL  
QUALIFICATIONS

Biotechnology Intermediate 2

Section A

1	C	11	C	21	A
2	B	12	D	22	B
3	A	13	C	23	D
4	D	14	B	24	C
5	C	15	B	25	B
6	D	16	B		
7	B	17	C		
8	A	18	A		
9	B	19	C		
10	B	20	D		

## Section B

- 1 a Number of hours =11 hours  
b 5 - 10 hours  
c Ethanol concentration rises  
d

Aerobic respiration	Anaerobic respiration
B	A
D	C

*4 Correct — 2 marks, 3 or 2 correct — 1 mark*

- 2 a Breed: B  
Explanation: Wool quality is excellent and incidence of twins is 1 in 2/high
- b Pest or disease resistance/improved food yield/drought resistance/faster growth/increased rate of photosynthesis OR specific example eg more seeds per head of wheat, larger barley plants, less fragile wheat, easier to thresh wheat, petal colour etc.
- c (i) D → B → A → E → C.  
(ii) Speed of growth/disease reduction/able to produce plants identical to parental plant/able to produce large numbers of plants/able to produce clones or plants identical to each other/requires little plant material to produce many plants.
- 3 a Initially penicillin has little/no effect on the numbers of bacteria, but after a certain length of time the number of bacteria starts to decrease.
- b To find the number of bacteria in a population without antibiotic/to find out the effect of the antibiotic.
- c Broad-spectrum antibiotics kill/attack a wide range/many types of micro-organisms/bacteria/fungi  
OR  
Narrow-spectrum antibiotics kill/inhibit/attack one/specific types(s) of micro-organisms/bacteria/fungi.
- 4 a Stage Y: Denitrification/denitrifying.  
b (Denitrifying) bacteria.  
c Compound X: Ammonia/NH<sub>3</sub>  
d Chemical element nitrogen is part of **amino acid** molecules.  
During biochemical synthesis, these **small** molecules are joined together to form molecules called **proteins**.  
*All 3 correct — 1 mark*

- 5 a (i) 2500cm<sup>3</sup> / 2.5 litres (units needed for the mark)
- (ii) Volume reduced/less juice produced
- (iii) Sugar is a breakdown product of cell wall or cellulose/sugar has been produced by the action of cellulase.
- (iv) Makes juice clear/less cloudy. Increases volume of juice produced.

*Both for 1 mark*

- b (i) (pH) 5
- (ii) Optimum (pH).
- c (Enzymes is) specific/specificity.
- 6 a Suitable/warm temperature  
Suitable/neutral pH  
Sterile conditions
- b Remove unwanted micro-organisms/bacteria/fungi OR prevent contamination
- c

Statement	Letter
Raw materials are added in a steady stream throughout the process.	C
The process is stopped at regular intervals to remove the product.	B
The concentration of raw materials decreases.	B

*3 correct — 2 marks*

*2,1 correct — 1 mark*

- 7 a Soil without (any) bacteria OR sterile soil.
- b Plants showed increased growth in soil inoculated with bacterium Y/plant growth was similar/identical in soil with bacterium X and the control soil/ X has no effect.
- c Mass or volume of soil/temperature/light intensity/moisture content of soil samples/numbers of bacteria in inoculum or volume of bacterial inoculum/ time/number or volume or mass of seeds/type of clover seed.
- d To take account of the fact that some seeds may not grow/to reduce the effect of different/unusual/atypical growth of seeds.
- e 20%
- 8 a 5000 (kg)
- b 2 natural methods : 1 biotechnological methods.
- c 75%
- d (i) Whey
- (ii) Inexpensive/removal of a waste material/reduces pollution upgrading waste.
- (iii) Animal feed/human food/production of Quorn.
- 9 a (i) (Rate of reaction) decreases
- (ii) Takes longer for sugar to reach yeast cells/less yeast cells in contact with sugar solution
- (iii) Addition: (6 cm<sup>3</sup> of) sodium alginate/beads without yeast.
- Reasons: Sodium alginate present in FlaskA/to make sure that there is only one variable changed.  
Both for one mark
- (iv) Immobilised yeast cells can be separated more easily or more cheaply/immobilised yeast cells can be re-used.
- b Produce less pollutants when burned/cheap/renewable energy source/easy to produce.
- 10 a 1 mark for blocks drawn correctly  
1 mark for both axes labelled correctly (quantities & units)  
1 mark for appropriate scale
- b Live on/obtain from dead/decaying materials
- c Glucose
- d Extra—cellular (enzymes).

- 11 a (i) Error 1: Loop in wrong area of flame
- (ii) Correct procedure: Loop within blue cone.
- (iii) Reason for correct procedure: To make sure loop has been sterilised/has become red hot.
- b (i) Error 2 : Lid from bottle placed on bench.
- (ii) Correct procedure : Lid held in hand.
- (iii) Reason for correct procedure: To reduce/stop contamination of lid (by micro-organisms on bench) OR to reduce/stop contamination of bench (by micro-organisms from lid)
- 12 a 40 times/x
- b (i) To stop bacteria being washed off/removed.
- (ii) To make it easier to see the bacteria/to show the shape or structure of the bacteria more clearly.
- c Sample contains two types of bacteria/sample contains more lactobacilli than streptococci/streptococci are round or lactobacilli are rod-shaped/lactobacilli stained darker than streptococci/lactobacilli than streptococci.

## Section C

1A Description (any 3 from 6)

Sewage is a food source for micro-organisms  
Micro-organisms break down sewage by aerobic respiration  
Aeration provides oxygen  
Carbon dioxide and/or water are produced  
Micro—organisms obtain energy by breaking down food  
A variety of micro—organisms is required to break down different wastes

Benefit (any 1 from 3)

Sewage treatment decreases pollution  
Products of aerobic respiration by micro-organisms are safe/harmless/non-toxic  
Takes up less land

*1 mark for coherence*

1B Description (any 3 from 5)

(raw materials) used are carbon dioxide and water  
light (energy) is needed  
chlorophyll is needed  
chlorophyll absorbs light  
(products) are glucose (any carbohydrate) and oxygen.

Uses (any 1 from 4)

Glucose is converted into complex carbohydrates (or names)  
Glucose used as energy source/used in respiration  
Carbohydrates used as energy store/food store  
Carbohydrates used to make cell wall/as structural component

*1 mark for coherence*



2A Description (any 5 from 7)

Name of the substrate used — molasses, sugar-beet, sugar, glucose

Name of fungus involved —Aspergillus (niger)

Aerobic conditions needed/oxygen needed

Citrus acid produced during/as by-product of respiration

Used as flavour enhancer

Used as anti-oxidant

Used as an acidity regulator.

2B Description (any 5 from 7)

Gene/plasmid made of DNA

Human insulin gene isolated/obtained

Bacterial plasmids isolated/obtained/used

Human insulin gene inserted into plasmids

Plasmids inserted into bacteria

Plasmids multiply inside bacteria

Bacteria containing plasmids with insulin gene multiply.

[END OF MARKING INSTRUCTIONS]