FOR OFFICIAL USE

Total for Sections B and C

X008/11/02

NATIONAL QUALIFICATIONS 2013

WEDNESDAY, 29 MAY
1.00 PM – 3.00 PM

BIOTECHNOLOGY INTERMEDIATE 2

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

Scottish candidate number

Number of seat

SECTION A (25 marks)

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

For this section of the examination you must use an **HB pencil**.

SECTION B AND SECTION C (75 marks)

1 (a) All questions should be attempted.

(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.

2 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**.

3 Additional space for answers 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.

4 The numbers of questions must be clearly inserted with any answers written in the additional space.

5 Rough work, if any should be necessary, should be written in this book and then scored through when the final copy has been written. If further space is required, a supplementary sheet for rough work may be obtained from the Invigilator.

6 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.

SECTION A

Read carefully

1 Check that the answer sheet provided is for **Biotechnology Intermediate 2 (Section A)**.

2 For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.

3 Check that the answer sheet you have been given has **your name**, **date of birth**, **SCN** (Scottish Candidate Number) and **Centre Name** printed on it.

Do not change any of these details.

4 If any of this information is wrong, tell the Invigilator immediately.

5 If this information is correct, **print** your name and seat number in the boxes provided.

6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).

7 There is **only one correct** answer to each question.

8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.

9 At the end of the examination, put the **answer sheet for Section A inside the front cover of this answer book**.

Sample Question

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

A Butter

B Bread

C Sugar

D Apple

The correct answer is **A—**Butter. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).

Changing an answer

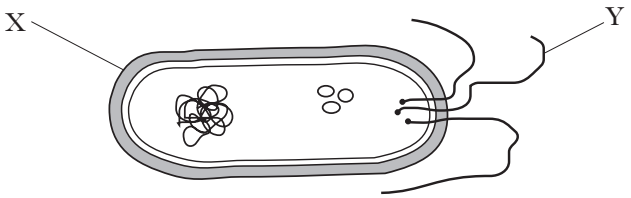
If you decide to change your answer, carefully erase your first answer and using your pencil, fill in the answer you want. The answer below has been changed to **D**.

SECTION A

All questions in this Section should be attempted.

Answers should be given on the separate answer sheet provided.

1. The diagram below shows a bacterium.



Which line in the table identifies correctly the parts labelled X and Y?

	X	*Y*
A	capsule	flagellum
B	cell wall	circular DNA
C	plasma membrane	flagellum
D	capsule	circular DNA

2. Protozoa always contains a

A contractile vacuole and chloroplasts

B nucleus and cell wall

C cell wall and cytoplasm

D plasma membrane and nucleus.

3. Which of the following statements describes correctly loop transfer from solid to liquid medium?

	Transfer from	*Transfer to*
A	nutrient agar plate	nutrient agar plate
B	nutrient broth	nutrient broth
C	nutrient agar plate	nutrient broth
D	nutrient broth	nutrient agar plate

4. Dried powder for making malt agar contains the following ingredients.

peptone A	6·0 g
yeast extract	2·0 g
malt extract	2·0 g
glucose	10·0 g
agar	20·0 g

Which of the following describes correctly the composition of this malt agar powder?

A Agar makes up 20% of the mass of malt agar powder

B Glucose makes up 10% of the mass of malt agar powder

C Peptone A makes up more than 20% of the mass of malt agar powder

D Yeast and malt extracts make up 10% of the mass of malt agar powder

5. A microscope with 10× eyepiece lens and 30× objective lens was used to examine a culture of *Paramecium*. Using these lenses, the length of a *Paramecium* was measured as 60 mm.

The **actual** length of a *Paramecium* is

A 0·2 mm

B 1·5 mm

C 2·0 mm

D 5·0 mm.

6. The raw materials used in aerobic respiration are

A carbon dioxide and water

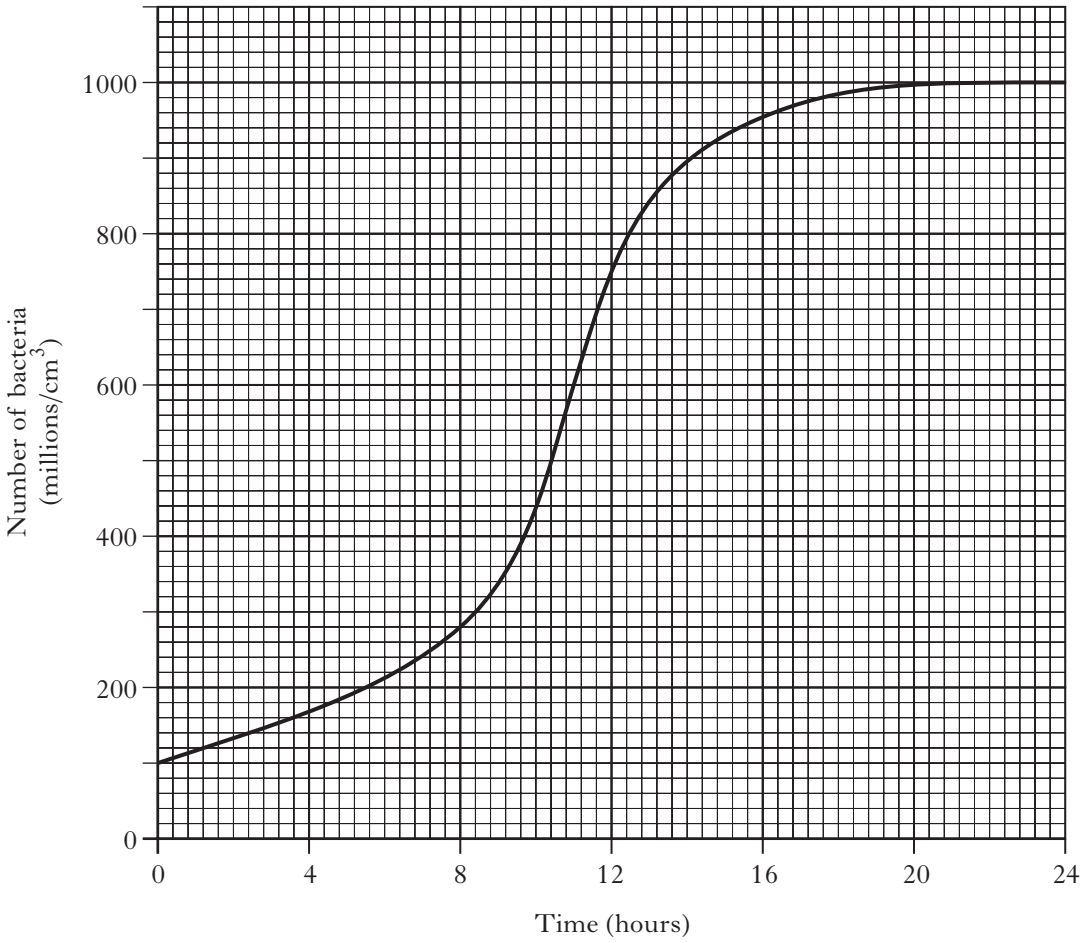
B oxygen and carbon dioxide

C glucose and oxygen

D water and glucose.

[Turn over

7. The graph below shows the change in the number of bacteria in a broth culture over 24 hours.



During which 4 hour period was there the greatest increase in the number of bacteria?

A 12 – 16 hours

B 8 – 12 hours

C 4 – 8 hours

D 0 – 4 hours

8. Which of the following responses correctly identifies processes that occur in algae?

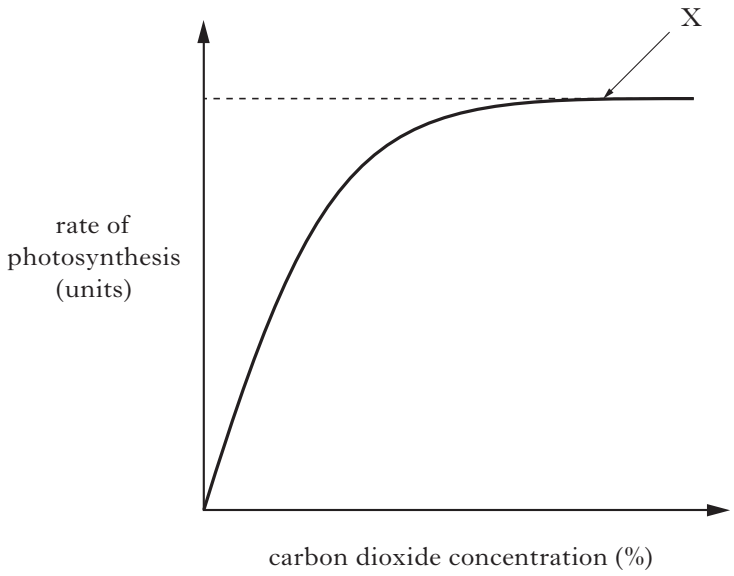
A photosynthesis and aerobic respiration

B aerobic respiration and budding

C photosynthesis and budding

D nitrogen fixation and anaerobic respiration

9. The rate of photosynthesis in a culture of *Chlorella* at different concentrations of carbon dioxide is shown in the graph below.



A factor limiting photosynthesis at point X could be

A carbon dioxide concentration

B light intensity

C oxygen concentration

D glucose concentration.

10. Which of the following is the correct order of events in the asexual reproduction of *Mucor*?

A mycelium → spores → sporangia

B spores → sporangia → mycelium

C mycelium → sporangia → spores

D sporangia → mycelium → spores

11. Saprophytic nutrition does **not** involve

A obtaining food from decaying organisms

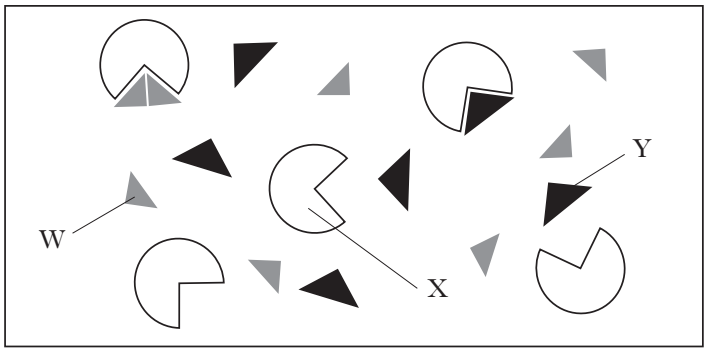
B the absorption of digested food products

C obtaining food from living organisms

D the use of extracellular enzymes.

12. The diagram below represents the enzyme, substrate and product molecules present during a **breakdown** reaction.

Which line in the table correctly identifies the molecules?



	Enzyme	*Substrate*	*Product*
A	W	X	Y
B	X	Y	W
C	W	Y	X
D	X	W	Y

13. Which of the following is **not** a complex molecule synthesised from glucose?

A Starch

B Cellulose

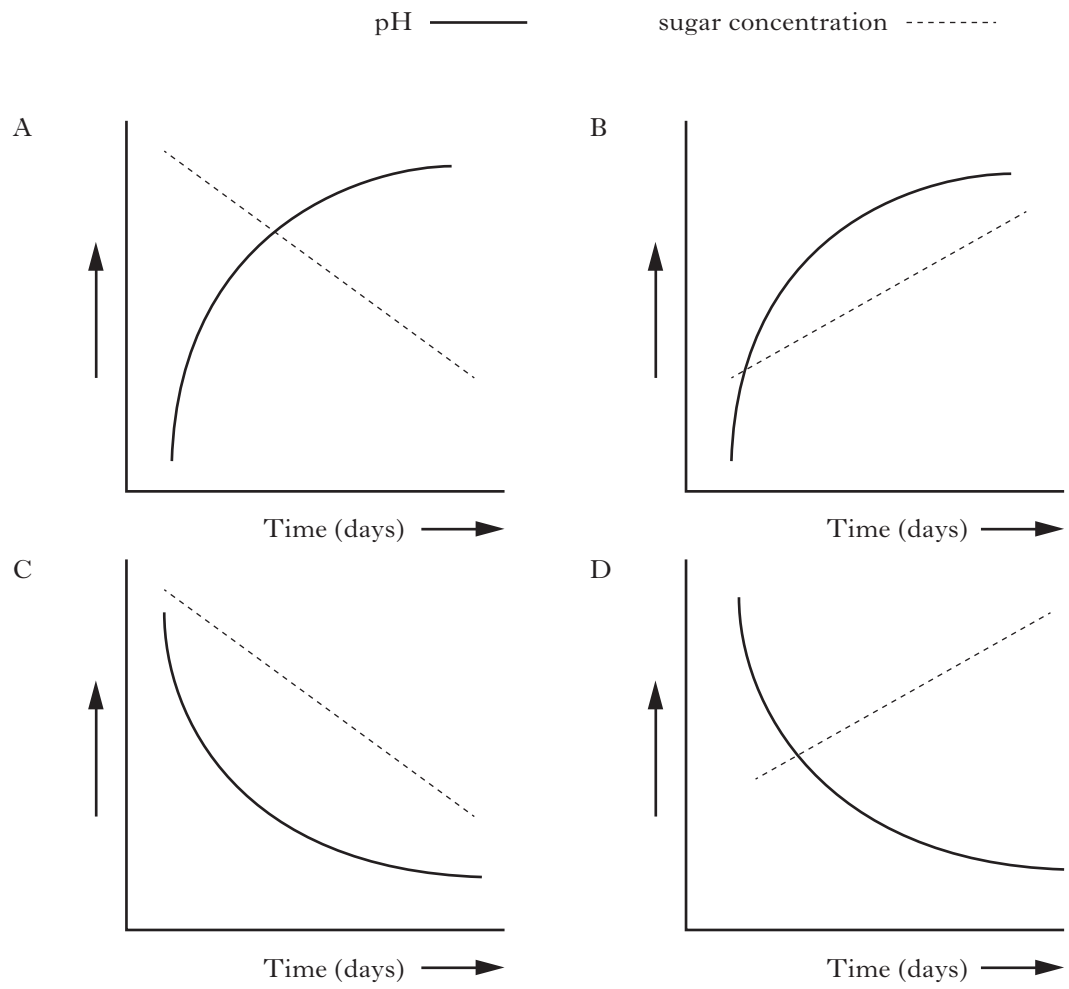
C Chitin

D Protein

[Turn over

14. During silage production the pH and sugar concentration are monitored.

Identify which graph shows silage with the **highest** nutritional value.



15. Which of the following identifies the advantages of genetically engineered insulin?

A Unlimited supply; reduced allergic response; large quantities available

B Limited supply; reduced allergic response; small quantities available

C Limited supply; increased allergic response; large quantities available

D Unlimited supply; reduced allergic response; small quantities available

16. Two features of producing ethanol by continuous flow processing are that the immobilised cells

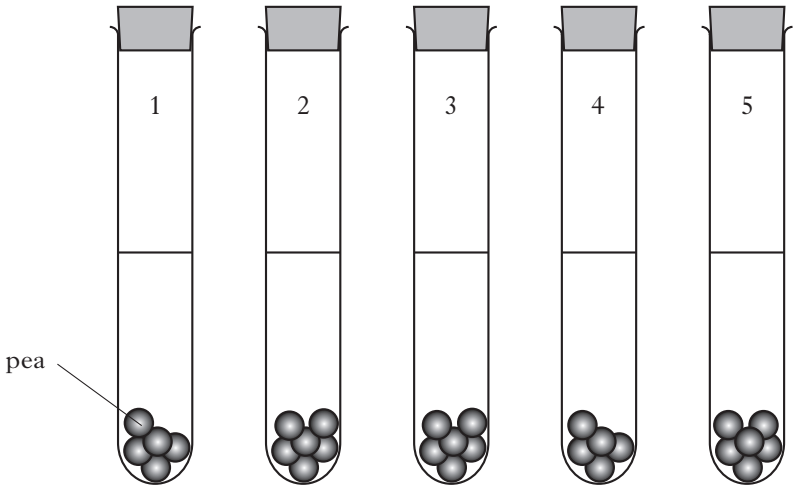
A can be reused and the separation of ethanol is easier

B cannot be reused and the separation of the ethanol is easier

C can be reused and the separation of ethanol is more difficult

D cannot be reused and the separation of ethanol is more difficult.

17. The diagram below shows an investigation into the preservation of peas by different salt solutions.



	1	2	3	4	5
Concentration of sodium citrate (%)	0·5	1·0	1·0	0	0
Concentration of sodium chloride (%)	0	0	0	0	1·0
Incubation temperature (°C)	30	20	30	30	20

What was being investigated when comparing tubes 2 and 5?

A Concentration of salt solution

B Type of salt solution

C Temperature

D Number of peas

18. The micro-organism *Aspergillus* is a

A bacterium used in the production of citric acid

B bacterium used in the production of ethanol

C fungus used in the production of citric acid

D fungus used in the production of ethanol.

19. The following statements describe some of the stages involved in the production of gasohol from maize.

W Alcohol is separated by distillation

X Gasohol is produced by mixing petrol with alcohol

Y Starch from maize is broken down into sugars

Z Sugars are fermented into alcohol by *Saccharomyces*

Which is the correct order of the stages?

A W → Y → Z → X

B Y → W → X → Z

C Z → X → Y → W

D Y → Z → W → X

20. Which line in the table describes correctly the cycling of carbon by micro-organisms?

	Energy fixation by	*Energy release by*
A	aerobic respiration	photosynthesis
B	photosynthesis	aerobic respiration
C	anaerobic respiration	nitrification
D	nitrification	anaerobic respiration

21. Antibiotics are substances that

A inhibit the growth of micro-organisms and increase competition

B inhibit the growth of micro-organisms and decrease competition

C stimulate the growth of micro-organisms and increase competition

D stimulate the growth of micro-organisms and decrease competition.

22. Which of the following statements describes correctly the treatment of sewage involving biological filters?

A Aerobic conditions created by trickling effluent through stones

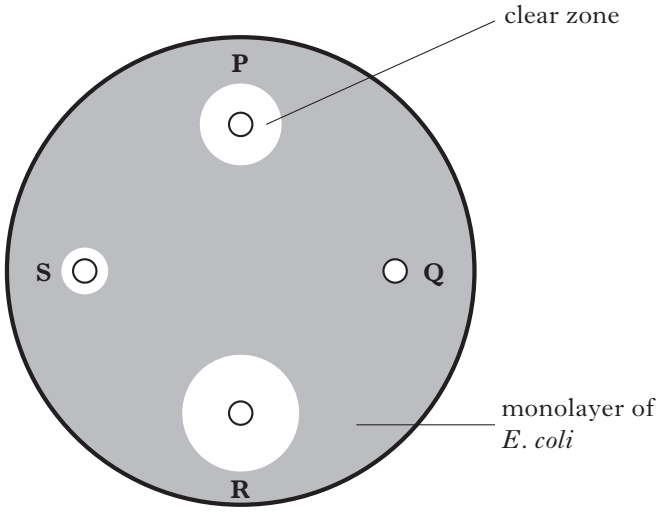
B Anaerobic conditions created by bubbling air into tanks

C Anaerobic conditions created by trickling effluent through stones

D Aerobic conditions created by bubbling air into tanks

Questions 23 and **24** refer to the diagram below.

The diagram below shows the effects of placing discs of filter paper containing different brands anti-bacterial soaps (P, Q, R and S) on a nutrient agar plate with the bacterium *E. coli*.



23. A valid conclusion from the results of **this experiment** is that anti-bacterial soap

A **P** is more effective than **R** at stopping the growth of all bacteria

B **S** is more effective than **R** at stopping the growth of *E. coli*

C **R** is more effective than **Q** at stopping the growth of all bacteria

D **P** is more effective than **S** at stopping the growth of *E. coli*.

24. One way of improving the **reliability** of the results from this experiment is to

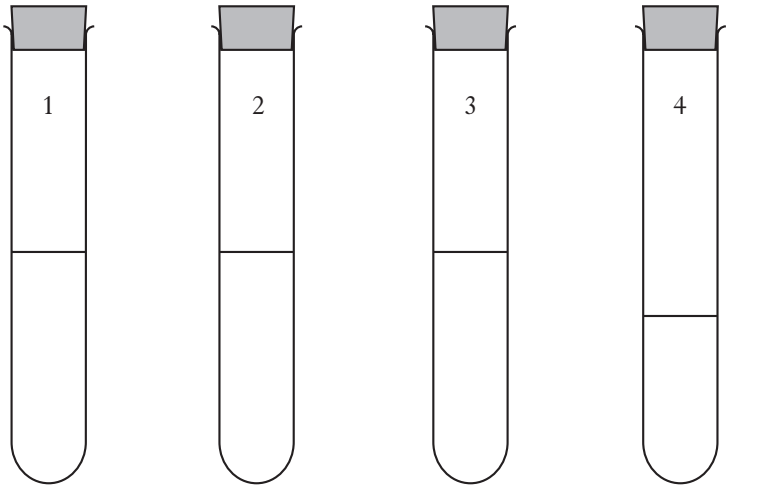
A use more brands of anti-bacterial soap

B use different types of agar

C set up another identical plate

D add the same volume of anti-bacterial soap to the filter papers.

25. Which of the following test-tubes should be used to investigate the breakdown of proteins by the bacterium *Bacillus subtilis*?



A 1 and 2

B 1 and 3

C 2 and 3

D 3 and 4

Candidates are reminded that the answer sheet for Section A MUST be returned INSIDE the front cover of this answer book.

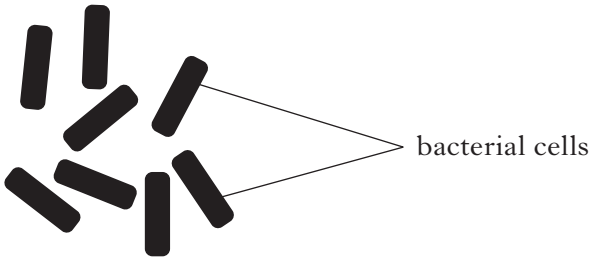
[Turn over for SECTION B on *Page ten*

Marks

SECTION B

All questions in this section should be attempted.
All answers must be written clearly and legibly in ink.

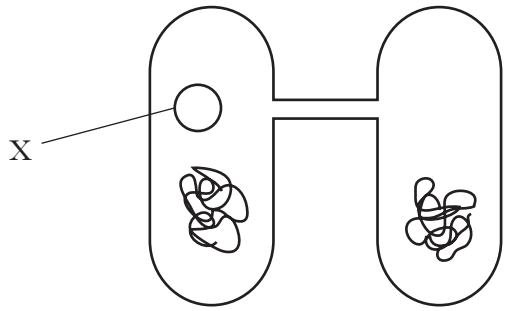
1. The diagram below shows the shape of some bacterial cells.



(*a*) What name is given to bacterial cells with this shape?

_____ **1**

(*b*) The diagram below shows a process in which bacteria exchange genetic material.



(i) Name this process.

_____ **1**

(ii) Name the structure labelled X.

_____ **1**

(iii) Complete the following sentences by <u>underlining</u> **one** of the options in each pair.

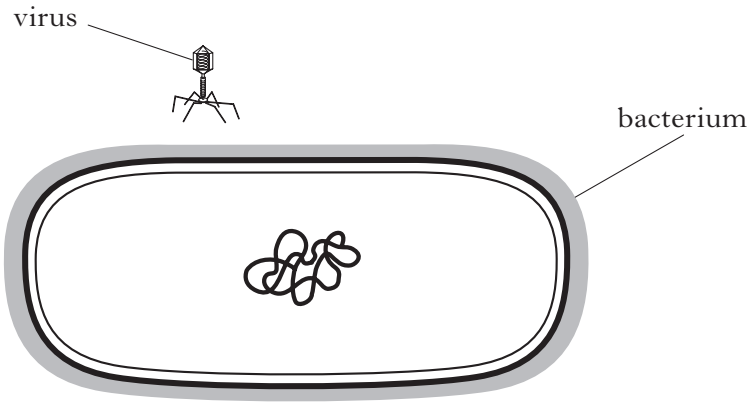
This process results in { non-identical / identical } cells and leads to { increase / decrease }

in variation in bacterial populations. **1**

Marks

1. (continued)

(*c*) The diagram below shows a virus infecting a bacterium.



The statements below describe some of the steps in this process.

Step A Viral DNA copied and viral proteins produced

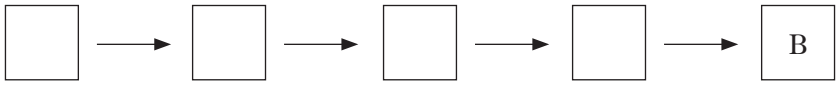
Step B Viruses released from bacterium

Step C New viruses assembled

Step D Virus attaches to bacterium

Step E Injection of viral DNA into bacterium

Place the steps in the correct order by inserting the correct letter into each box.



1

[Turn over

Marks

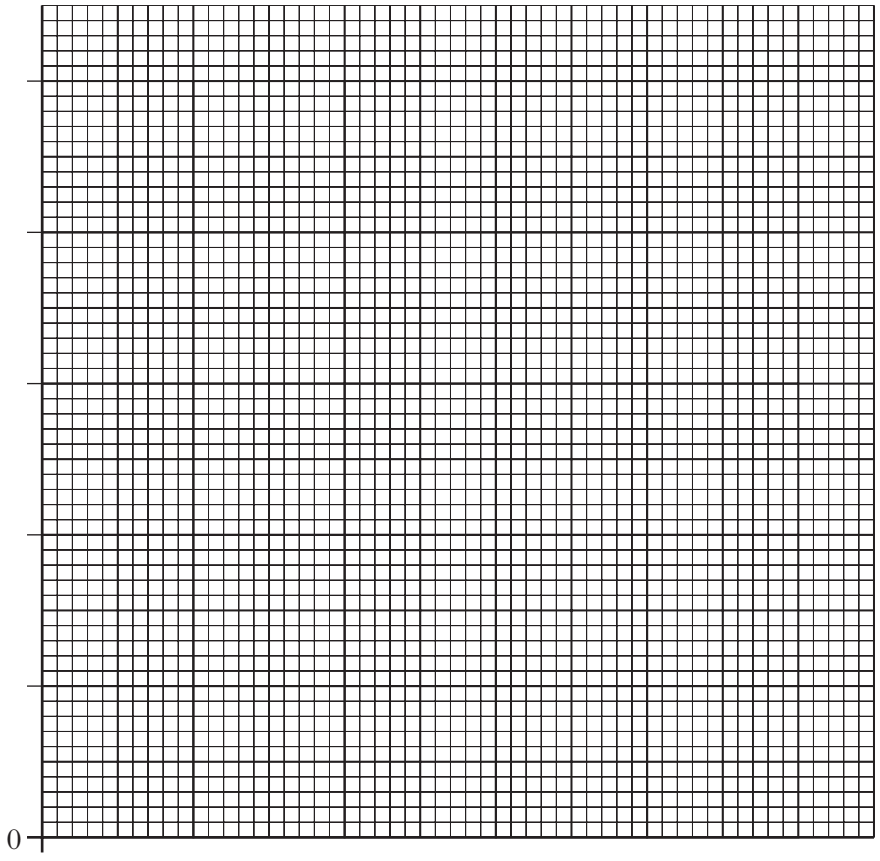
2. Swimmers in fresh water lochs can be poisoned by high levels of algae.

The table below shows the number of algae in a Scottish loch over a six month period.

Month	*Number of algae per* cm^3
April	1000
May	1500
June	3500
July	5000
August	3000
September	2000

(*a*) Use the results in the table to draw a bar chart to show the number of algae over 6 months.

(Additional graph paper, if required, can be found on *Page thirty-one*.)



3

Marks

2. (continued)

(*b*) The number of algae increases between April and July.

(i) Name **one** factor which could have caused this increase.

_____ **1**

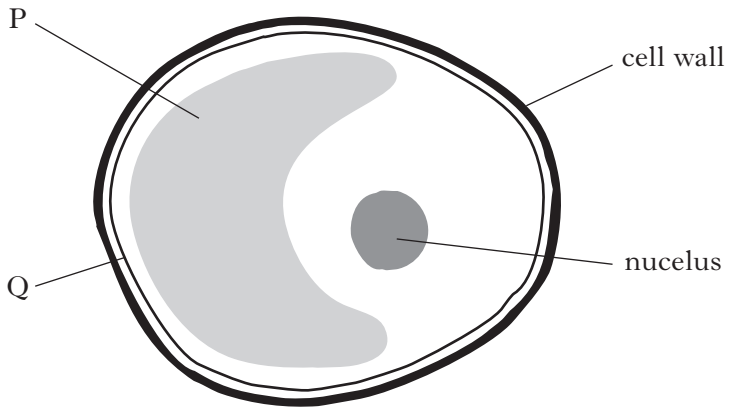
(ii) Explain how this factor increases the number of algae.

_____

_____

_____ **2**

(*c*) The diagram below shows an algal cell.



(i) Identify the structures labelled P and Q.

P _____

Q _____ **1**

(ii) Name the type of asexual reproduction used by the algal cell.

_____ **1**

[Turn over

Marks

3. The information below describes some problems which have arisen during practical work in a Biotechnology lab.

(*a*) A student prepared some agar plates, a number of which have become contaminated.

A description of how she prepared herself and her workspace is given below.

> *She entered the lab, opened the window and put on her lab coat, before thoroughly washing the smooth work top. Next she removed the agar plates from the fridge and placed her plates, cultures and metal inoculating loop on the worktop, close to the lit Bunsen. She turned the Bunsen to a yellow safety flame for flame sterilisation of the inoculating loop.*

(i) Identify **two** errors in the above procedure that could have led to the bacterial contamination.

Error 1 _____ **1**

Error 2 _____ **1**

(ii) Explain how **one** of the errors identified above could lead to contamination.

Error Number _____

Explanation _____

_____ **1**

(*b*) A student is having difficulties setting up a microscope to view micro-organisms.

A description of these difficulties is given below.

> *A - the student does not know which objective lens to use first.*
> *B - on looking down the microscope, the field of view is totally dark.*

Suggest how the student overcomes these **two** difficulties.

Difficulty A _____

_____ **1**

Difficulty B _____

_____ **1**

(*c*) When viewed under the microscope, yeast cells do not stand out against the background.

Suggest how this contrast could be improved.

_____ **1**

Marks

4. The table below shows the steps taken when pouring agar plates.

(*a*) Complete the table by describing steps 3 and 5.

Step	*Description*
1	Person and work space prepared
2	Bottle of sterile liquid agar cooled to pouring temperature
3	
4	Remove top and flame neck of bottle
5	
6	Pour liquid agar into plate
7	Replace agar plate lid

2

(*b*) State the correct pouring temperature for agar.

_____ °C **1**

(*c*) Describe **one** feature that would make a plate unacceptable for use **immediately** after the agar has set. Identify an error which could cause this to occur.

Feature _____

_____ **1**

Error _____

_____ **1**

(*d*) After inoculation, list **four** details which should be written on a correctly labelled agar plate.

1 _____ 2 _____

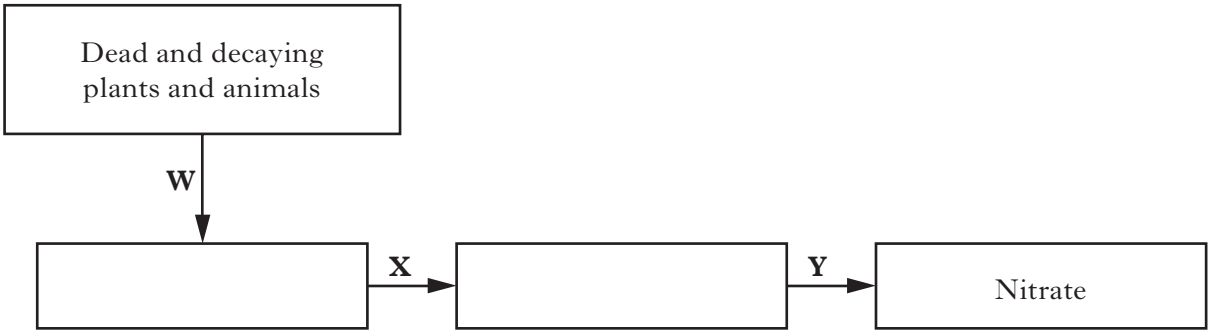
3 _____ 4 _____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

5. Part of the nitrogen cycle is shown in the diagram below.



(*a*) (i) Complete the boxes in the diagram by inserting the correct words from the list below.

List
Amino Acid
Ammonia
Nitrite
Oxygen
Protein

2

(ii) Complete the table below to show the involvement of micro-organisms in steps **W**, **X** and **Y** in the nitrogen cycle.

Tick (✓) **one** box for each step to indicate if mico-organisms are involved or not.

Step	*Micro-organisms involved*	*Micro-organisms **not** involved*
W		
X		
Y		

2

(*b*) Denitrification and nitrogen fixation are also part of the nitrogen cycle.

Complete the chemical conversion which takes place in these two processes.

Denitrification: _____ ⟶ Nitrogen **1**

Nitrogen fixation: _____ ⟶ Ammonia **1**

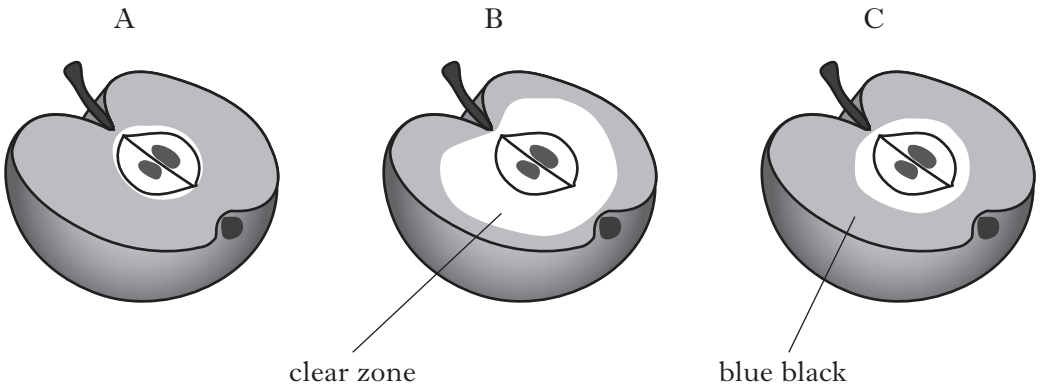
[Turn over for Question 6 on *Page eighteen*

Marks

6. A fruit farmer grows three different varieties of apples. After picking, the apples are stored to ripen until ready to eat. During ripening, starch is converted into sugar.

To find out whether apples are ready to eat the fruit farmer selects one apple of each variety and tests it for starch by cutting in half and then dipping it into iodine solution.

The diagram below shows the results for the three different varieties of apple which had been stored at 20 °C.



(*a*) (i) The fruit farmer wants to compare the results from each variety of apple.

Name **one** factor which should be kept the same relating to the apples and the test for starch.

Apples _____

_____ **1**

Test for starch _____

_____ **1**

(ii) Suggest a way of improving the reliability of the results in the above tests.

_____ **1**

(*b*) (i) Which apple has the highest starch content?

Apple _____ **1**

(ii) Which apple is most ripe and ready to eat?

Apple _____ **1**

(iii) Suggest a method for measuring the area of starch in the apples.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

6. (continued)

(*c*) Name the enzyme which converts starch into sugar.

_____ **1**

(*d*) (i) What effect would storing at 4 °C have on the ripening of the apples?

_____ **1**

(ii) Explain your answer to (*d*)(i) above.

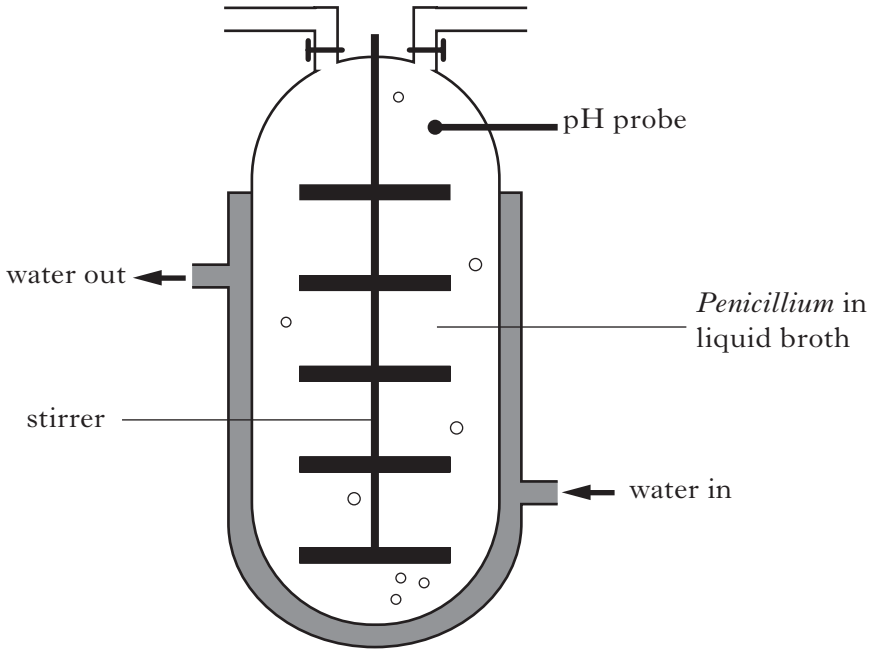
_____

_____ **1**

[Turn over

Marks

7. An inoculum of *Penicillium* was added to a fermenter containing liquid broth medium with added sugar and a source of nitrogen.



(*a*) (i) What type of micro-organism is *Penicillium*?

_____ **1**

(ii) *Penicillium* needs a source of nitrogen in the liquid broth medium to synthesise chemicals important for growth.

Name a compound that requires nitrogen for its synthesis.

_____ **1**

(iii) Antibiotics can be produced commercially by batch processing.

Describe what is meant by batch processing.

_____

_____ **1**

(*b*) Antibiotics can be either narrow spectrum or broad spectrum in their action.

Explain the difference in the action of these two types of antibiotics.

Narrow spectrum _____

_____

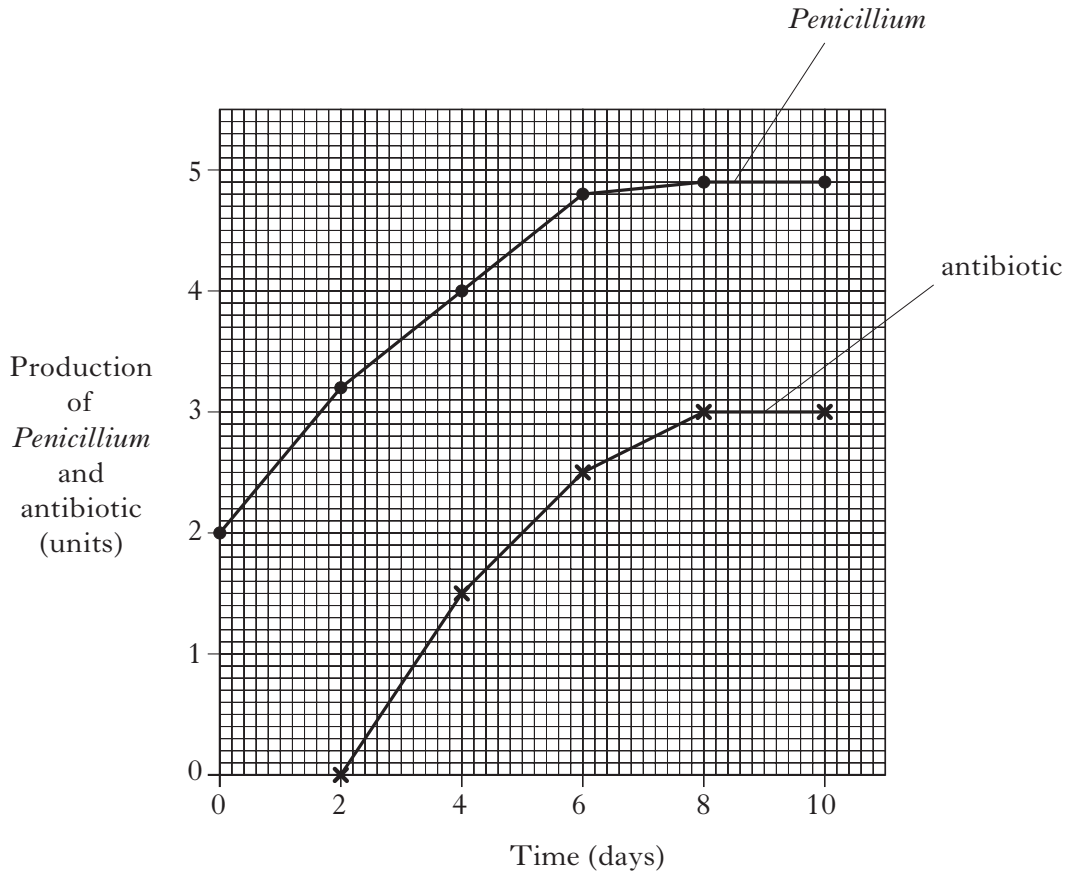
Broad spectrum _____

_____ **2**

7. (continued)

Marks

(*c*) The graph below shows the production of *Penicillium* and an antibiotic synthesised by this micro-organism over 10 days.



(i) **Using the data from the graph**, describe the production of the antibiotic from day 2 to day 10.

_____

_____

_____ **2**

(ii) Suggest a reason why the production of *Penicillium* levels off after 8 days.

_____

_____ **1**

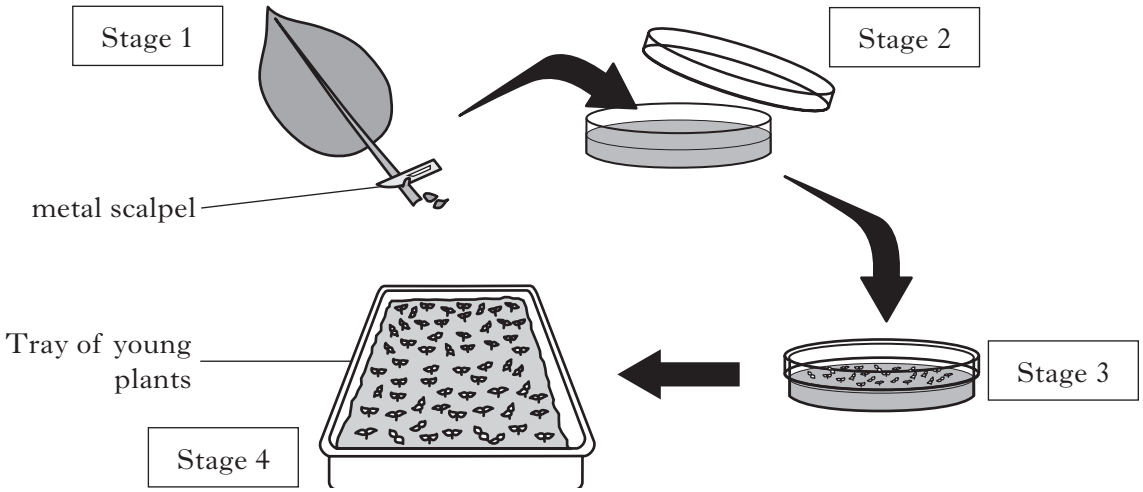
(iii) Calculate the percentage increase in antibiotic production between 4 and 8 days.

Space for calculation

_____ % **1**

Marks

8. (*a*) The diagram below represents some of the stages involved in a plant breeding technique.



(i) Name this technique.

_____ **1**

(ii) Give **one** advantage of using this technique in the reproduction of plants.

_____

_____ **1**

(iii) Describe how the metal scalpel used in Stage 1 is sterilised.

_____

_____ **1**

(*b*) Selective breeding can be used to improve crop plants.

Give **one** advantage and **one** disadvantage of selecting breeding.

Advantage _____

_____ **1**

Disadvantage _____

_____ **1**

Marks

8. (continued)

(*c*) Decide if the following statements about techniques in breeding are **True** or **False** and tick (✓) the correct box.

If the statement is **False**, write the correct word in the Correction box to replace the word underlined in the statement.

Statement	*True*	*False*	*Correction*
Genome mapping is a method of identifying the function and location of proteins.			
Genetic modification involves the transfer of desirable genes into chromosomes.			

2

[Turn over

9. Anaerobic digesters are used to treat organic waste and produce methane gas.

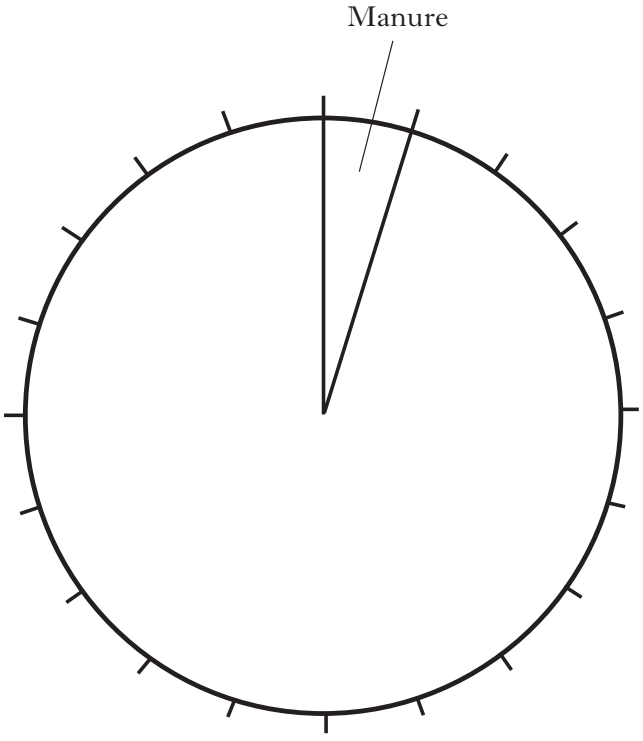
Marks

(*a*) The table below shows a variety of organic wastes and their methane yield.

Source of organic wastes	*Methane yield* (m^3/tonne)
Manure	200
Crops	400
Food industry	600
Breweries	800
Pharmaceutical industry	1200
Slaughterhouses	800

(i) Complete the pie chart using the information in the table.

(An additional pie chart, if required, can be found on *Page thirty-two*.)



2

(ii) Calculate the simple whole number ratio of the methane yield produced by Manure compared to Crops and to Breweries.

Space for calculation

_____ : _____ : _____

Manure Crops Breweries

1

Marks

9. (continued)

(*b*) (i) The organic waste contains micro-organisms.

Explain their role in the production of methane gas.

_____

_____ **1**

(ii) Give **one** use of the methane gas produced.

_____ **1**

(iii) As with sewage treatment, organic wastes have to be checked for contaminating substances that would inhibit methane production.

Name **one** contaminating substance.

_____ **1**

(iv) Slaughterhouse waste is heated to 120 °C before being added to a digester.

Give a reason for this treatment.

_____

_____ **1**

(*c*) Give an **environmental** advantage of treating organic wastes as described above.

_____

_____ **1**

[Turn over for SECTION C on *Page twenty-six*

SECTION C

Marks

Both questions in this section should be attempted.

Note that each question contains a choice.

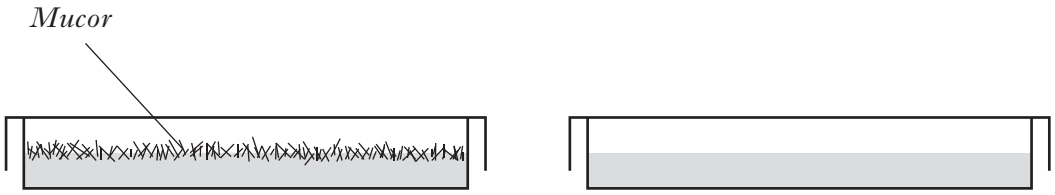
Questions 1 and 2 should be attempted on the blank pages which follow.

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

Labelled diagrams may be included where appropriate.

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

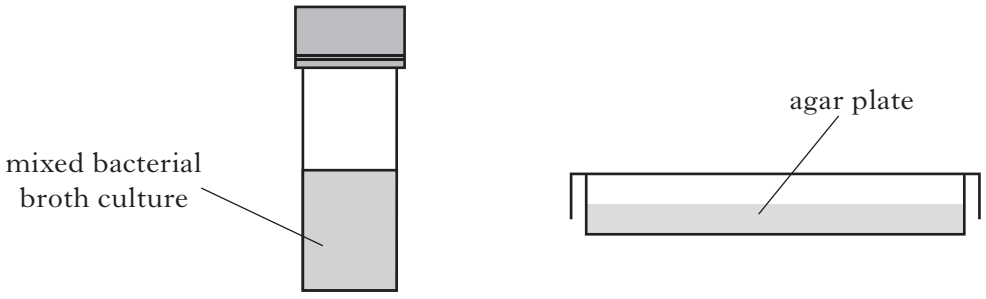
A. The diagram below shows two agar plates. Plate X contains a culture of the fungus *Mucor*; plate Y is a sterile agar plate.



Describe the steps involved in the aseptic transfer of *Mucor* from plate X to plate Y. **5**

OR

B. The diagram below shows a mixed bacterial broth culture and a sterile agar plate.



Describe the steps needed to produce a streak plate from this mixed bacterial broth culture. **5**

DO NOT WRITE IN THIS MARGIN

Marks

SPACE FOR ANSWER TO QUESTION 1

Please complete the box below to indicate which part, A or B, you are answering.

☐

[Turn over for Question 2 on *Page twenty-eight*

DO NOT WRITE IN THIS MARGIN

Marks

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

A. In the food industry, vinegar is produced by a biotechnological process.

Describe this process by naming the micro-organism and raw materials involved. Describe the benefits and uses of vinegar. **5**

OR

B. In the dairy industry, lactic acid is produced in the process of making yoghurt.

Describe this process by naming the micro-organism and raw materials involved. Describe the benefits and uses of lactic acid in the dairy industry. **5**

[*END OF QUESTION PAPER*]

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SPACE FOR ANSWER TO QUESTION 2

Please complete the box below to indicate which part, A or B, you are answering.

DO NOT WRITE IN THIS MARGIN

Marks

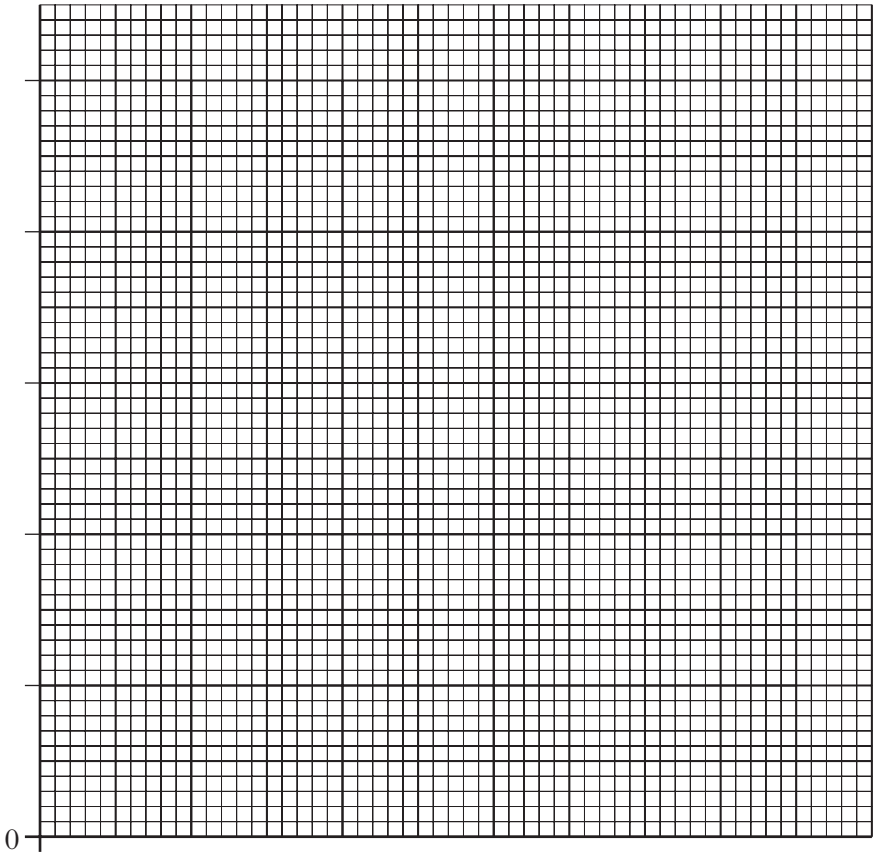
ADDITIONAL SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

Marks

ADDITIONAL SPACE FOR ANSWERS

Additional graph paper for use in Question 2(*a*)



Month

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ADDITIONAL SPACE FOR ANSWERS

Additional pie chart for use in Question 9(*a*)(i)