FOR OFFICIAL USE

Total for Sections B and C

X008/201

NATIONAL QUALIFICATIONS 2010

TUESDAY, 18 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?

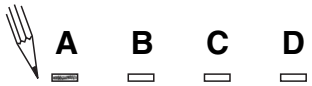
A Butter

B Bread

C Sugar

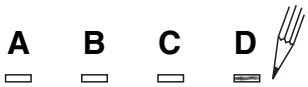
D Apple

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. Which line in the table below identifies correctly the melting and setting temperatures of agar?

	Melting Temperature (°C)	*Setting Temperature* (°C)
A	55	42
B	42	20
C	95	42
D	95	20

2. Which of the following statements gives the correct purpose of working in the **updraught** of a Bunsen burner flame?

A Carrying of micro-organisms in the air away from work space.

B Sterilising of metal instruments.

C Flaming of bottles.

D Killing of micro-organisms in the air above work space.

3. For **safety** reasons, the correct labelling information on an inoculated agar plate is

A student name and incubation temperature

B student name, incubation temperature and micro-organism name

C incubation temperature and micro-organism name

D student name, micro-organism name and inoculation date.

4. Which of the following is **not** part of the preparation of the laboratory before starting a microbiological procedure?

A Disinfecting the bench area

B Closing windows and doors

C Putting on a laboratory coat

D Setting up a Bunsen burner

5. Which line in the table below identifies correctly the best conditions for avoiding condensation on the surface of an agar plate?

	Storage Temperature (°C)	*Storage of plate*
A	4	Right way up
B	4	Upside down
C	20	Right way up
D	20	Upside down

[Turn over

6. Which line in the table below describes correctly the function of the parts of the microscope?

	Lens	*Stage*	*Focussing control*
A	Makes specimen brighter	Reflects light onto slide	Changes lens in use
B	Magnifies specimen	Where slide is placed	Changes lens in use
C	Magnifies specimen	Reflects light onto slide	Brings slide into focus
D	Magnifies specimen	Where slide is placed	Brings slide into focus

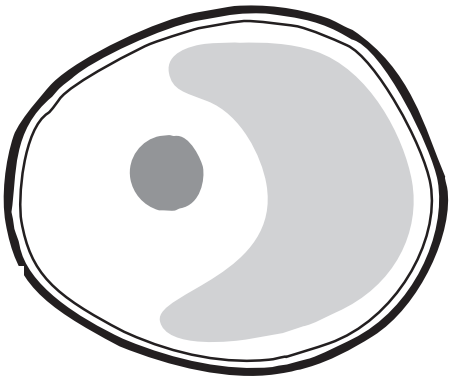
7. A light microscope has an eyepiece magnification of ×10 and three objective lenses: ×4, ×10, ×30.

Which line in the table below shows the correct minimum and maximum **total magnifications** for this microscope?

	Minimum total magnification	*Maximum total magnification*
A	×10	×30
B	×10	×300
C	×40	×300
D	×40	×1200

8. The diagram below shows *Chlorella*, as viewed under a microscope.

The microscope had a total magnification of 1000×.



10 millimetres

(1 millimetre = 1000 micrometers)

The size of this *Chlorella* is

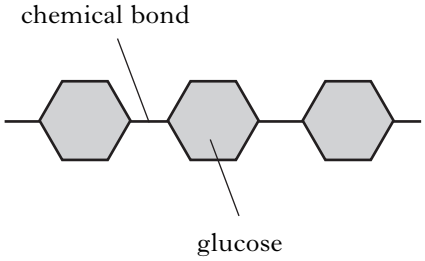
A 0·01 micrometers

B 10 micrometers

C 10 millimetres

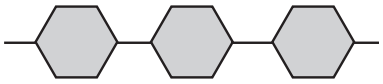
D 10 000 micrometers

9. The diagram below shows the structure of a complex carbohydrate.



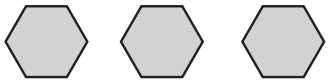
Which of the following must be present at the start of the synthesis of this complex carbohydrate?

A enzyme +

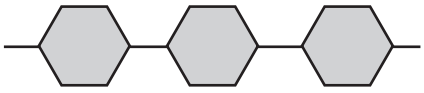


B

C enzyme +



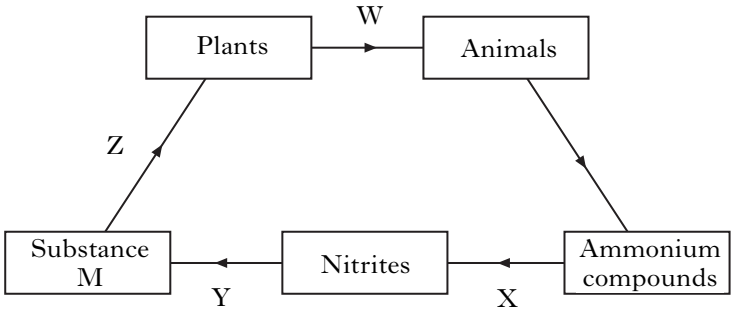
D



10. Which line in the table below describes correctly reproduction in yeast and *Mucor*?

	Budding in yeast	*Sporangia production by Mucor*
A	Sexual	Sexual
B	Asexual	Sexual
C	Sexual	Asexual
D	Asexual	Asexual

Questions **11** and **12** refer to the diagram below which shows some of the stages in the nitrogen cycle.



11. Substance M is

A amino acids

B nitrates

C nitrogen

D protein

12. Identify the letters which label the stages involving micro-organisms.

A X and Y

B W and X

C Y and W

D Z and X

13. Which line in the table below describes correctly what happens to sewage in activated sludge and biological filter treatment?

	Activated sludge treatment	*Biological filter treatment*
A	Trickled over stones	Air bubbled in
B	Trickled over stones	Trickled over stones
C	Air bubbled in	Trickled over stones
D	Air bubbled in	Air bubbled in

14. Which line in the table below matches correctly a micro-organism and its product?

	Micro-organism	*Product*
A	*Zygomonas*	Methane
B	*Mucor*	Ethanol
C	*Rhizobium*	Methane
D	*Saccharomyces*	Ethanol

15. The global fixation of energy into biomass by micro-organisms is the result of

A photosynthesis

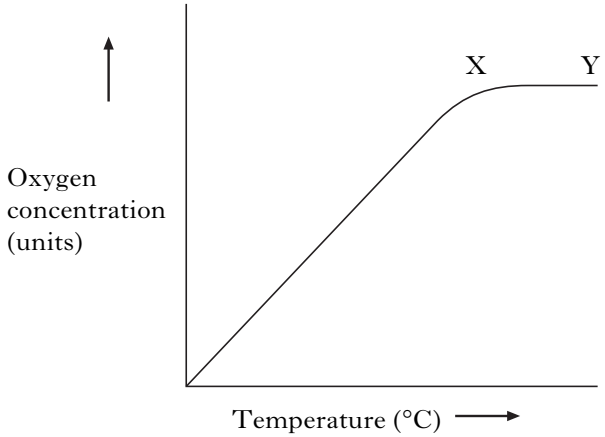
B nitrogen fixation

C respiration

D denitrification.

[Turn over

16. The graph below shows the effect of temperature on the rate of oxygen production during photosynthesis by *Chlorella*.



Identify the factor which could be limiting photosynthesis between points X and Y.

A Glucose concentration

B Light intensity

C Oxygen concentration

D Temperature

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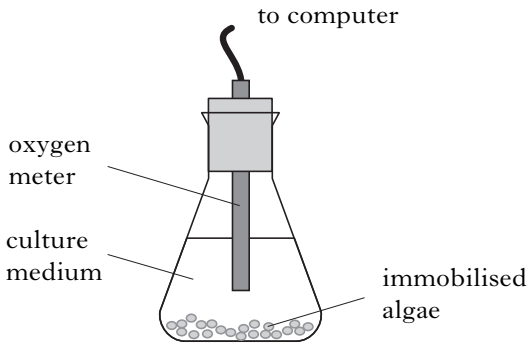
17. The diagram below shows an experiment set up to measure oxygen production by immobilised algae.

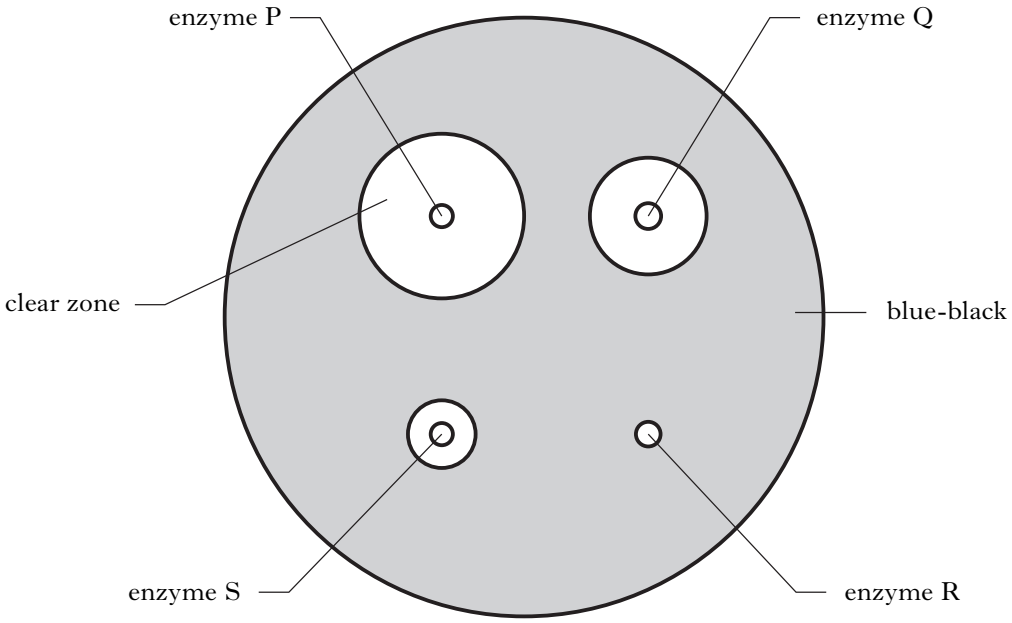


The flask containing the algae was left on the window ledge. The table shows the resulting oxygen concentrations over an 18 hour period.

	Oxygen concentration (units) *at*			
	Midnight	*6.00 am*	*Noon*	*6.00 pm*
A	10	30	0	10
B	0	30	10	10
C	0	10	0	30
D	0	10	30	10

Which line in the table above identifies correctly the oxygen concentration in the flask over the 18 hour period?

18. The diagram below shows the results of an experiment set up to investigate the digestion of starch by enzymes. The starch agar plate was stained with iodine solution at the end of the experiment. Iodine solution turns blue/black in the presence of starch.



A valid conclusion from the result of **this experiment** is

A amylase breaks down starch

B enzymes P and Q break down starch

C enzyme R is specific in its action

D enzyme S does not break down starch.

19. Narrow spectrum antibiotics are active against

A few species of bacteria

B all species of viruses

C all species of bacteria

D few species of viruses.

20. In anaerobic respiration in yeast cells

A glucose is used up and water and carbon dioxide are produced

B glucose is used up and ethanol and carbon dioxide are produced

C glucose and oxygen are used up and ethanol and carbon dioxide are produced

D glucose and oxygen are used up and water and carbon dioxide are produced.

21. Which of the following micro-organisms are used for the production of ethanol by **continuous flow processing?**

A *Aspergillus*

B *Penicillium*

C *Saccharomyces*

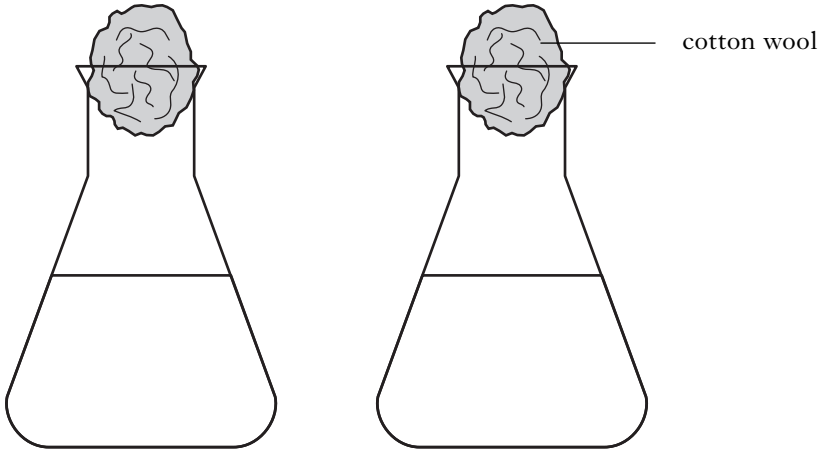
D *Zygomonas*

22. Two agar plates were inoculated with the same number of bacteria. One plate (X) was placed at 20 °C and the second plate (Y) was placed at 30 °C. After two days the number of colonies was counted on each plate. Plate X had 160 colonies and plate Y had 400 colonies.

Which line in the table below identifies correctly the simple whole number ratio of colonies on plate X to plate Y?

	Plate X	*Plate Y*
A	5	2
B	1	2
C	2	5
D	4	10

23. The diagram below shows an experiment set up to investigate the growth of fungi in the presence of copper salts and detergent.



5 g of fungi
40 cm^3 culture medium
20 cm^3 water

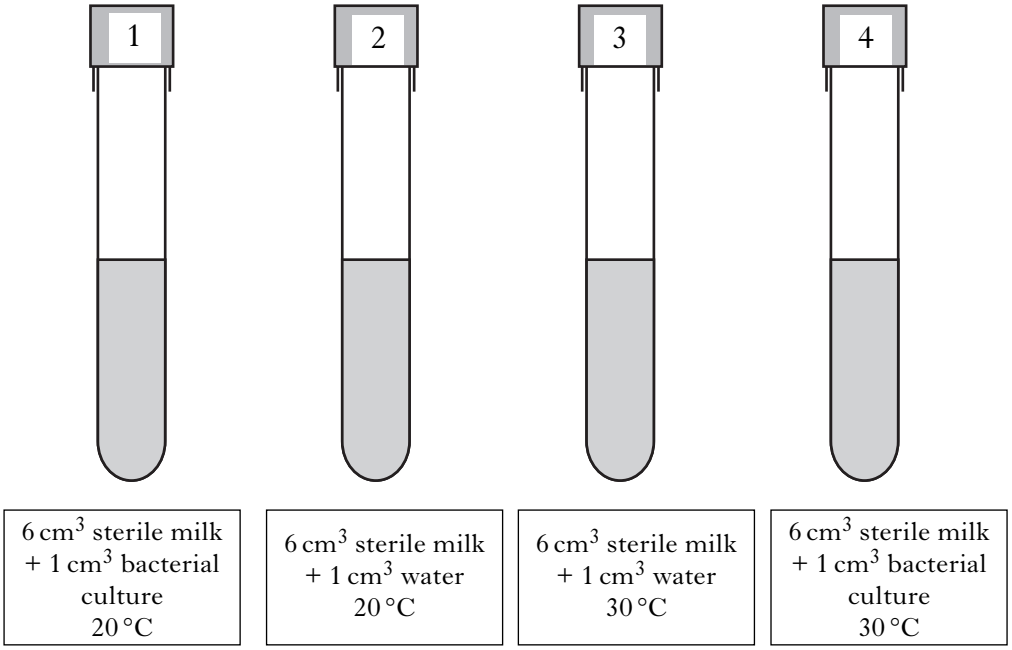
5 g of fungi
40 cm^3 culture medium
10 cm^3 detergent
10 cm^3 copper salts

Another flask was set up with 5 g of fungi to find the effect of copper salts only on fungal growth.

Which line in the table identifies correctly the contents of this flask?

	Volume of culture medium (cm^3)	*Volume of detergent* (cm^3)	*Volume of copper salts* (cm^3)	*Volume of water* (cm^3)
A	40	0	20	0
B	20	20	0	40
C	20	0	40	10
D	40	0	20	20

24. Which of the following test tubes could be used to investigate the effect of temperature on yoghurt production by bacteria?



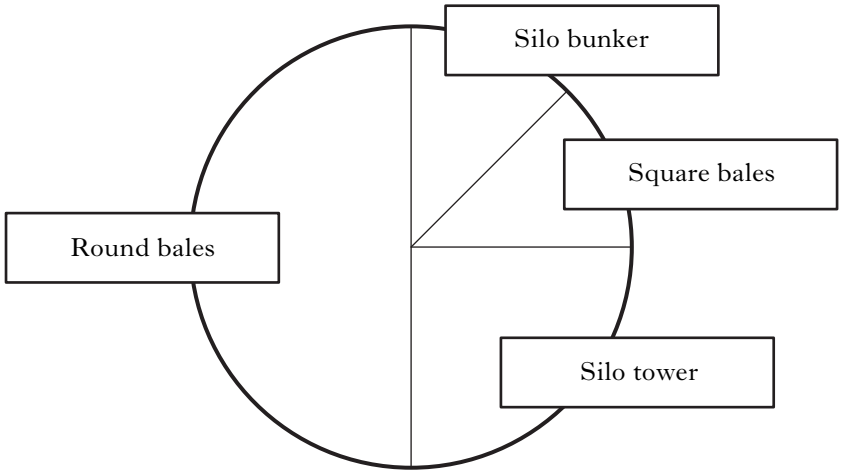
A 1 and 4

B 2 and 3

C 1 and 3

D 1 and 2

25. The pie chart below shows silage production by different methods in Scotland.



The percentage of silage produced in bales is

A 12·5%

B 50·0%

C 62·5%

D 75·0%

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*

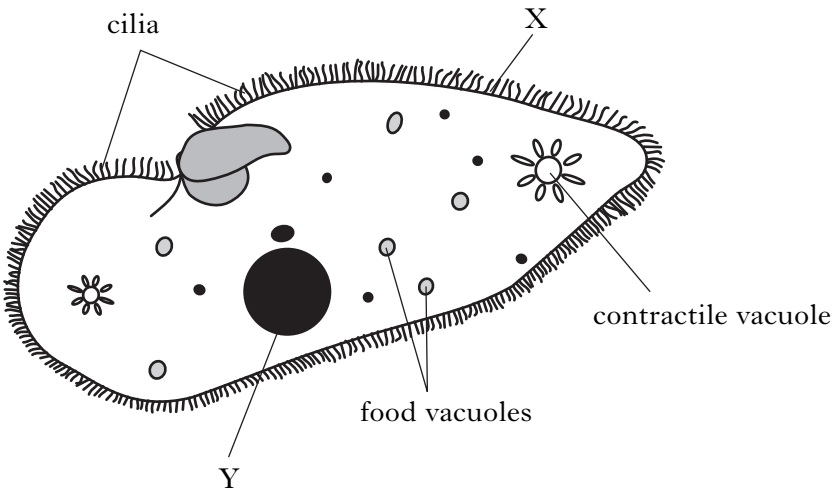
DO NOT WRITE IN THIS MARGIN

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 structure of a micro-organism.



(*a*) Complete the following sentences by underlining one of the options in each pair.

The type of micro-organism shown in the diagram is {algae / protozoa}. This cell has food vacuoles which contain {enzyme / DNA} molecules. These molecules are involved in {digestion / synthesis} reactions. **2**

(*b*) Name the structures labelled X and Y in the diagram.

X _____ **1**

Y _____ **1**

(*c*) Name the type of asexual reproduction used by this micro-organism.

_____ **1**

(*d*) Some of the food taken in by this micro-organism is used for aerobic respiration.

Decide whether the following substances relating to aerobic respiration are used up or produced. Tick (✓) the correct box **in each line**.

Substance	*Used up*	*Produced*
carbon dioxide		
glucose		
oxygen		
water		

2

DO NOT WRITE IN THIS MARGIN

Marks

2. A biotechnology student used a microscope to study micro-organisms.

He produced a thin bacterial smear, fixed the smear to a microscope slide and stained it with methylene blue.

(*a*) Suggest a reason why the smear must be thin.

_____ **1**

(*b*) (i) Describe how a bacterial smear is fixed to a microscope slide.

_____ **1**

(ii) Give **one** advantage of fixing micro-organisms onto a slide.

_____ **1**

(*c*) Explain why the bacterial smear is stained before viewing under the microscope.

_____ **1**

(*d*) A smear of micro-organisms can also be prepared for microscopy using a **vital** stain.

(i) What is the advantage of this type of staining?

_____ **1**

(ii) Describe how the student should dispose of this slide safely after viewing.

_____

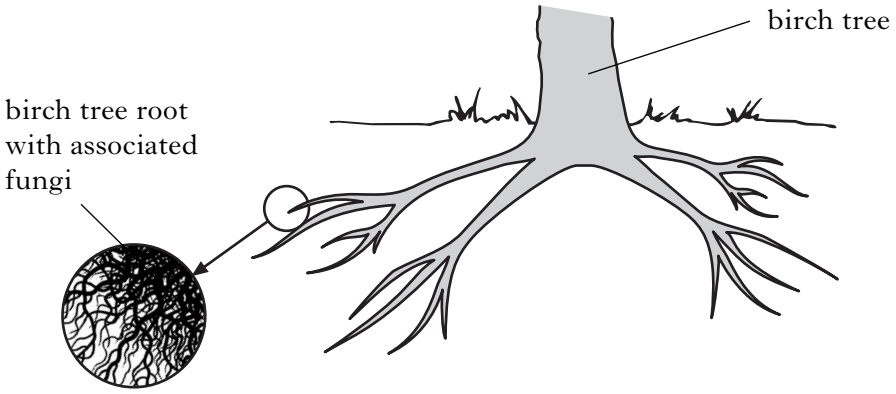
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

3. The diagram below shows an association between a birch tree root and a fungus.



(*a*) The birch tree and the fungus obtain a benefit from this association.

Name this type of association.

_____ **1**

(*b*) The diagram below shows the transfer of substances between the two organisms.

Complete the boxes in the diagram using the appropriate words from the list.

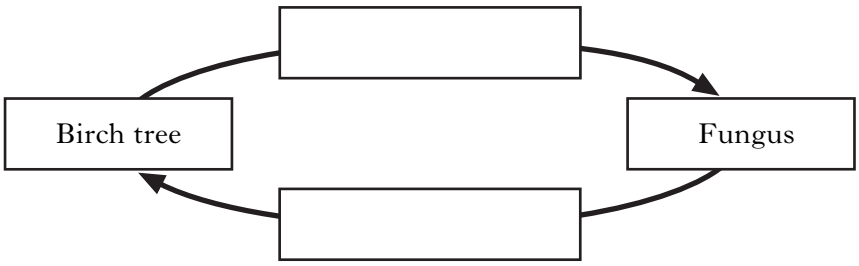
protein

carbohydrate

nitrate

oxygen

fat



2

(*c*) This fungus uses saprophytic nutrition.

(i) Name a possible food source for this type of micro-organism.

_____ **1**

Marks

3. (*c*) (continued)

(ii) Decide if the following statements about saprophytic nutrition 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*
In saprophytic nutrition, digestion is external			
Digestion in saprophytic nutrition requires intracellular enzymes			
In saprophytic nutrition, the products of digestion are absorbed			

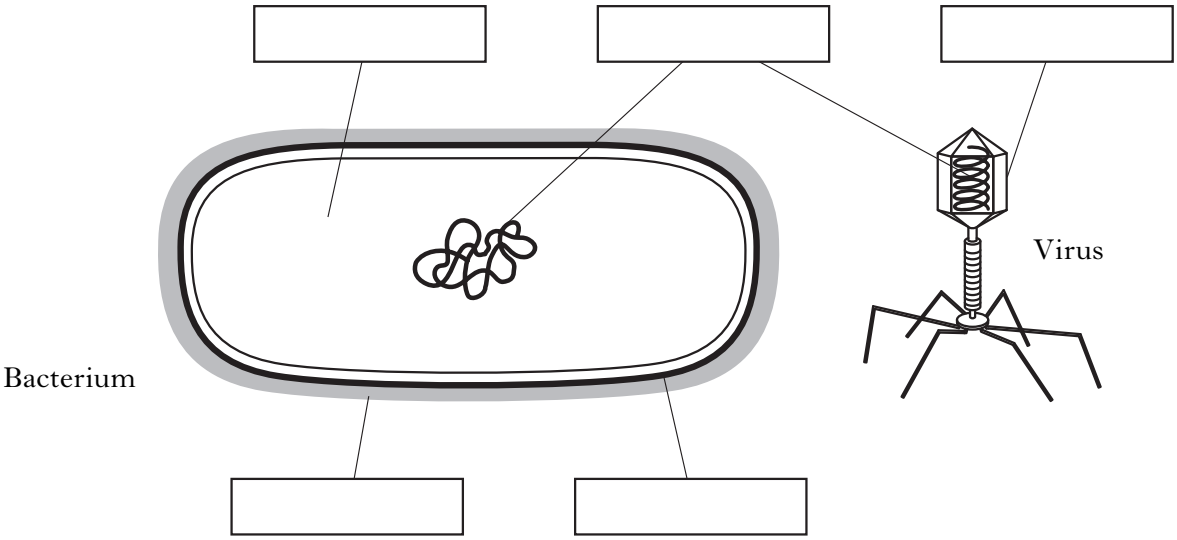
3

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

4. The diagram below shows a bacterium and a virus **(not at the same magnification)**.



(*a*) (i) Complete the diagram by adding the names of the parts of the bacterium and virus to the boxes. **3**

(ii) The structure of a virus can be described as non-cellular.

Describe **one** feature of a virus that makes it a non-cellular structure.

_____ **1**

(*b*) The list below shows different micro-organisms. Place them in the boxes according to their size.

viruses	***protozoa***	***bacteria***

increasing order of size ⟶

	→	→

1

DO NOT WRITE IN THIS MARGIN

Marks

4. (continued)

(*c*) The table below shows some of the stages in the replication of a virus. Complete the table by describing what happens in Stages 1 and 3.

Stage	*Description of stage*
1	
2	Injection of viral DNA into a host cell
3	
4	New viruses are assembled
5	Viruses are released from host cell

2

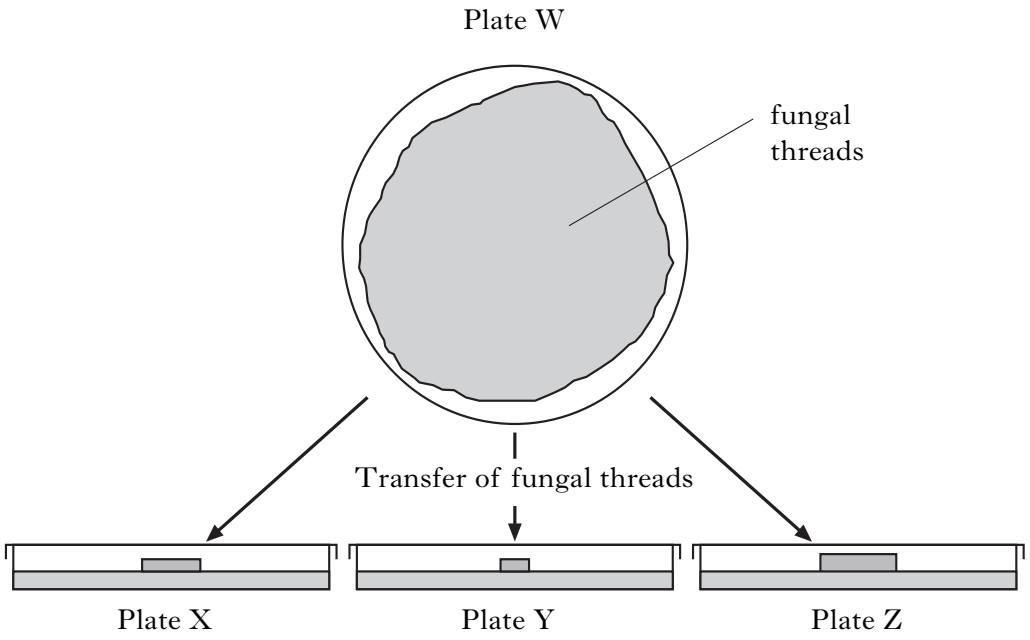
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

5. An experiment was set up to investigate the growth of a fungus at 25 °C.

Aseptic technique was used to transfer one piece of fungi from plate W to plates X, Y and Z.



(*a*) What name is given to the structures formed by the fungal threads?

_____ **1**

(*b*) Name two variables which should be controlled to make this experiment valid.

Variable 1 _____ **1**

Variable 2 _____ **1**

(*c*) (i) Describe a method of measuring growth of the fungus in the above experiment.

_____

_____ **1**

(ii) Describe **one** disadvantage of your chosen method of measuring growth.

_____

_____ **1**

(*d*) After 5 days, the fungi had grown to the edge of plates X, Y and Z.

Predict the growth of the fungi after 5 days at 10 °C.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

6. Some diabetics do not produce enough insulin. To prevent problems, diabetics may inject insulin.

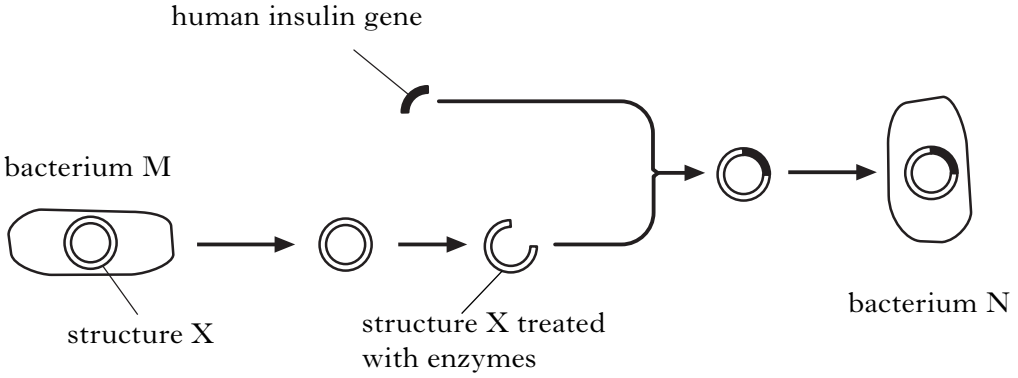
Insulin can be obtained from the pancreas of a pig or from genetically engineered bacteria.

(*a*) Suggest **one** advantage of using bacteria to produce insulin, instead of collecting it from the pancreas of a pig.

_____

_____ **1**

(*b*) The flow diagram below shows some of the stages in the genetic engineering of bacteria to produce human insulin.



(i) Identify structure X which is used in genetic engineering.

_____ **1**

(ii) Suggest a reason for treating structure X with enzymes during this process.

_____ **1**

(iii) Explain why bacterium N can make human insulin, but bacterium M cannot.

_____

_____ **1**

(iv) Give the name of a bacterium that can be used in the genetic engineering of human insulin.

_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

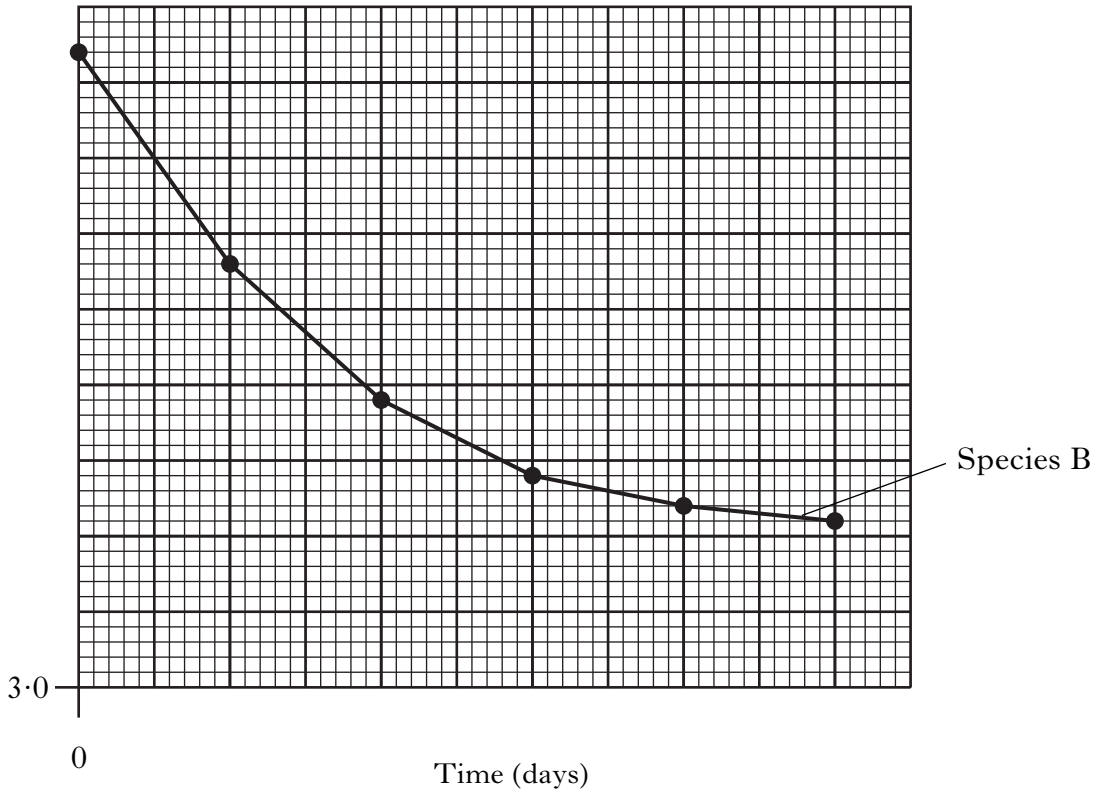
Marks

7. An investigation was set up to look at the effect of two species of micro-organisms (Species A and Species B) on silage production. The pH of the developing silage was measured over 20 days. The results are shown in the table below.

Time (days)	*pH of developing silage*	
	Species A	*Species B*
0	7·2	7·2
4	5·6	5·8
8	4·2	4·9
12	3·6	4·4
16	3·4	4·2
20	3·4	4·1

(*a*) (i) Use the information in the table to complete the line graph to show the change in the pH of the developing silage with Species A.

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



3

DO NOT WRITE IN THIS MARGIN

Marks

7. (*a*) (continued)

(ii) Which species of micro-organism is most effective in silage production?

Species_____ **1**

Give **one** reason for your choice.

_____

_____ **1**

(iii) During this investigation, the sugar concentration and temperature of the developing silage were also measured.

Predict the changes in these variables by underlining the correct responses.

The sugar concentration { decreases / stays the same / increases }.

The temperature { decreases / stays the same / increases }. **2**

(*b*) Identify a micro-organism which could be used in silage production.

Circle the correct response.

Chlorella *Lactobacillus* *Rhizobium* *Zygomonas* **1**

(*c*) During silage production, the acids produced preserve the silage by preventing putrefaction.

Explain the preservative effect of the acids.

_____

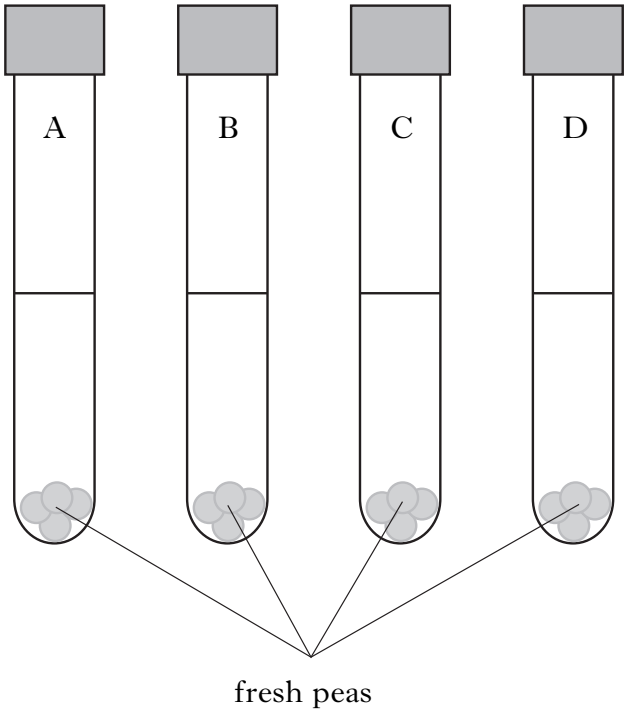
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

8. The diagram and table below show the set up at the start of an investigation into the preservation of fresh peas.



Test tube	*Liquid content of test tube*
A	Water
B	0·5% acetic acid
C	0·5% sodium chloride
D	0·5% sodium citrate

(*a*) (i) What is the aim of this investigation?

_____

_____ **1**

(ii) Name two factors, **not** shown in the diagram or table, which should be kept the same when carrying out this experiment.

Factor 1 _____ **1**

Factor 2 _____ **1**

(*b*) At the end of the experiment, the cloudiness in the liquids was observed.

Predict and explain the appearance of the liquid in test tube A at the end of the experiment.

Prediction _____ **1**

Explanation _____

_____ **1**

Marks

8. (continued)

(*c*) Micro-organisms are used in the production of preservatives for the food industry.

Draw a line from **each** micro-organism to the preservative that it produces.

Micro-organism	***Preservative produced***
	lactic acid
Acetobacter	citric acid
Aspergillus	vinegar

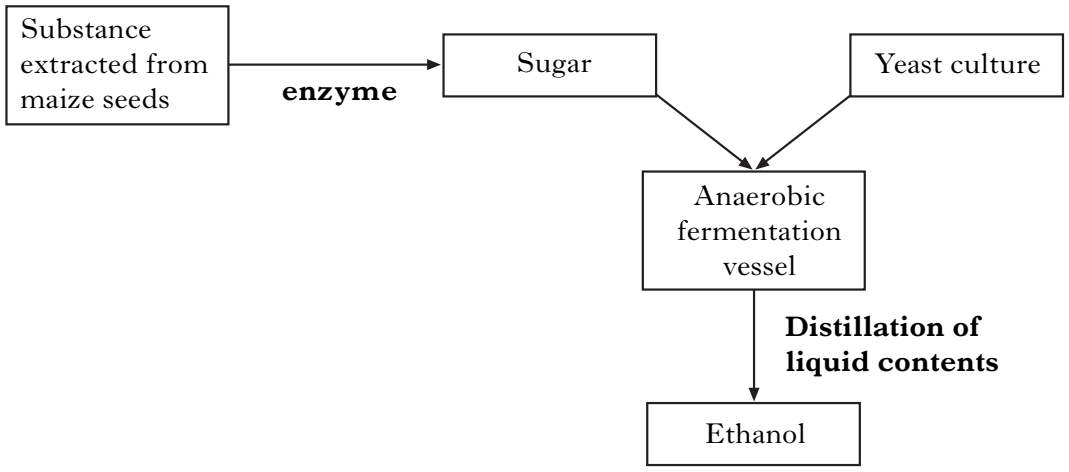
2

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

9. The diagram below shows some stages in the industrial process for making ethanol from a substance extracted from maize seeds.



(*a*) Name the substance extracted from maize seeds which is broken down by the enzyme into sugar.

_____ **1**

(*b*) Explain why it is important that conditions in the fermentation vessels are anaerobic, rather than aerobic.

_____

_____

_____ **1**

(*c*) Explain why the liquid contents of the fermenter are distilled in the final stage of ethanol production.

_____

_____ **1**

(*d*) Suggest one use for the ethanol made by this industrial process.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

9. (continued)

(*e*) The table below shows the increase in the concentration of ethanol during fermentation.

Time (hours)	*Ethanol concentration* (%)
5	0·7
10	2·2
15	3·8
20	7·6
25	8·8
30	9·2

(i) During which 5 hour period did the concentration of ethanol increase the most?

Space for calculation

from _____ hours to _____ hours **1**

(ii) Calculate the percentage increase in ethanol concentration between 10 hours and 25 hours.

Space for calculation

_____% **1**

[Turn over

Marks

10. (*a*) Various biotechnology techniques are used in agriculture.

Decide if the following statements about biotechnology techniques used in agriculture 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(s) underlined in the statement.

Statement	*True*	*False*	*Correction*
Tissue culture can be used to produce many plants from a small sample			
Selective breeding can be used to introduce desirable characteristics from different species into an organism			
Genome mapping is used to identify desirable chromosomes for breeding			

3

(*b*) Soil inoculants can be used in agriculture.

Draw a line from each soil inoculant to the correct agricultural use.

Soil inoculant	***Agricultural use***
	Increases yield of legumes
Rhizobium inoculant	Establishes plants in land reclamation
Mycorrhizal inoculant	Improves preservation of silage's nutritional value

2

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

DO NOT WRITE IN THIS MARGIN

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.

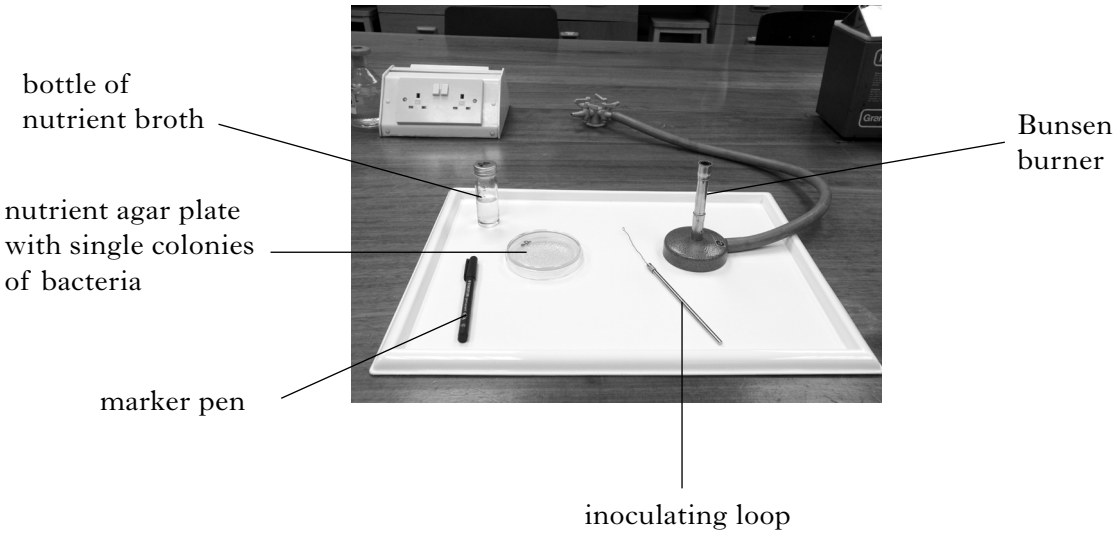
Supplementary sheets, if required, may be obtained from the invigilator.

Labelled diagrams may be included where appropriate.

Marks

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

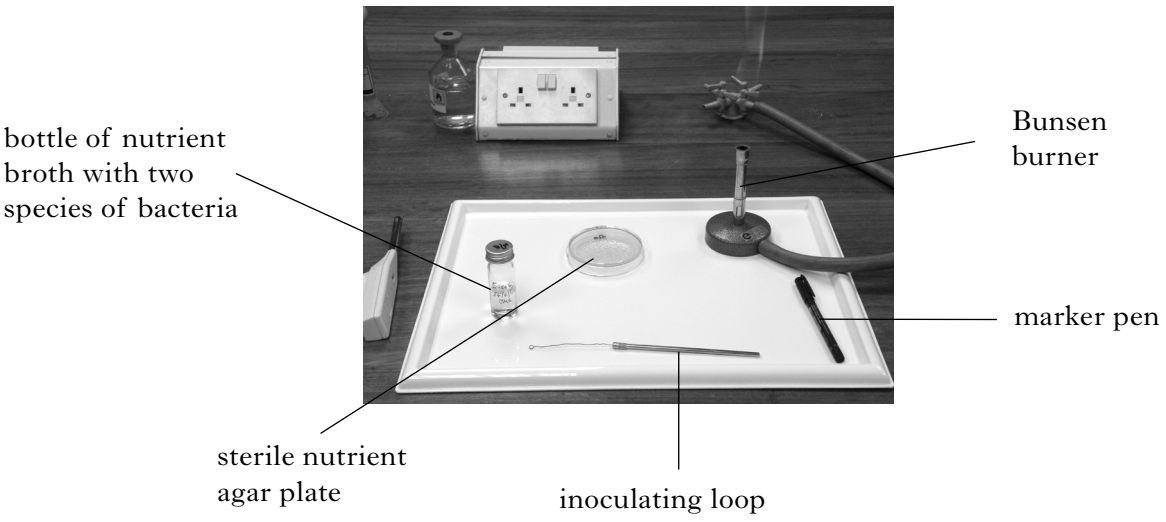
A. The photograph below shows the equipment needed for the aseptic transfer of bacteria from a nutrient agar plate to liquid nutrient broth using a loop.



Describe the steps involved in this procedure. **5**

OR

B. The photograph below shows the equipment that can be used to separate two species of bacteria from a nutrient broth culture.



Describe the steps involved in separating the two species of bacteria using a streak plate. **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.

DO NOT WRITE IN THIS MARGIN

Marks

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

A. The fungus *Penicillium* can be grown in suspension under controlled conditions in a fermenter.

Name three of these conditions and explain the importance of controlling each of them. **5**

OR

B. Single cell protein (SCP) can be produced by a biotechnological process.

Describe this process to include the raw materials used and the benefits and uses of the SCP. **5**

[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

Marks

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

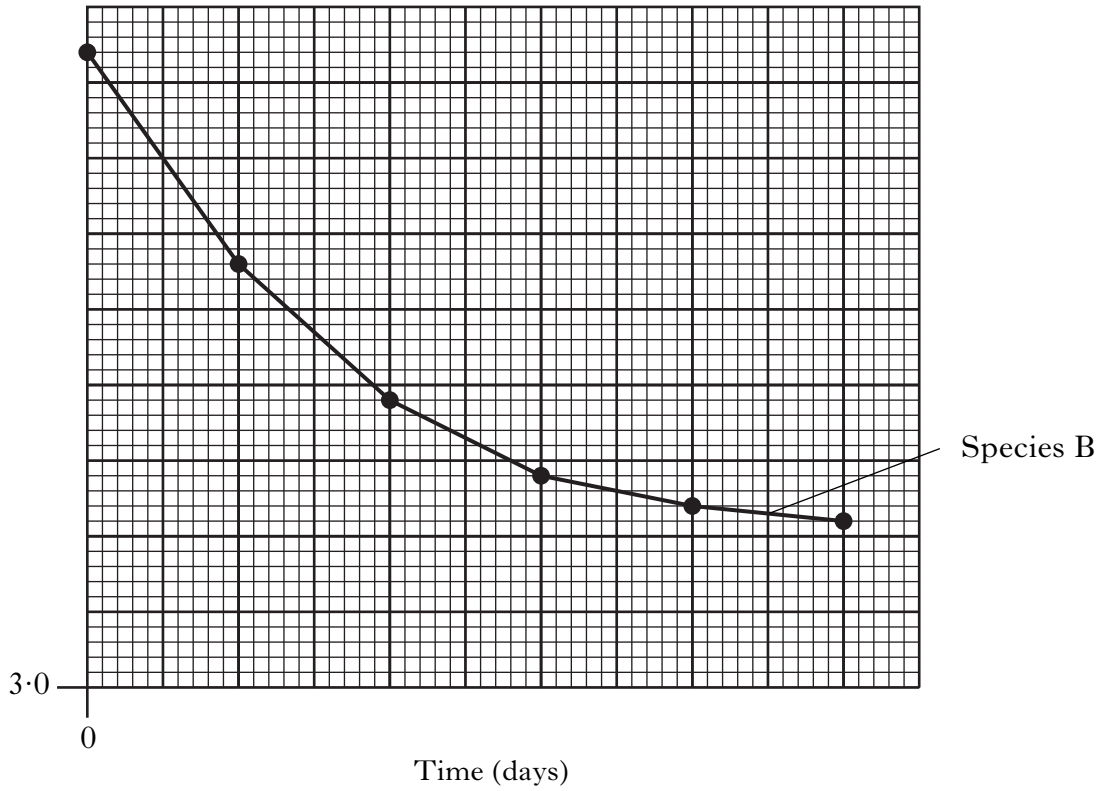
ADDITIONAL SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

Marks

ADDITIONAL SPACE FOR ANSWERS

Additional graph paper for use in Question 7(*a*)(i).



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