FOR OFFICIAL USE

Total for Sections B and C

X008/201

NATIONAL QUALIFICATIONS 2007

THURSDAY, 17 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 fair 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 exam, 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?

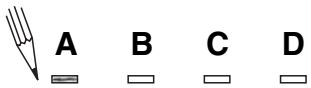
A Butter

B Bread

C Sugar

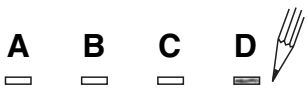
D Apple

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**.



1. Which line in the table describes correctly the structure of bacteria?

	Nucleus	*Cell wall*	*Vacuole*
A	present	absent	absent
B	absent	present	absent
C	present	absent	present
D	absent	present	present

2. Some species of fungi make an enzyme which breaks down proteins into

A amino acids

B glucose

C ethanol

D lactic acid.

3. Bacteria which are facultative anaerobes can be grown in the

A presence of oxygen and carbon dioxide only

B presence of oxygen only

C absence of oxygen only

D absence or presence of oxygen.

4. Exchange of genetic material in bacteria occurs by

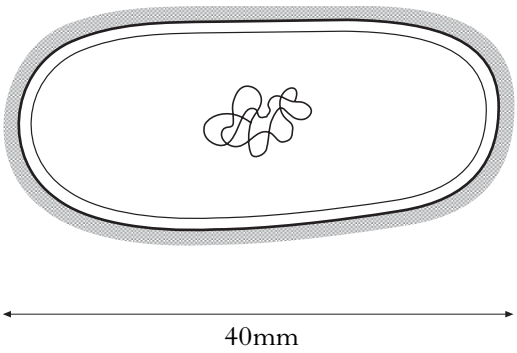
A conjugation

B replication

C budding

D binary fission.

5. The diagram below shows a micro-organism at a magnification of × 40 000.



(1 millimetre = 1000 micrometres)

The actual length of this micro-organism is

A 0·001 micrometre

B 1·0 micrometre

C 1·0 millimetre

D 40 millimetres.

6. Photosynthesis in algae is limited by

A light intensity, oxygen concentration and temperature

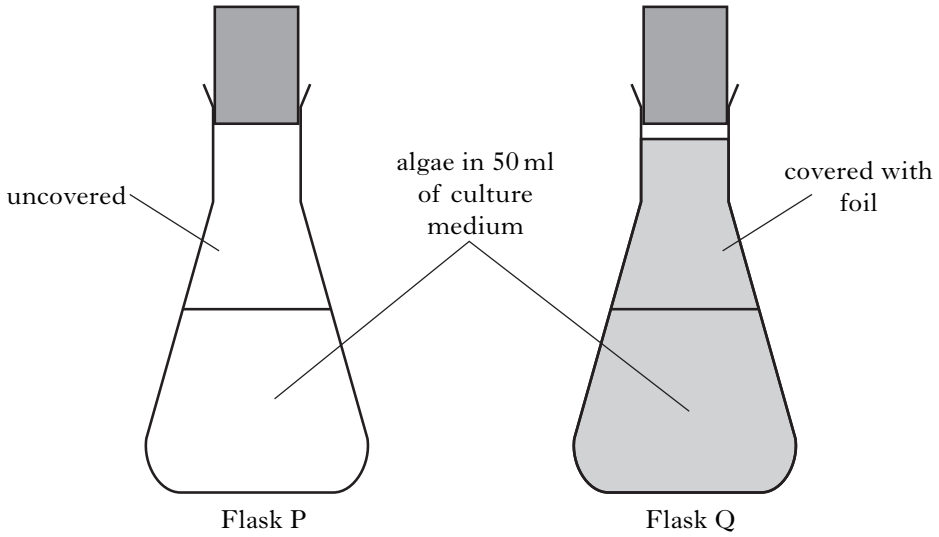
B oxygen concentration, light intensity and carbon dioxide concentration

C carbon dioxide concentration, temperature and light intensity

D temperature, oxygen concentration and carbon dioxide concentration.

[Turn over

7. Two flasks were set up as shown in the diagram below.



The concentration of oxygen in both flasks was measured at the start of the experiment. The flasks were exposed to a light source for 3 hours and the concentration of oxygen measured again.

Which line in the table correctly describes the change in concentration of oxygen in each flask?

	Oxygen concentration in Flask P	*Oxygen concentration in Flask Q*
A	Unchanged	Increased
B	Decreased	Increased
C	Decreased	Unchanged
D	Increased	Decreased

8. The complex molecule cellulose is a

A carbohydrate made from lactose

B protein made from lactose

C carbohydrate made from glucose

D protein made from glucose.

9. The following statements describe some of the steps involved in the removal of a cube of fungal mycelium from an agar plate using aseptic technique.

W flame the scalpel blade

X lift the lid of the agar plate

Y dip the scalpel blade in ethanol

Z cut and remove a cube of fungal mycelium

Which is the correct order of the steps?

A W → X → Z → Y

B X → Y → W → Z

C Y → W → X → Z

D X → Z → W → Y

Questions 10, **11** and **12** refer to the following information.

An experiment was set up to compare the growth of fungi in different culture media. The increase in biomass in the flasks was measured after 24 hours and is shown in the table.

Flask	*Concentration of nitrate* (mg per litre)	*Concentration of phosphate* (mg per litre)	*Percentage increase in biomass* (%)
P	4	0	3
Q	2	1	9
R	2	2	12
S	6	2	18

10. Which flasks should be compared to show the effect of phosphate concentration on the increase in biomass of fungi?

A P and Q

B Q and R

C P and R

D R and S

11. The simple whole number ratio of the percentage increase in biomass in flask P to flask S is

A 1 : 6

B 2 : 3

C 3 : 18

D 6 : 1.

12. Which of the following factors would affect the growth of fungi in this experiment?

A Temperature only

B Light only

C Carbon dioxide concentration only

D Light and carbon dioxide concentration

13. Which of the following equations describes anaerobic respiration in yeast cells?

A glucose + oxygen → energy + ethanol + water

B glucose → energy + carbon dioxide + water

C glucose + oxygen → energy + carbon dioxide + water

D glucose → energy + ethanol + carbon dioxide.

14. Which type of micro-organism forms mycorrhizal associations with plants?

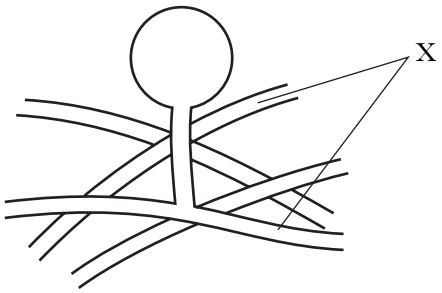
A Algae

B Bacteria

C Fungi

D Protozoa

15. The diagram below shows the structure of *Mucor* during reproduction.



The structure labelled X is a

A gamete

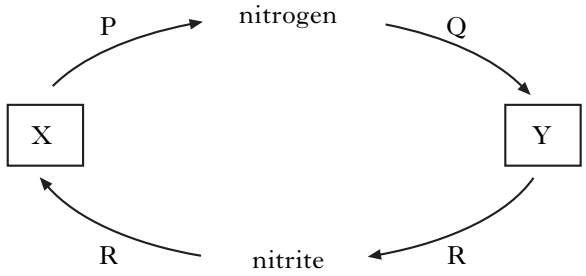
B mycelium

C zygospore

D sporangium.

[Turn over

Questions 16 and **17** refer to the diagram below which summarises the cycling of nitrogen by micro-organisms.



16. Compound X is

A amino acid

B ammonia

C nitrate

D protein.

17. Process R is

A denitrification

B nitrification

C nitrogen fixation

D respiration.

18. The name of the bacterium involved in nitrogen fixation is

A *Acetobacter*

B *E. coli*

C *Lactobacillus*

D *Rhizobium*.

19. A packet of nutrient broth powder contains the following chemicals.

Glucose	20 g
Peptone	15 g
Beef extract	10 g
Sodium chloride	5 g

This packet makes 0·5 litre of nutrient broth.

What mass of peptone would be present in 250 cm^3 of this liquid nutrient broth?

A 3·75 g

B 7·50 g

C 15·00 g

D 30·00 g

20. The micro-organism which is used to produce citric acid is a

A fungus called *Saccharomyces*

B bacterium called *Saccharomyces*

C fungus called *Aspergillus*

D bacterium called *Aspergillus*.

21. The following statements describe some of the steps involved in the production of human insulin from *E. coli*.

V Human insulin gene inserted into plasmid

W *E. coli* produce human insulin

X Human insulin is separated and purified

Y Plasmid containing human insulin gene returned to *E. coli*

Z Human insulin gene isolated

Which is the correct order of the steps?

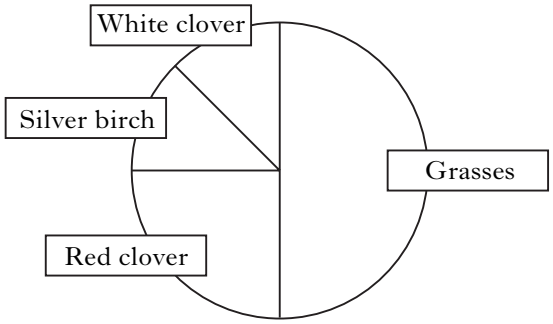
A X → Z → V → W → Y

B Z → V → Y → W → X

C X → V → Z → Y → W

D Z → W → Y → X → V

22. The pie chart below illustrates the mixture of plants found in an area of poor soil.



The percentage of clover found in this area of land is

A 62·5%

B 37·5%

C 25·0%

D 12·5%.

23. Single cell protein (SCP) can be produced by growing micro-organisms on waste materials.

Which line in the table identifies correctly the waste material used and its source in SCP production?

	Waste material	*Source of waste material*
A	Whey	Cheese industry
B	Molasses	Cheese industry
C	Starch	Sugar refining
D	Ethanol	Sugar refining

24. The table below shows the change in average live mass of chickens produced in the USA from 1920 to 2000. This change in average live mass has been due largely to a selective breeding programme.

Year	*Average live mass* (units)
1920	2·0
1930	2·5
1940	3·0
1950	3·1
1960	3·4
1970	3·8
1980	4·0
1990	4·5
2000	8·5

One conclusion which can be drawn from this data is

A the increase in average live mass was greater between 1950 and 1960 than between 1980 and 1990

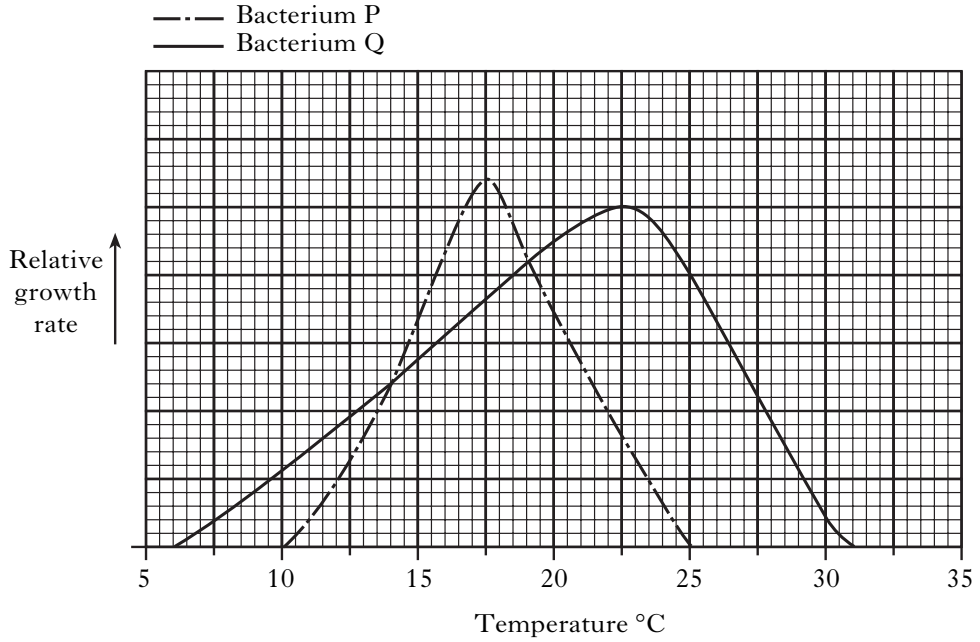
B the largest increase in average live mass was between 1920 and 1930

C the smallest increase in average live mass was between 1940 and 1950

D the increase in average live mass was greater between 1960 and 1970 than between 1930 and 1940.

[Turn over

25. The graph below shows the effect of temperature on the growth of two different species of bacteria (P and Q).



Which of the following statements correctly describes the growth of bacteria P and Q in the temperature range of 17·5 °C – 20 °C?

A P increases and Q increases

B P decreases and Q increases

C P increases and Q decreases

D P decreases and Q decreases

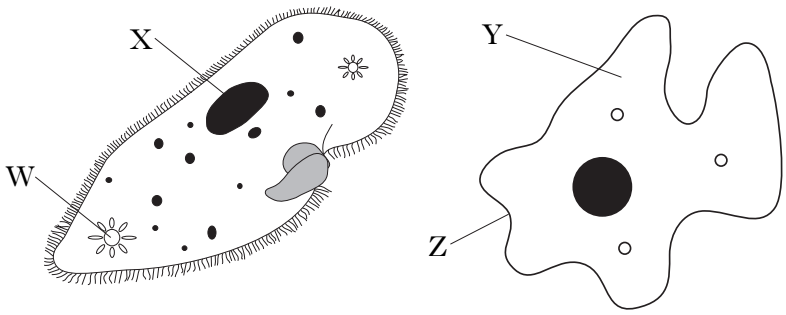
Candidates are reminded that the answer sheet for Section A MUST be returned INSIDE the front cover of this answer book.

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 two different protozoa.



List
cytoplasm
flagellum
plasmid
contractile vacuole
nucleus

(*a*) Identify structures W, X and Y using the appropriate word(s) from the list.

W _____

X _____

Y _____ **2**

(*b*) What is the function of structure Z in protozoa?

_____ **1**

(*c*) Protozoa can be stained before being observed under the microscope.
Explain the reason for staining protozoa.

_____

_____ **1**

(*d*) **Vital** stains are often used with protozoa.
Give **one** advantage of using a **vital** stain.

_____

_____ **1**

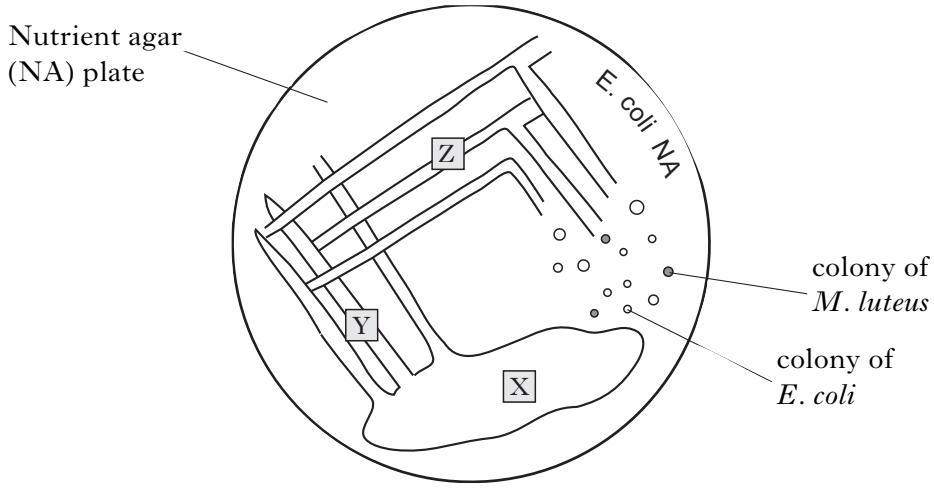
(*e*) Name **one** structure found in algae that is not present in protozoa.

_____ **1**

Marks

2. A student was asked to produce a streak plate inoculation from a mixed broth culture of *E. coli* and *M. luteus*.

The diagram below shows the results of this streaking out.



The statements below show the steps taken to produce this streak plate.

P Draw out 3 streaks from area Y

Q Apply inoculum to area X by repeated streaking

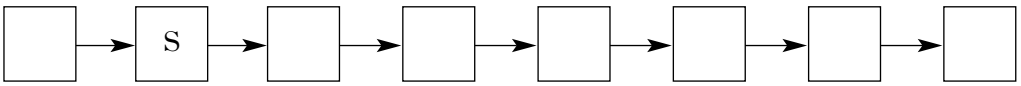
R Draw out 3 streaks from area Z

S Flame inoculating loop

T Draw out 3 streaks from area X

(*a*) Place the steps in the correct order by inserting a letter into each box.

Each letter may be used **once** or **more than once**.



2

(*b*) Explain the importance of flaming the inoculating loop during streak plating.

_____

_____ **1**

(*c*) Give **two** reasons why streak plating is carried out with a mixed broth culture of *E. coli* and *M. luteus*.

Reason 1 _____

_____ **1**

Reason 2 _____

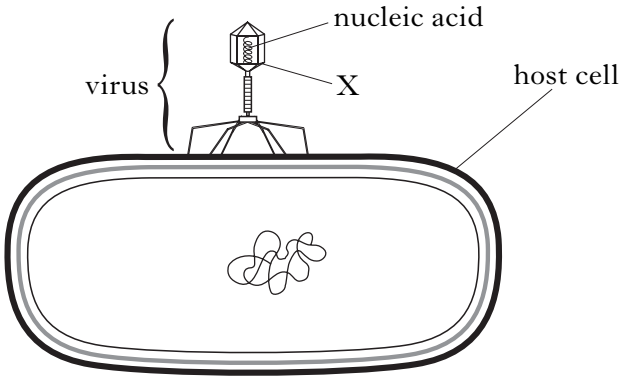
_____ **1**

(*d*) What **two** items are missing from the labelling of the streak plate?

_____ **1**

Marks

3. The diagram below shows a virus which has attached to a host cell.



(*a*) What is structure X made from?

_____ **1**

(*b*) Describe the next step in the infection of the host cell.

_____

_____ **1**

(*c*) Name the **two** types of nucleic acid that could be present in viruses.

_____

_____ **2**

(*d*) What type of micro-organism is the host cell?

_____ **1**

(*e*) Biotechnologists describe viruses as non cellular structures.
Give **one** reason why viruses are referred to as non cellular structures.

_____

_____ **1**

[Turn over

Marks

4. (*a*) Some steps in the manufacture of cheese are given below.

Step 1 Milk is pasteurised by heating to 72 °C for 16 seconds.

Step 2 The milk is then pumped into a cheese vat and kept at 35 °C.

Step 3 A culture of micro-organisms is added to the milk in the cheese vat.

Step 4 After 2 days, rennin (an enzyme) is added and the temperature is kept at 35 °C.

Step 5 Solid material (cheese) forms and is separated, pressed and matured for several months.

(i) Suggest a reason why the milk is heated to 72 °C for 16 seconds in **Step 1**.

_____

_____ **1**

(ii) Identify the type of micro-organism involved in **Step 3** in the manufacture of cheese.

Underline the correct answer.

algae bacteria protozoa viruses **1**

(iii) During **Steps 3** and **4**, the pH value of the milk changes from a starting value of 6·5.

Predict the pH range of the milk at the end of **Step 4**.

Tick (✓) the correct box.

pH range

4·0 – 5·0 ☐

6·5 – 7·5 ☐

8·0 – 9·0 ☐

9·5 – 10·5 ☐ **1**

(iv) Why is it important that the temperature is maintained at 35 °C during **Step 4**?

_____

_____ **1**

(*b*) Give **one** benefit of converting milk to cheese.

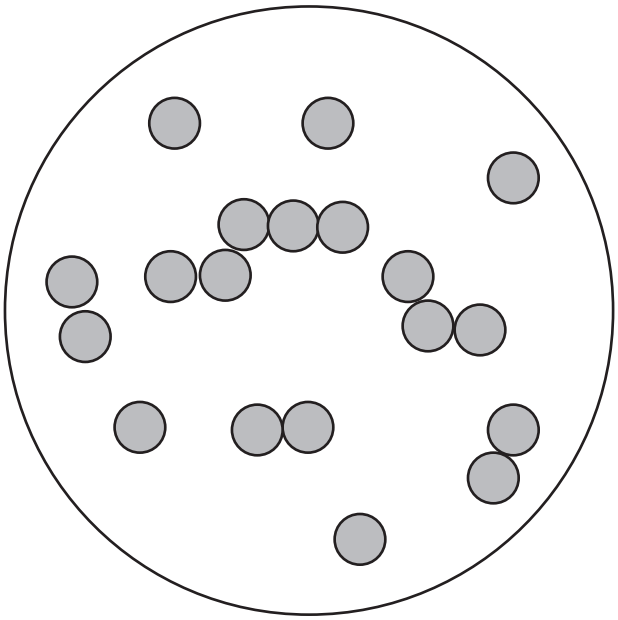
_____

_____ **1**

Marks

4. (continued)

(*c*) The diagram below shows the shape of some of the micro-organisms involved in cheese manufacture as they appear under the microscope.

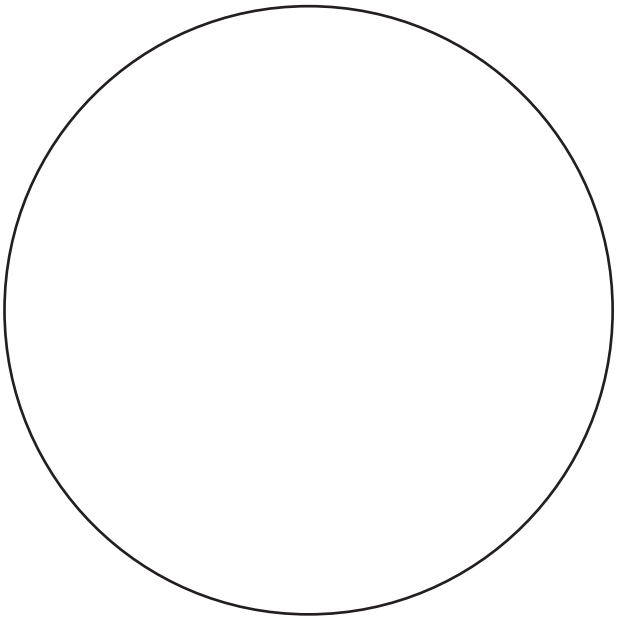


(i) What term is used to describe the shape of these round micro-organisms?

_____ **1**

(ii) A second species of micro-organism called *Lactobacillus* is also present in the culture added to the milk in **Step 3**.

Draw some *Lactobacilli*, showing their shape, in the circle below.



1

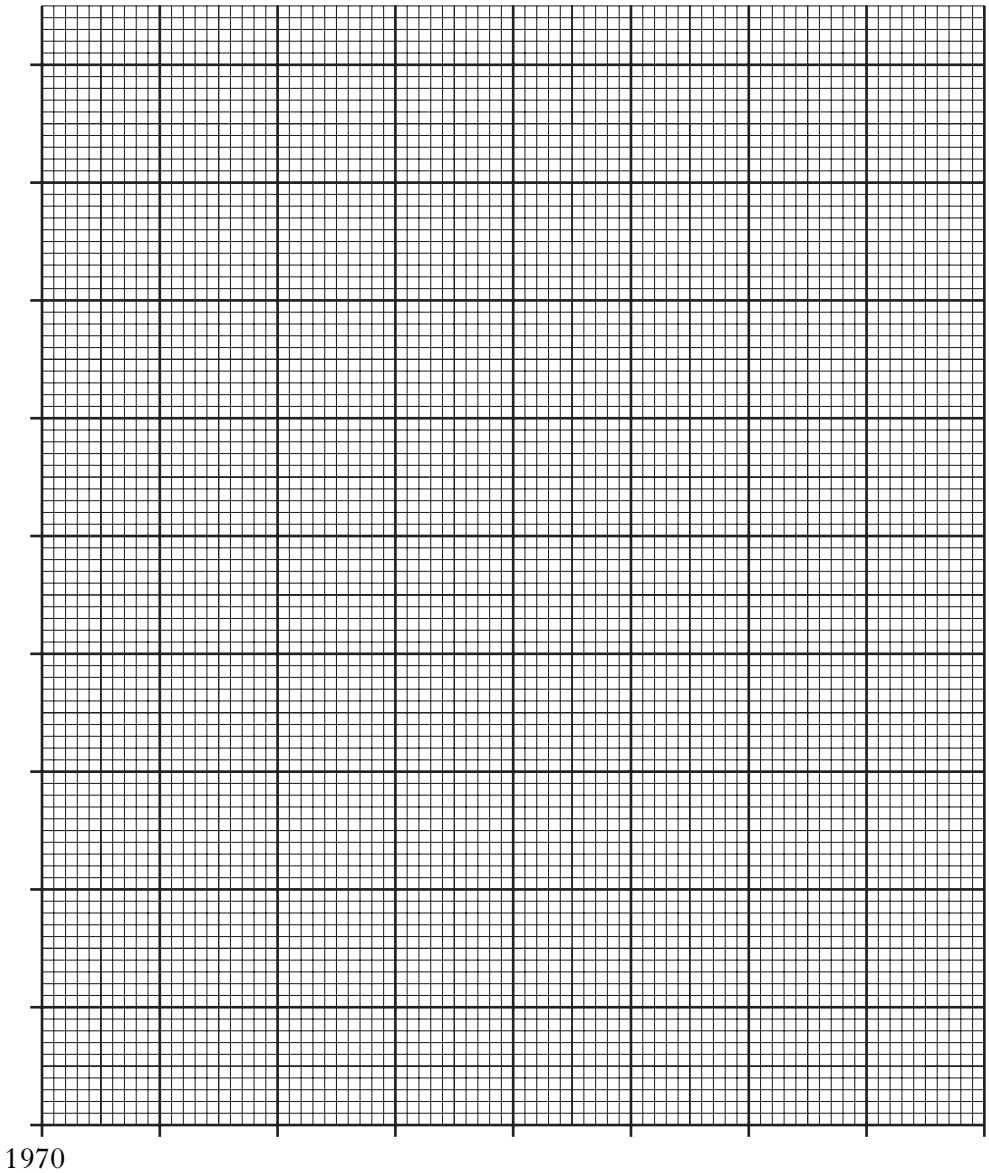
Marks

5. Over the last 35 years, selective breeding has led to a major reduction in the fat content of pork. The table below shows the average fat thickness in pigs between 1972 and 2006.

Year	*Average fat thickness* (mm)
1972	18
1985	16
1997	12
2006	4

(*a*) Use the information in the table to draw a **line graph** showing the change in average fat thickness between 1972 and 2006.

(Additional graph paper, if required, can be found on page 28.)



1970

3

Marks

5. (continued)

(*b*) Calculate the percentage decrease in fat thickness in pigs between 1985 and 2006.

Space for calculation

_____ % **1**

(*c*) Selective breeding of animals takes place over a number of generations.

Describe what happens during selective breeding of animals.

_____

_____

_____

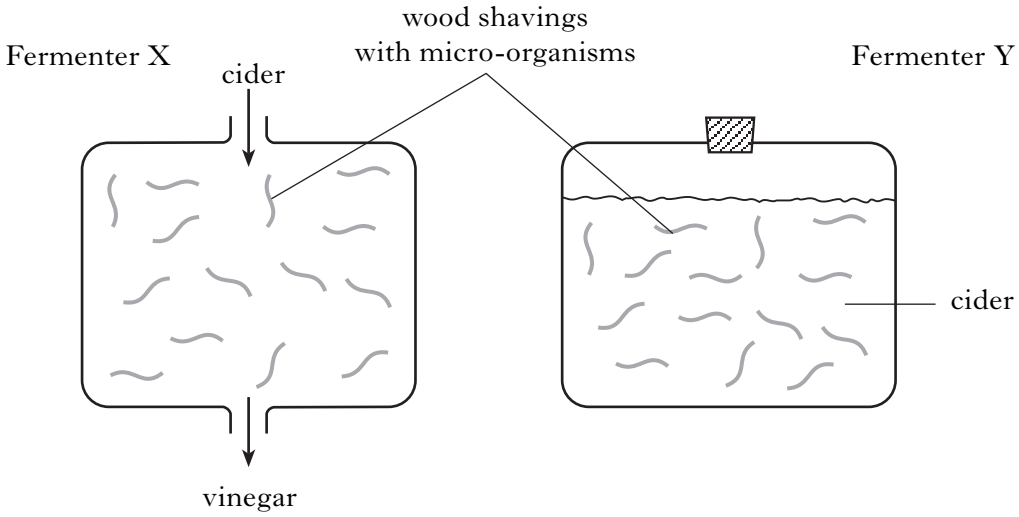
_____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

6. A student compared cider vinegar production in two different fermenters (X and Y), as shown in the diagram below.



(*a*) The bacteria in the fermenters are immobilised onto wood shavings.

Give an advantage of immobilising the micro-organisms in this experiment.

_____

_____ **1**

(*b*) Name the type of processing that occurs in fermenter Y.

_____ **1**

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

The type of micro-organism involved in vinegar production is a {bacterium / fungus} called {*Acetobacter* / *Aspergillus*}. The substance in the stale cider that is converted into vinegar is {molasses / ethanol}. **3**

(*d*) Give **one** use of vinegar in the food industry.

_____ **1**

7. A fish farmer noticed that many of his fish were infected with a white fungus.

(*a*) As the fungus grew, damage was observed on the tails of the fish.

What type of nutrition is involved in the damage to the tails of the fish?

Underline the correct response.

photosynthetic saprophytic parasitic **1**

(*b*) Damage to the fish is caused by the action of enzymes.

Give a reason why the fungus produces these enzymes.

_____ **1**

(*c*) Antibiotics can be used to treat fungal infections. The fish were treated by adding broad-spectrum antibiotics to their water.

Explain why a broad-spectrum antibiotic was used, rather than a narrow-spectrum antibiotic.

_____

_____

_____ **2**

(*d*) Some of the fish died and started to decay due to the action of micro-organisms. This decay process leads to the re-cycling of the elements carbon and nitrogen.

Which **two** of the following substances contain both carbon and nitrogen?

Tick (✓) the **two** correct boxes.

Glucose ☐

Amino acids ☐

Proteins ☐

Starch ☐ **1**

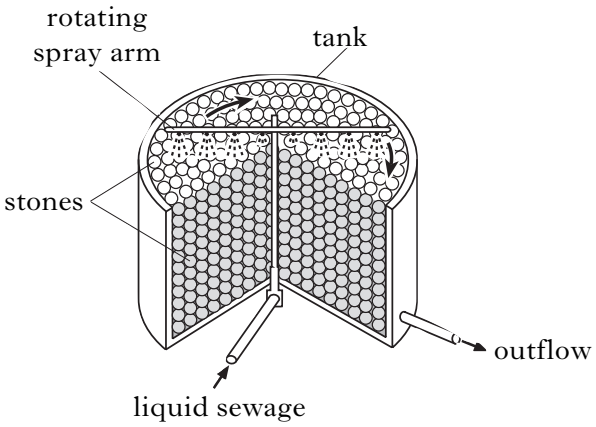
[Turn over

Marks

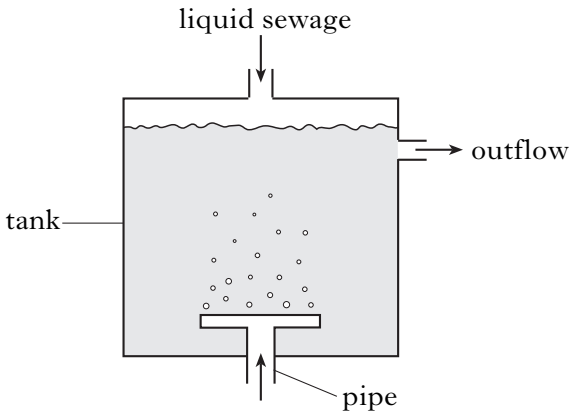
8. During sewage treatment, the liquid sewage is separated from the solid sewage. Micro-organisms are used in the breakdown of the liquid sewage.

The diagram below shows two different treatments of the liquid sewage.

Treatment X



Treatment Y



(*a*) (i) The same type of respiration occurs in both treatments.

Name this type of respiration.

_____ **1**

(ii) The conditions required for this type of respiration are created by different methods in treatments X and Y.

Use the information in the diagram to describe these methods.

Treatment X _____

_____ **1**

Treatment Y _____

_____ **1**

(*b*) Draw one line connecting each treatment to its name.

Treatment	*Name*
	Sedimentation
X	
	Activated sludge
Y	
	Biological filter

2

Marks

8. (continued)

(*c*) Treatment of sewage requires a large variety of micro-organisms to be involved.

Why are many different types of micro-organisms needed for treatment of sewage?

_____

_____ **1**

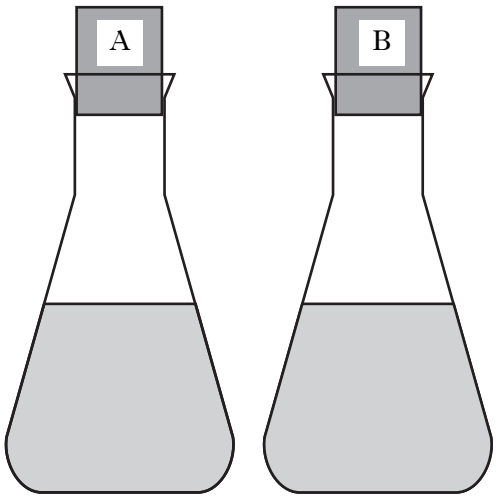
(*d*) Name **one** contaminant which interferes with sewage treatment.

_____ **1**

[Turn over

Marks

9. The diagram and table below shows details of an experiment set up to investigate the production of citric acid by fungi.



Contents of flask	*Volume in flask* (cm^3)	
	A	*B*
Fungal culture	1	1
1% sucrose solution	45	45
5% calcium chloride	4	0
Water	0	4

(*a*) What variable is under investigation in this experiment?

_____ **1**

(*b*) Name **one** factor, **not shown** in the diagram or the table, which should be kept the same to make this experiment valid.

Factor _____ **1**

(*c*) Explain the reason for adding 4 cm^3 of water to flask B in this experiment.

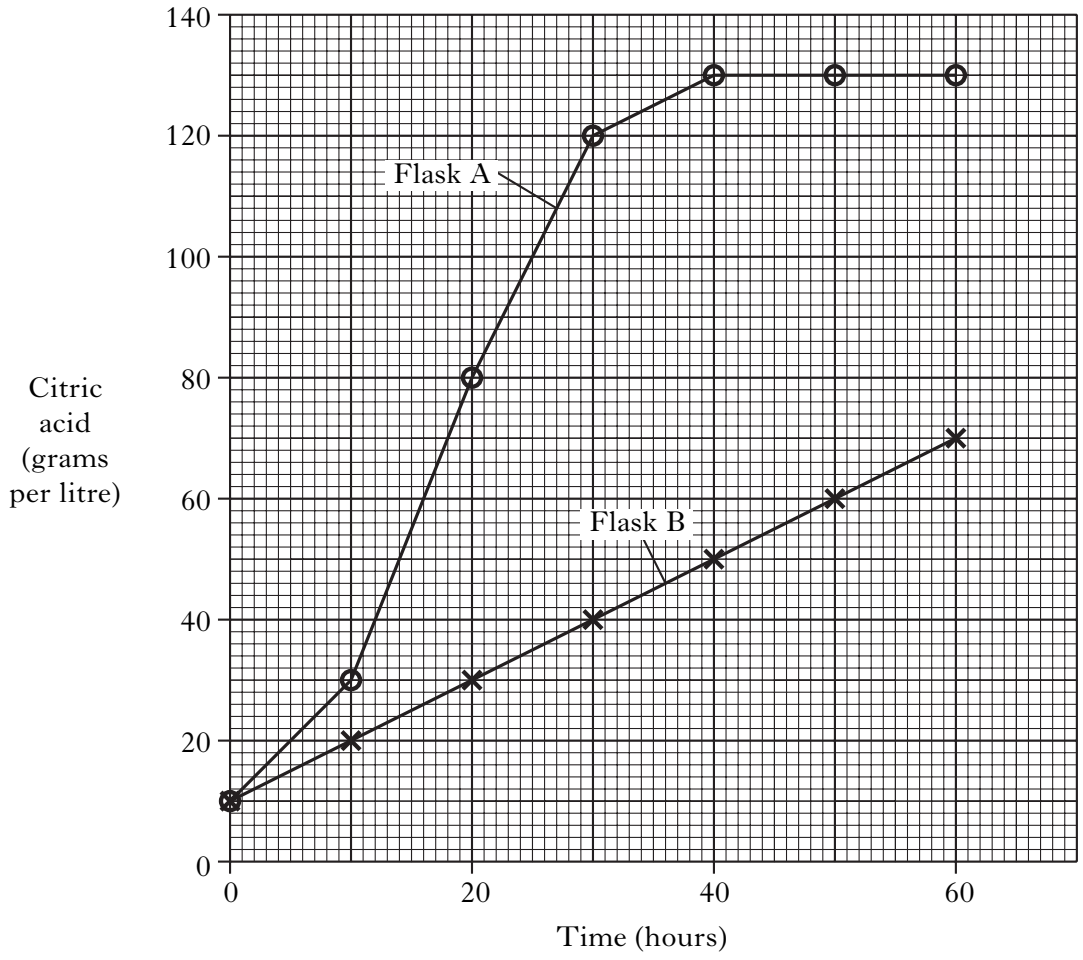
_____

_____ **1**

Marks

9. (continued)

(*d*) The graph below shows the results of this experiment.



(i) What effect does the contents of Flask A have on citric acid production?

_____ **1**

(ii) Describe the production of citric acid in Flask A between 0 and 60 hours.

_____

_____

_____ **2**

(iii) At what times do Flask A and Flask B produce 60 grams per litre of citric acid?

Flask A _____ hours Flask B _____ hours **1**

(iv) Predict the concentration of citric acid produced after 65 hours in Flask B.

_____ grams per litre **1**

Marks

10. Corn crops can be used for silage production. Trials were set up to compare the sugar content of different varieties of corn crops.

The table below shows the results of these trials.

Variety of corn crop	*Sugar content* (units)
Master's choice	8·5
North	8·7
Prairie Seed	8·7
Speedway	9·2
Pioneer	9·7
Mid-Atlantic	9·8

(*a*) Calculate the average sugar content of the varieties shown in the table.

Space for calculation

_____ units **1**

(*b*) Name **two** factors that should be kept constant on the farms when carrying out these trials.

Factor 1 _____ **1**

Factor 2 _____ **1**

(*c*) Which variety of corn crop would a farmer select for silage production?

_____ **1**

Give a reason for your answer.

_____

_____ **1**

(*d*) After harvesting, the corn was placed in plastic bags and tightly sealed.

Why is it important to seal the bags **tightly** during silage production?

_____ **1**

Marks

10. (continued)

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

During silage production, the temperature in the sealed bags {increases / decreases}.

The action of bacteria causes the pH to {increase / decrease} which prevents {putrefaction / fermentation} taking place. **2**

[Turn over

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SECTION C

Both questions in this section should be attempted.

Note that each question contains a choice.

Marks

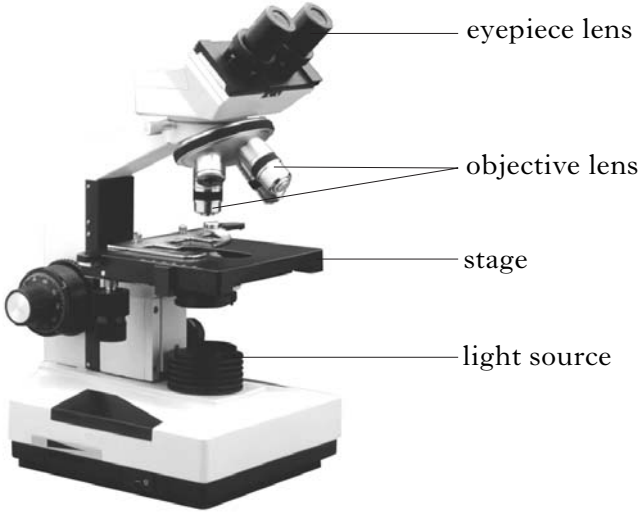
Questions 1 and 2 should be attempted on the blank pages which follow.

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

Labelled diagrams may be included where appropriate.

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

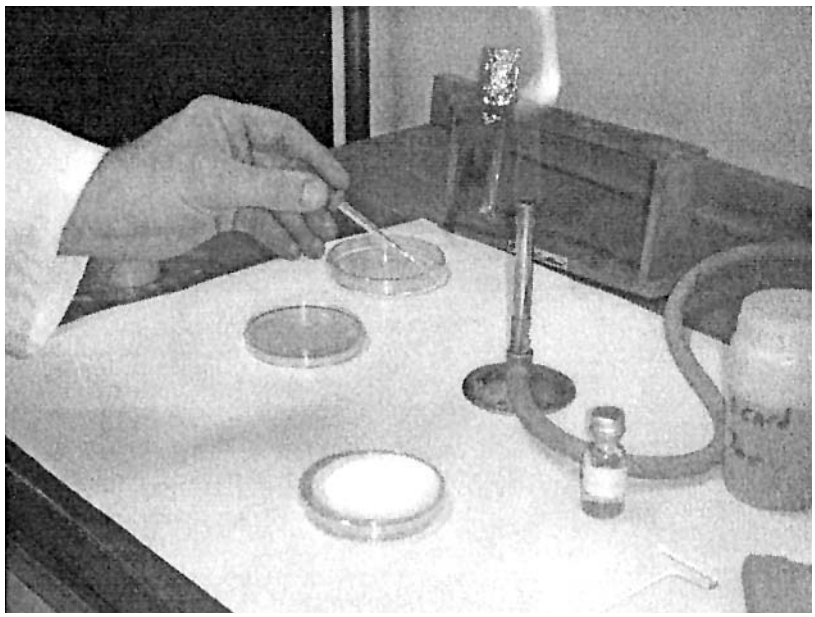
A. The photograph below shows a light microscope used for viewing a slide of micro-organisms.



Describe the steps which should be taken to set up the microscope for viewing a slide under the medium power objective lens.

OR

B. The photograph below shows a student who has just completed the aseptic transfer of bacteria from nutrient broth to nutrient agar using a sterile pipette. **5**



Describe the next steps that should be taken to make the work space and the student safe before the student leaves the laboratory. **5**

Question 2 is on *page twenty-six*

SPACE FOR ANSWER TO QUESTION 1

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

☐

Marks

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

A. Methane can be produced by a biotechnological process.

Describe this process to include the raw materials used, and **one** use and **one** benefit of the methane. **5**

OR

B. Ethanol can be produced by a biotechnological process.

Describe this process to include the raw materials used, and **one** use and **one** benefit of the ethanol. **5**

[*END OF QUESTION PAPER*]

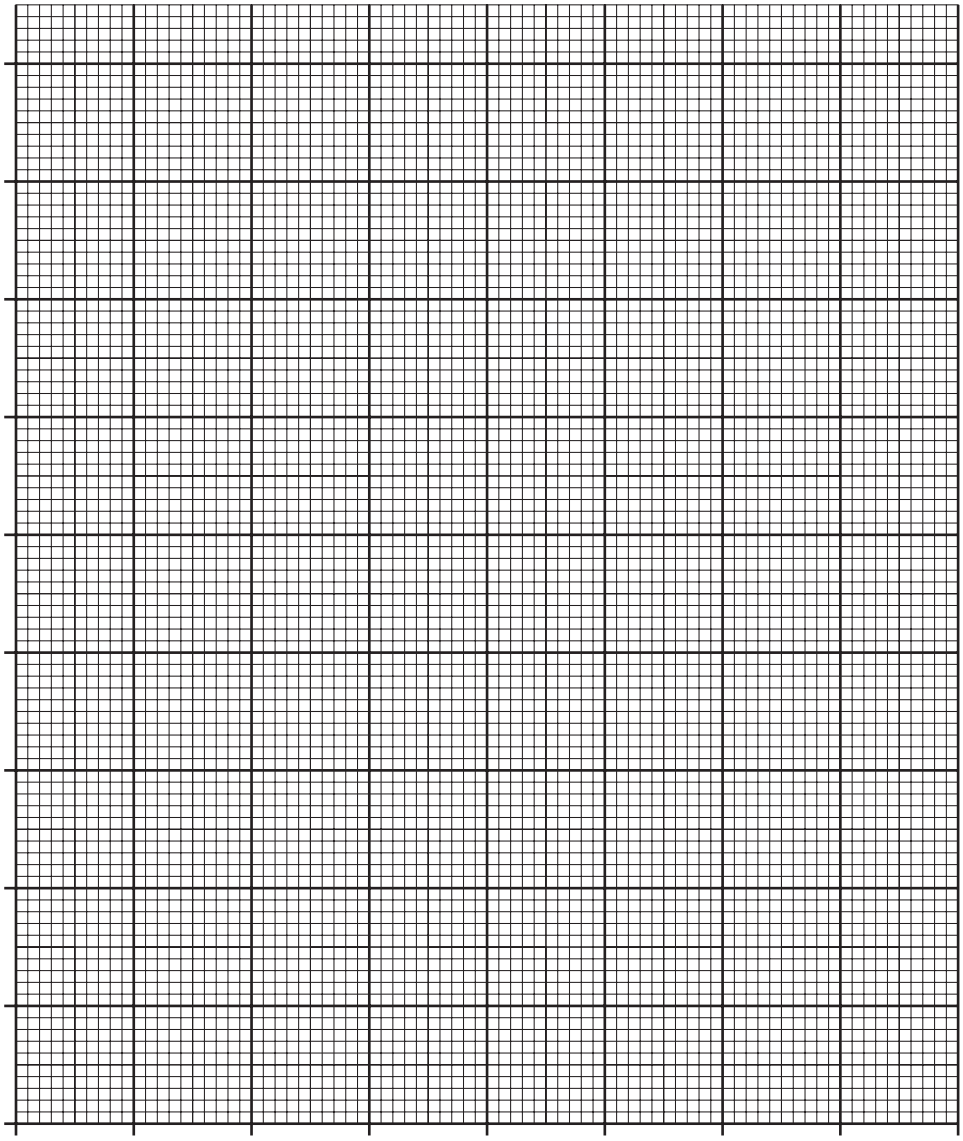
SPACE FOR ANSWER TO QUESTION 2

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

☐

SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 5(*a*)



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ADDITIONAL SPACE FOR ANSWERS

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