

FOR OFFICIAL USE

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Total for
Sections
B and C

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X008/301

NATIONAL
QUALIFICATIONS
2008

WEDNESDAY, 21 MAY
1.00 PM – 3.30 PM

BIOTECHNOLOGY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

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Town

--

Forename(s)

--

Surname

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Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

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SECTION A (30 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 (100 marks)

- All questions should be attempted.
 - It should be noted that in **Section C** questions 1 and 2 each contain a choice.
 - Question 4 is on pages 16, 17 and 18. Question 5 is on page 19. Question 6 is on pages 20 and 21. Pages 18 and 19 are fold-out pages.
- 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 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. If further space is required, a supplementary sheet for rough work may be obtained from the invigilator.
- 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

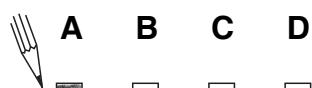
- 1 Check that the answer sheet provided is for **Biotechnology Higher (Section A)**.
- 2 For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.
- 3 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate Number) 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

What name is given to a culture of micro-organisms which contains more than one species of organisms?

- A Mixed
- B Pure
- C Simple
- D Complex

The correct answer is **A—Mixed**. 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.

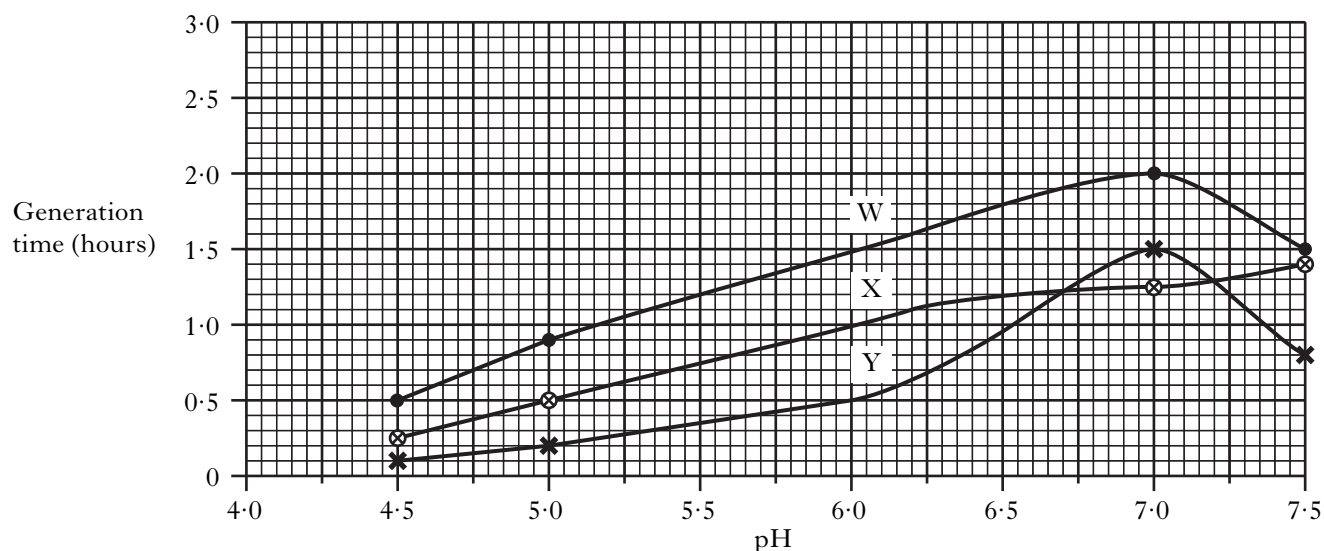
1. Which line in the table below identifies correctly the organelle with its function?

	<i>Golgi apparatus</i>	<i>Lysosome</i>	<i>Ribosome</i>
A	Protein synthesis	Contains digestive enzymes	Modifies and transports materials
B	Modifies and transports materials	Contains digestive enzymes	Protein synthesis
C	Contains digestive enzymes	Modifies and transports materials	Protein synthesis
D	Modifies and transports materials	Protein synthesis	Contains digestive enzymes

2. In anaerobic respiration, ATP is produced

- A during the formation of pyruvic acid from glucose
- B during the formation of lactic acid from pyruvic acid
- C in the Krebs cycle
- D in the cytochrome system.

Questions 3 and 4 refer to the graph below which shows the effect of pH on the generation time of three different bacterial species (W, X and Y).



3. The number of generations per hour for species W at a pH of 7.0 is

- A 0.5
- B 1.0
- C 2.0
- D 4.0.

4. Which of the following statements is true for all three species?

- A The optimum pH for growth is 7.0.
- B They are all killed at pH values above 7.0.
- C As pH increases up to 7.0 the time taken for the bacteria to reproduce decreases.
- D As pH increases up to 7.0 the time taken for the bacteria to reproduce increases.

5. Which line in the table identifies correctly the mRNA codon and tRNA anticodon for the DNA triplet TAC?

	<i>mRNA codon</i>	<i>tRNA anticodon</i>
A	AUG	TAC
B	ATG	TAC
C	AUG	UAC
D	ATG	UAC

6. Two enzymes involved in the synthesis and modification of DNA are described below.

Enzyme X catalyses the addition of single nucleotides to DNA strands.

Enzyme Y catalyses the joining of small sections of DNA.

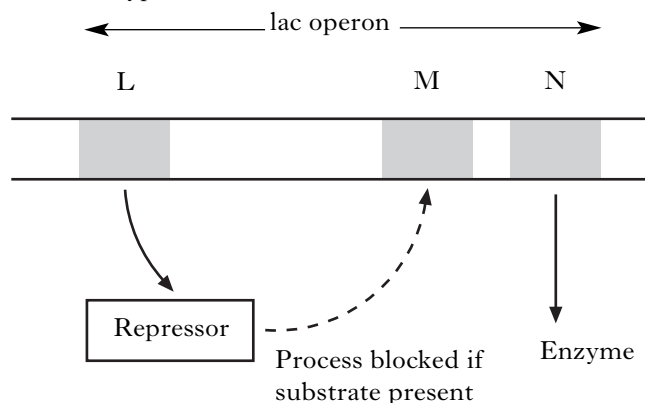
Which line in the table identifies correctly enzyme X and enzyme Y?

	<i>Enzyme X</i>	<i>Enzyme Y</i>
A	DNA polymerase	DNA ligase
B	DNA ligase	restriction endonuclease
C	restriction endonuclease	DNA ligase
D	DNA polymerase	restriction endonuclease

7. Which line in the table identifies correctly bonds associated with the structure of proteins?

	<i>Primary structure</i>	<i>Secondary structure</i>	<i>Tertiary structure</i>
A	peptide bonds	peptide bonds	hydrogen bonds
B	peptide bonds	hydrogen bonds	hydrogen bonds
C	hydrogen bonds	hydrogen bonds	peptide bonds
D	hydrogen bonds	peptide bonds	hydrogen bonds

8. The diagram below illustrates the control of enzyme synthesis as suggested by the Jacob-Monod hypothesis.



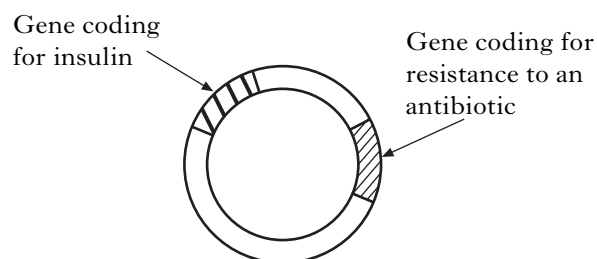
Which line in the table below identifies correctly L, M and N?

	<i>L</i>	<i>M</i>	<i>N</i>
A	operator	structural gene	regulator gene
B	regulator gene	operator	structural gene
C	operator	regulator gene	structural gene
D	structural gene	operator	regulator gene

9. Which of the following procedures in genetic engineering uses the enzyme reverse transcriptase?

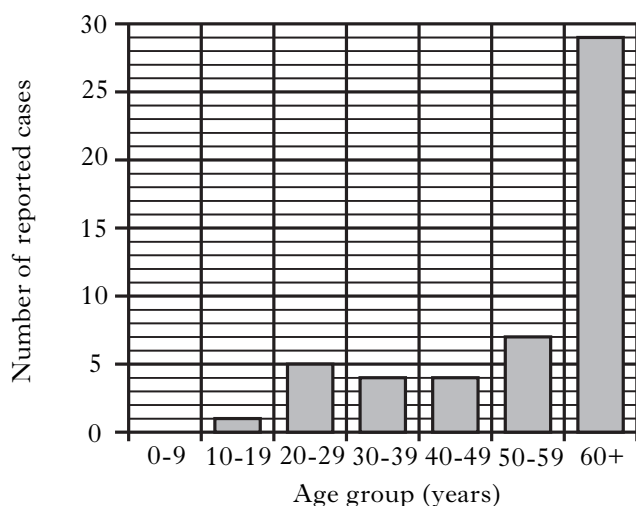
- A Cloning of complementary DNA (cDNA)
- B Labelling of single stranded DNA
- C Cutting DNA at specific sites
- D Formation of complementary DNA (cDNA)

- 10 The diagram below shows a plasmid used to transform bacterial cells for production of insulin.



The gene for antibiotic resistance is used to

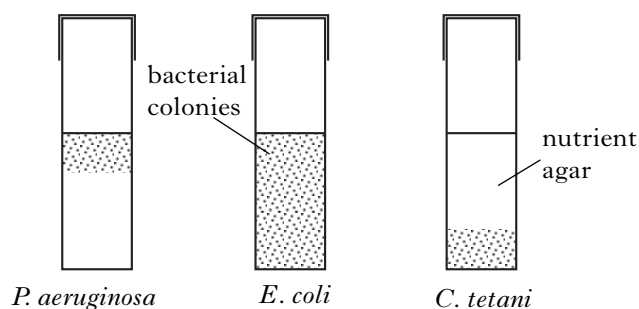
- A identify bacteria which produce insulin
 - B ensure insulin is not affected by antibiotics
 - C assist uptake of the plasmid by the bacteria
 - D allow the bacteria to produce antibiotics.
11. The graph below shows the number of reported cases of tetanus in relation to age.



What is the percentage of total reported cases which occurred in adults aged 40 or over?

- A 4
- B 8
- C 40
- D 80

12. The effect of oxygen on the growth of three bacteria is shown below.



Which line in the table below identifies correctly each of the bacteria?

	<i>Obligate aerobe</i>	<i>Obligate anaerobe</i>	<i>Facultative anaerobe</i>
A	<i>P. aeruginosa</i>	<i>C. tetani</i>	<i>E. coli</i>
B	<i>E. coli</i>	<i>C. tetani</i>	<i>P. aeruginosa</i>
C	<i>P. aeruginosa</i>	<i>E. coli</i>	<i>C. tetani</i>
D	<i>C. tetani</i>	<i>P. aeruginosa</i>	<i>E. coli</i>

13. Some of the steps in Gram staining are shown below.

- W Add alcohol for 10 seconds.
- X Add Grams iodine for 1 minute.
- Y Add pink stain for 30 seconds.
- Z Add crystal violet for 1 minute.

Which of the following is the correct sequence of the steps?

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

[Turn over

14. Bacteria can be tested to show whether they secrete the following enzymes:

Amylase – an enzyme that digests starch

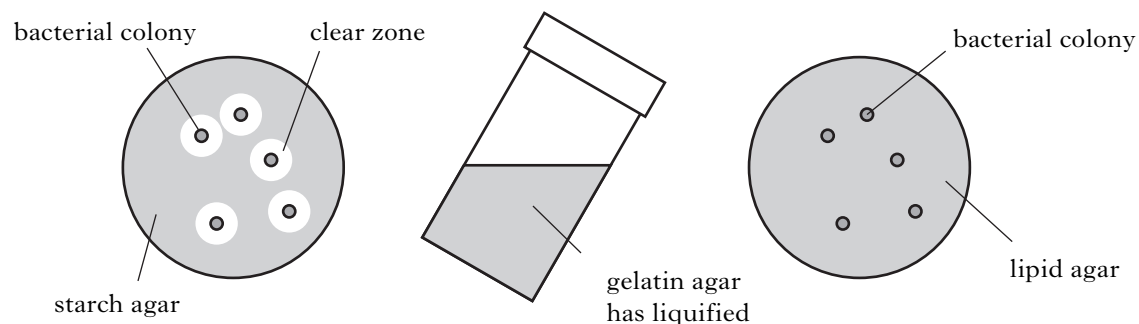
Gelatinase – an enzyme that digests gelatin

Lipase – an enzyme that digests lipid

Bacterium X was tested for each of the enzymes as described below.

Test 1	Test 2	Test 3
Bacterium X inoculated onto a plate of starch agar.	Bacterium X inoculated into a bottle of molten gelatin agar, then agar allowed to set.	Bacterium X inoculated onto a plate of lipid agar.

The results after incubation are shown below.



The results shown above support the conclusion that bacterium X secretes

- A amylase and lipase only
- B gelatinase and lipase only
- C amylase and gelatinase only
- D amylase, gelatinase and lipase.

15. A sparger is used to aerate a fermenter. The most effective design of a sparger would include holes that are

- A large and numerous
- B small and numerous
- C large and few
- D small and few.

16. Which of the following features of protein molecules are used in their purification using column chromatography?

- A Size and shape only
- B Size and charge only
- C Charge and shape only
- D Size, charge and shape

17. Which line in the table below identifies correctly stages that are involved in the processing of intracellular enzymes?

(Key: ✓ = involved — = not involved)

	<i>Stage</i>				
	<i>Cells grown by batch culture</i>	<i>Cells grown by continuous culture</i>	<i>Cells isolated</i>	<i>Cell walls broken down</i>	<i>Filtration and precipitation</i>
A	✓	—	✓	✓	✓
B	—	✓	✓	—	✓
C	✓	—	✓	—	✓
D	—	✓	—	✓	—

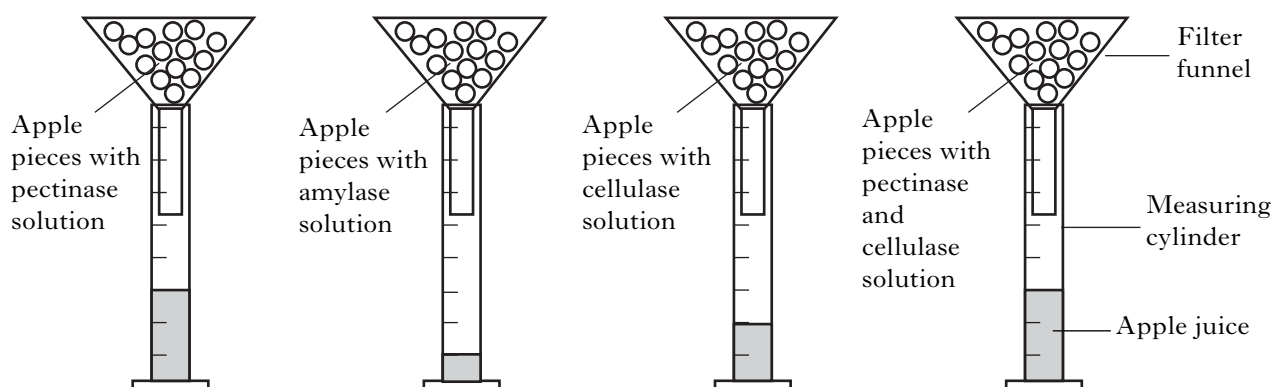
18. Which of the following methods is **not** used in the immobilisation of enzymes?

- A Bonding
- B Flocculation
- C Entrapment
- D Adsorption

[Turn over

Questions 19, 20 and 21 are based on the information given below.

The result of an investigation into the production of juice from apples treated with enzymes is shown below.



19. Based on this result, which of the following enzyme(s) should be recommended for scaling up to industrial production?

- A Pectinase only
- B Cellulase only
- C Pectinase and cellulase
- D Pectinase and amylase

20. A suitable control for this investigation would use identical apparatus and

- A apple only
- B boiled apple only
- C apple and distilled water
- D apple and a solution of all three enzymes.

21. The list contains some precautions that could be taken in this experiment.

- W Apple pieces are the same size.
- X The total volume of enzyme solutions used are the same.
- Y The measuring cylinders have the same volume.
- Z The temperature is kept constant.

Which precautions are essential to ensure the validity of the result of this experiment?

- A W, X and Y only
- B W, X and Z only
- C X, Y and Z only
- D W, X, Y and Z.

22. A fertilised cow egg can be bisected at the two-cell stage before implantation.

What is the result of this process?

- A Offspring that are genetically identical to the mother are produced
- B Therapeutic proteins can be produced
- C Many identical copies of the animal are produced
- D Reproductive rate is doubled

23. The Bt toxin is produced by bacteria which are

- A sporulating
- B actively dividing
- C senescent
- D preparing to divide.

24. Which of the following is **not** a method used for crop protection?

- A Spray plants with *Bacillus thuringiensis*
- B Transform plants with viral surface antigens
- C Transform plants with herbicide resistance gene
- D Transfer gene for protein toxin into plants

25. Which of the following types of micro-organism can be used as a eukaryotic host for the production of hepatitis vaccine?

- A Bacterium
- B Virus
- C Yeast
- D Hyphal fungus

26. Four different monoclonal antibodies (MAb) can be used to identify beef, chicken, rabbit and fish antigens.

Extracts of food can be mixed with each individual MAb. If the antigen is present, a green colour is observed (G). If no antigen is present, no colour change is observed (NC).

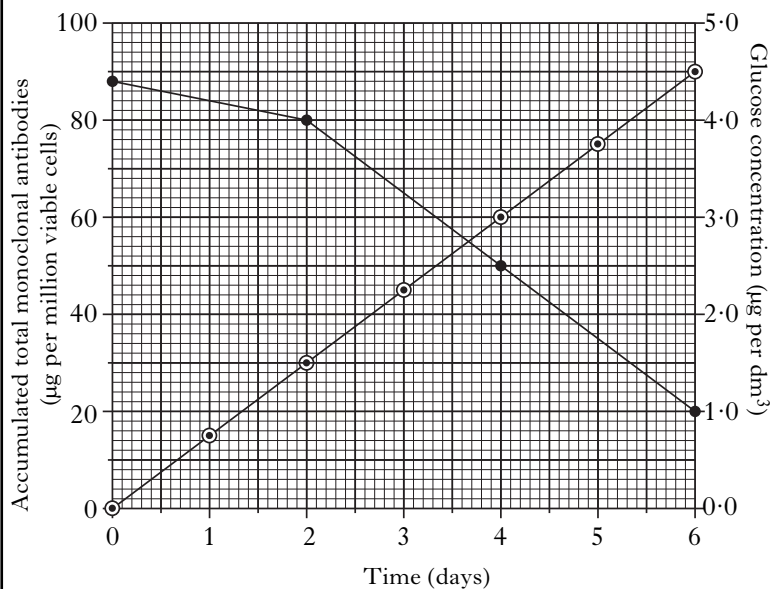
The table below shows the colour change observed when four pet foods were tested for the presence of beef, chicken, rabbit and fish using the four different MABs.

<i>Pet food</i>	<i>Monoclonal antibody</i>			
	<i>Beef</i>	<i>Chicken</i>	<i>Rabbit</i>	<i>Fish</i>
P	G	NC	G	NC
Q	NC	NC	NC	G
R	NC	NC	G	G
S	NC	NC	G	NC

Which of the following statements about the pet foods is true?

- A P and S both contain chicken
- B Q does not contain fish
- C R contains rabbit and fish
- D Beef is present in Q, R and S

27. Hybrid cells producing monoclonal antibodies were grown over a period of 6 days. The graph shows the accumulated mass of monoclonal antibodies and the concentration of glucose in the growth medium over this time period.



- Key
- antibodies
 - glucose

What was the accumulated mass of monoclonal antibodies when 50 percent of the glucose was used?

- A 2.2 µg per million viable cells
- B 3.3 µg per million viable cells
- C 44.0 µg per million viable cells
- D 66.0 µg per million viable cells

[Turn over

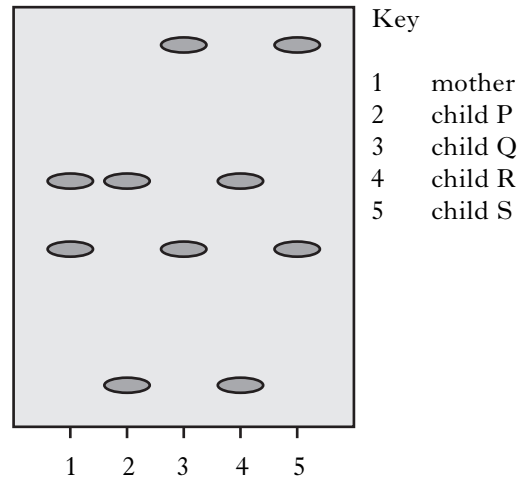
28. During the process used to obtain monoclonal antibodies, B-lymphocytes are fused with cancer cells.

Cancer cells are used in this process because

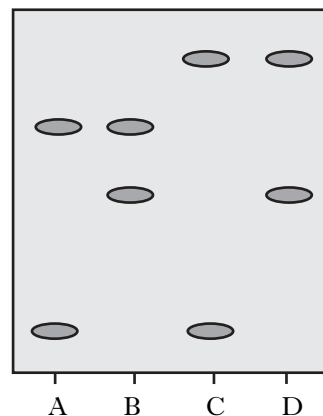
- A they can be selected easily
 - B they produce antigens
 - C they produce antibodies
 - D they are immortal.
29. Stem cells could be used for the production of
- A vaccines
 - B anti-cancer drugs
 - C monoclonal antibodies
 - D organs for transplant.

30. The biological father of four children has gone missing. A forensic scientist is reconstructing his DNA profile to help trace him.

The DNA profile of the four children and their biological mother is shown below.



Which of the following is likely to be the DNA profile of the missing father?



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

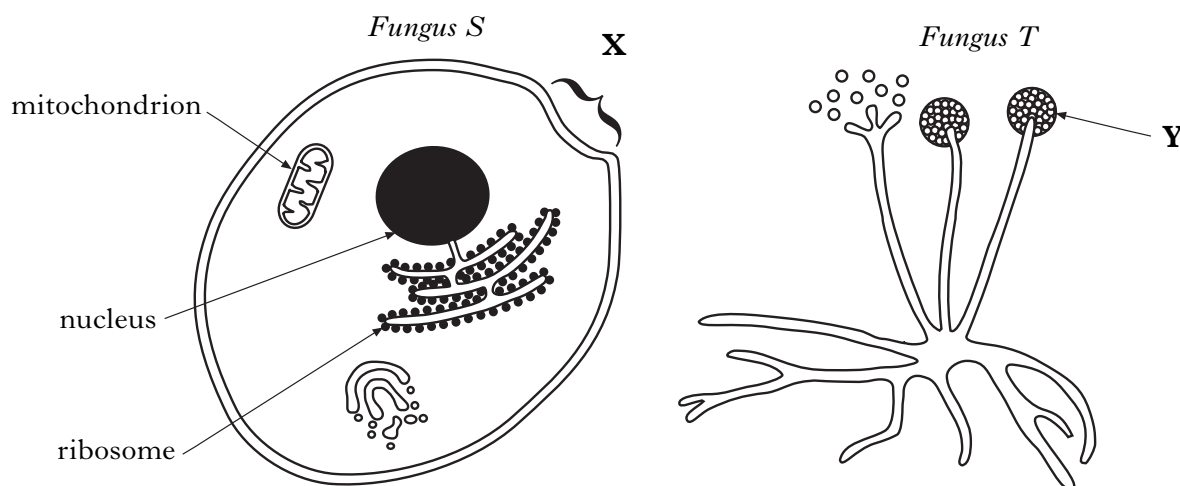
Marks

SECTION B

All questions in this Section should be attempted.

All answers must be written clearly and legibly in ink.

1. The diagram shows two different structural forms of fungi.



- (a) In the following sentence, underline one of the alternatives in each pair to make the sentence correct.

Fungus S is a {prokaryote / eukaryote} because of the presence of the {nucleus / ribosomes} within the cytoplasm.

1

- (b) (i) What type of fungus is Fungus S?

1

- (ii) Fungus S has undergone a form of reproduction that has produced the area marked **X**. Name this form of reproduction.

1

- (c) (i) Name Fungus T.

1

- (ii) Describe the function of structure **Y** in Fungus T.

1

[Turn over

2. (a) The table shows the function of cells involved in the immune response.
Complete the table to show the cell types and their functions.

Marks

<i>Cell</i>	<i>Cell type</i>	<i>Cell function</i>
A	Macrophage	
B		Involved in the cell-mediated immune response
C		Secrete antibodies in response to antigens

2

- (b) Active and passive are two forms of immunity.

- (i) Describe what is meant by **active** immunity.

1

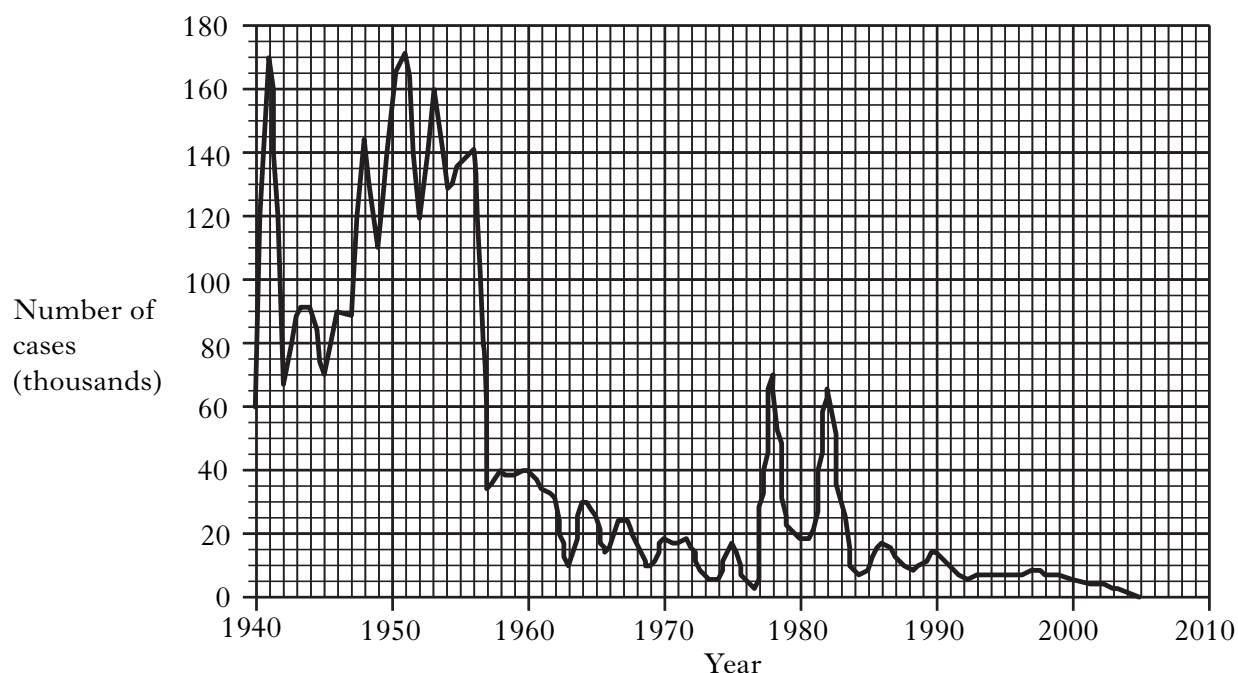
- (ii) Give **one** example of natural passive immunity

1

Marks

2. (continued)

(c) The graph shows the number of whooping cough cases over a 65 year period.



- (i) From the graph, in which year was a vaccine for whooping cough introduced?

1

- (ii) In 1977 newspaper reports suggested that the vaccine was unsafe. This led to a reduction in the number of children being vaccinated.

What was the percentage increase in cases of whooping cough between 1977 and 1978?

Space for calculation

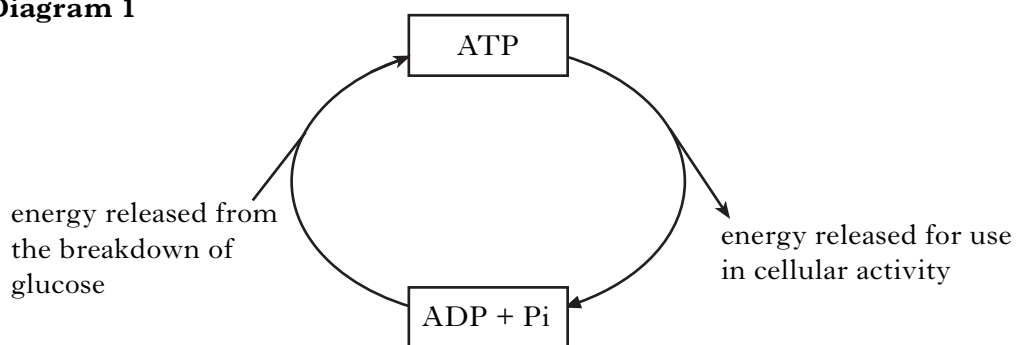
1

[Turn over

Marks

3. Diagram 1 shows a summary of cellular respiration in yeast.

Diagram 1



- (a) (i) What type of energy is stored in ATP?

1

- (ii) Give an example of a cellular activity in yeast which requires energy from ATP.

1

- (b) There is a net production of ATP during glycolysis, which is the first step in cellular respiration.

- (i) In a yeast cell, where does glycolysis take place?

1

- (ii) Explain why there is a **net** production of ATP from glycolysis.

1

- (c) Cellular respiration can occur in either aerobic or anaerobic conditions. Explain why less ATP is produced in anaerobic conditions.

2

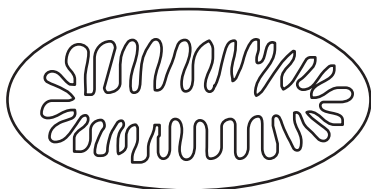
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3. (continued)

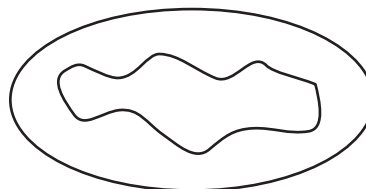
(d) Diagram 2 shows the structure of mitochondria in two different cells.

Diagram 2

mitochondrion in cell X



mitochondrion in cell Y



Explain why the mitochondrion in cell X may produce more ATP than the mitochondrion in cell Y.

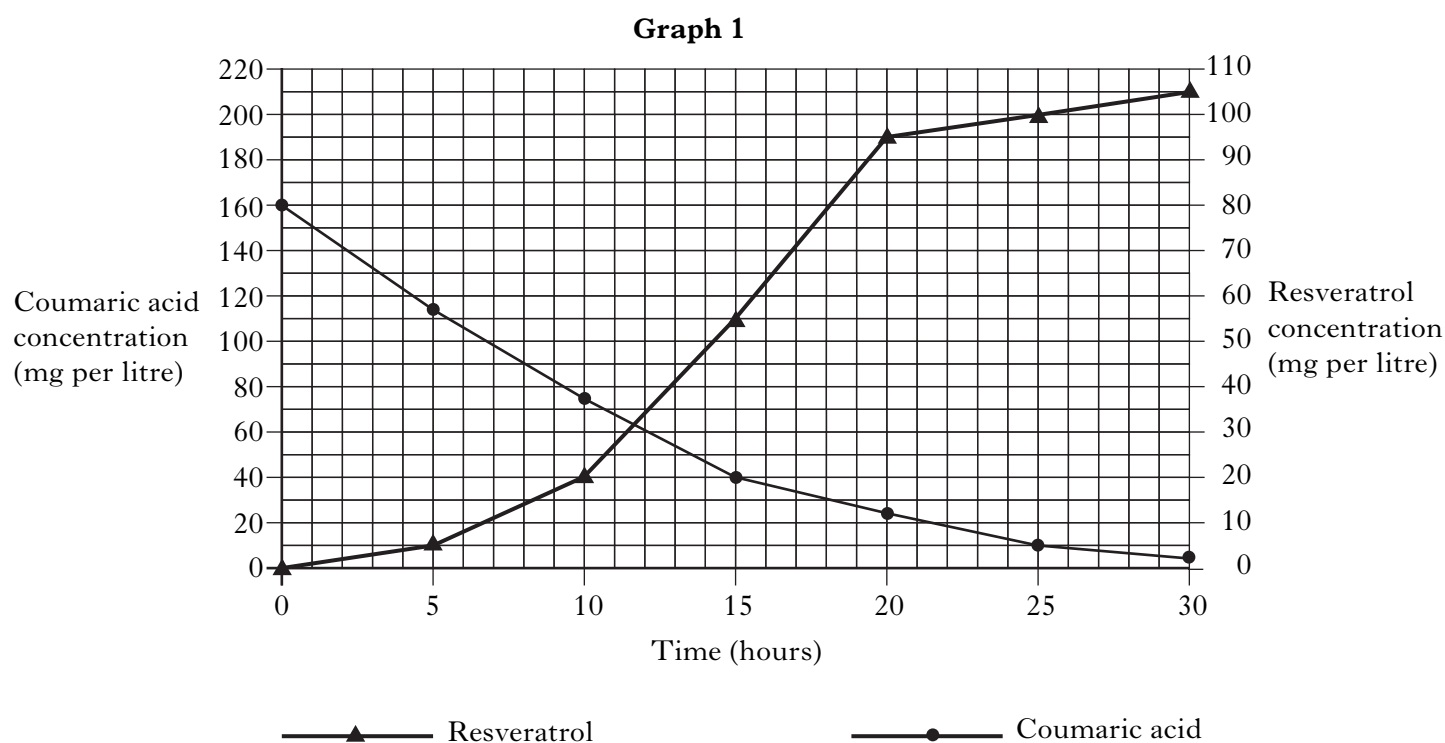
2

[Turn over]

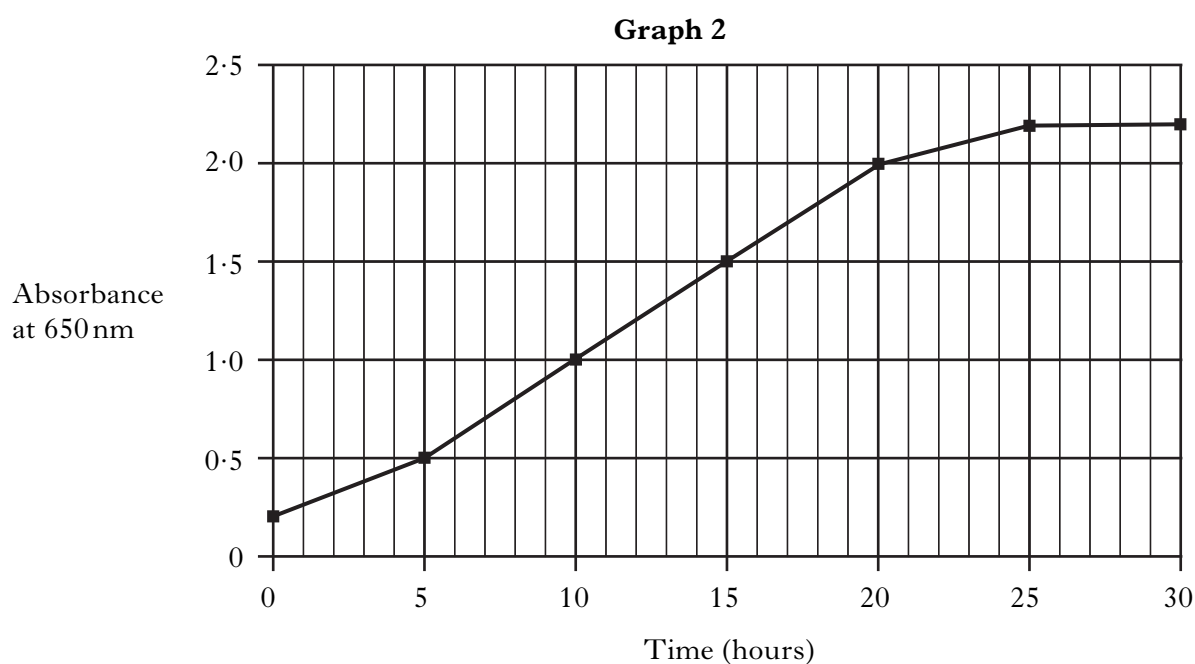
4. Resveratrol is a plant cell metabolite that may have health benefits. A strain of *E. coli* has been genetically modified to produce resveratrol.

The genetically modified *E. coli* were grown in batch culture in a medium containing coumaric acid. The concentrations of coumaric acid and resveratrol in the medium were measured over 30 hours.

The results are shown in Graph 1.



Graph 2 shows the growth of the bacteria, measured using a spectrophotometer, over the same 30 hour time period.



4. (continued)*Marks*

- (a) (i) From Graph 1, use data to describe the relationship between coumaric acid and resveratrol concentrations in the culture over the first 20 hours.

2

- (ii) Resveratrol is not produced unless there is coumaric acid in the medium. Suggest why coumaric acid is essential.

1

- (iii) From Graph 1, when does the concentration of resveratrol first become greater than the concentration of coumaric acid?

1

- (iv) From Graph 1, what percentage of coumaric acid has been used up after 15 hours?

Space for calculation

1

- (b) (i) From Graph 2, when does the culture of *E. coli* enter stationary phase?

1

- (ii) Give **one** reason why a culture enters stationary phase.

1

[Question 4 continues on Page eighteen]

Marks

4. (continued)

- (c) The total volume of culture was 1.2 litres. Using Graphs 1 and 2, what is the total mass of resveratrol present when the absorbance at 650 nm is 2.0?

Space for calculation

_____ mg **1**

- (d) *E. coli* growth is pH sensitive. The growth of the *E. coli* is affected if the concentration of coumaric acid is altered.

Predict how the growth of *E. coli* would be altered if **more** coumaric acid is added at the start of the experiment.

Justify your answer.

Prediction _____

Justification _____

_____ **1**

- (e) *E. coli* can be genetically modified by inserting foreign DNA. Give **one** advantage and **one** disadvantage of using *E. coli* to carry foreign DNA.

Advantage _____ **1**

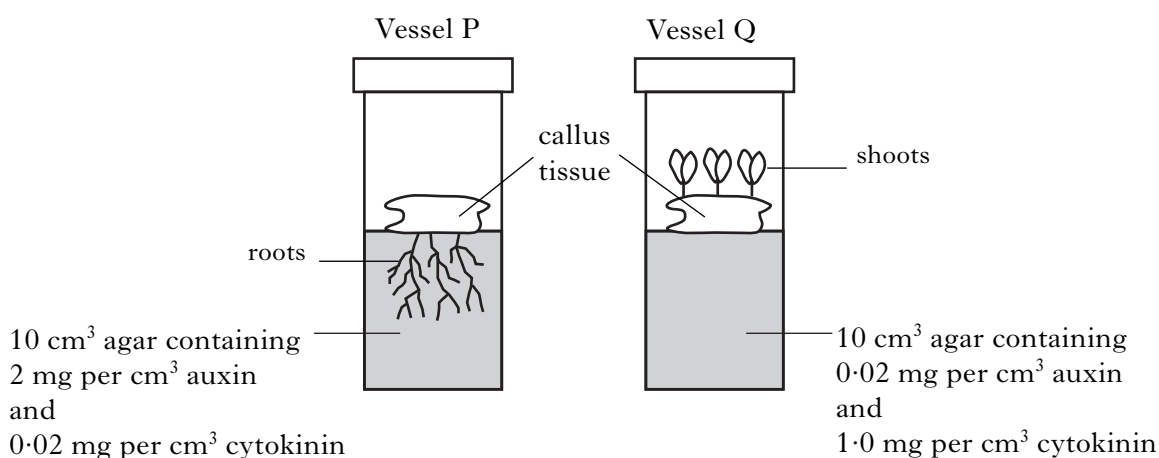
Disadvantage _____ **1**

[Question 5 is on fold-out Page nineteen]

Marks

5. An experiment was set up to show the effect of plant hormones on the differentiation of callus tissue.

The diagram shows the result of this experiment.



- (a) What is a plant callus?

1

- (b) In setting up this experiment, a stock solution of auxin was used. The concentration of the stock solution was 400 mg per cm³.

Calculate the volume of the stock solution that was added to give the final concentration of auxin in vessel P.

Space for calculation

1

- (c) Give **two** conclusions that could be drawn from the results of this experiment.

1 _____

2 _____

2

- (d) Name **one** other substance that must be included in the agar to ensure plant growth.

1

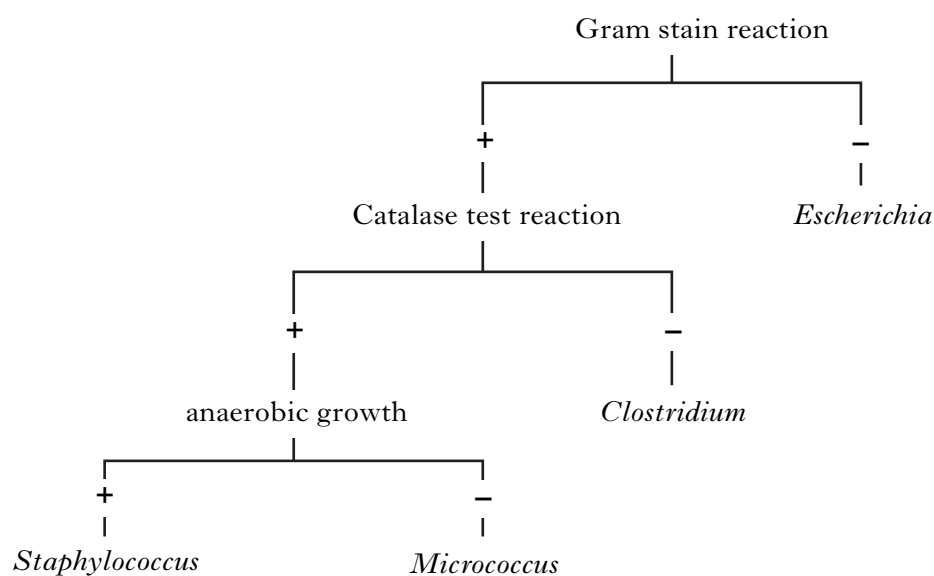
6. A scientist identified the range of species of bacteria present in a sample of polluted river water.

Bacteria isolated from the river water were cultured in a range of growth conditions. A Gram stain and biochemical tests were then carried out on the bacterial cultures.

Some of the results are shown in the table below.

<i>Bacterial culture</i>	<i>Gram stain reaction</i>	<i>Aerobic growth</i>	<i>Anaerobic growth</i>	<i>Growth on MacConkey agar</i>	<i>Catalase test reaction</i>	<i>Starch digestion</i>
W: _____	+	+	+	-	+	-
X: _____	+	-	+	-	-	-
Y: <i>Escherichia</i>	-	+	+	+	+	-
Z: _____	+	+	-	-	+	-

Identification was completed by referring to the key below.



6. (continued)**Marks**

- (a) (i) Use the key to complete the table by identifying the bacteria W, X and Z. **1**

- (ii) Use the key and the table to identify the obligate anaerobe.

1

- (iii) Use the table to explain why *Escherichia* is more resistant to the antibiotic penicillin than the other bacterial cultures.

2

- (b) Name **two** factors that affect the growth of bacteria on different media.

1 _____

2 _____

1

- (c) Describe the biochemical test used to show catalase activity in a bacterial culture.

2

- (d) MacConkey agar is a medium that contains bile salts, which inhibit the growth of non-intestinal bacteria. What name is given to this type of medium?

1

- (e) The scientist suspected that the starch digestion test had not worked. What control should be included when repeating the experiment?

1**[Turn over**

Marks

7. Anthrax is a disease caused by infection with the bacterium *Bacillus anthracis*. A vaccine against *B. anthracis* is available.

Production of anthrax vaccine involves culturing *B. anthracis* in a fermenter to produce a protein known as Protective Antigen (PA).

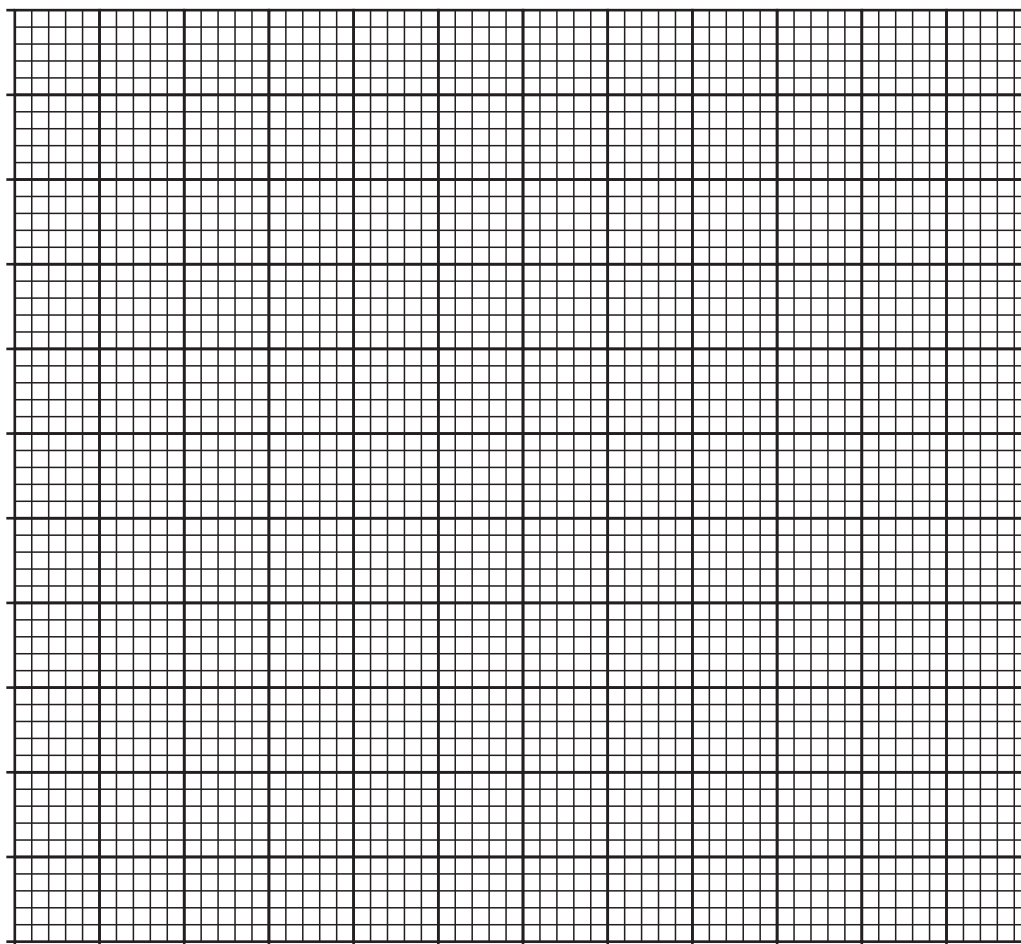
Researchers grew three strains of *B. anthracis* at different temperatures and recorded the concentration of PA produced at each temperature.

The results are shown in the table.

Strain	Concentration of PA produced (grams per litre)		
	Temperature		
	30 °C	35 °C	40 °C
X	4.70	4.85	4.70
Y	4.40	4.50	4.60
Z	3.75	5.15	3.50

- (a) (i) Plot a bar graph to show the concentration of PA produced (in grams per litre) for each strain at each temperature. Use an appropriate scale to fill most of the graph paper.

(Additional graph paper, if required, can be found on Page 34)



7. (a) (continued)

Marks

- (ii) Use the information to identify the strain that produces the highest concentration of PA per litre of culture.

1

- (b) A further experiment was carried out in which strain Y was incubated at 45 °C.

Suggest a reason why this experiment was carried out.

1

- (c) Predict the effect on the concentration of PA produced if strain X was incubated at 45 °C. Explain your answer.

Prediction _____

Explanation _____

1

- (d) Production of the vaccine against *B. anthracis* is carried out using batch culture.

- (i) The first step in this process is to produce a starter culture. A small volume of nutrient broth is inoculated with *B. anthracis* and incubated for 24 hours at 37 °C.

Explain why the starter culture is incubated for 24 hours.

1

- (ii) The second step in the batch process is the transfer of the starter culture to a large culture tank containing nutrient broth. This is incubated for 27 hours at 37 °C.

Explain why the incubation time and temperature must be carefully controlled during each batch culture.

1

- (iii) The final volume of vaccine produced is 550 cm³. If the yield of antigen is 5 mg per cm³ of vaccine, how much antigen is produced in total?

Space for calculation

1

Marks

8. Microbial products are used in large quantities as flavouring agents and as preservatives by food manufacturers.

(a) Lactic acid is used as a flavouring agent and preservative and is normally produced by a continuous flow culture.

(i) State **two** advantages of continuous flow culture over batch culture.

1 _____

2 _____

2

(ii) Extraction of lactic acid from culture medium is usually achieved by precipitation. Name a chemical that is used for precipitation of lactic acid.

1

(b) Invertase is an enzyme used in an immobilised form by the confectionery industry to convert sucrose to a sweeter sugar.

(i) Explain what is meant by the term “immobilised enzyme”.

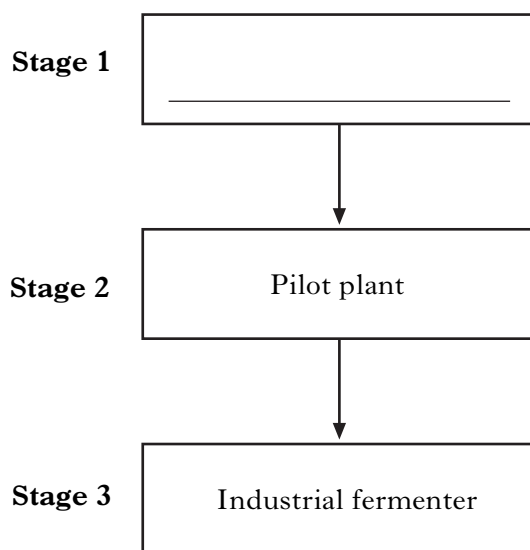
1

(ii) Explain why the use of an immobilised enzyme such as invertase is of benefit to the environment.

1

9. (a) The diagram shows the stages of development of an industrial scale process.

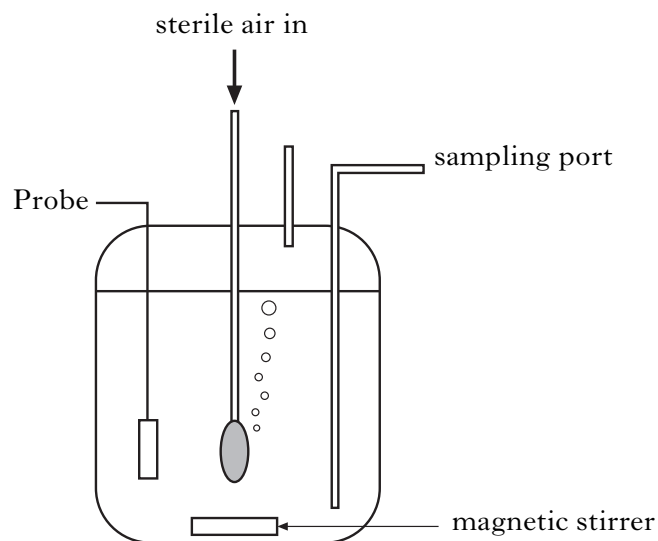
Marks



Complete the diagram by naming Stage 1 of the process.

1

- (b) The diagram shows a pilot plant fermenter.



- (i) Mark an **X** on the diagram to show where an air filter should be placed.

1

- (ii) Name one condition that could be monitored by the probe.

1

- (iii) Explain the function of the magnetic stirrer.

1

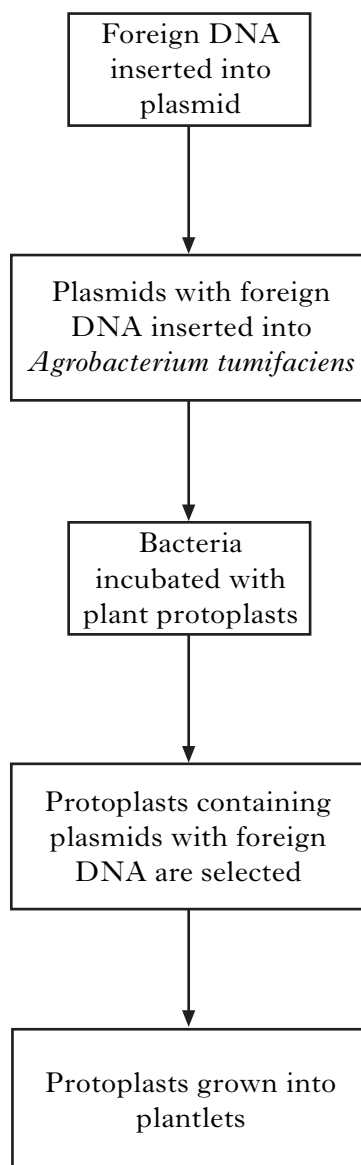
- (c) Name the part of an **industrial** fermenter that helps to maintain its temperature.

1

Marks

10. (a) Transgenic raspberry plants have been developed that are rain-tolerant.

Some stages in the production of transgenic plants are shown below.



- (i) Explain why *Agrobacterium tumefaciens* is used in the production of transgenic plants.
- _____ 1
- (ii) Describe how protoplasts containing plasmids with foreign DNA are selected.
- _____ 2
- _____
- (iii) Name a technique used for rapid production of a large number of plantlets.
- _____ 1

Marks

10. (continued)

- (b) The table below shows the area of transgenic crops planted in five countries in the years 1999, 2000 and 2001.

<i>Country</i>	<i>Total area (million hectares)</i>		
	<i>Year</i>		
	1999	2000	2001
USA	28·7	30·8	35·7
Argentina	6·7	9·4	11·8
Canada	4·0	3·0	3·2
China	0·3	0·5	1·5
South Africa	0·1	0·3	0·3

- (i) In the year 2000, what percentage of the total area of transgenic crops planted in these five countries was in the USA?

Space for calculation

1

- (ii) The country with the largest percentage increase in area planted with transgenic crops between 1999 and 2000 is South Africa.

Explain why the use of percentage increase is the most effective method of comparing the difference between these countries.

1

- (iii) Suggest a reason for the decrease in area planted in Canada between 1999 and 2000.

1

Marks

11. (a) New technology has been used to produce GM cattle.

(i) Describe **one** method used to produce GM cattle.

1

(ii) Explain why blood clotting factor can be produced in the milk of GM cattle.

1

(b) A mule is traditionally produced by crossing a female horse with a male donkey. As mules are sterile animals it is not possible to breed them to produce successive generations. In May 2003 scientists succeeded in producing a mule known as Idaho Gem by somatic cell cloning.



Idaho Gem

(i) State **two** advantages of using somatic cell cloning over traditional breeding methods.

1

2

2

(ii) Describe the difference between the donor cells used in somatic cell cloning and embryo cloning.

1

(c) Suggest **one** ethical argument against the production of GM animals.

1

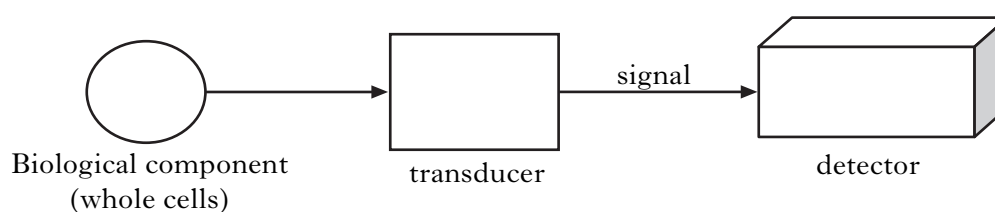
Marks

12. Polycyclic aromatic hydrocarbons (PAH) are toxic chemicals sometimes found in contaminated soil. Bioremediation is a method of treating contaminated soil.

- (a) Describe how bioremediation may be used in the treatment of contaminated soil.

2

- (b) The presence of PAH in soil can be detected by use of a biosensor. The diagram shows the components of a biosensor.



- (i) Describe the role of the biological component in the biosensor.

1

- (ii) Name **one** biological component, other than whole cells, that could be used in a biosensor.

1

- (iii) Name **one** type of signal that may be produced by the transducer.

1

[Turn over for Section C on Page thirty

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.

All answers must be written clearly and legibly in ink.

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

Labelled diagrams may be used where appropriate.

1. Answer either A or B.

A. Give an account of **moist heat** sterilisation under the following headings:

- (a) use of the autoclave; 5
- (b) hazards and risks associated with autoclaving. 5

(10)

OR

B. Discuss the enumeration of micro-organisms under the following headings:

- (a) total count; 2
- (b) viable count; 4
- (c) plaque assay. 4

(10)

In Question 2 ONE mark is available for coherence and ONE mark is available for relevance.

2. Answer either A or B.

A. Give an account of RNA structure and function in protein synthesis. **(10)**

OR

B. Compare the structure and reproduction of bacteria and viruses. **(10)**

[END OF QUESTION PAPER]

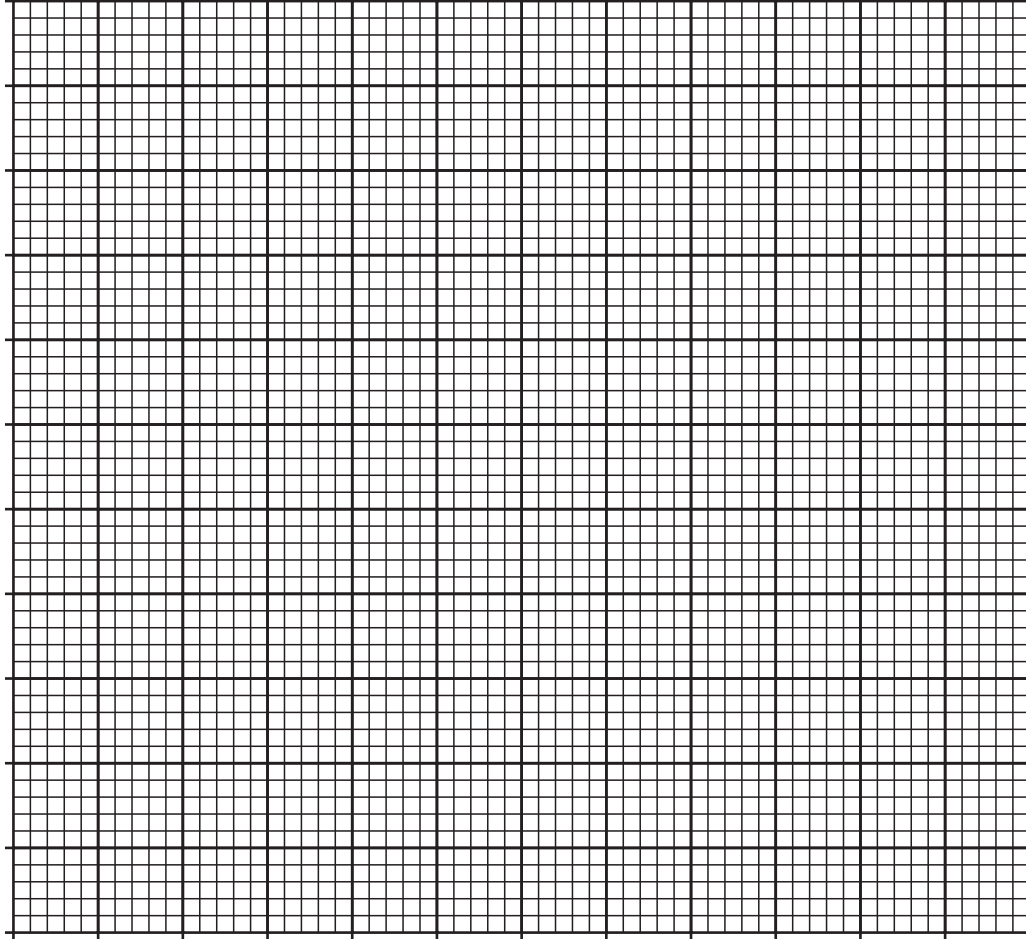
SPACE FOR ANSWERS

SPACE FOR ANSWERS

SPACE FOR ANSWERS

SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR USE IN QUESTION 7 (a) (i)



ACKNOWLEDGEMENTS

Question 11b—Photo of Idaho Gem from article *The latter day saint who cloned a mule* taken from www.meridanmagazine.com. Permission is being sought from Meridan Magazine