

FOR OFFICIAL USE

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Total for
Sections
B & C

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X008/12/02

NATIONAL
QUALIFICATIONS
2013

WEDNESDAY, 29 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)

- (a) All questions should be attempted.
(b) It should be noted that in **Section C** questions 1 and 2 each contain a choice.
(c) Question 6 is on pages 18, 19 and 20. Question 7 is on page 22. Question 8 is on page 23. Pages 20 and 21 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 examination, 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.

Answers should be given on the separate answer sheet provided.

1. 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	Hydrogen	Peptide
B	Peptide	Hydrogen	Hydrogen
C	Hydrogen	Peptide	Peptide
D	Hydrogen	Peptide	Hydrogen

2. Which of the following must be present in a cell for glycolysis to occur?

- A ATP and oxygen
- B glucose and oxygen
- C ATP and pyruvic acid
- D glucose and ATP

3. In anaerobic respiration ATP is produced

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

4. The table below gives information about substances produced in cellular respiration.

<i>Process</i>	<i>Carbon dioxide produced</i>	<i>Water produced</i>
X	yes	no
Y	no	yes
Z	no	no

Which of the following correctly identifies processes X, Y and Z?

	X	Y	Z
A	Krebs cycle	cytochrome system	glycolysis
B	cytochrome system	Krebs cycle	glycolysis
C	glycolysis	cytochrome system	Krebs cycle
D	Krebs cycle	glycolysis	cytochrome system

5. A bacterial culture contains 20 000 cells. If the doubling time for this bacterium is 20 minutes, how many cells will be present after 2 hours?

- A 120 000
- B 140 000
- C 640 000
- D 1 280 000

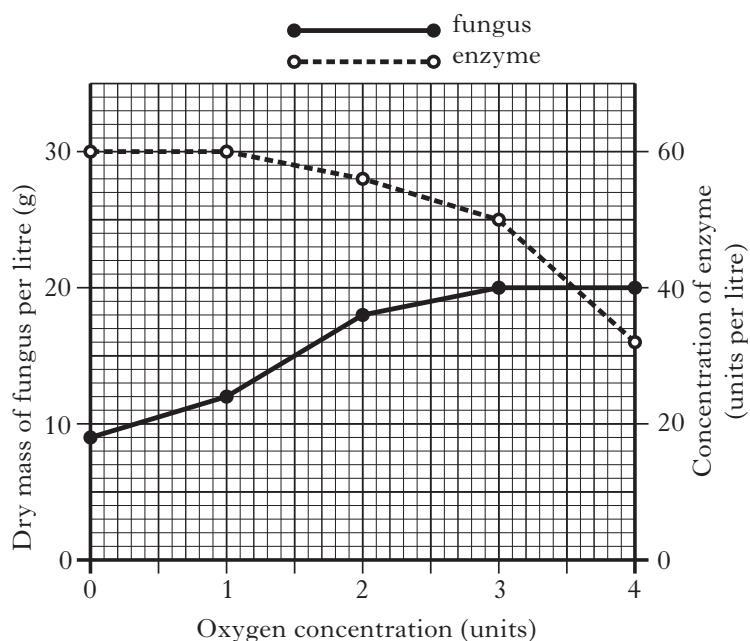
6. The role of lysosomes during phagocytosis is to

- A engulf bacteria
- B neutralise bacterial toxins
- C store enzymes which destroy bacteria
- D produce antibodies in response to bacterial antigens.

[Turn over

7. A circular piece of DNA has four sites for a restriction enzyme. Into how many fragments will that restriction enzyme cut the DNA?
- A 3
B 4
C 5
D 6
8. During production of cDNA which of the following are required?
- A DNA polymerase, mRNA, reverse transcriptase, alkali
B RNA polymerase, DNA, reverse transcriptase, alkali
C DNA polymerase, mRNA, reverse transcriptase, acid
D RNA polymerase, DNA, reverse transcriptase, acid
9. An advantage of using yeast, rather than *E. coli*, as a recipient of foreign DNA is that yeast
- A grows rapidly
B produces protein
C can be easily manipulated
D can add sugar residues to proteins.
10. The humoral immune response involves production of antibodies by
- A B-lymphocytes
B macrophages
C T-lymphocytes
D hybrid cells.

11. A fungus growing in batch culture releases enzyme into the culture medium. The graph shows the effect of oxygen concentration on the dry mass of fungus and the concentration of enzyme in the medium after 50 hours growth.



How many units of enzyme are produced per gram of fungus at an oxygen concentration of 1 unit?

- A 0.2
B 1.25
C 2.5
D 5.0
12. In which order should the following steps be carried out to deal with a small scale spillage in the laboratory?
- V Autoclave the waste
W Put on personal protective clothing
X Apply disinfectant to the spillage
Y Cover the spillage with a paper towel
Z Leave for an appropriate time
- A W → Z → Y → X → V
B W → Y → X → Z → V
C W → Y → Z → X → V
D W → X → Z → Y → V

13. A number of tests for identifying bacteria were carried out. The table shows the results.

	<i>Aerobic growth</i>	<i>Anaerobic growth</i>	<i>Growth on MacConkey agar</i>	<i>Catalase reaction</i>
<i>Staphylococcus</i>	+	+	-	+
<i>Clostridium</i>	-	+	-	-
<i>Escherichia</i>	+	+	+	+
<i>Micrococcus</i>	+	-	-	+

Which of the following combinations of tests distinguish *Staphylococcus* from the other three bacteria?

- A Aerobic growth, growth on MacConkey agar, catalase reaction
- B Anaerobic growth, catalase reaction
- C Aerobic growth, anaerobic growth, growth on MacConkey agar
- D Growth on MacConkey agar, catalase reaction

14. Plant apical meristems are

- A a mass of differentiated cells
- B produced by cloning
- C produced by micropropagation
- D found at root tips.

15. Which of the following would result in growth medium containing 1% calf serum?

- A 500 cm³ calf serum + 4500 cm³ medium
- B 50 cm³ calf serum + 4950 cm³ medium
- C 50 cm³ calf serum + 5000 cm³ medium
- D 500 cm³ calf serum + 5000 cm³ medium

16. Bacteria were grown in a medium containing glucose and mineral salts. Growth reached a stationary phase. The onset of the stationary phase was thought to be due to the concentration of phosphate in the medium becoming limiting.

This hypothesis could be confirmed if more growth took place after

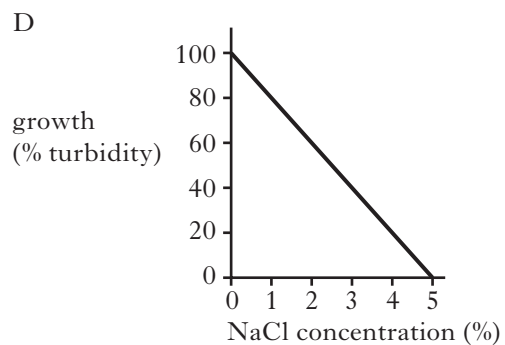
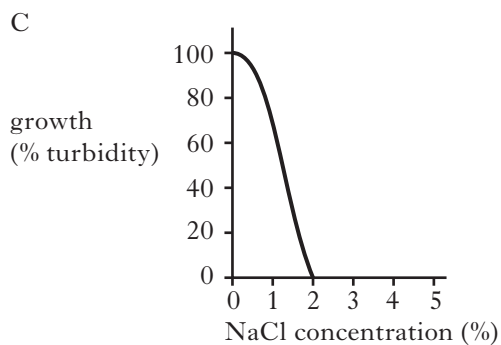
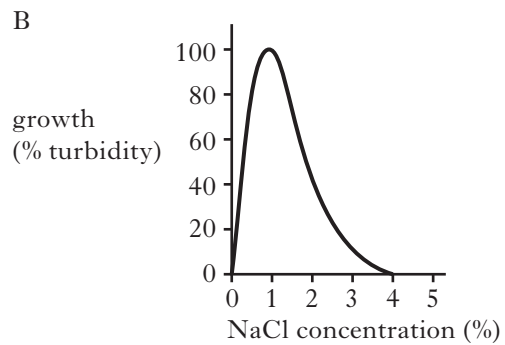
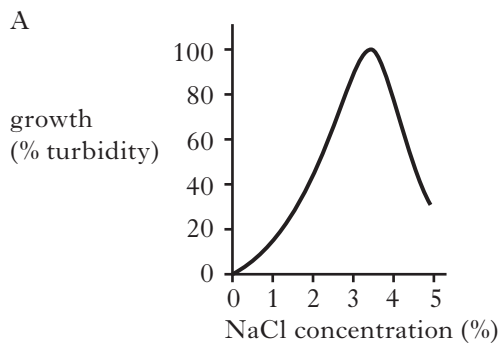
- A transferring a sample of bacteria to medium containing no phosphate
- B adding more glucose solution to the culture
- C repeating the experiment using medium with a lower phosphate concentration
- D adding phosphate solution to the culture.

17. Which of the following is **not** used for the identification of bacteria?

- A Oxidase test
- B Plaque assay
- C Hydrolysis of starch
- D Fermentation of carbohydrates

[Turn over

18. The graphs below show the growth of four different micro-organisms A, B, C, D in marine environments with varying sodium chloride (NaCl) concentrations.



Which of these micro-organisms could be isolated from the others by adding sodium chloride to the medium?

19. A 10^{-6} dilution of cells from tissue culture was found to contain 3.0×10^3 cells per cm^3 .

How many cells were in the original 500 cm^3 culture?

- A 1.5×10^6
- B 6.0×10^6
- C 3.0×10^9
- D 1.5×10^{12}

20. Research into the production of organs for transplant is based on

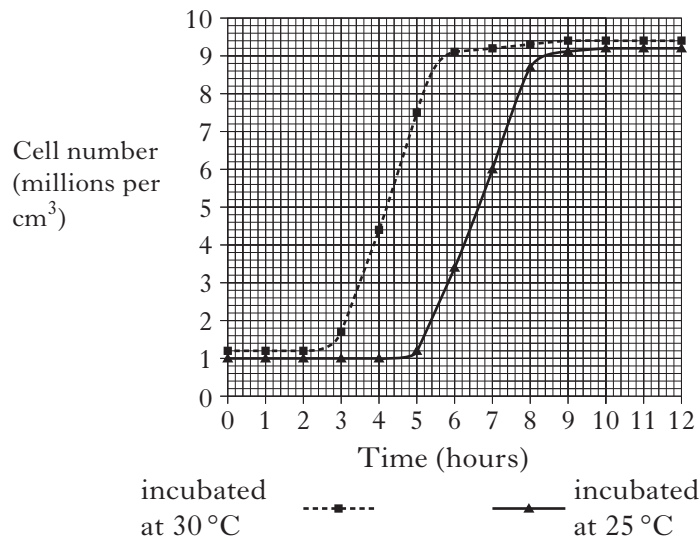
- A transgenic cells
- B stem cells
- C somatic cells
- D monoclonal cells.

21. Which line in the table below correctly identifies the components of an industrial anaerobic fermenter?

	<i>safety valve</i>	<i>pressure gauge</i>	<i>sparger</i>	<i>harvest pipe</i>
A	no	yes	yes	yes
B	yes	no	yes	yes
C	yes	yes	no	yes
D	yes	yes	yes	no

Questions 22 and 23 are based on the graph below.

The graph shows the results of an experiment to investigate the effects of temperature on the growth of a species of bacteria.



22. Which of the following is a valid conclusion from these results?
- A Lag phase is shorter at 30 °C than at 25 °C.
 - B Mean generation time is shorter at 25 °C than at 30 °C.
 - C The optimum temperature for growth of this species is 30 °C.
 - D Stationary phase is shorter at 25 °C than at 30 °C.
23. These bacteria produce a metabolite during the stationary phase of growth. Which of the following would produce the greatest quantity of the metabolite?
- A Growth at 30 °C after 5.5 hours
 - B Growth at 30 °C after 12 hours
 - C Growth at 25 °C after 8 hours
 - D Growth at 25 °C after 12 hours

24. The following growth vessels are used in scaling up

- 1 a laboratory fermenter
- 2 a tissue culture flask
- 3 an industrial plant
- 4 a pilot plant.

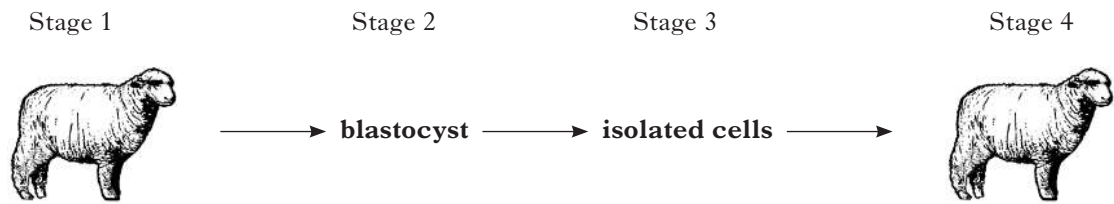
Which of the following sequences gives the correct order in which these vessels are used in scaling up?

- A 2 4 1 3
- B 2 1 3 4
- C 2 1 4 3
- D 2 3 4 1

25. When scaling up biotechnology processes to pilot plant, which of the following factors should be considered?

- A Containment of micro-organisms
- B Mean generation time
- C Optimum growth conditions
- D Rate of substrate use

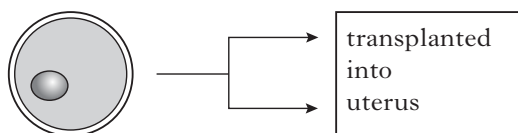
26. The diagram below represents some stages in embryo cloning.



Which line in the table correctly describes embryo cloning?

	<i>Stage 1</i>	<i>Stage 2</i>	<i>Stage 3</i>	<i>Stage 4</i>
A	donor	blastocyst	differentiated cells	surrogate
B	surrogate	blastocyst	undifferentiated cells	donor
C	donor	blastocyst	undifferentiated cells	surrogate
D	surrogate	blastocyst	differentiated cells	donor

27. The diagram below represents an animal breeding technique.



Fertilised egg divided at two cell stage

The purpose of this technique is to

- A double the reproductive rate by cloning
- B isolate stem cells by cloning
- C double the reproductive rate by embryo manipulation
- D isolate stem cells by embryo manipulation.

28. The following procedures are used to insert foreign DNA.

- 1 microinjection into a fertilised egg
- 2 viral infection of a fertilised egg
- 3 microinjection into an unfertilised egg
- 4 viral infection of an unfertilised egg

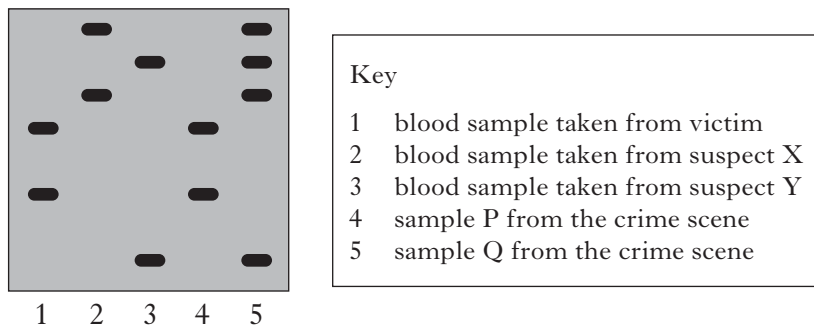
Which of these procedures are used in the production of transgenic animals?

- A 1 only
- B 4 only
- C 1 and 2 only
- D 3 and 4 only

29. Which of the following is **not** used as a component of a biosensor?

- A DNA
- B Antibody
- C Cell
- D Enzyme

30. The diagram below shows the DNA profile from a crime investigation.



The following conclusions were drawn from these results.

- 1 Sample P shows that both suspects were present at the crime scene
- 2 Sample Q shows that both subjects were present at the crime scene
- 3 Only the DNA of the victim was found at the crime scene
- 4 The DNA of the victim and both suspects was found at the crime scene

Which of these is correct?

- A 1 and 4 only
- B 2 and 3 only
- C 1 and 3 only
- D 2 and 4 only

**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*

SECTION B

Marks

All questions in this section should be attempted.

All answers must be written clearly and legibly in ink.

1. Scientists have found that banknotes are contaminated with micro-organisms.
- (a) Name the structure found in some bacteria that allows them to attach to the surface of the banknote.
- _____ 1
- (b) One type of micro-organism found on banknotes is the Gram positive bacterium *Bacillus cereus*.
- (i) What shape are *Bacillus* bacteria?
- _____ 1
- (ii) State the colour this bacterium would appear when Gram stained.
- _____ 1
- (iii) Explain why the structure of *Bacillus cereus* gives a positive Gram stain.
- _____ 1
- _____ 1
- (iv) Suggest **one** possible source of error in Gram staining, and how it might affect the result.
- _____ 1
- _____ 1
- (c) *Bacillus cereus* can cause food poisoning.
- What term describes micro-organisms that cause disease?
- _____ 1

1. (continued)

Marks

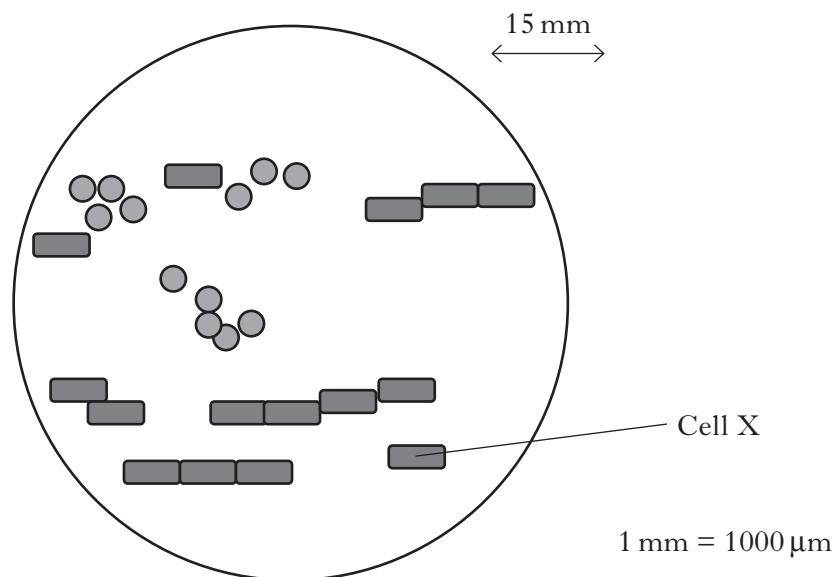
- (d) It was found that the average banknote carried 1×10^6 bacteria per cm^2 . A £10 note measures $14 \text{ cm} \times 7.5 \text{ cm}$.

Calculate the total number of bacteria which would be present on one side of the £10 note.

Space for calculation

1

- (e) A sample of bacteria from a banknote was emulsified in a drop of sterile water on a microscope slide then fixed before staining and viewing under the microscope at 2000 times magnification. The results are shown in the diagram.



- (i) Calculate the actual length of bacterial cell X.

Space for calculation

μm

1

- (ii) State how the slide should be safely disposed of after viewing.

1

Marks

2. The lac repressor is a protein found in *E. coli* bacteria. The protein is coded for by a gene found with other genes involved in the metabolism of lactose.

(a) What term describes a group of genes with related functions?

1

(b) *E. coli* is able to turn the transcription of these related genes on or off in response to the availability of lactose.

(i) State the advantage of this type of control.

1

(ii) Name the molecule produced by transcription.

1

(iii) State the location of transcription in *E. coli* cells.

1

(c) The DNA sequence of part of the repressor gene is shown below.

DNA: TACTTCGGTCAA

The table shows the anticodons for six amino acids.

<i>Anticodon</i>	<i>Amino acid</i>
AAU	Leu
CAA	Val
GGU	Pro
UAC	Met
UGG	Thr
UUC	Lys

Using the information given, work out the amino acid sequence of the polypeptide produced from the DNA sequence.

Space for working

Amino acid sequence _____

1

Marks

2. (continued)

- (d) A mutated version of the lac repressor gene is shown below.

DNA: TACTTCGCAA

Name this type of mutation.

1

- (e) Complete the table below to show the consequence of mutations within the lac repressor gene.

<i>Effect of mutation on lac repressor protein</i>	<i>RNA Polymerase binds to operator? Yes/No</i>	<i>Lactose metabolised? Yes/No</i>
Cannot bind to operator site		
Cannot bind lactose		

2**[Turn over**

Marks

3. The yeast *Candida utilis* is used as a source of protein for animal feed. The yeast can be grown on a variety of substrates including wood sugar (a by-product of paper production) and molasses (a by-product of sugar refining).

The cell composition of *Candida utilis* grown on both of these substrates is shown in the table below.

Substrate	Percentage (%) cell composition		
	Protein	Fat	Other
Wood sugar	54.20	3.76	42.04
Molasses	46.70	5.82	47.48

- (a) If 62 kg of yeast was harvested following growth on molasses, calculate the mass of protein this would yield for use in processed foods.

Space for calculation

_____ 1

- (b) (i) Based on the results in the table, a scientist concluded that wood sugar is the best substrate for growth of *Candida*.

What evidence in the table supports this conclusion?

_____ 1

- (ii) The scientist formed the hypothesis that it is the presence of cellulose in the wood sugar substrate that increased the growth of *Candida utilis*. Suggest an experiment that could be carried out to test this hypothesis.

_____ 1

Marks

3. (continued)

(c) Yeast can increase in number by asexual reproduction.

(i) Name the method of asexual reproduction used by yeast.

1

(ii) Describe how the cells produced differ from cells produced by sexual reproduction.

1

(d) Give **one** other commercial use of yeast.

1

[Turn over

Marks

4. The bacterium *Clostridium difficile* is the major cause of hospital-acquired infectious diarrhoea. The disease symptoms result from the bacteria producing toxins in the gut. The percentage of people with *Clostridium difficile* infection varies dramatically between the general population and hospital patients as shown in the table below.

<i>Population</i>	<i>Percentage (%) testing positive for Clostridium difficile</i>
General population	4
Hospital patients	32

- (a) Calculate the simplest whole number ratio of infection rates between the two populations.

General population _____ : _____ Hospital patients

1

- (b) In recent years the number of cases caused by *Clostridium difficile* have hit the headlines in the UK, and scientists are working to develop a new vaccine to offer protection. The new vaccine uses a “toxoid”, a weakened version of the *Clostridium difficile* toxin, to stimulate an immune defence against a future infection.

- (i) Tick (✓) the correct box in each line of the table below to show the type of immunity this would provide.

Natural	<input type="checkbox"/>	Artificial	<input type="checkbox"/>
Active	<input type="checkbox"/>	Passive	<input type="checkbox"/>

1

- (ii) Other than vaccination, describe a way in which adults can acquire immunity to the *Clostridium difficile* bacterial toxin.

1

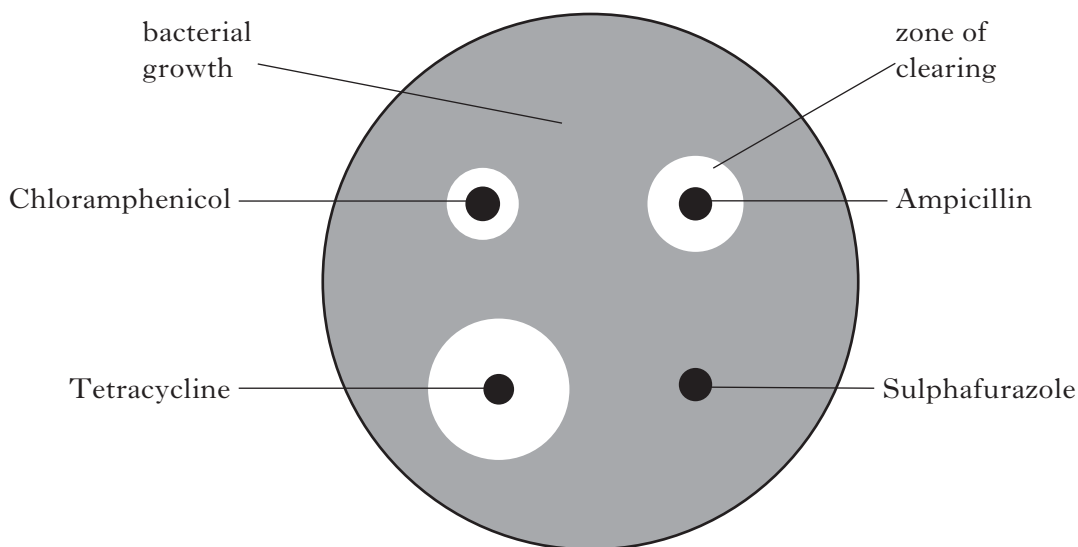
- (c) Babies are particularly susceptible to *Clostridium difficile*.

Describe a natural form of immunity that gives protection to babies.

1

Marks

5. An experiment was set up to test the antibiotic sensitivity of the bacterium *Staphylococcus epidermidis*. A lawn of the bacteria was prepared, and disks soaked in four different antibiotics were placed on the lawn. The antibiotics used and the results following incubation are shown in the diagram below.



- (a) (i) What is indicated by the zone of clearing?

1

- (ii) Name the antibiotic to which *Staphylococcus epidermidis* is most resistant.

1

- (b) State **one** variable that should be controlled in this experiment.

1

- (c) Describe an experiment that could be set up to test whether these antibiotics are biocidal or biostatic.

2

- (d) Give another use for a bacterial lawn.

1

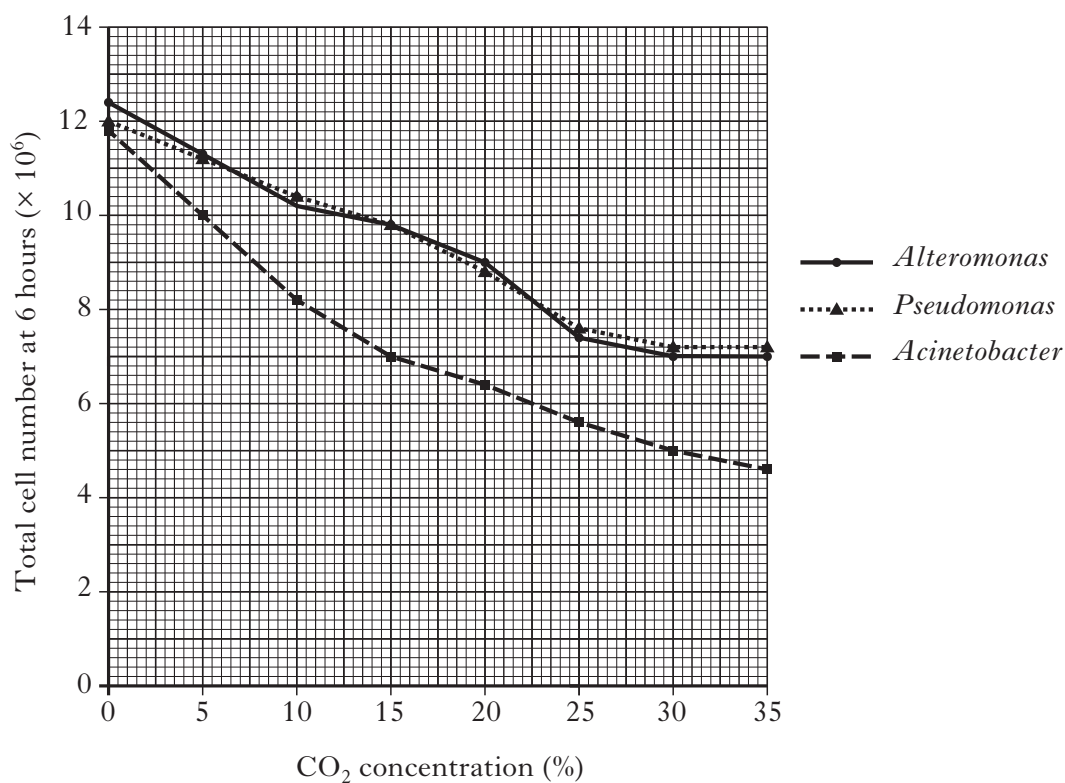
[Turn over

Marks

6. Carbon dioxide (CO_2) can be used to inhibit the growth of bacteria involved in the spoilage of chilled meat. An experiment was carried out to investigate the effects of different concentrations of CO_2 on the growth of three species of bacteria, *Alteromonas*, *Pseudomonas* and *Acinetobacter*.

For each species, an equal number of cells was added to liquid medium and grown at 30°C in different CO_2 concentrations. The total cell number was then measured after 6 hours of growth. The results are shown in **Graph 1**.

Graph 1



- (a) State a method that could be used to measure total cell number in this experiment.

1

Marks

6. (continued)

(b) (i) State **two** conclusions that can be drawn from these results.

2

(ii) *Acinetobacter* is an obligate aerobe.

Predict the effect on *Acinetobacter* of increasing the CO₂ concentration to 45%.

Explain your prediction

Prediction _____

Explanation _____

1

(iii) At which CO₂ concentration is the greatest difference in inhibition between *Pseudomonas* and *Acinetobacter*?

_____ %

1

(c) *Alteromonas* and *Pseudomonas* are facultative anaerobes.

What evidence from **Graph 1** indicates this?

1

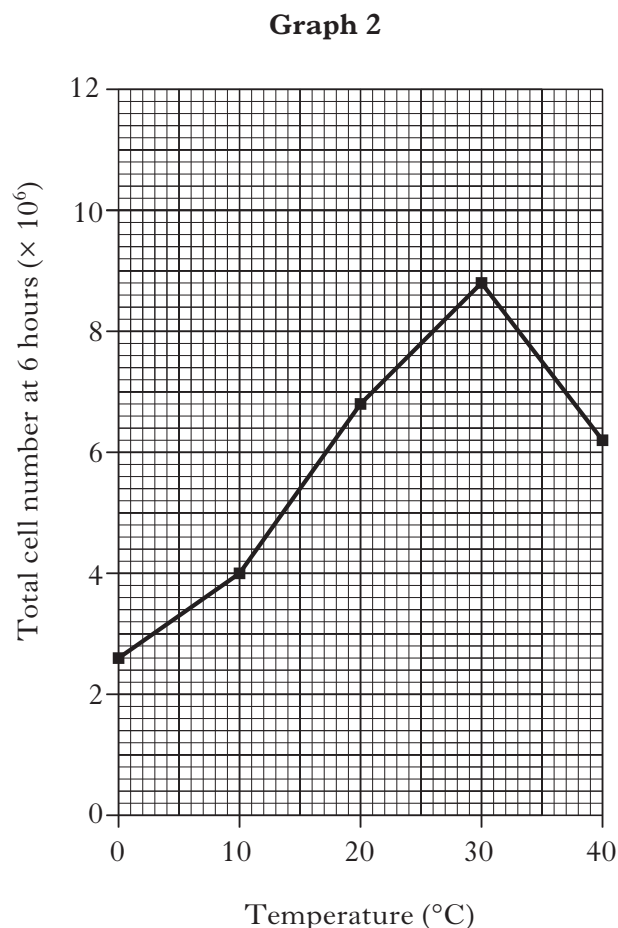
[Question 6 continues on *Page twenty*]

Marks

6. (continued)

- (d) A further experiment was carried out to investigate the effect of temperature on growth of *Pseudomonas* at a constant CO₂ concentration.

The results are shown in **Graph 2**.



- (i) A student concluded that the optimum temperature for growth at this CO₂ concentration was 30 °C. Explain why this is **not** a valid conclusion based on the results in **Graph 2**.

1

- (ii) Using **all** the information given, find the CO₂ concentration at which the results shown in **Graph 2** were obtained.

_____ %

1

[OPEN OUT]

Marks

7. Hynes medium is used to isolate *Salmonella* and *Shigella* species from *E. coli*. These bacteria cause gastroenteritis in humans. Some of the components of Hynes medium and their functions are shown in the table below.

<i>Component of medium</i>	<i>Function</i>
Lactose	
Neutral red	pH indicator
Sodium deoxycholate	inhibits growth of <i>E. coli</i>
Agar	

- (a) **Complete the table** to show the function of the lactose and the agar in the medium.

1

- (b) When grown on Hynes medium, *Shigella* ferments lactose to produce acid, *Salmonella* does not.

Explain why Hynes medium is both a differential and selective medium.

Selective _____

Differential _____

2

- (c) Using the information given, suggest what the optimum temperature for growth of *Salmonella* and *Shigella* would be.

_____ °C

1

- (d) Plates of Hynes medium are prepared by dissolving powdered medium in distilled water, sterilising then pouring into Petri dishes. Sodium deoxycholate is destroyed when heated above 100 °C, therefore the rest of the components are autoclaved before sterile sodium deoxycholate is added.

- (i) Suggest a method that could be used to sterilise the sodium deoxycholate.

1

- (ii) The plates were poured using aseptic technique.

Describe how this would be carried out.

2

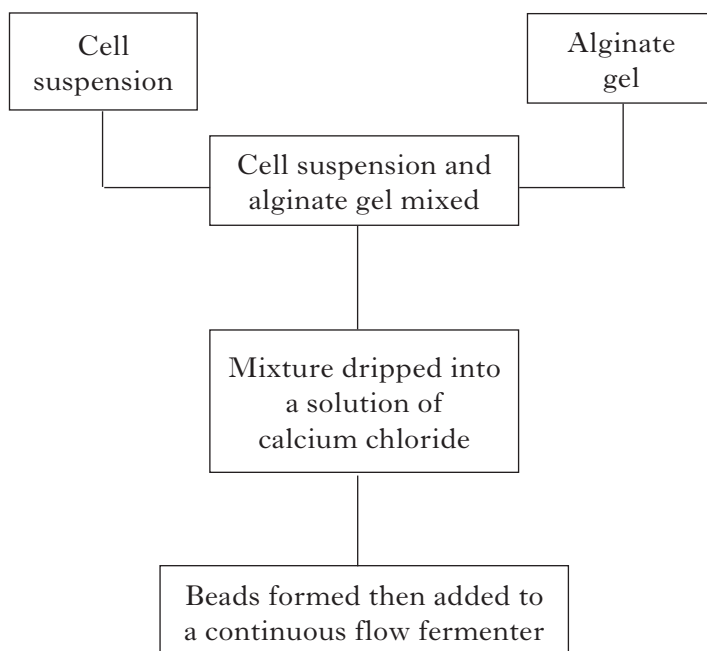
- (iii) After pouring, the plates were found to have condensation.

How could this have been avoided?

1

Marks

8. Pectinase can be produced by immobilised cells in a continuous flow process. The enzyme can be isolated and used commercially. Some of the steps in the process are shown in the diagram.



- (a) Name the type of immobilisation described.

_____ 1

- (b) (i) State **two** advantages of continuous flow processing over batch processing.

1 _____

2 _____ 2

- (ii) Describe what happens in a continuous flow process.

_____ 2

- (c) How is pectinase used commercially?

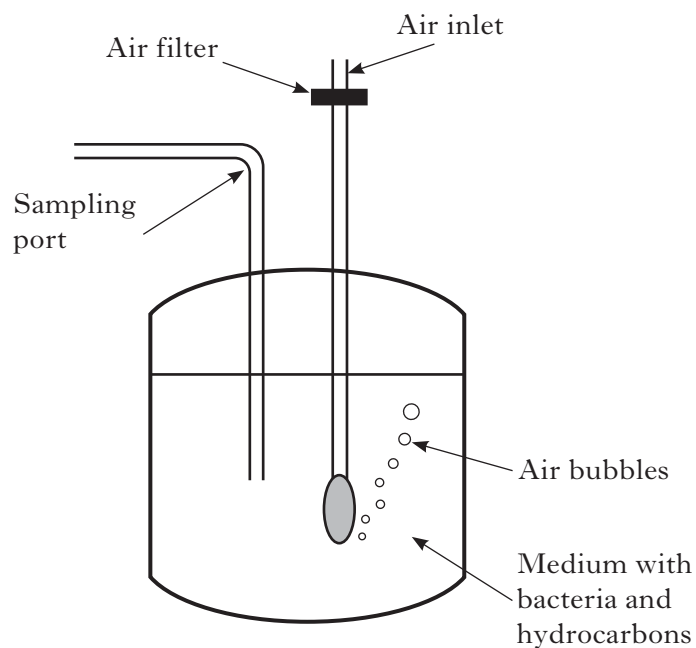
_____ 1

- (d) Name **one** other enzyme produced in a biotechnology process and describe its use.

Name _____

Use _____ 1

9. A biotechnology company investigated the breakdown of hydrocarbons in oil by *Mycobacterium*. The fermenter set up for this investigation is shown in the diagram.



Samples of the culture were removed every two hours in order to measure the bacterial growth and the concentration of hydrocarbon. The results are shown in the table.

<i>Time</i> (hours)	<i>Bacterial Growth</i> (absorbance at 650 nm)	<i>Hydrocarbon concentration</i> (g/cm ³)
0	0.20	190
4	0.55	188
8	2.40	176
12	4.00	150
16	4.50	112
20	4.55	98

9. (continued)

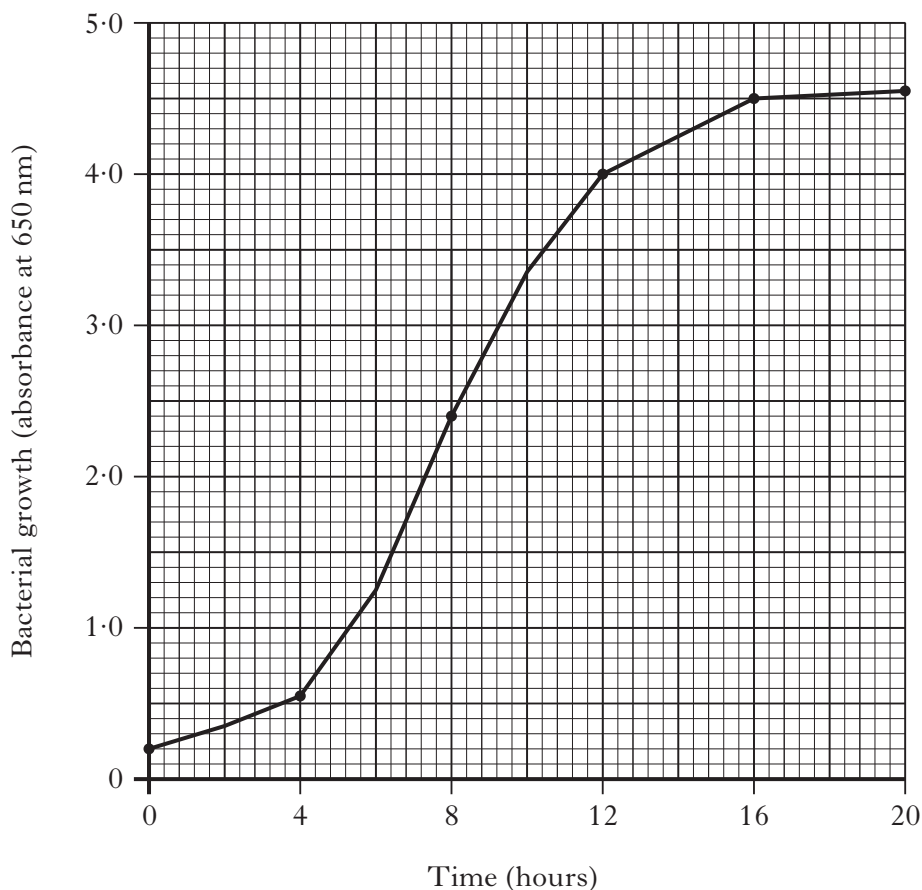
Marks

- (a) Complete the line graph to show the hydrocarbon concentration at each time point by

- labelling and adding a scale to the right hand axis,
- plotting the results.

The bacterial growth (absorbance) measured at each time point is already plotted.

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



2

- (b) **Using data from the table**, describe the relationship between bacterial growth and hydrocarbon concentration.

2

- (c) (i) Describe how temperature could be controlled in this experiment.

1

- (ii) State **one** other variable that should be controlled in this experiment.

1

Marks

9. (continued)

- (d) Suggest why there is a filter on the air inlet and **not** on the sampling port in a fermenter.

2

- (e) The purpose of this investigation was to identify bacteria that could be used to spray on oil spills in the sea.

- (i) What term is used to describe the biotechnology process in which organisms are used to degrade pollutants such as oil?

1

- (ii) Suggest a potential problem with using bacteria to treat oil spills in this way.

1

Marks

10. Transgenic tomato plants have been developed which have a gene from *Bacillus thuringiensis* inserted into their genome. The gene product is a microbial pesticide which gives the plants resistance to gypsy moth caterpillars.

(a) What is the chemical nature of this transgenic gene product?

1

(b) Explain how this gene product protects the transgenic plants from the gypsy moth caterpillar.

1

(c) (i) Describe how *Bacillus thuringiensis* can be used in crop protection without producing transgenic plants.

1

(ii) Explain why an alternative method not using transgenic plants may be more publicly acceptable.

1

(d) Transgenic wheat plants have been developed which are resistant to herbicides such as glyphosate.

Explain why weeds are killed by glyphosate but the transgenic wheat plants are not.

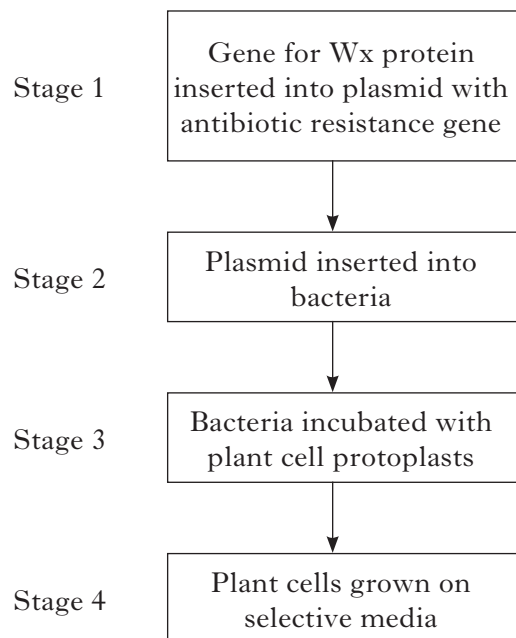
2

[Turn over

Marks

11. The quality, texture and appearance of cooked rice grains is determined by the level of a protein called Waxy Protein (Wx protein). Good quality rice has low levels of Wx protein. Transgenic rice plants produce rice with low levels of Wx protein.

Scientists used the following procedure to produce the transgenic rice plants.



- (a) Name the bacteria used at Stage 2.

1

- (b) (i) Describe how protoplasts are made from plant cells.

1

- (ii) Explain why plant cell protoplasts are used at Stage 3.

1

- (c) (i) What must be added to the medium to select for transgenic plant cells?

1

- (ii) Explain why this media would select for transgenic plant cells.

1

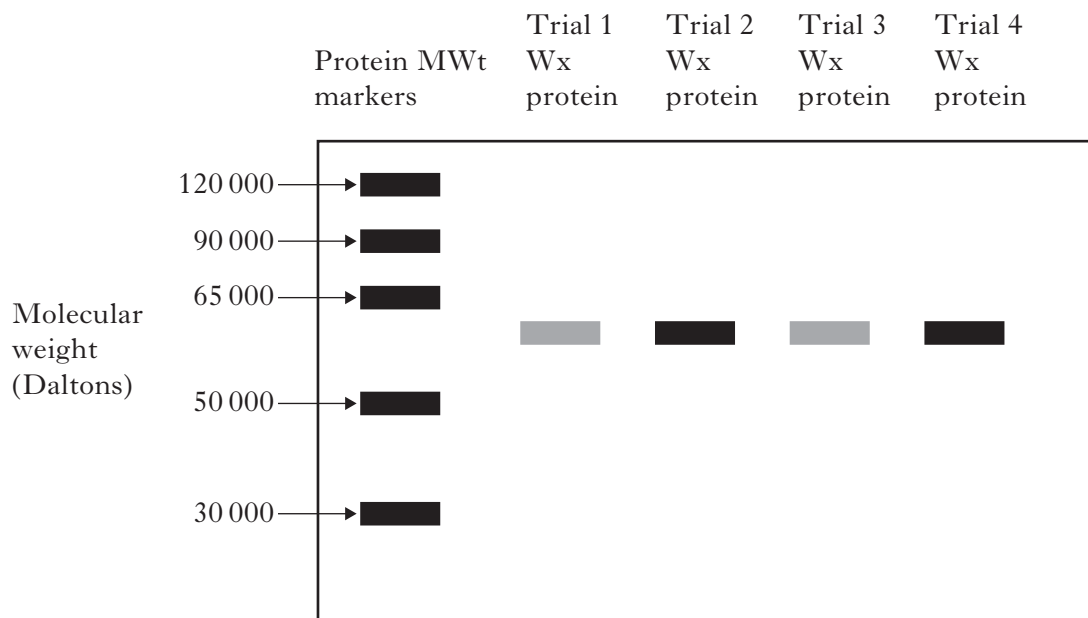
- (d) The plants from Stage 4 were then grown in tissue culture. Apart from reducing cost, state **one** benefit of this technique.

1

Marks

11. (continued)

- (e) Plants from 4 different trials were compared for their level of W_x protein. Proteins were analysed by gel electrophoresis as shown in the diagram, and their molecular weight (MWt) was measured. The darker the protein band the greater the level of protein.



- (i) Use the information in the diagram to estimate the molecular weight of W_x protein.

1

- (ii) Use **all** the information given to identify which trial(s) were the most successful. Give a reason for your answer.

Trial(s) _____

Reason _____

1

[Turn over for SECTION C on *Page thirty*

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.

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 viruses under the following headings:

- | | |
|-------------------------------|---|
| (a) the structure of viruses; | 3 |
| (b) replication of viruses; | 5 |
| (c) uses of viruses. | 2 |

(10)

OR

B. Give an account of nucleic acids in eukaryotic cells under the following headings:

- | | |
|-------------------------|---|
| (a) structure of DNA; | 5 |
| (b) replication of DNA; | 3 |
| (c) structure of RNA. | 2 |

(10)

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

2. Answer either A or B.

A. Describe the processes involved in the extraction and purification of end products from industrial fermenters. **(10)**

OR

B. Describe the use of biotechnology in the production of medical products. **(10)**

[END OF QUESTION PAPER]

SPACE FOR ANSWERS

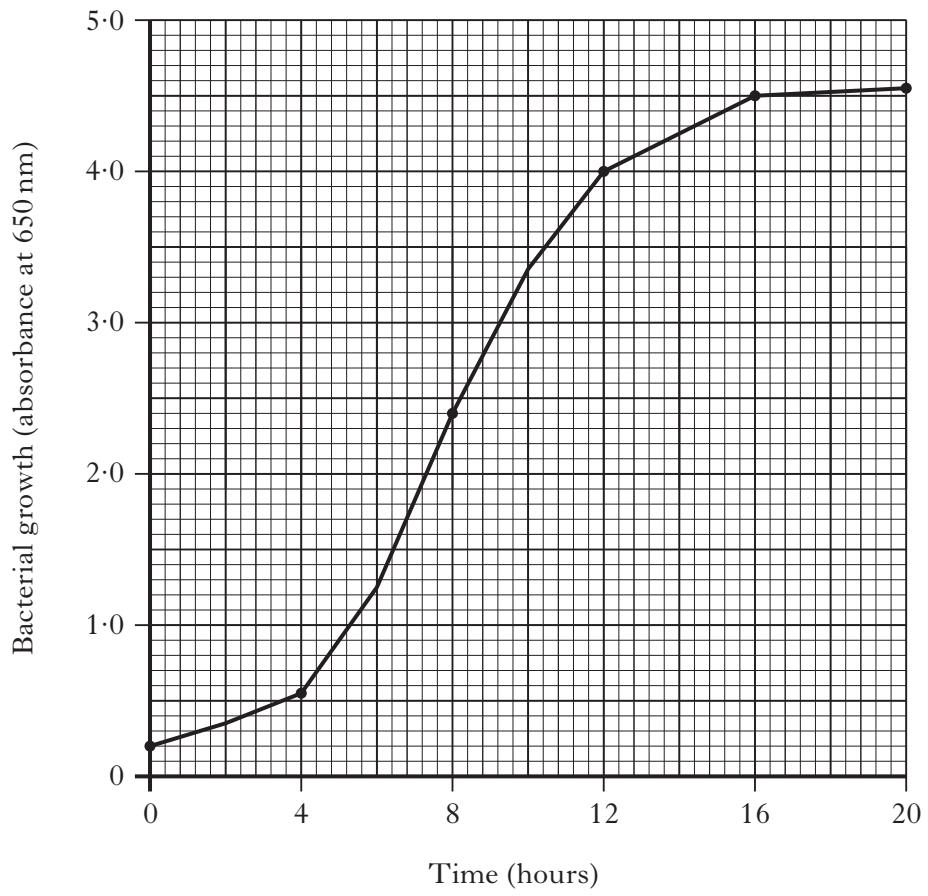
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SPACE FOR ANSWERS

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SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR USE IN QUESTION 9(a)



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