FOR OFFICIAL USE

Total for Sections B and C

X008/301

NATIONAL QUALIFICATIONS 2011

TUESDAY, 17 MAY
1.00 PM – 3.30 PM

BIOTECHNOLOGY HIGHER

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 (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)

1 (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 9 is on pages 26, 27 and 28. Question 10 is on page 29. Question 11 is on pages 30 and 31. Pages 28 and 29 are fold-out pages.

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 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?

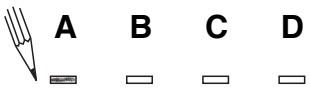
A Mixed

B Pure

C Simple

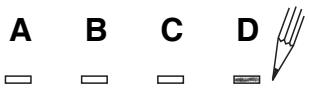
D Complex

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**.

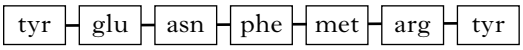


SECTION A

All questions in this Section should be attempted.

Answers should be given on the separate answer sheet provided.

1. The diagram below shows a short chain of amino acids.



The level(s) of protein structure shown is

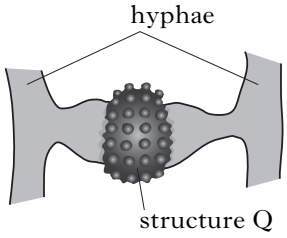
A primary only

B secondary only

C primary and secondary only

D primary, secondary and tertiary.

2. The diagram below shows sexual reproduction in the fungus *Mucor*.



Structure Q is

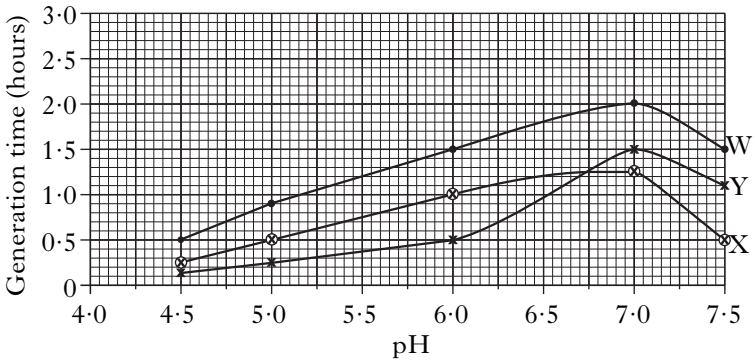
A a sporangium

B an endospore

C a bud

D a zygospore.

3. The graph below shows the effect of pH on the generation time of three different bacterial species (W, X and Y).



The number of generations per hour for species X at pH 5·0 is

A 0·5

B 1·0

C 2·0

D 4·0.

4. A molecule of DNA has one strand labelled with radioactive phosphate. This molecule replicates to form two new molecules, X and Y.

Which of the following correctly describes the two new molecules?

	DNA molecule X	*DNA molecule Y*
A	2 labelled strands	2 unlabelled strands
B	2 labelled strands	1 labelled strand 1 unlabelled strand
C	1 labelled strand 1 unlabelled strand	2 unlabelled strands
D	1 labelled strand 1 unlabelled strand	1 labelled strand 1 unlabelled strand

[Turn over

5. A chromosome contains 6×10^9 base pairs. Only 4% of the base pairs code for protein. How many codons does this represent?

A 8×10^7

B 8×10^8

C $2{\cdot}4 \times 10^7$

D $2{\cdot}4 \times 10^8$

6. The sequence of bases on a strand of DNA is shown below.

ATTCCGGATAACCGCGCATTT

The mRNA produced from this sequence is used to make protein. How many of the tRNA anticodons will have **more than one** uracil?

A one

B two

C three

D four

7. Bacteria growing in a flask of medium containing glucose and mineral salts reached stationary phase. The onset of stationary phase was thought to be due to the concentration of nitrate in the medium becoming limiting.

This hypothesis could be tested by measuring growth after

A transferring a sample of the bacteria from this flask to fresh medium

B repeating the experiment using fresh medium with a higher nitrate concentration

C transferring a sample of the bacteria from this flask to fresh medium containing nitrate

D adding nitrate to this culture.

8. A plasmid has the following characteristics:

1. It carries an antibiotic resistance gene
2. It can be cut with the restriction endonuclease *Eco R1*
3. It can have foreign DNA inserted into it

Which characteristics are essential for the plasmid to be used as a cloning vector?

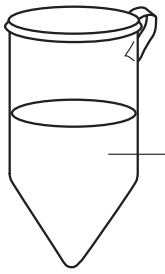
A 1 only

B 3 only

C 2 and 3 only

D 1 and 3 only

9. Bacterial cells were transformed with a plasmid containing a gene for a human hormone and an antibiotic resistance marker gene.



Some of these bacterial cells were able to grow on agar plates containing antibiotic.

What would a suitable control tube contain to prove that these bacteria grew because they had been transformed with plasmid?

	plasmid DNA	*buffer*	*bacterial cells*	*Antibiotic solution*
A	0 µl	20 µl	100 µl	0 µl
B	10 µl	0 µl	100 µl	10 µl
C	0 µl	10 µl	100 µl	10 µl
D	10 µl	110 µl	0 µl	0 µl

10. Which of the following procedures used in genetic engineering is carried out using reverse transcriptase?

A cloning of complementary DNA

B labelling of single stranded DNA

C formation of mRNA from DNA

D formation of complementary DNA

11. Human insulin can be produced by the bacterium *E. coli* using the following steps:

1 Culture large quantities of *E. coli*.

2 Insert human insulin gene into plasmid DNA, then transform *E. coli*.

3 Cut insulin gene from human chromosome using enzymes.

4 Extract insulin from culture.

The correct order for these steps is

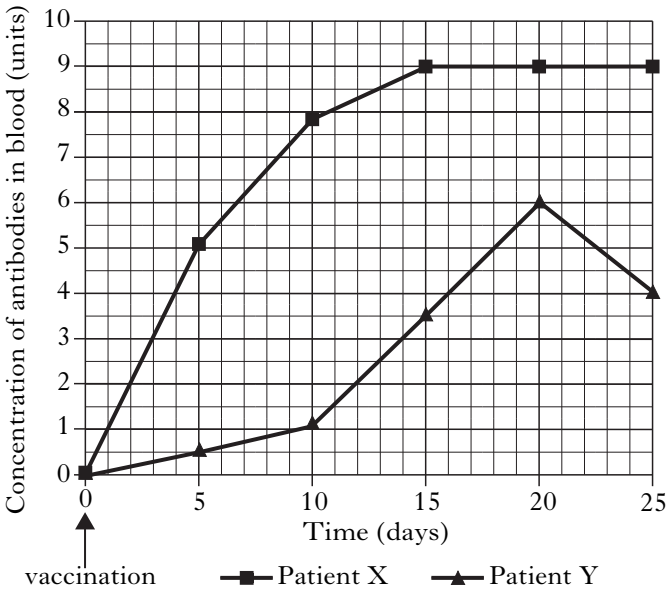
A 3, 2, 1, 4

B 3, 1, 2, 4

C 1, 4, 3, 2

D 1, 2, 3, 4.

12. The graph below shows the concentration of rubella antibodies in two patients following vaccination.



The concentration of rubella antibodies in both patients X and Y

A increases to a maximum and then levels off

B increases to a maximum level and then decreases

C is at a maximum level on day 20

D reaches a peak on day 20.

13. The immunity gained from an injection of tetanus antitoxin can be described as

A artificial passive

B artificial active

C natural passive

D natural active.

[Turn over

14. Which of the following describes correctly the function of a macrophage?

A Production of lymphocytes

B Phagocytosis of pathogens

C Initiation of the humoral response

D Production of antibodies

15. Which of the following would be an appropriate use for a chemical disinfectant in a microbiology laboratory?

W Wiping the bench before inoculating plates with bacteria.

X Sterilisation of plastic inoculating loops before use.

Y Discarding of plastic inoculating loops after use.

Z Wiping the bench after inoculating agar plates with bacteria.

A W, X and Y only

B W, Y and Z only

C X, Y and Z only

D W, X and Z only

16. An investigation was carried out to find out if a chemical agent was biocidal or biostatic.

Which line in the table below identifies correctly the results obtained if the chemical agent was biocidal?

	Growth in nutrient agar	*Growth in medium containing chemical agent*	*Growth in medium after exposure to chemical agent*
A	yes	no	no
B	yes	yes	no
C	yes	no	yes
D	no	no	no

17. Agar plates were prepared by combining precise quantities of known ingredients. In use, these plates allowed growth of some bacterial species but prevented growth of others.

The agar could be described as

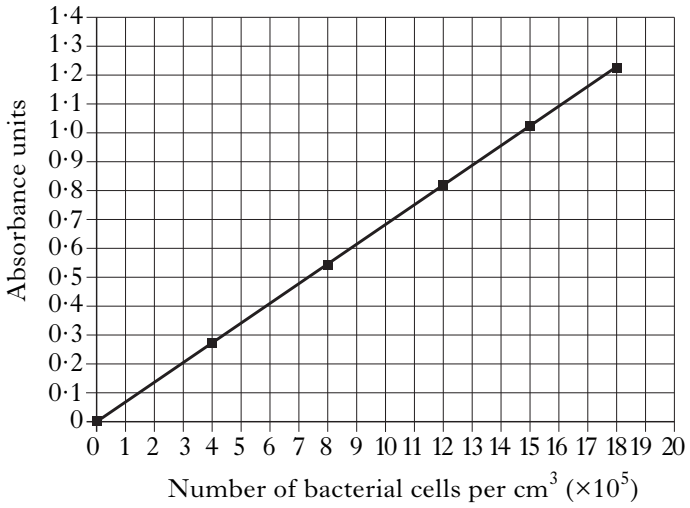
A complex, selective medium

B synthetic, selective medium

C complex, differential medium

D synthetic, differential medium.

18. The graph below shows the absorbance recorded when tubes containing known numbers of bacterial cells were read in a spectrophotometer.



How many bacterial cells would be in 10 cm^3 of a culture that gave a reading of 0·75 absorbance units?

A $5{\cdot}0 \times 10^4$

B $5{\cdot}0 \times 10^5$

C $1{\cdot}1 \times 10^6$

D $1{\cdot}1 \times 10^7$

19. Bacteria may be inoculated onto agar plates as a lawn or as a streak.

Inoculated plates may be used for the following purposes:

W plaque assay

X isolation of a pure culture

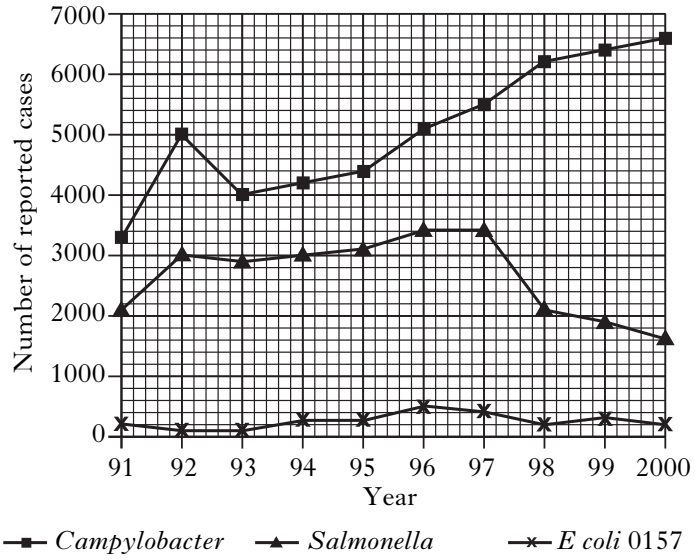
Y investigations using antibiotic discs

Z growth of a stock culture for further inoculation.

Which line in the table below identifies correctly the appropriate use for each type of plate?

	Streak plate	*Lawn plate*
A	W and Y	X and Z
B	X and Y	W and Z
C	W and Z	X and Y
D	X and Z	W and Y

20. The graph below shows reported cases of gastronintestinal disease caused by three types of bacteria in Scotland from 1991 to 2000.



To the nearest whole number, what percentage of the total number of cases in 1997 was caused by *Salmonella*?

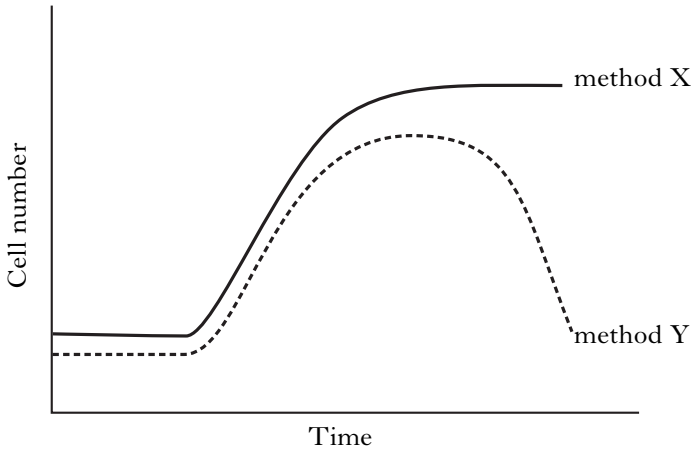
A 34%

B 37%

C 38%

D 59%

21. The graph below shows the result of an experiment to count the number of cells in a bacterial culture by two different methods.



Which of the following descriptions is correct for method X and Y?

A X is a viable count, Y is a total count

B X is an indirect count, Y is a direct count

C X was measured by colorimeter, Y was measured by plate count

D X is a measure of living cells only, Y is a measure of living and dead cells

22. The uses of three enzymes produced by biotechnological processes are shown below.

Enzyme 1: clarification of fruit juice

Enzyme 2: removal of fibrin clots

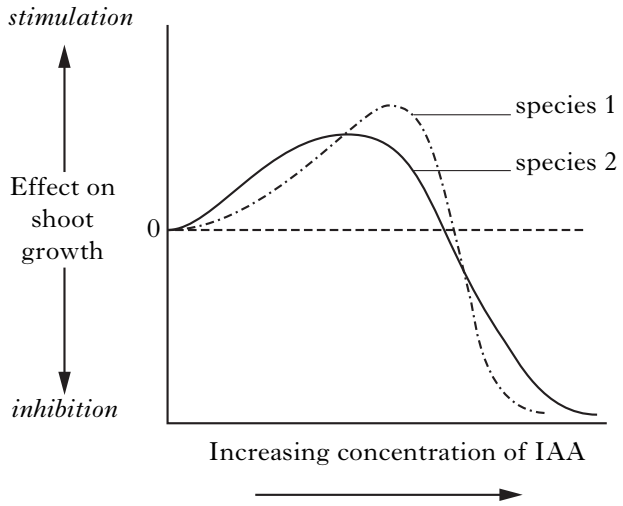
Enzyme 3: production of feedstock

Which line in the table below identifies correctly the three enzymes?

	Cellulase	*Pectinase*	*Urokinase*
A	Enzyme 3	Enzyme 1	Enzyme 2
B	Enzyme 1	Enzyme 3	Enzyme 2
C	Enzyme 2	Enzyme 1	Enzyme 3
D	Enzyme 3	Enzyme 2	Enzyme 1

[Turn over

23. An investigation was carried out into the effect of IAA concentration on the growth of shoots of two species of plants. The graph below gives a summary of the results.



Which of the following conclusions can be drawn from these results?

A Species 1 shows maximum stimulation at a lower concentration of IAA than species 2.

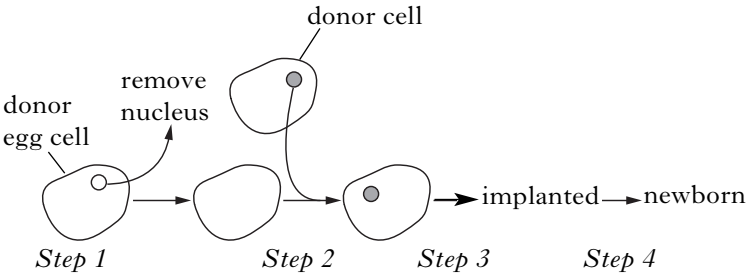
B Species 2 starts to show inhibition at a higher concentration of IAA than species 1.

C Species 1 shows stimulation over a greater range of concentrations of IAA than species 2.

D Species 2 is stimulated at some concentrations of IAA that inhibit species 1.

Questions 24 and **25** are based on the information given below.

Some of the steps in somatic cell cloning are shown below.



24. In which step(s) does nuclear transfer take place?

A Step 1 only

B Step 2 only

C Step 1 and step 2 only

D Step 1 and step 3 only

25. The donor cell in step 2 is

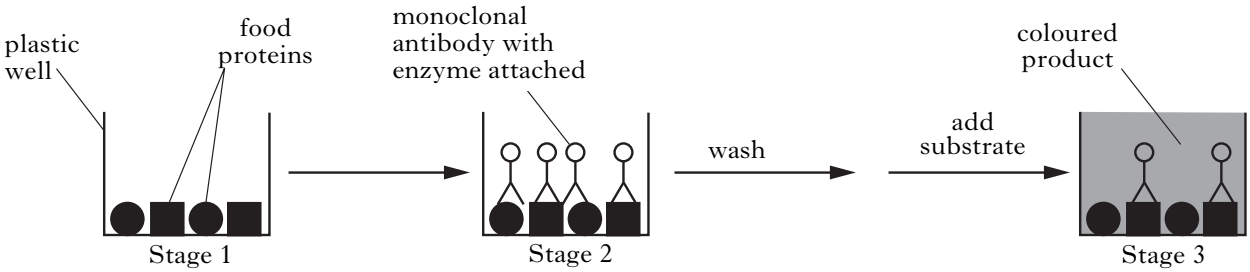
A a differentiated cell from an adult

B a differentiated cell from an embryo

C an undifferentiated cell from an adult

D an undifferentiated cell from an embryo.

26. The quantity of a specific protein in a sample of food is estimated using monoclonal antibodies as shown below.



Stage 1: A sample of food is added to a plastic well. Food proteins stick to the plastic.

Stage 2: Monoclonal antibodies with an attached enzyme are added. The antibodies attach to the specific protein.

Stage 3: A substrate for the enzyme is added which is converted to a coloured product. The intensity of the coloured product indicates the quantity of the specific protein.

Predict the result if the process was carried out without the wash after stage 2.

A Substrate and enzyme will not react.

B The quantity of the specific protein will be overestimated.

C The quantity of the specific protein will be underestimated.

D Coloured product will not be made.

27. Which of the following is **not** a use for monoclonal antibodies?

A Tissue typing

B Identifying infective agents

C Production of immobilised enzymes

D Targeting of anti-cancer drugs

28. In the production of monoclonal antibodies, cancer cells are fused with B lymphocytes. Why are B lymphocytes used in this process?

A To produce hybrid cells that divide continuously.

B Because each lymphocyte can produce several types of antibodies.

C To produce hybrid cells that can be easily selected.

D Because each lymphocyte produces only one type of antibody.

29. Which of the following is a possible use for stem cells?

A Pregnancy testing

B Detection of genetic disorders

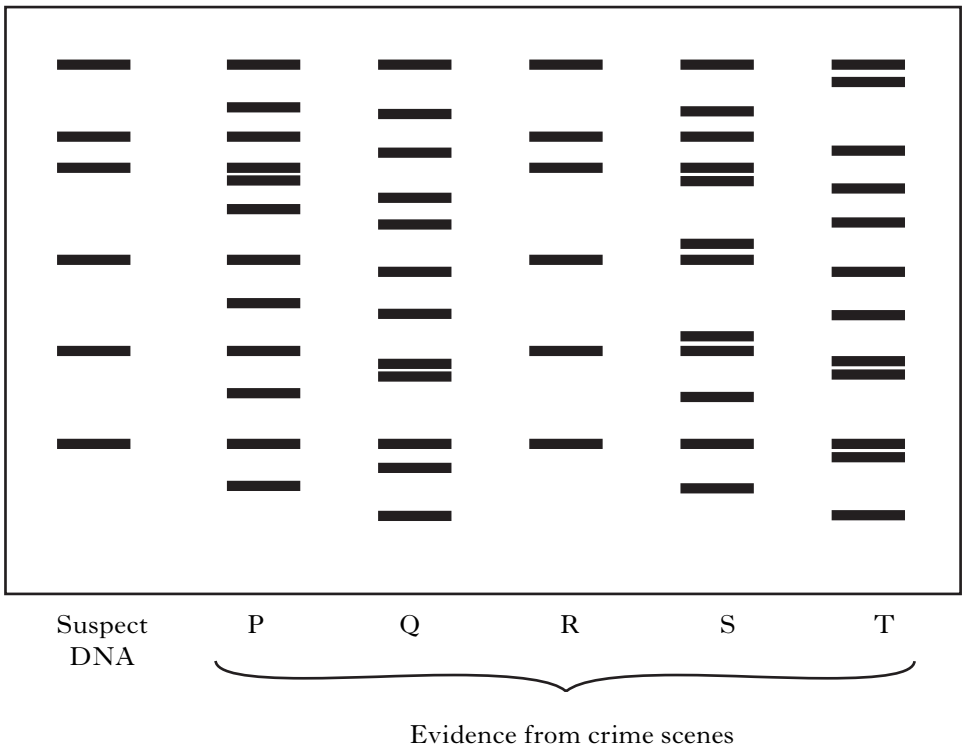
C Production of therapeutic proteins

D Production of tissues for transplantation

[Turn over

30. A suspect for several crimes has given a DNA sample to the police. The suspect's DNA profile was compared with DNA evidence collected from the crime scenes. In some cases, the evidence contained more than one person's DNA.

The profiles are shown below.



In which crime(s) was the suspect involved?

A R only

B Q and S only

C P, R and S only

D P, Q, R, S and T

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 twelve*

DO NOT WRITE IN THIS MARGIN

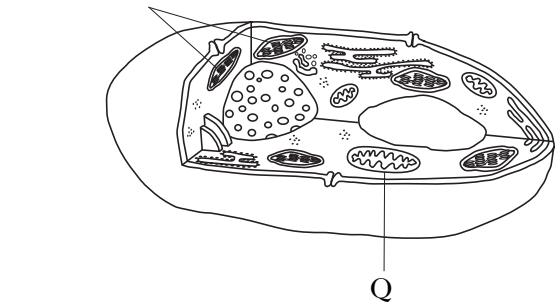
Marks

SECTION B

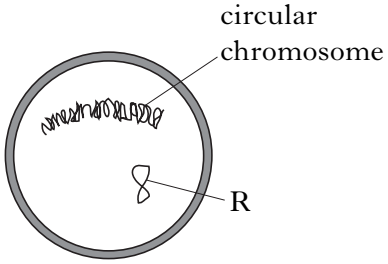
All questions in this section should be attempted.
All answers must be written clearly and legibly in ink.

1. The diagrams below illustrate two different types of cell.

Cell Y



Cell Z



(*a*) Add a label to cell Y to show the endoplasmic reticulum. **1**

(*b*) Name and give the function of structures Q and R.

Q Name _____

Function _____

_____

R Name _____

Function _____

_____ **2**

(*c*) Name **one** structure that would be present in both cell Y and cell Z.

_____ **1**

(*d*) Cell Z is an example of one of the organisms named in the list below. **Underline** the organism represented by cell Z.

Bacillus subtilis

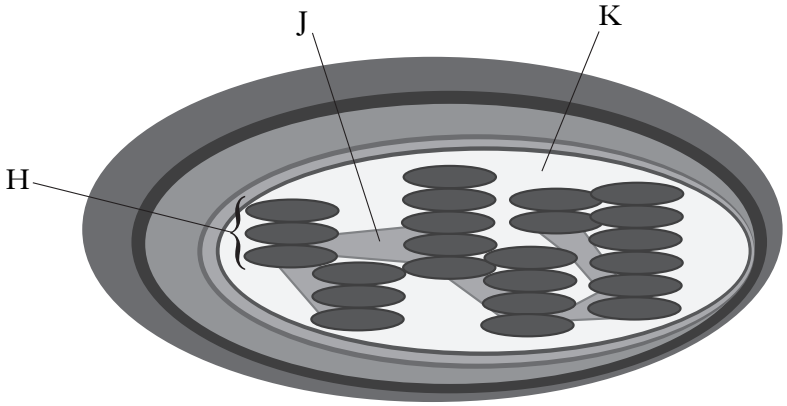
Saccharomyces cerevisiae

Staphylococcus aureus **1**

Marks

1. (continued)

(*e*) The diagram below shows a chloroplast.



Name the parts labelled H, J and K.

H _____

J _____

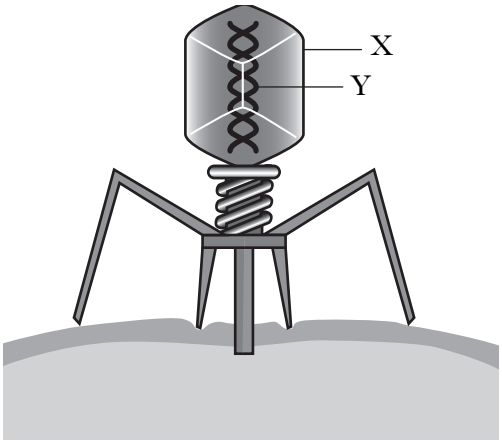
K _____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

2. The diagram below shows a bacteriophage infecting its host cell.



(*a*) What is a bacteriophage?

_____ **1**

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

X _____

Y _____ **1**

(*c*) Bacteriophage increase in number in the lytic cycle by making use of host cell processes and materials.

Name **two** host cell processes and the raw material used by the bacteriophage in each process.

Process 1 _____

Raw material _____

Process 2 _____

Raw material _____ **2**

(*d*) Describe how bacteriophage exit a host cell in the lytic cycle.

_____ **1**

Marks

2. (continued)

(*e*) The number of bacteriophage in a suspension was calculated using the following method.

- 10 µl of bacteriophage suspension was mixed with 990 µl of a broth culture of *E. coli*.
- 200 µl of this mixture was spread on an agar plate.
- After incubation, 120 plaques were counted on the plate.

Calculate the concentration of bacteriophage in the original suspension.

Space for calculation

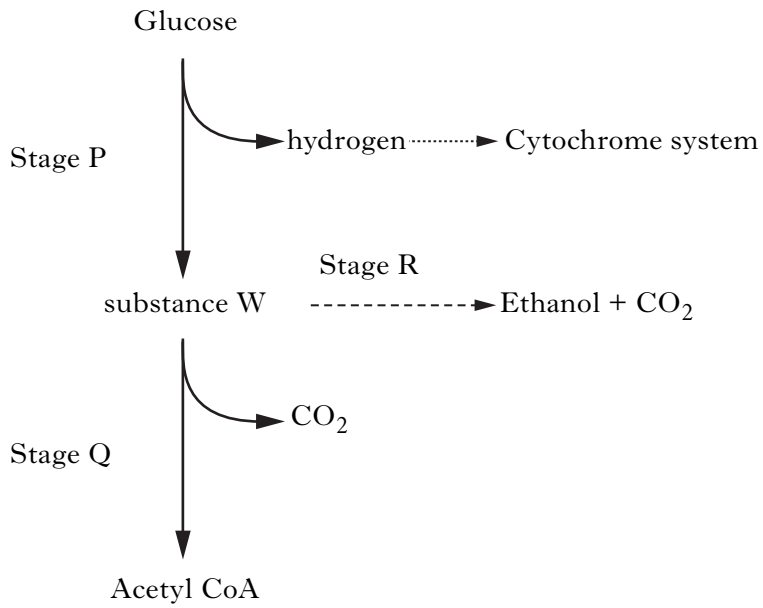
_____ bacteriophage per µl **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

3. The diagram shows part of the pathway of respiration in yeast cells.



(*a*) What name is given to Stage P?

_____ **1**

(*b*) How many carbon atoms are in substance W?

_____ **1**

(*c*) Describe how acetyl CoA enters the Krebs cycle.

_____

_____ **2**

(*d*) (i) What change in conditions would cause Stage R to occur instead of Stage Q?

_____ **1**

(ii) Ethanol is commercially produced from yeast in industrial fermenters. What method is used to extract ethanol?

_____ **1**

Marks

3. (continued)

During the process of respiration, hydrogen is produced and carried to the cytochrome system.

(*e*) (i) What carries hydrogen to the cytochrome system?

_____ **1**

(ii) What is the final hydrogen acceptor in the cytochrome system?

_____ **1**

(*f*) The energy from cellular respiration is required for many processes in cells.

Give **one** example of an energy requiring process in yeast cells.

_____ **1**

[Turn over

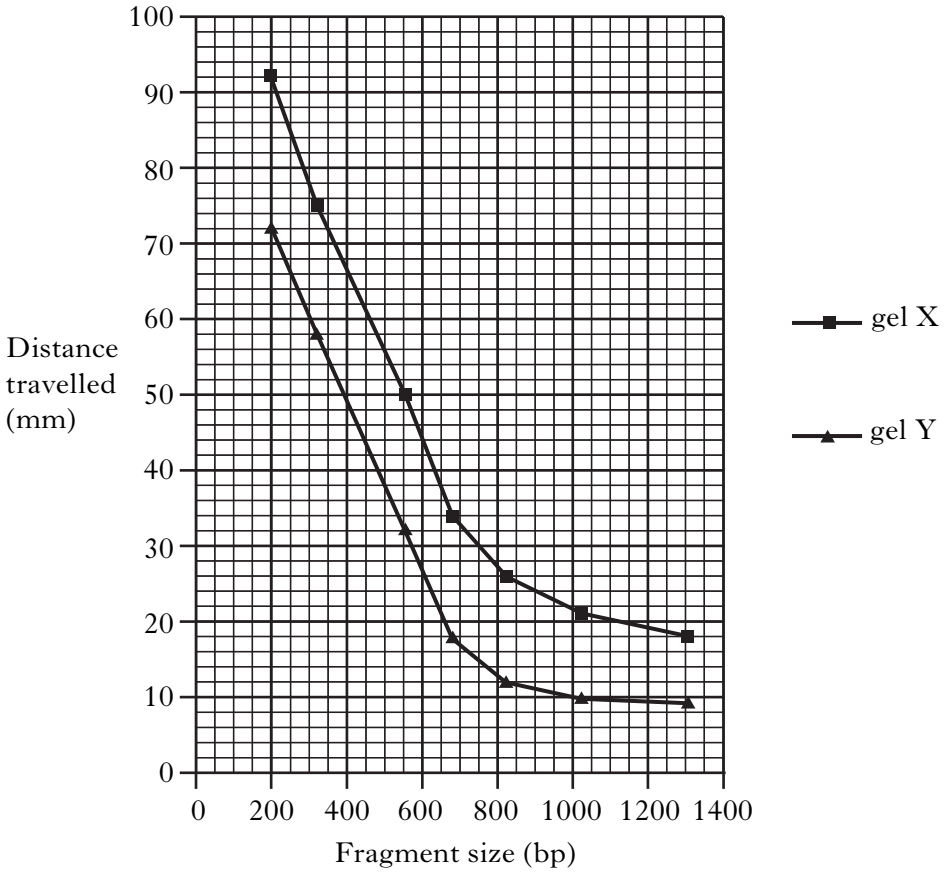
DO NOT WRITE IN THIS MARGIN

Marks

4. DNA fragments can be separated by gel electrophoresis.

A DNA sample containing fragments of known sizes was run on two different gels X and Y. The gels were made using different concentrations of agarose.

The graph shows the distances travelled by the DNA fragments on gel X and gel Y.



(*a*) (i) How much further does the smallest fragment travel on gel X than on gel Y?

Space for calculation

_____ **1**

(ii) Which gel, X or Y, would be best suited to separate a fragment of 800 bp from a fragment of 1200 bp in size? Give a reason for your answer.

Gel _____

Reason _____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

4. (*a*) (continued)

(iii) Using the graph predict how far a fragment 150 bp in size would travel on gel Y.

_____ mm **1**

(*b*) Gel X was made of 0·8% agarose.

(i) How much agarose powder should be weighed to prepare 30 cm^3 of a 0·8% gel?

Space for calculation

_____ g of agarose powder **1**

(ii) What property of DNA causes it to travel through the agarose gel towards the anode?

_____ **1**

(iii) Other than agarose concentration, state **two** factors that could be used to control the distance travelled by DNA fragments on an agarose gel.

_____

_____ **2**

(*c*) A sample of DNA of unknown size was cut with the restriction enzyme *Eco R1* and run on a gel with the same agarose concentration as gel X.

The distances travelled by the three fragments produced are shown in the table.

Fragment no.	*Distance travelled* (mm)	*Size* (bp)
1	82	
2	60	
3	45	

(i) Using the graph, complete the table to show the sizes of the fragments. **1**

(ii) When the same sample of DNA is cut with *Eco R1* and another restriction enzyme, *Hind*III, four fragments of DNA are produced. How many times does *Hind*III cut the piece of DNA?

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks

5. A biotechnologist set up an experiment to clone a plant using apical meristem tissue.

The plant tissue was sterilised and placed on to culture medium.

(*a*) State where apical meristems are found in plants.

_____ **1**

(*b*) Describe how plant tissue is sterilised.

_____ **1**

The plant tissue culture medium contained a carbon source and plant growth substances.

(*c*) Give **one** reason for including a carbon source in the medium.

_____

_____ **1**

(*d*) Why are plant growth substances included in the medium?

_____ **1**

(*e*) Name **one** plant growth substance.

_____ **1**

(*f*) Apart from the carbon source and plant growth substances, name **two** other substances that must be included in a plant growth medium.

_____

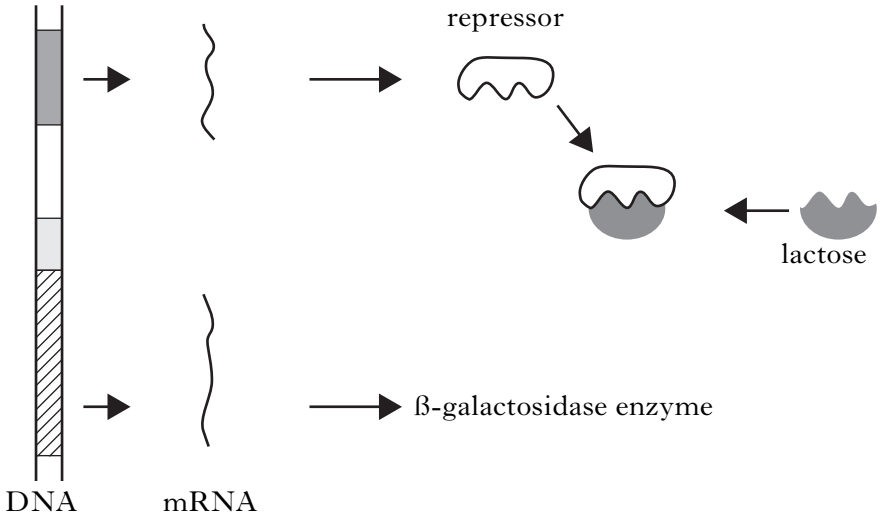
_____ **1**

(*g*) State **one** reason for plant cloning.

_____ **1**

Marks

6. The diagram below illustrates the Jacob-Monod model of gene action in *E. coli*.



(*a*) What name is given to this arrangement of genes in bacteria?

_____ **1**

(*b*) Match the following terms related to this model with their descriptions.
Use each word only once.

Structural gene Regulator gene Operator Lactose

Description	*Term*
acts as an inducer	
codes for the repressor molecule	
binds to the repressor	
codes for ß-galactosidase enzyme	

2

(*c*) Briefly describe what happens if lactose is not present.

_____

_____

_____

_____ **3**

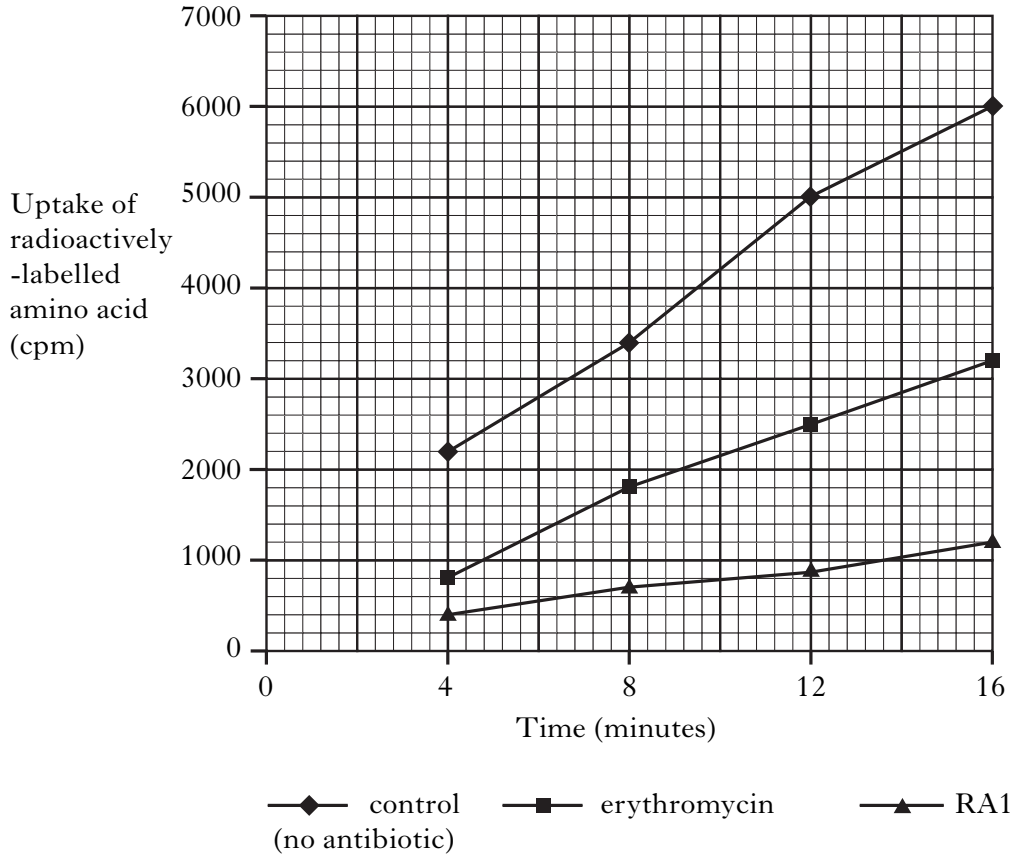
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks

7. The antibiotic erythromycin inhibits bacterial protein synthesis. An experiment was carried out to compare the effects of erythromycin with a new antibiotic RA1 by measuring protein synthesis in bacterial cells. Protein synthesis was measured by the uptake of a radioactively-labelled amino acid into the cells.

The results are shown in the graph below.



(*a*) Why was the control included in the experiment?

_____ **1**

(*b*) (i) When 3000 cpm of this amino acid has been taken up by the control cells, how much has been taken up by the cells treated with RA1?

_____ cpm **1**

(ii) What is the percentage decrease in uptake of this amino acid in RA1 treated cells compared to erythromycin treated cells at 16 minutes?

Space for calculation

_____% **1**

Marks

7. (continued)

(*c*) Compare the effect of erythromycin and RA1 on protein synthesis.

_____

_____ **1**

(*d*) **Underline** one of the alternatives in each pair to make the second sentence correct.

Erythromycin prevents protein synthesis by binding to bacterial ribosomes.

As a result, {DNA / mRNA} is unable to bind to the ribosome, preventing

{transcription / translation}. **1**

(*e*) Some bacterial cells are resistant to erythromycin. Suggest a mechanism by which a cell can resist this antibiotic.

_____

_____ **1**

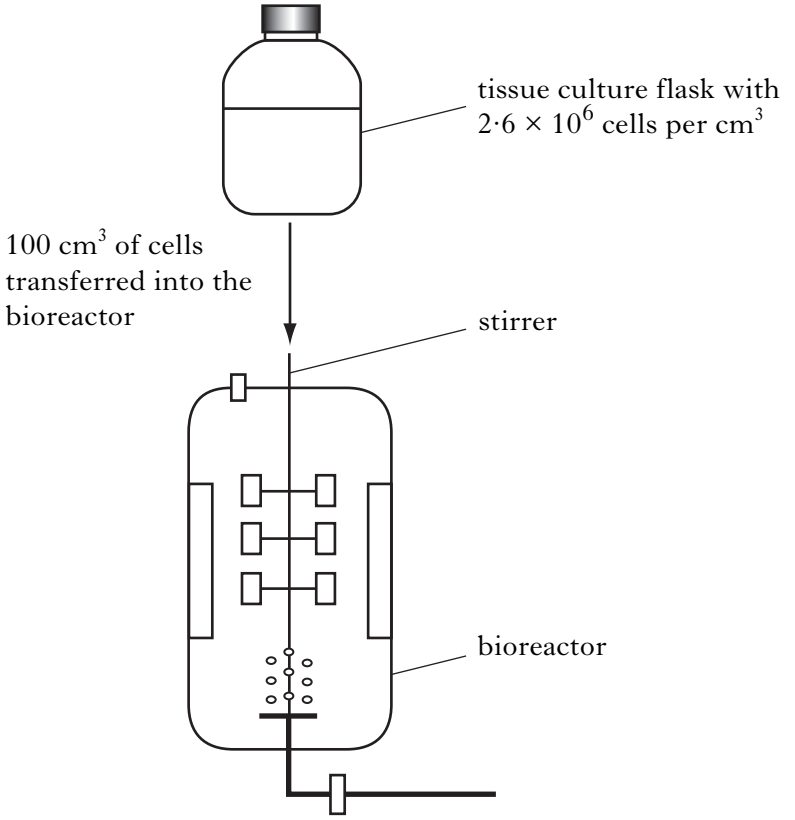
(*f*) Penicillin works by inhibiting cell wall synthesis in bacteria, not protein synthesis. Predict the uptake of radioactively-labelled amino acid (in cpm) at 4 minutes if penicillin was used in the experiment.

_____ cpm **1**

[Turn over

Marks

8. A type of animal cell produces a hormone that could be commercially valuable. A lab model was set up to investigate production of the hormone. The animal cells were grown in a tissue culture flask and then transferred into a bioreactor containing 1·9 litres of medium.



(*a*) (i) Calculate how many cells were transferred from the tissue culture flask into the bioreactor.

Space for calculation

_____ **1**

(ii) Calculate the initial concentration of cells per cm^3 in the bioreactor.

Space for calculation

_____cells per cm^3 **1**

DO NOT WRITE IN THIS MARGIN

Marks

8. (continued)

(*b*) (i) Explain why a buffer was included in the bioreactor growth medium.

_____ **1**

(ii) Explain why the contents of the bioreactor have to be mixed by the stirrer.

_____ **1**

(*c*) The optimum temperature for cell growth was 37 °C. Suggest what might happen to hormone production at 45 °C. Give a reason for your answer.

Suggestion _____

Reason _____

_____ **1**

(*d*) What is the purpose of the lab model in industrial processes?

_____ **1**

(*e*) How is temperature maintained when the process is scaled up in an industrial fermenter?

_____ **1**

[Turn over

9. Human Papilloma Virus (HPV) is thought to contribute to the development of cervical cancer. A vaccine was produced by inserting the gene for HPV viral coat protein (HPV-vcp) into yeast. The genetically modified yeast produce the HPV-vcp. Before it is used as a vaccine the protein is mixed with an adjuvant which increases the immune response.

A trial was set up to test the effectiveness of the vaccine in stimulating antibody production in humans.

Patient J received vaccinations with HPV-vcp vaccine plus adjuvant on day 0 then 2 months and 5 months later.

Patient K did not receive the vaccine as they had acquired the virus naturally.

Serum samples from both patients were tested for antibody levels. The results are shown in the table.

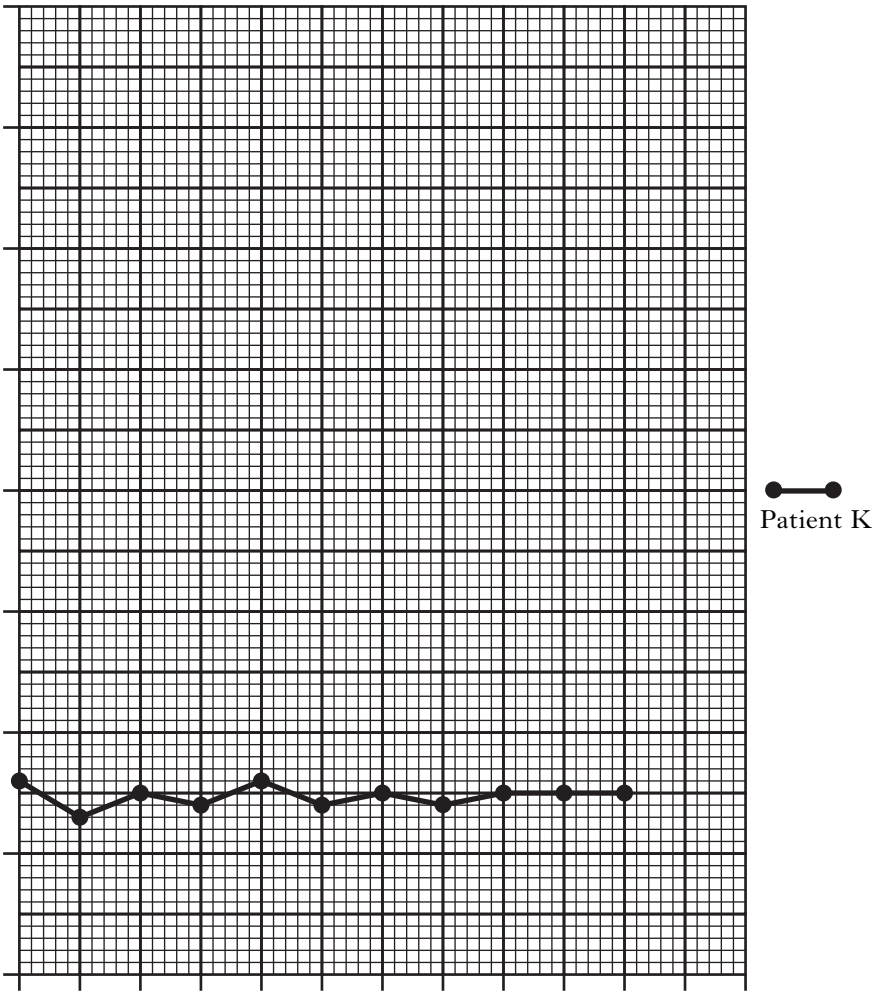
	Relative Levels of Antibody (units)	
Time (months)	*Patient J*	*Patient K*
0	0	3·2
1	1·4	2·6
2	2·5	3·0
3	7·7	2·8
4	4·0	3·2
5	3·6	2·8
6	14·5	3·0
7	9·8	2·8
8	7·4	3·0
9	3·2	3·0
10	2·8	3·0

Marks

9. (continued)

(*a*) Using the information from the table, label and complete the axes and plot the relative levels of antibody against time for Patient J. **2**

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



(*b*) Calculate the whole number ratio of antibody levels at 3 months in patients J and K.

Space for calculation

_____ : _____ **1**

patient J patient K

[Question 9 continues on *Page twenty-eight*

DO NOT WRITE IN THIS MARGIN

Marks

9. (continued)

(*c*) Describe **two** factors that should be controlled when selecting patients for this trial.

_____

_____ **2**

(*d*) Another patient was injected with **adjuvant only** and the serum levels of antibody were measured. Why was this control necessary?

_____

_____ **1**

(*e*) (i) State **two** conclusions that can be drawn from the data in the table.

_____

_____ **2**

(ii) How could the reliability of these conclusions be improved?

_____ **1**

(*f*) Suggest why only the viral coat protein was used to produce the vaccine.

_____

_____ **1**

[Question 10 is on fold-out *Page twenty-nine*

DO NOT WRITE IN THIS MARGIN

Marks

10. Gypsy Moth caterpillars are pests of oak trees. Trees can be sprayed with the bacteria *Bacillus thuringiensis* which produces a toxin (Bt toxin) that kills the Gypsy Moth caterpillar.

(*a*) (i) At what stage in its life cycle does the bacteria produce the toxin?

_____ **1**

(ii) What is the chemical nature of the toxin?

_____ **1**

Gypsy Moth caterpillars are also pests of tomato plants. The gene for Bt toxin can be transferred to tomato plants. This produces plants that are resistant to the Gypsy Moth caterpillar.

(*b*) (i) Describe how the bacterium *Agrobacterium tumefaciens* transfers the gene for Bt toxin into plants.

_____ **1**

(ii) Explain why plant protoplasts are used when transferring genes into plants.

_____ **1**

(iii) What term is used to describe organisms that contain DNA from another species?

_____ **1**

(*c*) Give **one** advantage and **one possible** disadvantage of controlling Gypsy Moth caterpillars by producing plants containing the gene for Bt toxin.

Advantage _____

Disadvantage _____ **2**

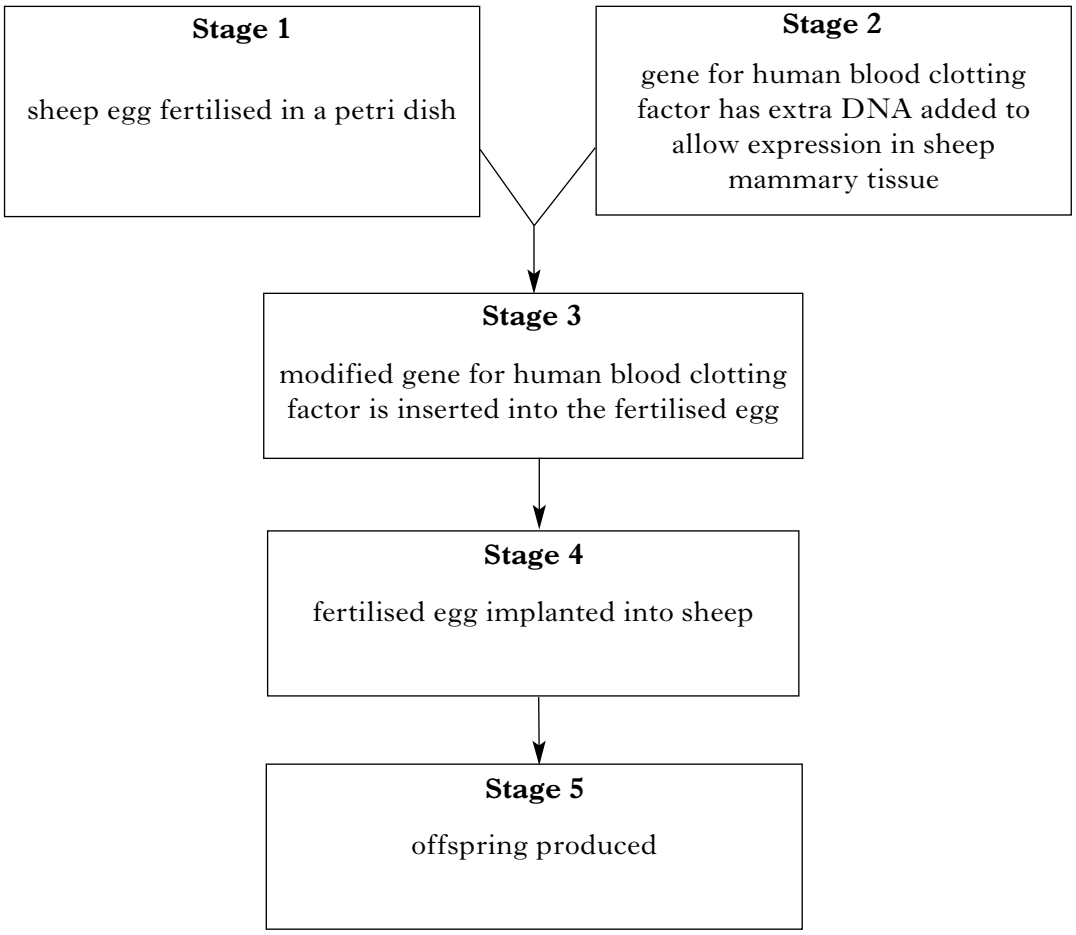
[OPEN OUT]

DO NOT WRITE IN THIS MARGIN

Marks

11. Human blood clotting factors can be produced in sheep and purified for use as a medical product.

Some of the stages are shown in the diagram.



(*a*) Name **one** method that can be used to insert DNA into the fertilised egg at Stage 3.

_____ **1**

(*b*) At Stage 4, what term is used to describe the sheep into which the fertilised egg is implanted?

_____ **1**

(*c*) What is the advantage of inserting a gene for a human protein into sheep mammary tissue?

_____ **1**

Marks

11. (continued)

(*d*) Explain why bacteria are not used to produce human blood clotting factor.

_____

_____ **1**

(*e*) Before the fertilised egg is implanted at Stage 4, embryo manipulation can be carried out to increase the reproductive rate.

Describe the technique of embryo manipulation.

_____

_____ **1**

[Turn over for Section C on *Page thirty-two*

Marks

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 the identification of bacteria under the following headings:

(*a*) Gram staining method; **4**

(*b*) shape and structures; **2**

(*c*) biochemical tests. **4**

(10)

OR

B. Give an account of the handling of microorganisms in the laboratory under the following headings:

(*a*) purpose of risk assessment; **2**

(*b*) types of risk assessment; **4**

(*c*) control measures. **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. Describe the production and purification of enzymes from batch culture. **(10)**

OR

B. Describe the detection and removal of environmental pollution using biotechnology. **(10)**

[*END OF QUESTION PAPER*]

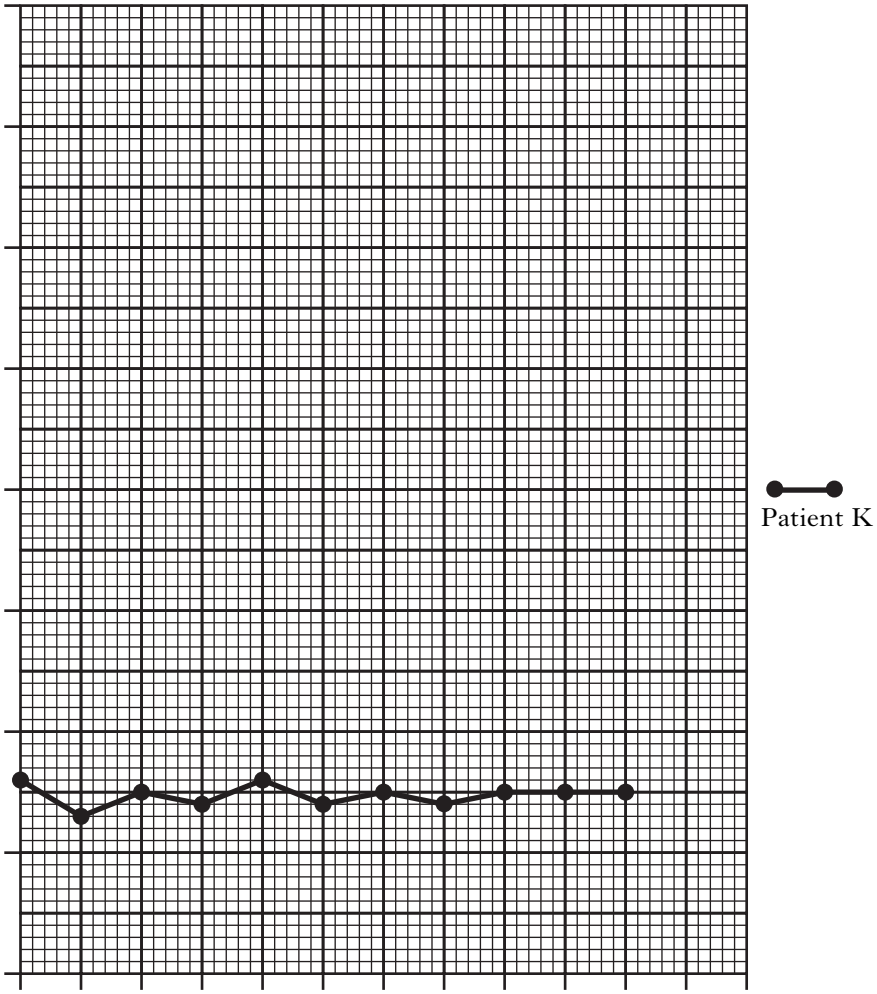
DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR USE IN QUESTON 9(*a*)



[BLANK PAGE]

[BLANK PAGE]

[BLANK PAGE]