FOR OFFICIAL USE

C

KU	PS

Total Marks

0300/402

NATIONAL QUALIFICATIONS 2006

TUESDAY, 23 MAY
10.50 AM – 12.20 PM

BIOLOGY
STANDARD GRADE
Credit Level

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

1 All questions should be attempted.

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.

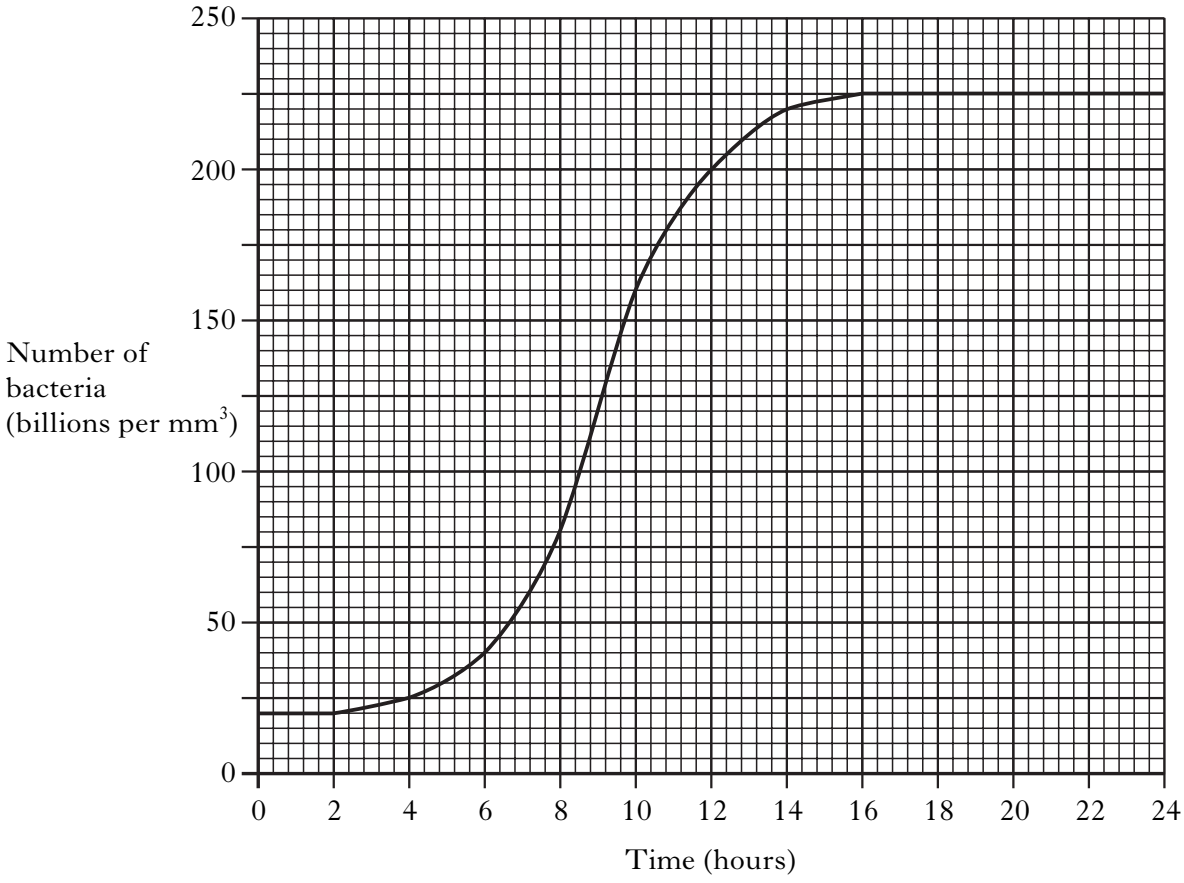
3 Rough work, if any should be necessary, as well as the fair copy, is to be written in this book. Additional spaces for answers and for rough work will be found at the end of the book. Rough work should be scored through when the fair copy has been written.

4 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.

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

1. The graph shows the growth curve of a population of bacteria in a fermenter at 30 °C over a 24 hour period.



(*a*) (i) How long did it take for the population to double its starting size?

_____ hours **1**

(ii) In which two-hour period was there the greatest increase in the number of bacteria?

Between _____ hours and _____ hours **1**

(iii) Between which times did the rate of production of new bacteria exceed the death rate?

Between _____ hours and _____ hours **1**

(*b*) (i) Describe the relationship between the number of bacteria in the population and time.

_____ **2**

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

1. (*b*) (continued)

(ii) Explain the changes in the shape of the growth curve between 10 hours and 18 hours in terms of the factors that affect population growth.

2

(iii) Draw a second line on the graph to predict the growth in population if the fermenter had been kept at a temperature of 20 °C.

(An additional graph, if needed, will be found on page 22.) **1**

(*c*) (i) Before setting up the fermenter, all the apparatus was heated to 150 °C for 15 minutes to eliminate any contamination by resistant cells of bacteria and fungi.

What name is given to these resistant cells?

1

(ii) The fermenter was stirred before removing the samples used to estimate the numbers of bacteria. How would this minimise possible errors in the results?

1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

2. (*a*) The table shows the percentage germination of four crop plants over a range of temperatures.

Temperature (°C)	*Percentage germination of crop plants*			
	Carrots	*Cauliflower*	*Okra*	*Spinach*
0	0	0	0	83
5	48	0	0	96
10	93	58	0	91
15	95	60	74	80
20	96	65	89	52
25	95	53	93	28
30	90	45	88	14
35	74	0	85	0
40	0	0	35	0

(i) Which **two** crop plants are able to germinate over the widest range of temperatures?

1 _____ 2 _____ **1**

(ii) Complete the table below by adding the correct heading, units and values to show the optimum germination temperature for each of the crop plants.

Crop plant	

2

(iii) Suggest which crop plant would germinate best in a hot climate.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

2. (*a*) (continued)

(iv) What is the minimum number of spinach seeds which should be sown at 15 °C in order to produce 1000 seedling plants?

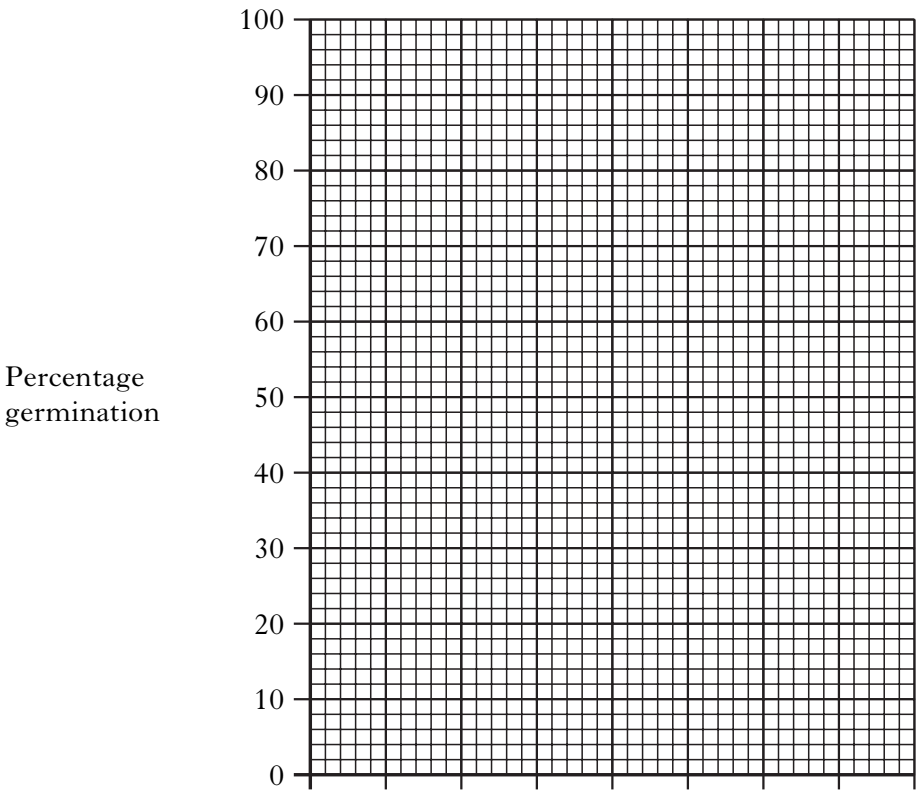
Space for calculation

Number of seeds

1

(v) On the grid below, complete a line graph of the change in percentage germination of cauliflower seeds with temperature.

(An additional graph, if needed, will be found on page 22.)



2

(*b*) Which part of a seed starts to develop during germination?

1

(*c*) Describe the changes in percentage germination of seeds that occur over a range of temperatures.

2

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

3. (*a*) Sexual reproduction in flowering plants depends on the processes of pollination and fertilisation.

Describe the events from the time a pollen grain of the correct species lands on the stigma, until fertilisation takes place in the ovary.

2

(*b*) Plant growers can propagate plants by artificial methods such as cuttings and grafting.

Give **two** advantages to the plant growers of artificial propagation of flowering plants.

1

2

2

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

4. (*a*) Fertilisation is the fusion of gametes and can be either internal or external in animals.

Explain why it is necessary for some animals to use internal fertilisation.

1

(*b*) A human fetus develops inside the mother's uterus, attached to the placenta.

Name **one** substance which passes across the placenta from mother to fetus.

1

(*c*) Some animal species take more care of their young than others.

Describe the relationship between the degree of parental care and the number of eggs that are produced at any one time by different species.

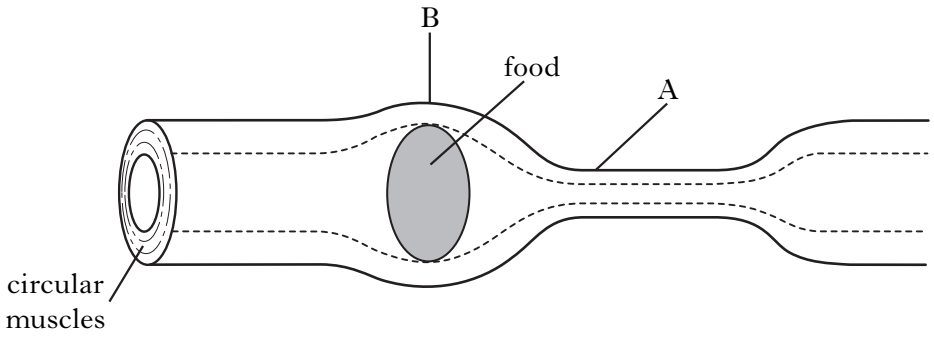
1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

5. (*a*) Food is moved along the alimentary canal by the action of circular muscles.



(i) What name is given to this movement of food?

1

(ii) Describe the state of the muscles at positions A and B in the diagram.

A

B

1

(*b*) When food reaches the stomach it is mixed with digestive juices.
Name **one** other organ that produces digestive juices.

1

(*c*) The table shows some of the daily vitamin and mineral requirements of teenagers.

	Daily requirement (mg)				
Sex	*Vitamin B3*	*Vitamin C*	*Calcium*	*Iron*	*Zinc*
Girls	13	40	1000	15	7
Boys	17	40	800	11	10

(i) Which substance is required in equal quantities by both sexes?

1

(ii) Which substances are required in greater quantities by boys?

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

5. (*c*) (continued)

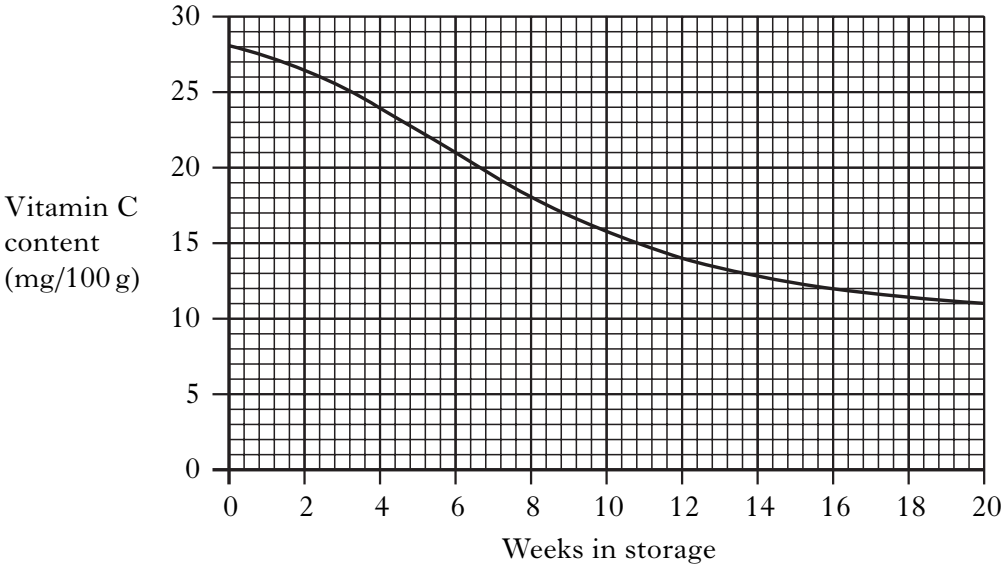
(iii) Calculate the daily requirement of calcium for girls compared to boys as a simple whole number ratio.

Space for calculation

____ : ____ **1**

girls : boys

(*d*) The graph shows the changes in the vitamin C content of potatoes during storage.



(i) How long did it take for the vitamin C content to fall to half of the original value?

____ weeks **1**

(ii) After six weeks in storage, what percentage of the original vitamin C still remains in the potato?

Space for calculation

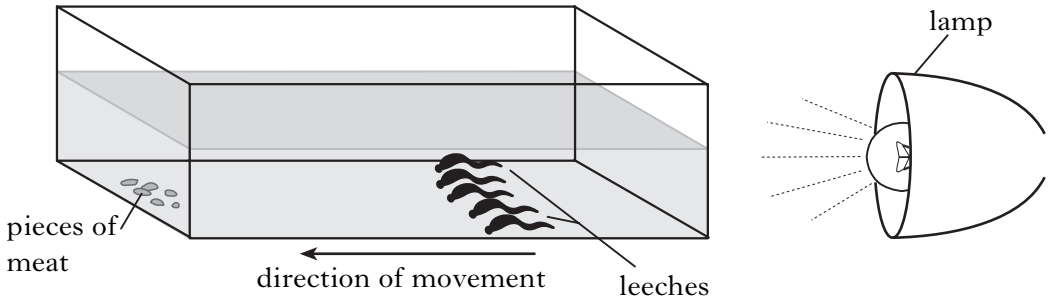
____ % **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

6. (*a*) In an investigation into behaviour, five leeches were placed in water in a shallow rectangular dish as shown in the diagram.



(i) During the investigation the leeches moved in the direction shown.

Give **two** possible explanations for this response.

1 _____

2 _____ **2**

(ii) Choose **one** of your explanations and suggest an advantage it has for the leeches.

Explanation number _____

Advantage _____

_____ **1**

(iii) Suggest **one** change which should be made to the set up of the investigation so that only one valid conclusion could be drawn from the leeches' response, assuming the direction of movement stays the same.

_____ **1**

(*b*) (i) Swallows migrate from Britain to Africa in the autumn.

Explain how this behaviour benefits the swallows.

_____ **1**

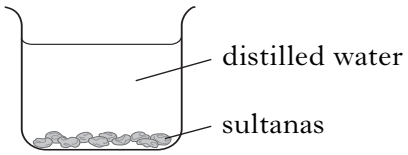
(ii) Migration is an example of a type of behaviour that is repeated regularly. What name is given to this type of behaviour?

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

7. In an investigation, three 25 g samples of sultanas were put into separate beakers of distilled water, as shown below.



After 24 hours, the sultanas were removed from the water, blotted on filter paper and reweighed. The results are shown in the table.

Sample	*Mass after 24 hours* (g)	*Percentage change in mass*
1	32·5	30·0
2	32·2	28·8
3	32·4	

(*a*) Complete the table with the percentage change in mass of the sultanas in sample 3.

Space for calculation

1

(*b*) The change in mass of the sultanas was caused by the movement of water.

(i) Name this process.

1

(ii) Explain the results in terms of water concentrations.

1

(*c*) Which of the following is the best reason for blotting the sultanas before reweighing?

Tick the correct box.

☐ To stop them sticking together ☐ To remove external sugar solution

☐ To remove external water ☐ To make sure the sultanas were dried 1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

8. The following statements refer to stages in mitosis.

1 Chromosomes become visible as pairs of chromatids.

2 Spindle fibres form.

3

4 Chromatids are pulled to opposite ends of the cell.

5 The nuclear membranes form.

6 The cytoplasm divides and two daughter cells are formed.

(*a*) Complete the sequence by writing in a description of the missing stage. **1**

(*b*) After mitosis, the daughter cells have the same number of chromosomes as the parent cell.
Explain why this is important.

1

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

9. Read the following passage and answer the questions using information from it.

Adapted from *The Herald*, October 2003

Scientists say that the North Sea is becoming too hot for many of the fish which are included in the normal Scottish diet. Experts are blaming global warming for driving the plankton, on which the fish depend, into more northern waters. As a result, stocks of cod and salmon are in danger of collapse. At the same time, more exotic species such as red mullet, horse mackerel and black bream are increasing off the east coast of Britain.

Sand eels are also dwindling in number, and this may be having a knock-on effect on the coastal birds which feed on them. A survey of their habitats showed breeding rates for puffins, kittiwakes, guillemots and razorbills to be the lowest on record.

These trends are based on the monitoring of plankton populations. They may help to explain why a reduction in fishing has not led to a full recovery of fish populations.

Two particular episodes are blamed. The first occurred in the late 1970s and was caused by an inflow of low-temperature, low-salinity water from the North Atlantic. This was due to a high release of Arctic ice into the ocean. The second occurred in the 1980s, and this time it was an inflow of water at higher temperatures and high salinity.

(*a*) What effect is global warming having on the plankton in the North Sea?

1

(*b*) Name **two** fish species which are decreasing in numbers in the North Sea.

1 2

1

(*c*) Suggest a reason why exotic fish species are increasing in number off the east coast of Britain.

1

(*d*) Explain the possible link between global warming and the expected reduction in the numbers of coastal birds.

1

(*e*) In what **two** ways did the water which caused problems in the 1980s differ from that which caused problems in the 1970s?

1

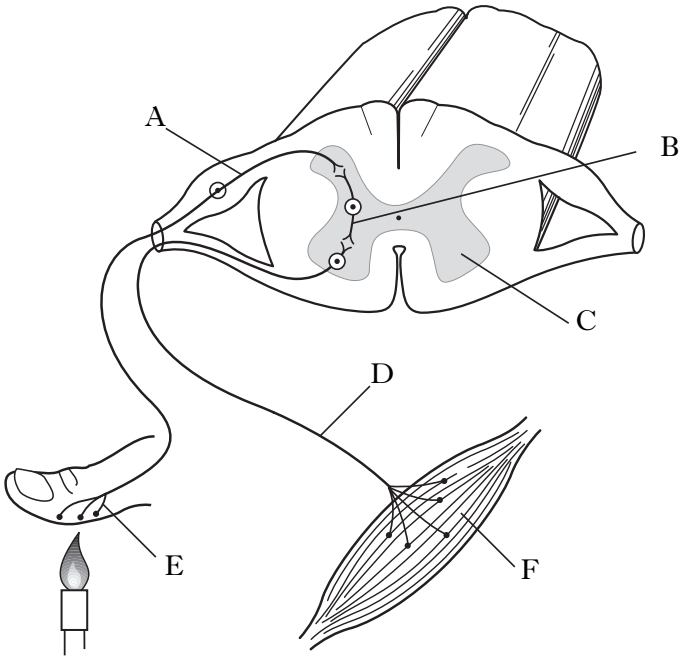
2

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

10. The diagram represents the structures involved in a reflex action which occurs when a finger touches a flame.



(*a*) Complete the table below with the correct letters from the diagram to identify the stages of the reflex action and with a description of the missing stage.

Stage	*Letter*
Stimulus detected by sensory receptor	
Information sent along a sensory nerve cell	
	B
Impulse sent along motor nerve cell	
Response made by effector organ	

2

DO NOT WRITE IN THIS MARGIN

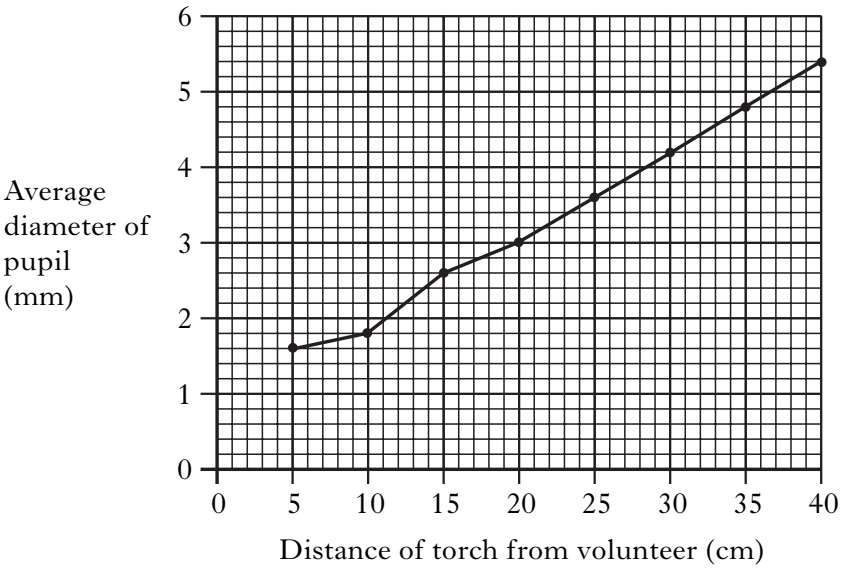
Marks	KU	PS

10. (continued)

(*b*) An investigation was carried out on the response of the pupil of the eye. A volunteer was seated in a dark room and a torch was switched on. The diameter of the volunteer's pupil was measured.

This was repeated at different distances from the volunteer.

The results are shown on the graph below.



(i) What was the diameter of the volunteer's pupil when the torch was 15 cm away from the eye?

_____ mm **1**

(ii) Draw **one** conclusion from these results.

1

(iii) The investigation was repeated several times and the average values of the pupil diameters were calculated before the graph was drawn.

Why is this good experimental procedure?

1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

11. (*a*) The following table gives examples of improvements in tomato plants.

Complete the table to show whether each improvement is a result only of mutation or if it also involves selective breeding.

Improvement	*Only mutation/ Involves selective breeding*
Over many generations, plants have been developed that grow successfully at cooler temperatures.	
Controlled pollination has produced new varieties with fruit that is sweeter tasting.	
Some seeds that were exposed to radiation germinated into plants that produced fruit with a greater vitamin C content.	

2

(*b*) Describe an example of a named animal's characteristics that can be improved by selective breeding.

Animal

Description of improved characteristic _____

1

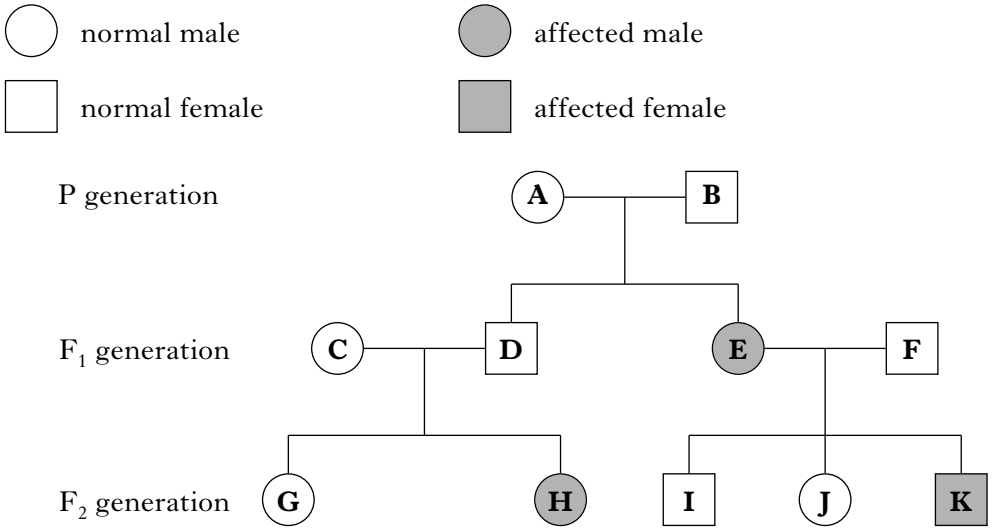
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

12. Tay-Sachs disease is an inherited condition which affects the nerves. Different forms of the same gene determine its effect.

T (dominant) represents the normal form of the gene.
t (recessive) represents the form of the gene which causes the disease.

The family tree diagram shows a pattern of inheritance of the disease.



(*a*) (i) Complete the table by writing the genotypes of persons **A**, **D** and **K**.

Person	*Genotype*
A	
D	
K	

2

(ii) A carrier of the disease is someone who does not show the symptoms of the disease but can pass it to their offspring.

Give the letter of **one** person from the F_2 generation who must be a carrier of the disease.

Letter ____ **1**

(iii) What kind of variation is shown by Tay-Sachs disease? Explain your answer.

Variation ____

Explanation _____

____ **1**

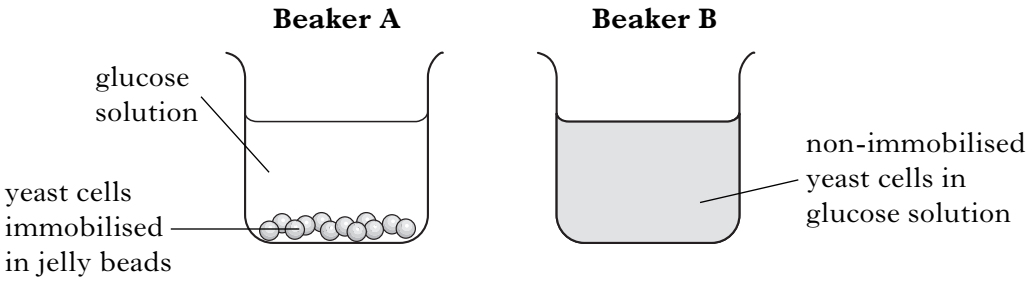
(*b*) What name is given to the different forms of the same gene?

____ **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

13. The investigation below was used to compare the respiration rates of immobilised and non-immobilised yeast cells.



A blue dye was added which changes colour as the yeast cells respire.
The colour changes of the dye are shown below.

blue ⟶ lilac ⟶ mauve ⟶ pink ⟶ colourless

The colour in each beaker was noted every three minutes and the results are shown below.

Time (minutes)	*Beaker A*	*Beaker B*
0	blue	blue
3	blue	lilac
6	lilac	mauve
9	lilac	mauve
12	mauve	colourless
15	mauve	colourless
18	pink	colourless
21	colourless	colourless

(*a*) (i) In which beaker did the yeast cells respire faster?
Give a reason for your answer.

Beaker ____

Reason ____ **1**

(ii) Suggest a time when the dye in beaker B might have been pink.

____ minutes **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

13. (*a*) (continued)

(iii) Give **two** precautions that would have to be taken to ensure a valid comparison could be made between the two beakers.

1

2

2

(*b*) Immobilised cells are used in some industrial processes.

Describe **one** advantage of using immobilised cells.

1

(*c*) The table gives information about respiration in yeast.

Tick the boxes to show whether each statement refers to aerobic respiration, anaerobic respiration or both.

Statement	*Aerobic*	*Anaerobic*
Oxygen is used up.		
Alcohol is produced.		
Maximum energy is released.		
Carbon dioxide is produced.		

2

[Turn over

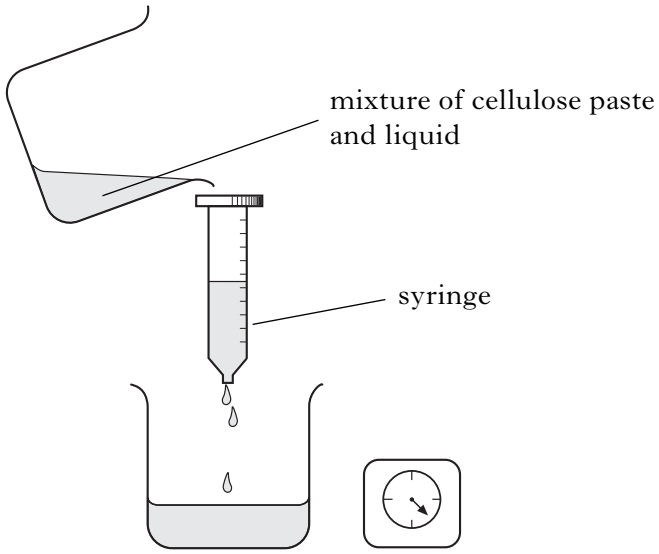
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

14. Cellulase is an enzyme which is produced by some soil micro-organisms. It breaks down cellulose into simple sugars. Cellulose is present in plant cell walls.

10 cm^3 samples of cellulose paste were mixed with three different liquids and left for 24 hours. The time taken for 5 cm^3 of each cellulose mixture to run through a syringe was recorded. The results are shown in the table.

Sample	*Liquid added to cellulose paste*	*Time for* 5 cm^3 *to run through* (seconds)
A	1 cm^3 cellulase solution	126
B	1 cm^3 water	375
C	1 cm^3 soil water	200



(*a*) (i) Using the results from samples A and B, describe the effect of cellulase on the thickness of cellulose paste.

1

(ii) Using the results, what can be concluded about soil water?

1

(*b*) (i) The samples were left in a warm place to provide optimum conditions for the enzyme.

Explain what is meant by the term *optimum conditions*.

1

(ii) Cellulase enzyme is specific for cellulose.

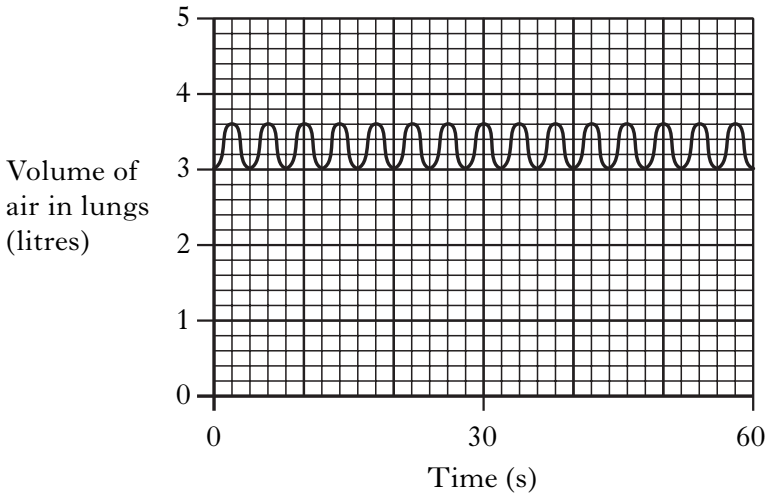
Explain what is meant by the term *specific*.

1

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

15. (*a*) The following chart shows the volume of air present in the lungs of a person during a period of normal breathing.



(i) What is the volume of air inhaled in one breath?

litres **1**

(ii) What is the person's breathing rate?

breaths per minute **1**

(*b*) (i) Regular exercise improves the efficiency of the lungs.
What other body system, essential for muscle activity, also benefits from regular exercise?

1

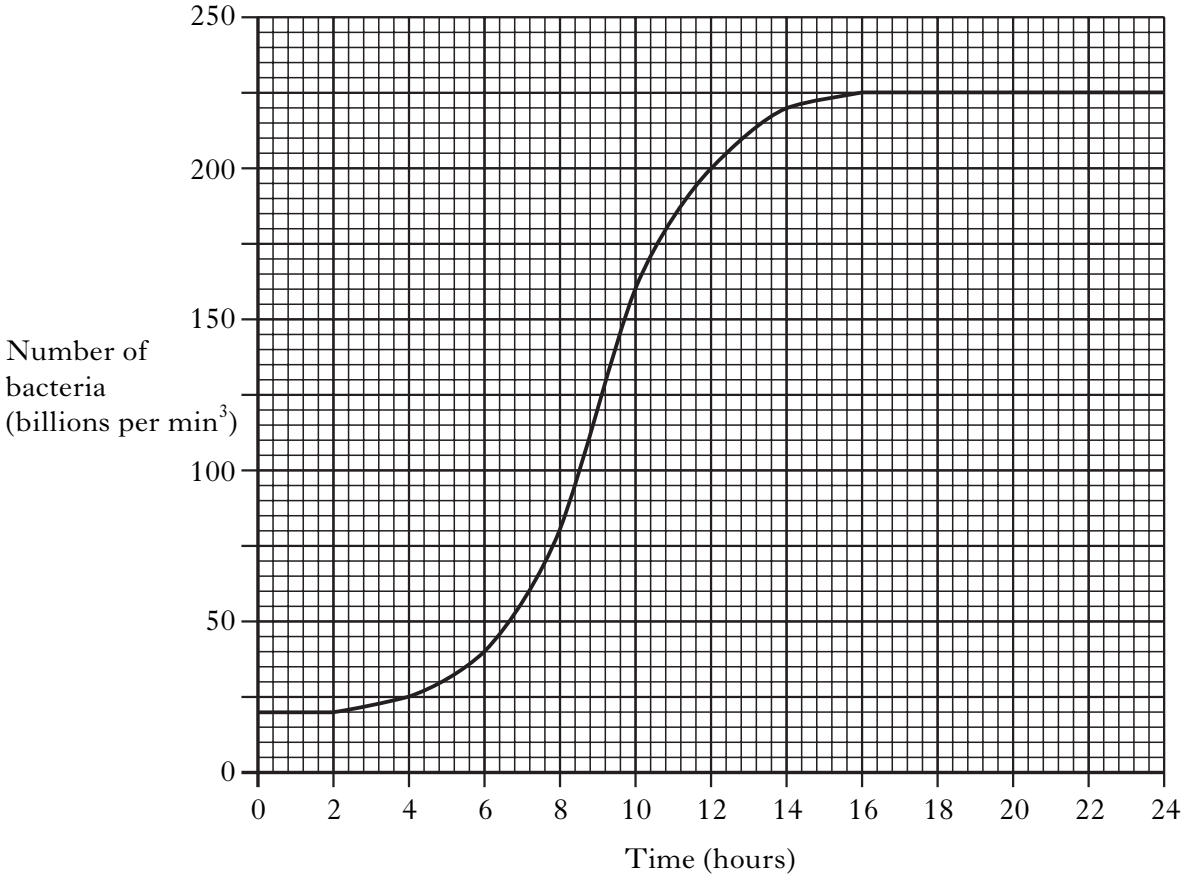
(ii) Explain why increased efficiency of the lungs results in an improved recovery time following exercise.

1

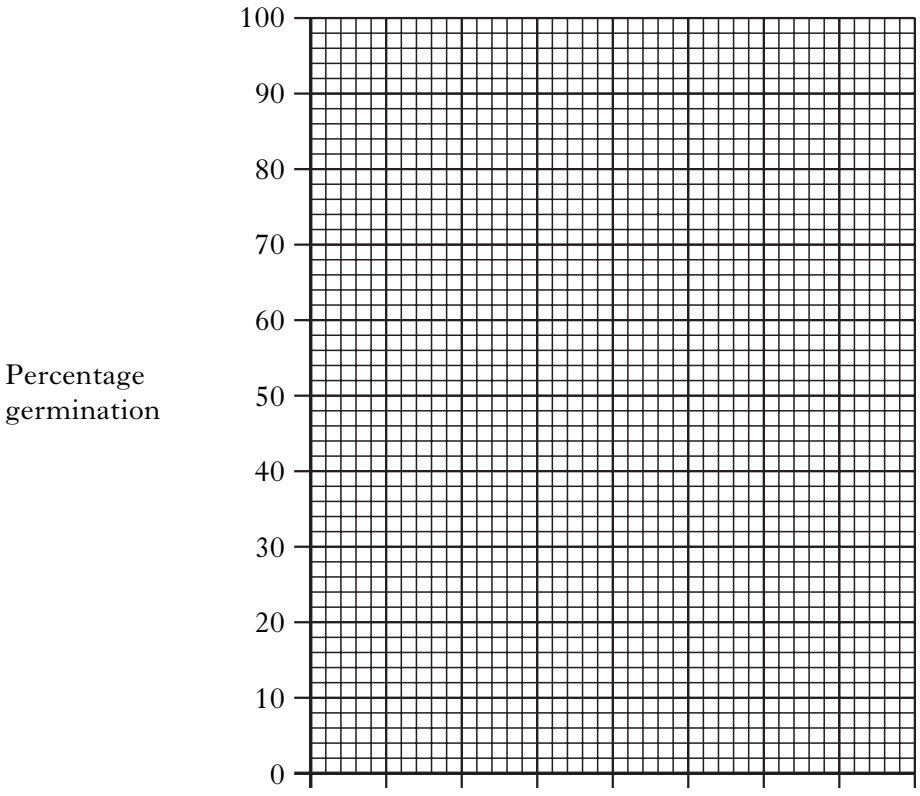
[*END OF QUESTION PAPER*]

[Turn over

ADDITIONAL GRAPH PAPER FOR QUESTION 1(*b*)(iii)



ADDITIONAL GRAPH PAPER FOR QUESTION 2(*a*)(v)



SPACE FOR ANSWERS
AND FOR ROUGH WORKING

SPACE FOR ANSWERS
AND FOR ROUGH WORKING