FOR OFFICIAL USE

C

KU	PS

Total Marks

0300/402

NATIONAL QUALIFICATIONS 2007

MONDAY, 21 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.

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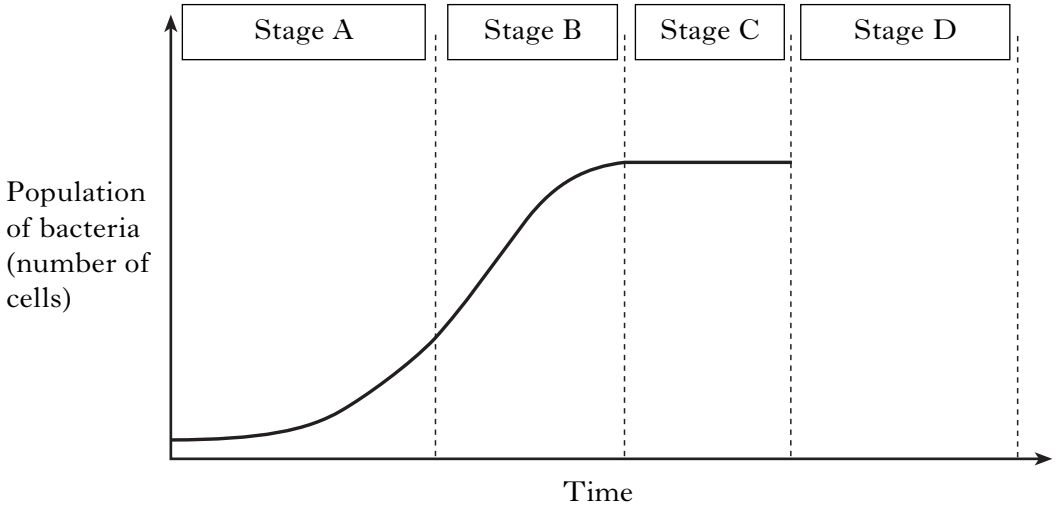
Marks	KU	PS

1. The graph shows the changes in the population of bacteria in a fermenter.



(*a*) (i) Describe the changes in population of the bacteria during Stage B.

1

(ii) Give a reason for the changes in population shown during Stage B on the graph.

1

(iii) Complete Stage D on the graph to show the effect of an increasing death rate on the population of bacteria. **1**

(*b*) Some bacteria can be grown on industrial waste materials to provide valuable products, such as animal foodstuffs.

State **one** way in which the nutritional value of the product has been increased.

1

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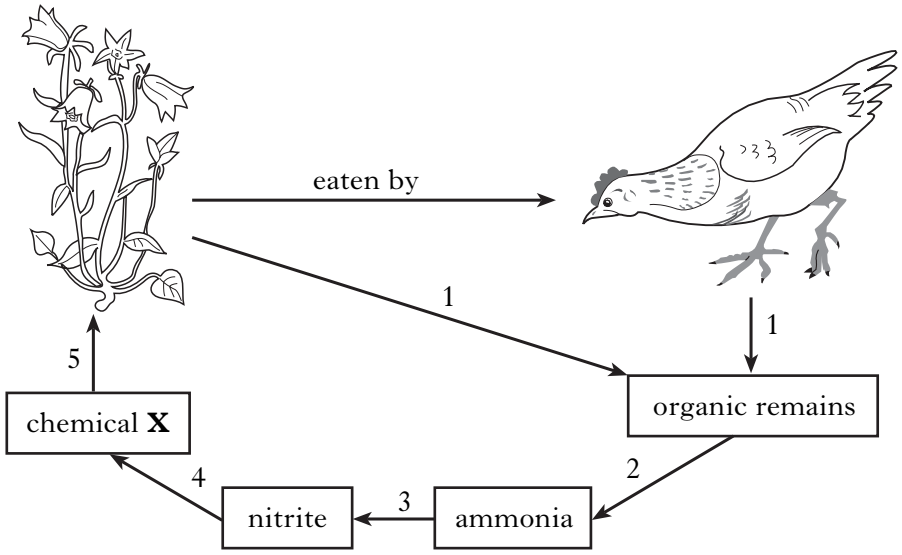
Marks	KU	PS

2. The diagram shows some of the stages in the nitrogen cycle.



(*a*) Complete the table by giving a number from the diagram to match each of the named stages.

Stage	*Number*
Absorption	
Death	
Nitrification	
Decomposition	

2

(*b*) Name chemical **X**.

1

(*c*) Name the type of organism responsible for Stage 3.

1

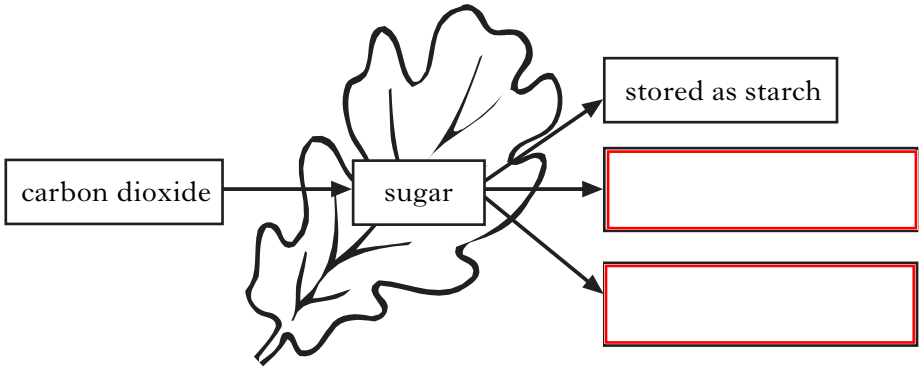
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

3. (*a*) Carbon dioxide is used during photosynthesis to produce sugar.

(i) Complete the diagram below to show the fates of carbon dioxide after photosynthesis has taken place.

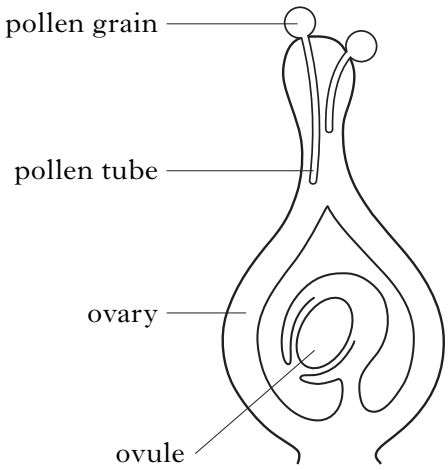


2

(ii) Explain why soot deposits on leaves reduce the rate of photosynthesis.

1

(*b*) (i) Draw an **X** on the following diagram to show where the pollen tube reaches when its growth is completed.



1

(ii) Describe the function of the pollen tube.

1

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Marks	KU	PS

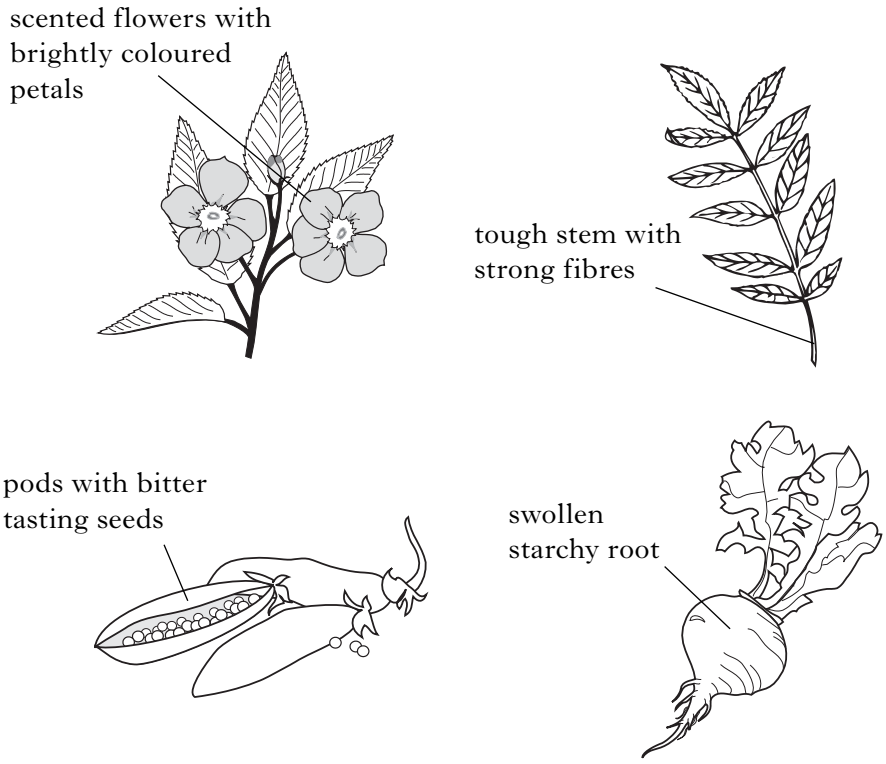
3. (continued)

(*c*) Tropical rain forests are being destroyed to clear land for farming. This leads to a reduction in the number of plant species.

Explain why this might lead to the extinction of some animal species.

1

(*d*) The diagrams show features of some newly discovered plants.



Select **one** of the plant features and describe a likely use for it.

Plant feature

Likely use _____

1

[Turn over

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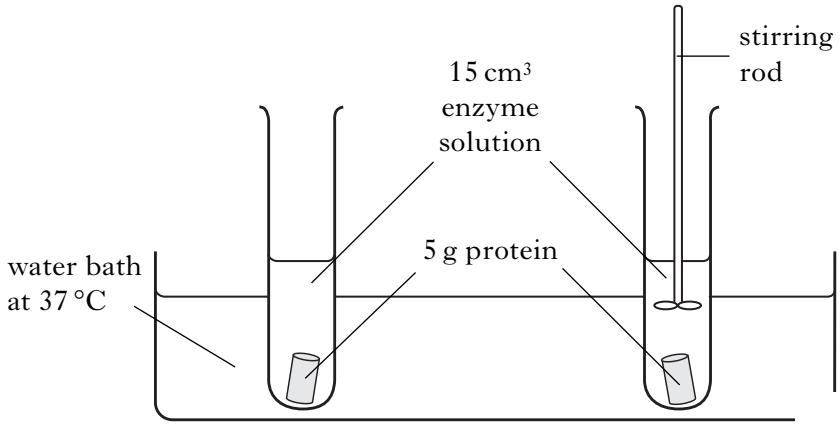
Marks	KU	PS

4. The following investigation was set up to examine the effects of stirring on the digestion of protein.

Each piece of protein was weighed every two hours.

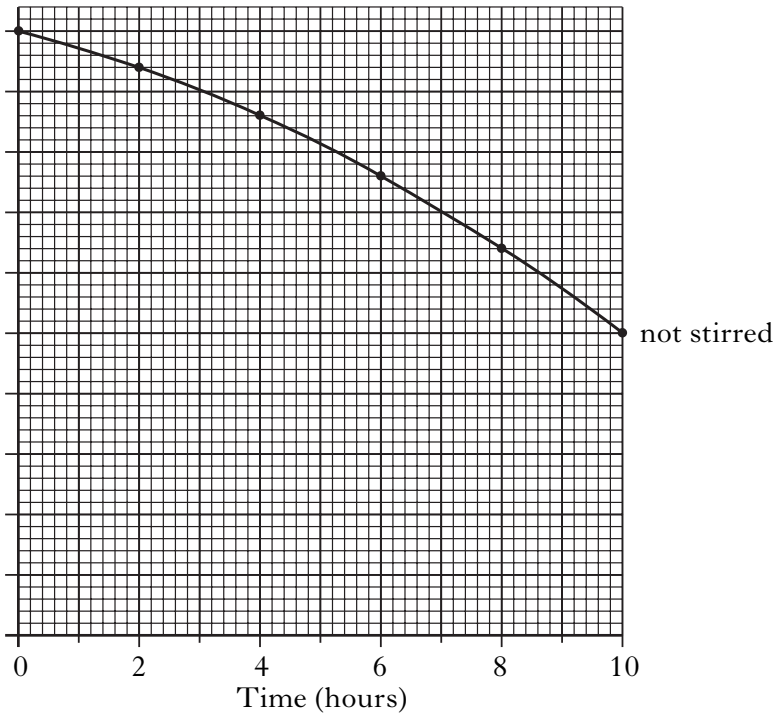


The results are shown in the table.

		Time (hours)					
		0	2	4	6	8	10
Mass of protein (g)	*not stirred*	5·0	4·7	4·3	3·8	3·2	2·5
	stirred	5·0	4·4	3·6	2·6	1·4	0·0

(*a*) Use the data in the table to complete the line graph below.

(An additional graph, if needed, will be found on page 25.)



2

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	Marks	KU	PS

4. (continued)

(*b*) Which type of enzyme would produce the results shown?

1

(*c*) When the protein was completely digested, no solid material remained in the tube. Explain why.

1

(*d*) Name **one** factor, not already mentioned, which would need to be the same in each tube at the start of the investigation.

1

(*e*) Suggest how the investigation could be improved to provide a more reliable measurement of the difference which stirring made.

1

(*f*) Stirring increased the rate at which the protein was digested. Explain why this happened.

1

(*g*) In the body, the stomach achieves a similar effect to stirring. Describe how this happens.

1

[Turn over

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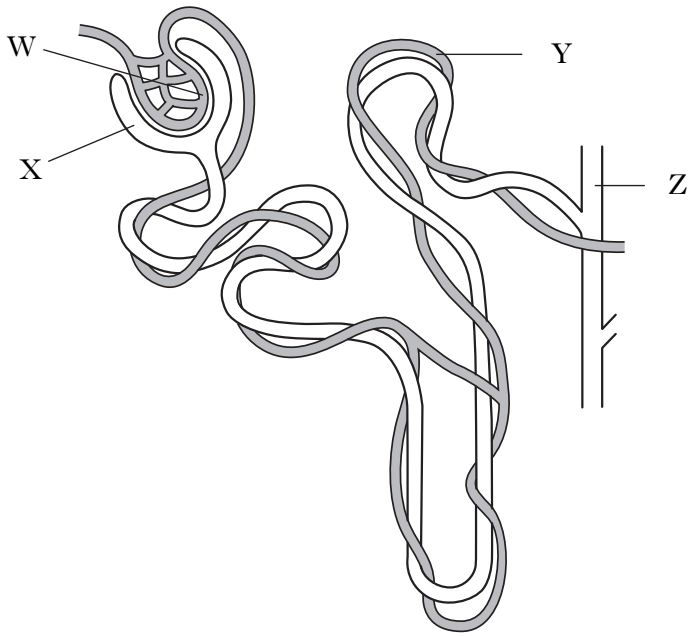
5. The diagram represents a microscopic part of a kidney.



(*a*) Complete the table to show the names and functions of the structures shown on the diagram.

	Name	*Function*
W	glomerulus	
X		collection of filtrate
Y		reabsorption
Z	collecting duct	

2

DO NOT WRITE IN THIS MARGIN

5. (continued)

Marks | KU | PS

(*b*) The table shows information about kidney function.

Fluid	*Component* (g per 100cm³)				
	urea	*glucose*	*amino acids*	*salts*	*proteins*
blood plasma	0·03	0·10	0·05	0·9	8·0
glomerular filtrate	0·03	0·10	0·05	0·9	none
urine	1·75	none	none	0·90–3·60	none

(i) In which organ is urea produced and how is it transported to the kidneys?

Organ _____

Means of transport _____ **1**

(ii) Name **one** component in the table which can pass through the wall of the glomerulus, and **one** component which cannot.

Can pass through _____

Cannot pass through _____ **1**

(*c*) In one investigation, the kidneys of an adult male were found to filter 1254 cm³ of blood per minute. This produced 114 cm³ of filtrate per minute and 1·2 cm³ of urine per minute.

(i) Express these volumes as a simple whole number ratio.

Space for calculation

_____ : _____ : _____
blood filtrate urine **1**

(ii) Using the results of this investigation and information from the table, calculate the mass of urea which would be excreted by this person in 24 hours.

Space for calculation

_____ g **1**

[Turn over

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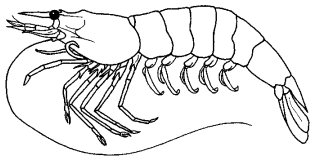
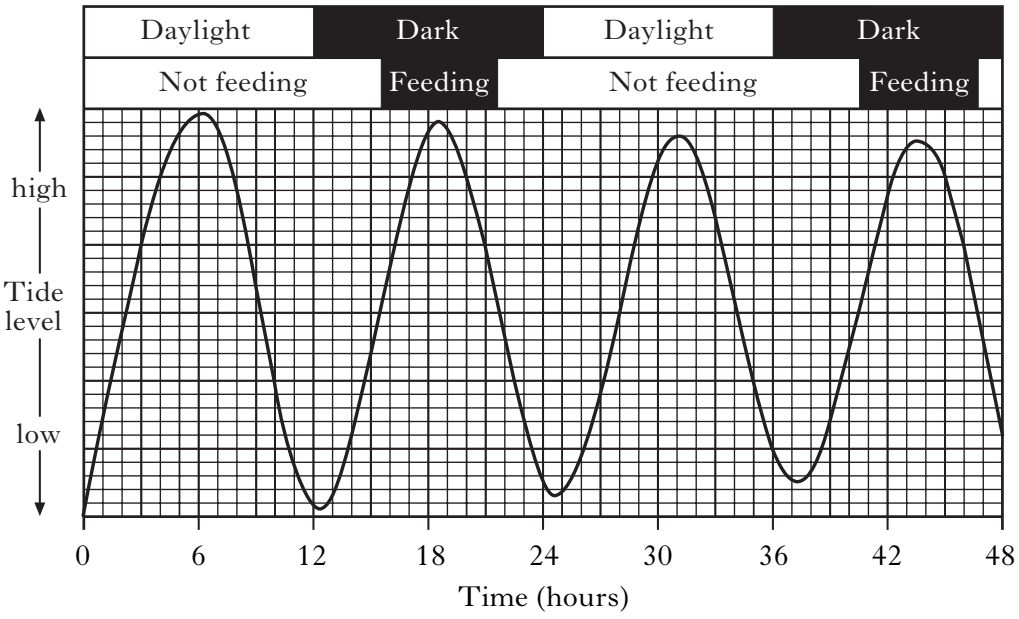
Marks	KU	PS

6. The brown shrimp is found all round our coastline.



The graph shows shrimp activity and changes in their environment over a 48 hour period.



(*a*) How many high tides occurred during the two days shown?

1

(*b*) Describe the conditions necessary for the shrimps to feed.

2

(*c*) Explain the significance of the behaviour shown to the survival of the shrimps.

1

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

7. A flower petal was examined under the microscope and then placed in a concentrated salt solution for 30 minutes. It was then re-examined under the microscope.

The diagrams show a cell from the petal before and after being in the solution.

before after

(*a*) (i) The movement of water caused the change in the appearance of the cell. What name is given to this movement of water?

1

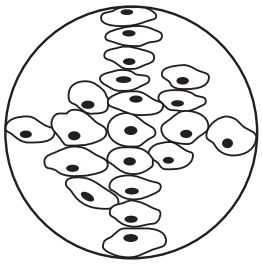
(ii) In terms of water concentration, explain **why** this movement of water took place.

1

(*b*) Name **one** substance, other than water, which must be able to pass into a cell for its survival.

1

(*c*) The diagram below shows a group of cells as seen under a microscope. The field of view was 2 mm in diameter.



Calculate the average length and width of the cells.

Space for calculation

Average length ____ mm

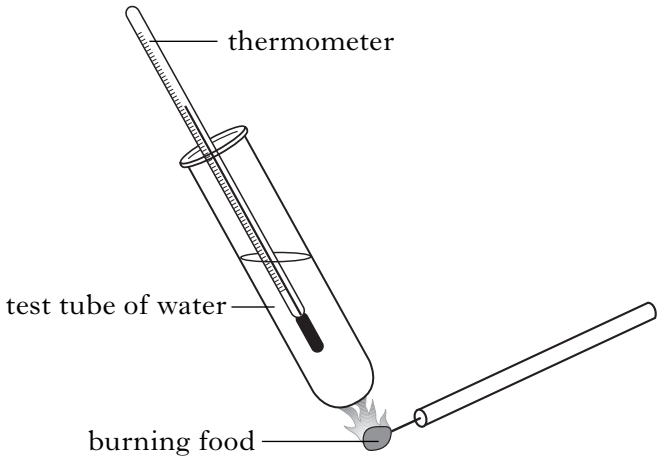
Average width ____ mm **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

8. (*a*) The diagram shows a method used to investigate the energy content of a variety of foods.



The rise in temperature can be used to calculate the energy content of each food in kilojoules.

The results are shown in the table.

Type of food	*mass* (g)	*energy content* (kilojoules)
cheese	1·0	17·0
fish	1·0	0·5
steak	1·0	13·9
carrot	1·0	1·8
apple	1·0	2·5

(i) State **two** factors, not already mentioned, that should be kept constant for a valid comparison to be made between the foods.

1

2

2

(ii) Suggest why the energy contents found in the investigation might not have been as high as expected.

1

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

8. (*a*) (continued)

(iii) The energy content of each food was calculated using the following formula.

Energy content (kilojoules) = temperature rise × 0·21

Calculate the energy content of 1g of chicken, if it raised the temperature of the water by 30 °C.

Space for calculation

kilojoules per gram **1**

(*b*) Give **one** reason, other than providing heat, why cells need energy from food.

1

(*c*) Which component of food provides most energy per gram?

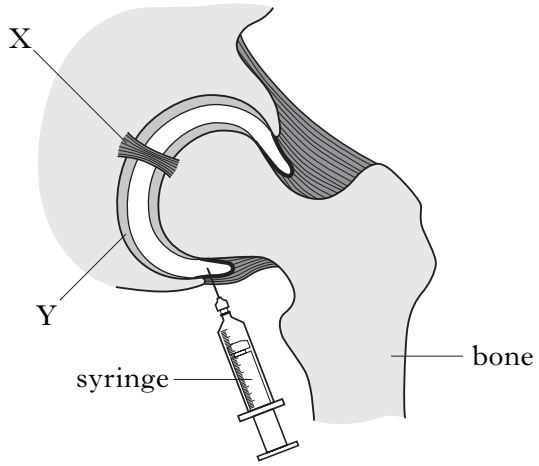
1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

9. The diagram below shows a cross-section through a joint.



(*a*) Name and describe the functions of parts X and Y on the diagram.

Part X Name

Function

1

Part Y Name

Function

1

(*b*) Some of the synovial fluid from inside a joint can be removed for medical tests using a syringe as shown in the diagram.

(i) Name the part of the joint which produces the synovial fluid and describe the function of the fluid.

Produced by

Function

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

9. (*b*) (continued)

(ii) The table below describes the features of the fluid which lead to the diagnosis of several joint abnormalities.

		Feature of synovial fluid		
		Viscosity	*Cloudiness*	*Colour*
Diagnosis	*Normal*	high	zero	light yellow
	Inflammation	low	slight	dark yellow
	Infection	low	high	dark yellow
	Blood leakage	intermediate	high	pink

Use the information from the table to complete the paired statement key to identify the diagnoses.

1. Fluid pink ..... Blood leakage

   Fluid not pink ..... go to 2

2. Low viscosity ..... [ ]

   High viscosity ..... [ ]

3. [ ] ..... Infection

   [ ] ..... [ ]

2

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

10. Read the following passage and answer the questions based on it.

Invasion of the Chinese Mitten Crab
Adapted from *Biological Sciences Review*, Volume 15, Number 2.

The Chinese mitten crab, *Eriocheir sinensis*, lives in fresh water as an adult, but it breeds in the lower reaches of estuaries and spends part of its early life in seawater.

It looks different from other crabs. Its claws are covered in a coating of fine brown hairs resembling mittens. This type of crab is a problem because it burrows into river banks, causing them to collapse and silt up river channels.

The mitten crab is not native to Europe. They were recorded in the River Thames in the 1930s. Their larvae may have been transported to the river in ships' ballast water and released during dumping of this water before the ship took on cargo.

Adult mitten crabs have been known to travel thousands of kilometres in freshwater at up to 18 km per day. The young crabs, when migrating upriver, seem to be mainly herbivorous. As they grow, they become omnivorous, eating vegetation, crustaceans, insects and dead fish—in fact anything they can get a hold of! Not only is this a problem for the plants and animals that they are eating, but also they compete with native species, such as freshwater crayfish, for food.

(*a*) How does the appearance of the Chinese mitten crab differ from other crabs?

1

(*b*) State the type of environment the Chinese mitten crabs are found in at each of the following stages in their life.

(i) Early years

(ii) Breeding times

(iii) Mature adults **1**

(*c*) How is it thought that the Chinese mitten crabs arrived in Britain?

1

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	Marks	KU	PS

10. (continued)

(*d*) Describe **one** problem the Chinese mitten crab causes to the habitat and **one** problem it causes to the native community.

Habitat _____ **1**

Community _____ **1**

(*e*) Describe the changes in its diet as a young adult mitten crab grows.

_____ **1**

(*f*) When moving at their maximum speed, how long would it take an adult mitten crab to travel the whole length of a 45 km river?

Space for calculation

_____ days **1**

[Turn over

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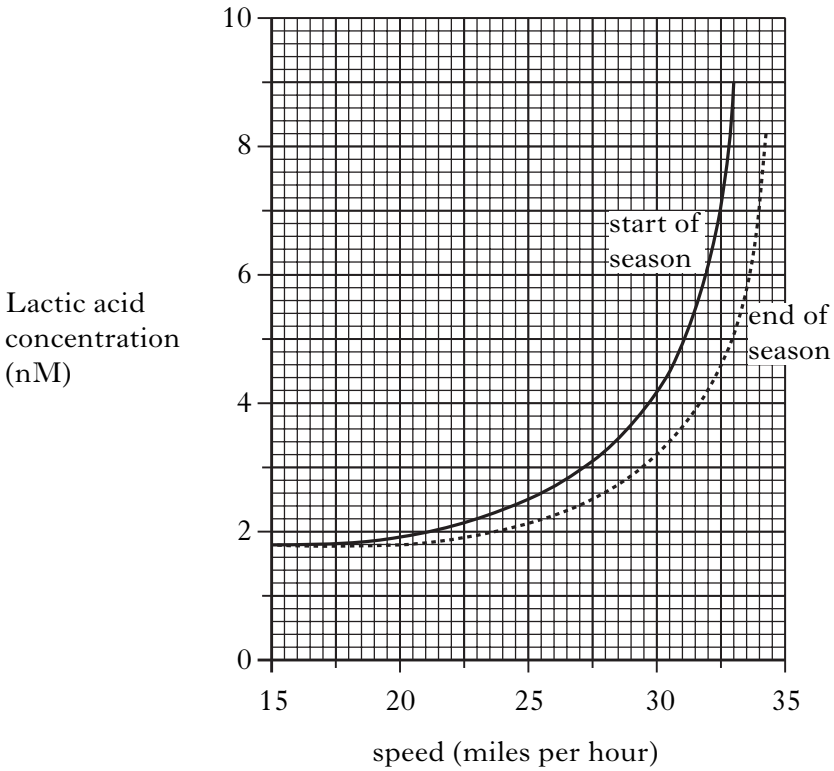
	Marks	KU	PS

11. (*a*) Lactic acid is a waste product from one type of respiration. What type of respiration produces lactic acid?

1

(*b*) The lactic acid content of the blood of a professional cyclist was measured while cycling at different speeds.

The graph shows the results of these measurements taken at the start of the racing season and at the end.



(i) What was the lactic acid concentration when the cyclist was travelling at 15 miles per hour?

nM **1**

(ii) At the start of the season, what was the speed of the cyclist when he was producing 50% of his maximum lactic acid concentration?

miles per hour **1**

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

11. (*b*) (continued)

(iii) When lactic acid concentration rises above 2·5 nM, the leg muscles quickly lose power and become painful.

1 What name is given to this condition?

1

2 What is the maximum speed this cyclist could maintain at the start of the season?

miles per hour **1**

(iv) The graph shows that training improves the efficiency of muscles. Other than muscle, name **two** organs whose efficiency is improved by training.

1

2 **1**

[Turn over

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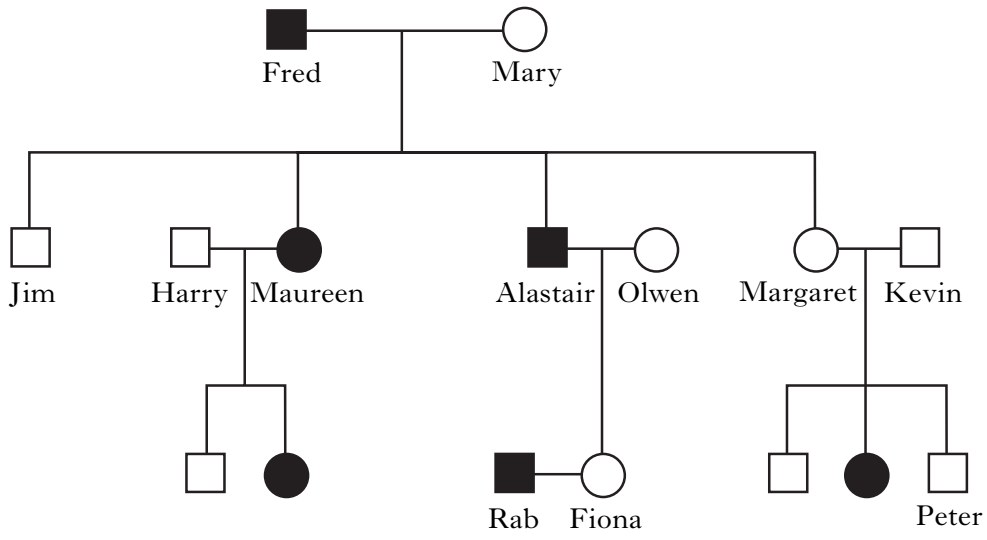
Marks	KU	PS

12. Tongue-rolling is an inherited characteristic. The diagram below shows the pattern of its inheritance in one family.

male roller female roller

male non-roller female non-roller



(*a*) (i) Using **R** for the dominant form of the gene and **r** for the recessive form, state the genotypes of:

1 Maureen

2 Jim

3 Kevin

2

(ii) If Rab and Fiona have a child, what are the chances of the child being able to roll its tongue?

Space for working

1

(iii) Which of the original parents could be described as true-breeding?

Tick (✓) the correct box.

Fred Mary

Both Neither

1

(iv) Name a tongue-roller from the F_1 generation.

1

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12. (continued)

Marks | KU | PS

(*b*) Explain why the proportions of the offspring phenotypes from genetic crosses are not always exactly as predicted.

1

(*c*) What term is used for the different forms of the same gene?

1

[Turn over

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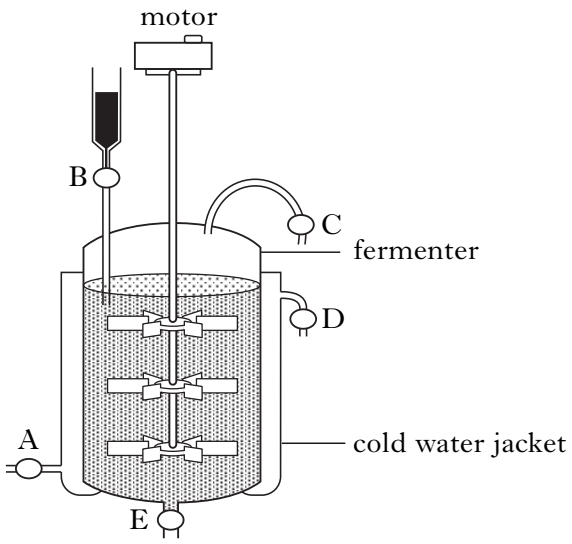
Marks	KU	PS

13. The diagram shows an industrial fermenter. It is fitted with a number of taps which allow substances to be added or removed.



(*a*) Which of the taps, A, B, C, D or E, would open to

(i) add nutrients to the mixture? ☐

(ii) remove waste gases? ☐

(iii) drain off the products? ☐

2

(*b*) The fermenter should be kept at 35 °C. Explain why the water jacket around the fermenter should be cold.

1

(*c*) After fermentation is complete, the fermenter is drained and the useful product is separated. New starting ingredients can then be added to the fermenter.

(i) What name is given to this type of process?

1

(ii) When the vessel is empty, it is treated to destroy residual spores of fungi and bacteria. How could this be done?

1

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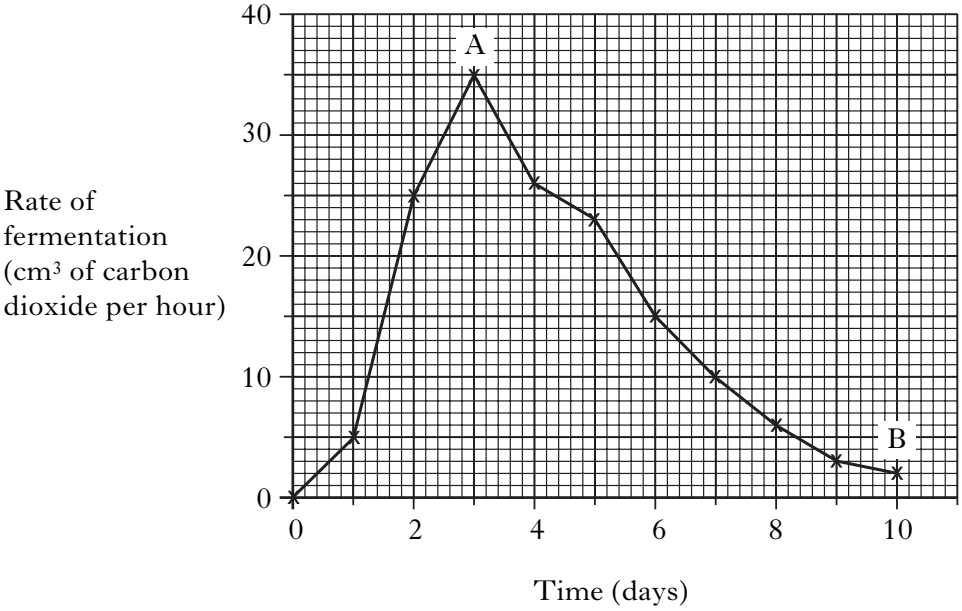
Marks	KU	PS

13. (continued)

(*d*) Barley malt extract, water and yeast were placed in the fermenter and left for several days.

The rate of fermentation was measured and the results are shown in the graph below.



(i) Describe the changes in the rate of fermentation over the ten days.

2

(ii) Suggest a reason for the change in the rate of fermentation between points A and B.

1

(iii) Why must the barley be malted before it can be used by the yeast?

1

[Turn over for Question 14 on *Page twenty-four*

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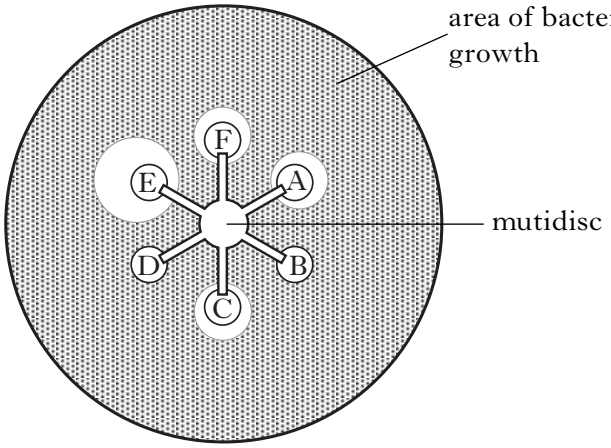
Marks	KU	PS

14. A nutrient agar plate was covered evenly with a suspension of bacteria. A multidisc was placed on the surface of the agar. Each of the six ends of the multidisc contained a different antibiotic.

The diagram shows the agar plate after incubation.



(*a*) Which antibiotic was most effective at preventing bacterial growth?

1

(*b*) To which antibiotics were the bacteria resistant?

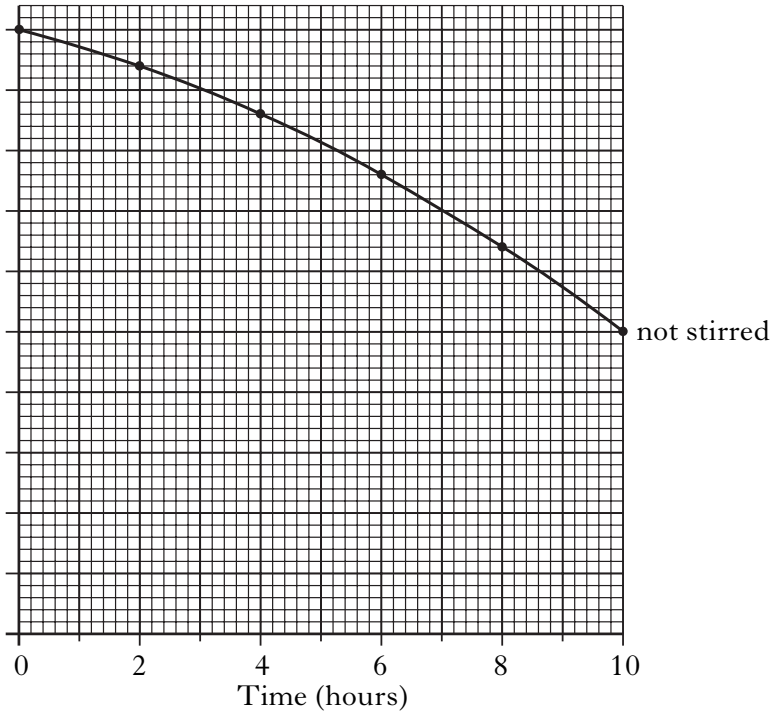
1

(*c*) Explain the need for a range of antibiotics in the treatment of diseases caused by bacteria.

1

[*END OF QUESTION PAPER*]

ADDITIONAL GRAPH PAPER FOR QUESTION 4(*a*)



[Turn over

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

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