

FOR OFFICIAL USE

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KU PS

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Total Marks

**0300/402**

NATIONAL  
QUALIFICATIONS  
2000

MONDAY, 29 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

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Scottish candidate number

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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.

Marks

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1. Diagram A shows three burrowing animals which live at different depths on Scottish beaches. They are eaten by various wading birds.

**Diagram A**

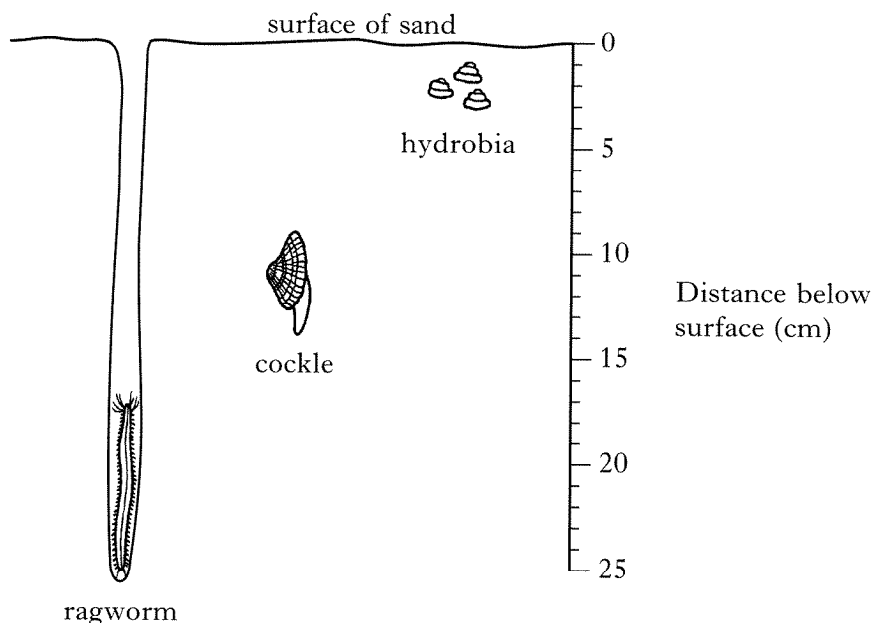
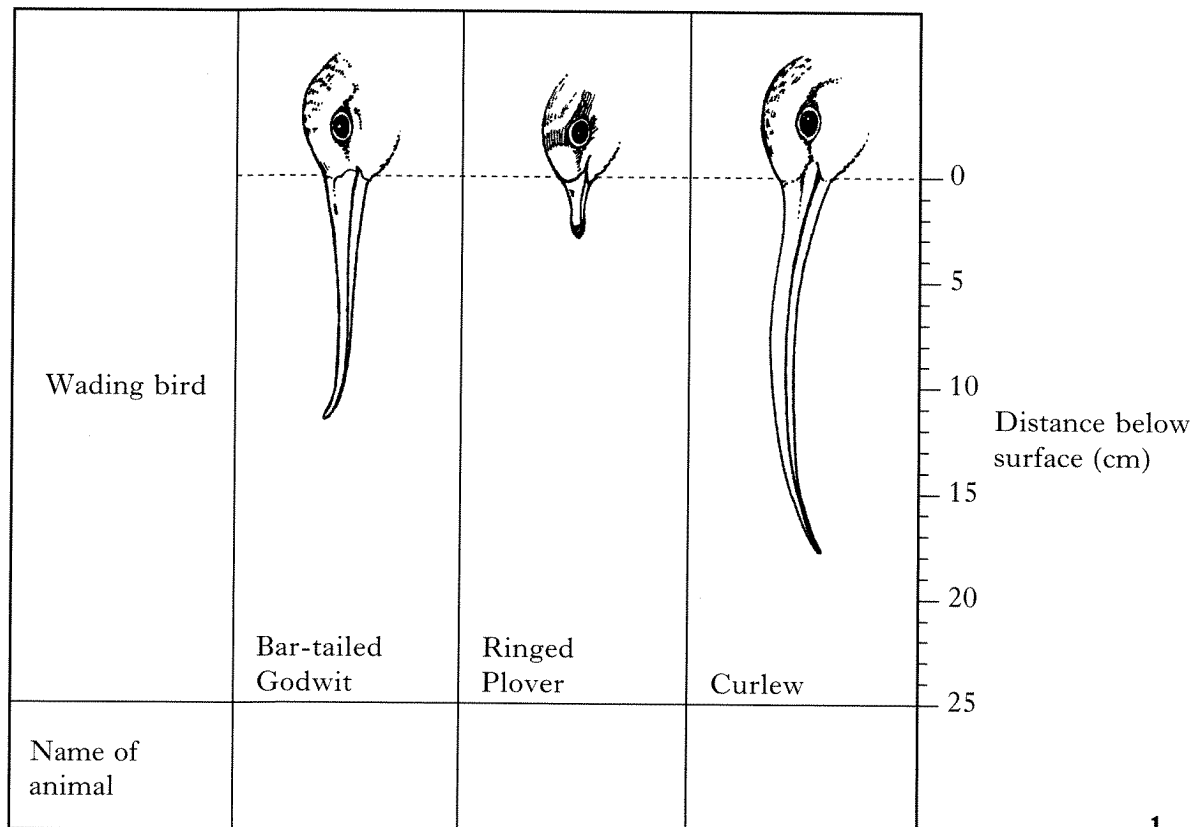


Diagram B shows the heads of three different species of wading birds.

- (a) Complete diagram B by writing the name of the burrowing animal each bird is likely to be feeding on, in the space below the bird.

**Diagram B**



1

Marks	KU	PS
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1		
1		

1. (continued)

- (b) (i) Which bird would be able to feed on all the burrowing animals shown?

\_\_\_\_\_

- (ii) Which bird would be able to feed on only one of the burrowing animals?

\_\_\_\_\_

- (c) Cockles are very sensitive to pollution and cannot live in polluted sand. Give **one** effect on the wildlife of a beach if the cockles were to die out.

\_\_\_\_\_

\_\_\_\_\_

- (d) What name is given to a species, such as cockles, whose presence or absence gives information about conditions in the habitat?

\_\_\_\_\_

[Turn over

Marks

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1		

2. The effect of carbon dioxide concentration on the growth rate of plants at 10°C was investigated. Identical groups of plants were grown in different concentrations of carbon dioxide for 30 days.

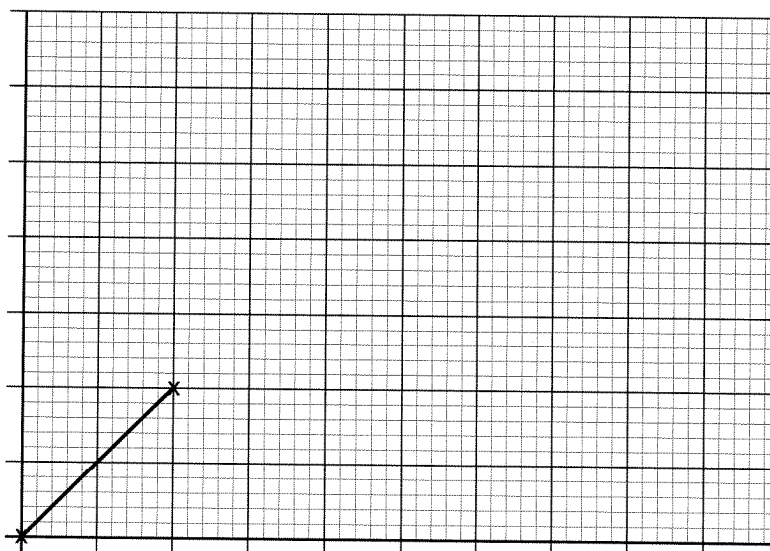
The plants were then collected, heated at 100°C and their dry mass recorded. The table below shows the results.

Concentration of carbon dioxide (%)	0	0.03	0.06	0.09	0.12	0.15
Gain in dry mass (g/day) at 10°C	0	0.1	0.18	0.26	0.3	0.3

- (a) (i) On the grid below, plot a line graph to show the effect of increasing carbon dioxide concentration on the rate of growth of the plants.

(Additional graph paper, if required, will be found on page 26.)

Gain in dry mass  
(g/day)



2

- (ii) Describe the relationship between the carbon dioxide concentration and the rate of growth of the plants.

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2

- (iii) Why was the dry mass of the plants measured, rather than the gain in fresh weight?

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2. (a) (continued)

(iv) At concentrations above 0.12%, carbon dioxide was no longer a limiting factor in the growth of the plants. Suggest another possible limiting factor.

\_\_\_\_\_

1

(b) (i) Name the layer of closely packed cells which carry out most of the photosynthesis in a leaf.

\_\_\_\_\_

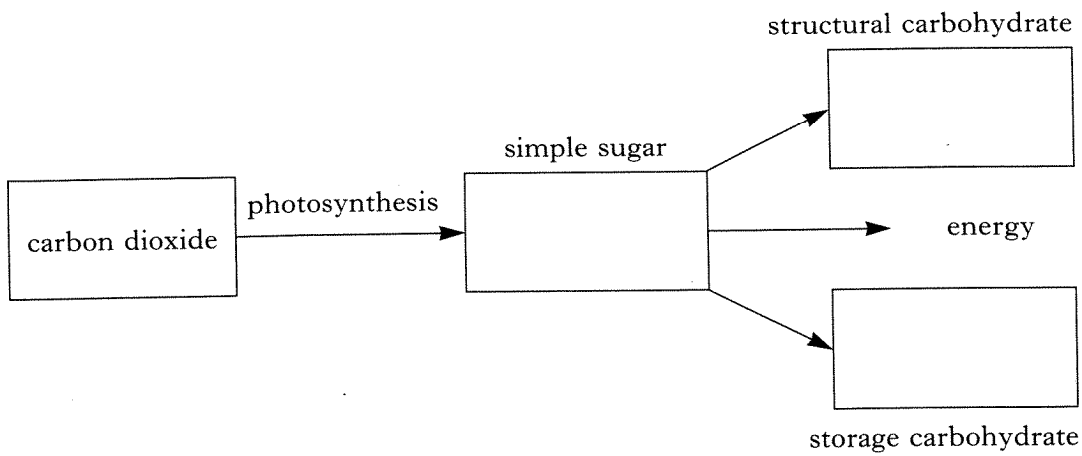
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(ii) What feature of the internal structure of a leaf allows carbon dioxide to diffuse from the stomata to the photosynthesising cells?

\_\_\_\_\_

1

(c) The diagram below shows the fate of the carbon dioxide used in photosynthesis. Complete the diagram by naming each of the carbohydrates described.



3

[Turn over

Marks KU PS

3. (a) The statements below refer to factors which affect the level of the hormone ADH in the blood.

- 1 Drinking a large volume of water
- 2 A low water concentration in the blood
- 3 Losing sweat when running
- 4 A high water concentration in the blood

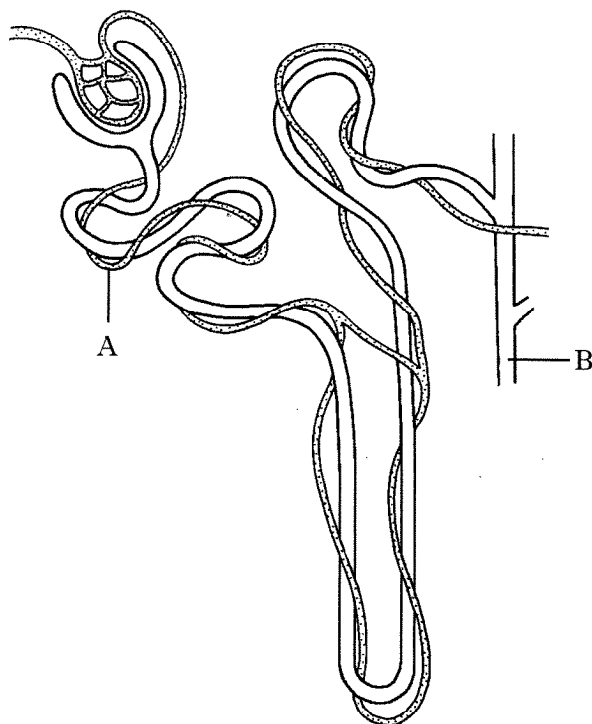
Which **two** factors would bring about a **decrease** in the level of ADH in the blood?

Tick the correct box.

- |              |                          |              |                          |
|--------------|--------------------------|--------------|--------------------------|
| 1 and 2 only | <input type="checkbox"/> | 2 and 3 only | <input type="checkbox"/> |
| 1 and 4 only | <input type="checkbox"/> | 3 and 4 only | <input type="checkbox"/> |

1

(b) The diagram below represents a kidney nephron.



Complete the table below to show the names and functions of the labelled parts of the nephron.

Letter	Name	Function
		transports reabsorbed glucose
	collecting duct	

2

Marks

KU	PS

3. (continued)

(c) The following table shows the composition of glomerular filtrate and of urine.

Substance	Composition of glomerular filtrate (%)	Composition of urine (%)
water	98.5	96
salts	1	1.8
glucose	0.1	0
urea	0.02	2
others	0.38	0.2

(i) Which substance, present in the glomerular filtrate, is completely reabsorbed back into the blood?

\_\_\_\_\_

1

(ii) A woman produced 150 litres of glomerular filtrate and 1.5 litres of urine in one day.

What percentage of the glomerular filtrate was passed as urine?

*Space for calculation*

\_\_\_\_\_ %

1

(iii) Even though most of the salt present in the glomerular filtrate is reabsorbed, the percentage of salt in the urine is greater than that in the filtrate.

Explain why this is so.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1

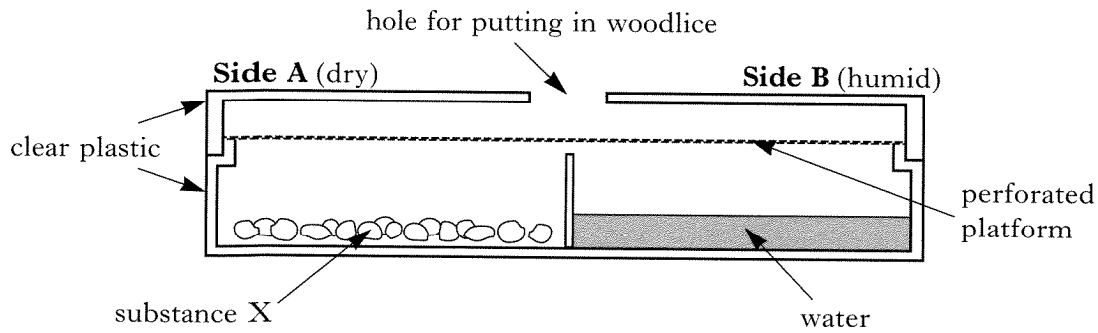
(d) Urine contains the waste chemical urea. From what food substance is urea produced?

\_\_\_\_\_

1

[Turn over

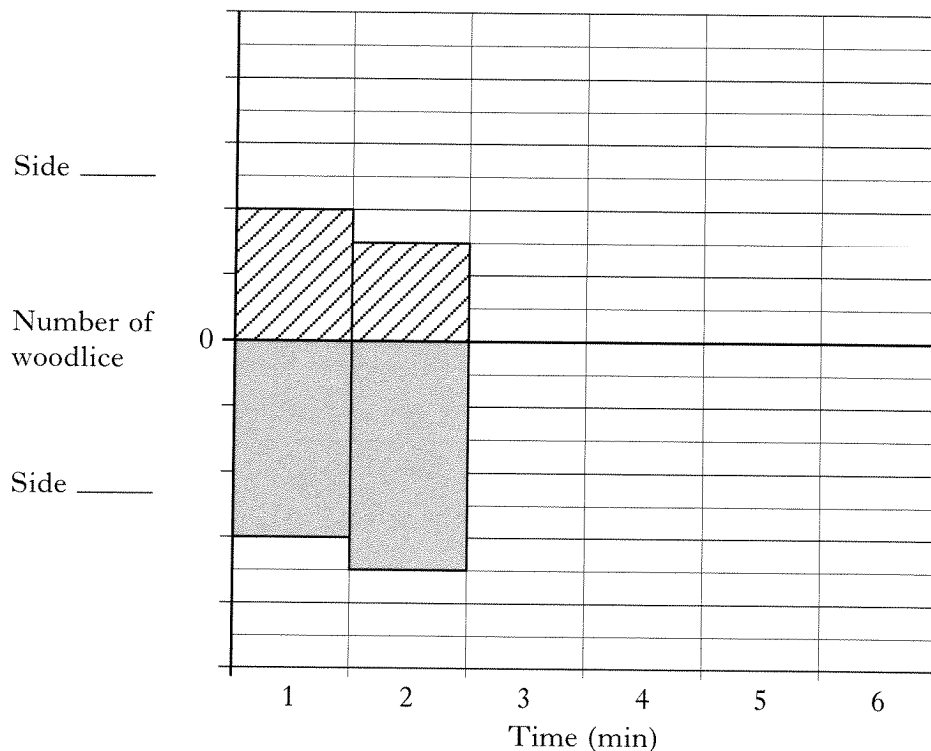
4. The diagram below shows a choice chamber.



Ten woodlice were released into the choice chamber. The number of animals present in both sides were recorded every minute for six minutes. The results are shown in the table.

Time (min)	Woodlice in Side A	Woodlice in Side B
1	4	6
2	3	7
3	1	9
4	2	8
5	1	9
6	0	10

(a) On the grid below, complete the bar graph of the results.  
(An additional grid, if required, will be found on page 26.)






Marks	KU	PS
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2		
1		

4. (continued)

(b) What is the function of substance X in the choice chamber?

\_\_\_\_\_

(c) (i) Describe how the choice chamber could be changed to study the response of woodlice to two different light intensities instead of to differences in humidity.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(ii) When such an experiment was carried out, the woodlice were found to gather in dark conditions.

Explain the benefit of this response to the survival of the woodlice.

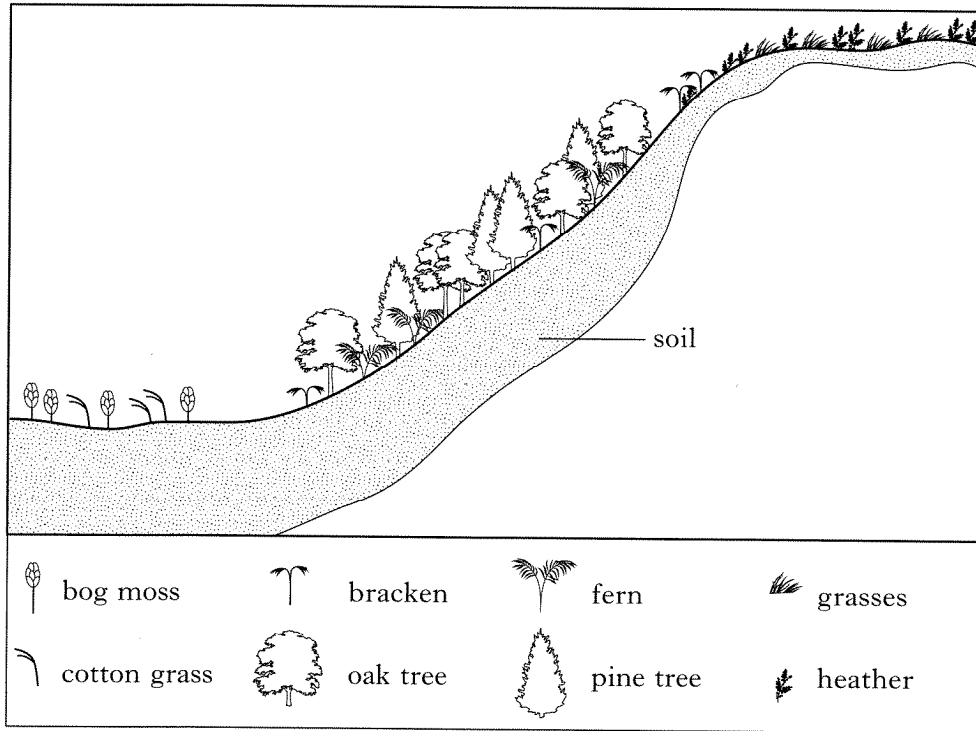
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[Turn over

Marks

KU PS

5. The diagram below shows the distribution of plants on a Scottish hillside.



(a) From the diagram, identify the plants which can live under oak trees and pine trees.

\_\_\_\_\_ and \_\_\_\_\_

1

(b) Heather does not grow well under trees. Suggest **one** abiotic factor which might be needed for heather to grow well.

\_\_\_\_\_

1

(c) Suggest **one** reason why there are no trees on the top of the hill.

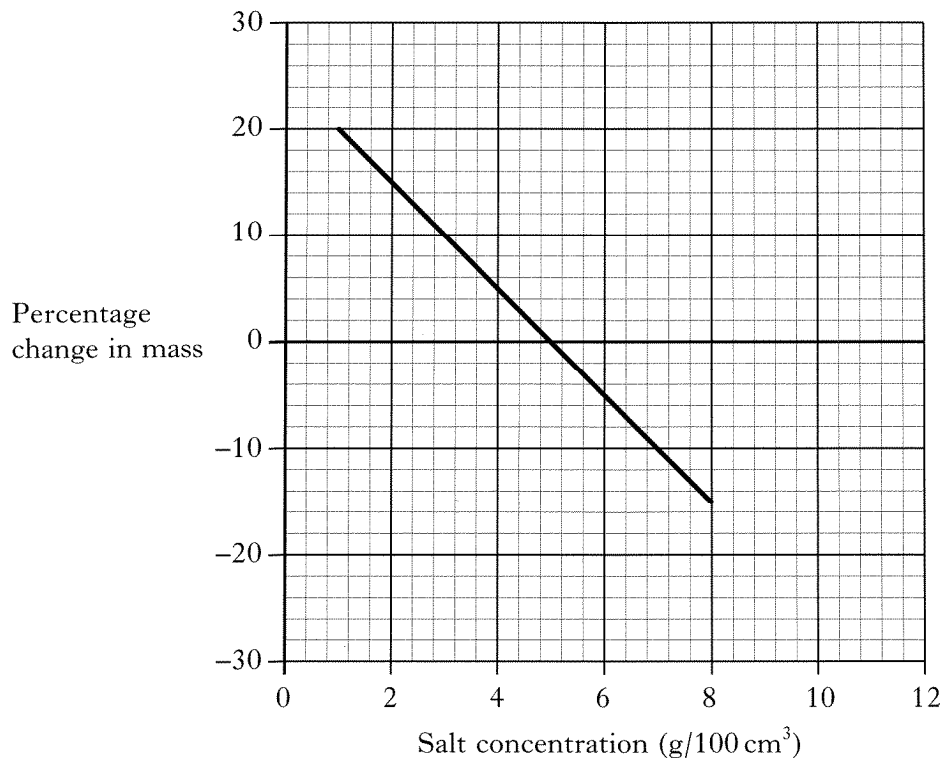
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1		

6. Several pieces of potato were blotted dry and weighed. Each was then placed in a different concentration of salt solution. After 2 hours the pieces of potato were removed, blotted dry and reweighed. The percentage change in mass was calculated and the results plotted on a graph.



- (a) At which salt concentration did the mass of the potato remain the same?

\_\_\_\_\_ g/100 cm<sup>3</sup>

1

- (b) State the percentage change in mass of the potato at a salt concentration of 7 g/100 cm<sup>3</sup> after two hours.

\_\_\_\_\_

1

- (c) Predict the salt concentration that will produce a 30% decrease in mass.

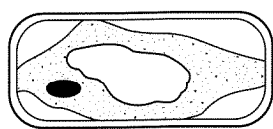
\_\_\_\_\_ g/100 cm<sup>3</sup>

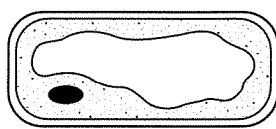
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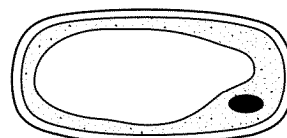
- (d) Cells from the potato in the 8 g/100 cm<sup>3</sup> solution were examined with a microscope.

Which of the following diagrams best represents one cell from the potato?

Tick the correct box.








1

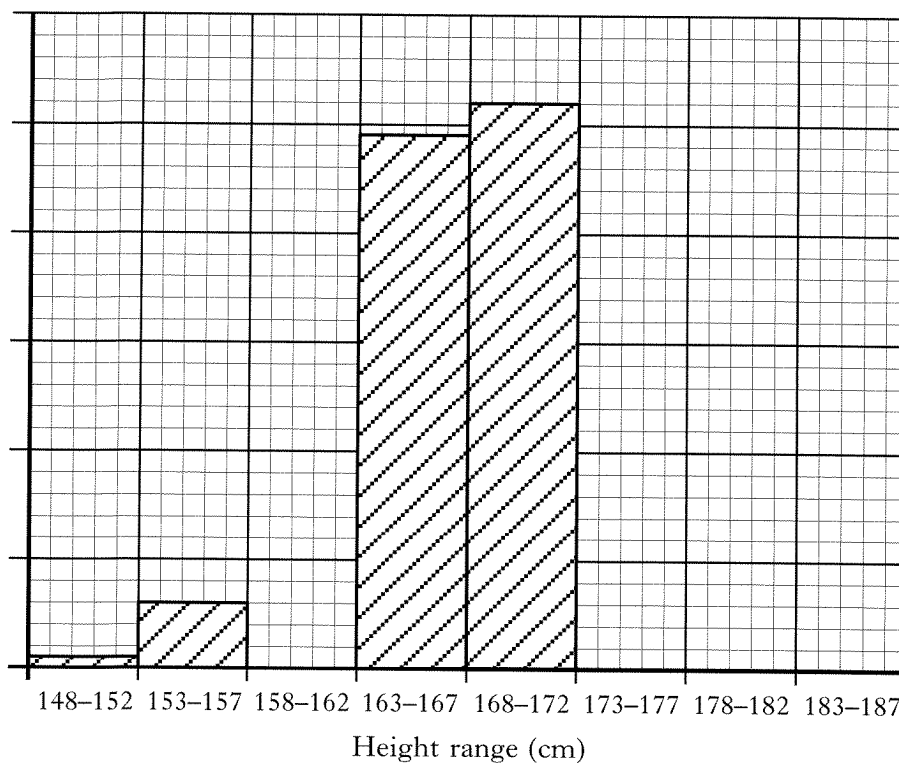
Marks

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2		
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1		

7. The distribution of heights of 175 school pupils is shown in the table.

Height range (cm)	148–152	153–157	158–162	163–167	168–172	173–177	178–182	183–187
Number of pupils	1	6	13	49	52	28	21	5

- (a) Use the results to complete the bar graph.  
(An additional bar graph, if required, will be found on page 27.)



- (b) What percentage of the pupils had heights in the range 163–167 cm?  
*Space for calculation*

\_\_\_\_\_ %

- (c) Height is an example of continuous variation.  
Explain what is meant by continuous variation.

\_\_\_\_\_  
\_\_\_\_\_

Marks

KU	PS
1	
1	
1	

8. In the Fruit fly *Drosophila*, grey body colour (G) is dominant to black (g). True-breeding grey-bodied flies were crossed with black-bodied flies, producing an F1 generation which were all grey-bodied.

(a) Complete the diagram below to show the missing genotypes of the cross.

**Parent phenotypes**              grey-bodied      ×      black-bodied

**Parent genotypes**              \_\_\_\_\_              \_\_\_\_\_ gg

**F1 phenotype**                                      all grey-bodied

**F1 genotype**                                      \_\_\_\_\_

(b) (i) F1 flies were crossed to produce an F2 generation containing 72 flies. Using the expected ratio, predict the number of grey bodied and black-bodied flies in the F2 generation.

*Space for calculation*

Predicted number of grey-bodied flies \_\_\_\_\_

Predicted number of black-bodied flies \_\_\_\_\_

(ii) If the numbers of grey-bodied and black-bodied flies in the F2 generation were different from the predicted numbers, how could this be explained?

\_\_\_\_\_

\_\_\_\_\_

(c) The letters G and g are used to represent different forms of a gene. What term means the different forms of a gene?

\_\_\_\_\_

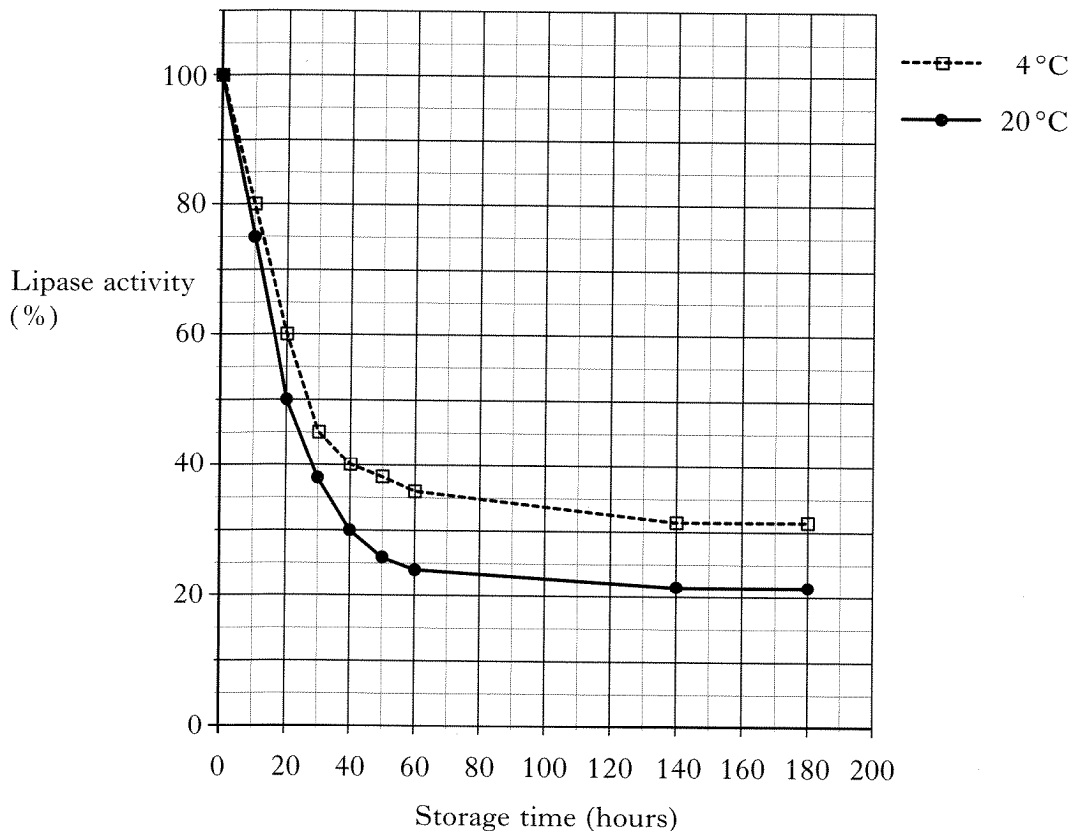
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Marks

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<b>1</b>		
<b>1</b>		

9. The enzyme lipase catalyses the breakdown of fats into fatty acids and glycerol. It can be obtained as a dry powder and made into a solution before use.

(a) The effect of storage at different temperatures on the activity of the lipase solution was investigated. The results are shown in the graph.



(i) How long did it take the lipase activity to decrease to 50% when stored at 20°C?

\_\_\_\_\_ hours

1

(ii) Which of the following lipase solutions would be the most active?  
*Tick the correct box.*

Stored at 4°C for 30 hours

Stored at 4°C for 140 hours

Stored at 20°C for 10 hours

Stored at 20°C for 50 hours

1

Marks	KU	PS
1		
1		
1		

9. (continued)

- (b) (i) The lipase activity was estimated by measuring the change in pH while it was breaking down fats.

Explain why the pH changed during this reaction.

\_\_\_\_\_

- (ii) The pH of the milk can also be changed by bacterial fermentation during the souring of milk.

Name the sugar in milk which is fermented by bacteria.

\_\_\_\_\_

- (c) In this investigation, the substrate for lipase was the fat in milk. Explain why a starch suspension could not be used as the substrate for lipase.

\_\_\_\_\_

[Turn over

Marks	KU	PS
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10. Read the passage below.

“**Gene genie**” adapted from an article in the *Sunday Times*, March 1998.

Cancer is the survival and uncontrolled multiplication of damaged cells. One in four of us will still die of cancer. In 60% of cancer cases the main cause is a faulty gene called **p53**. This “guardian angel” gene is the body’s naturally occurring brake that stops cancer before it begins.

Healthy **p53** tells a cell that it has been damaged by a cancer causing agent such as tobacco smoke, a high fat diet or ultra-violet light. The cell then destroys itself. In some people the “guardian angel” gene does not switch on. This makes the process fail and the result is a cancerous tumour.

Scientist David Lane, who discovered the gene, now plans to test a **p53** activator drug in Dundee. The aim of the drug is to use mechanisms already present in the body. It is designed to switch the **p53** gene on and, as a result, the cancer cells should be destroyed without damage to healthy cells. This will make the drug much kinder than the chemotherapy or radiotherapy treatments used at present.

The drug will be tested on a small number of patients with head and neck cancers. Doctors believe these tumours are more accessible and easier to monitor than other types of cancer.

Answer the following questions based on the passage.

(a) Name **two** cancer causing agents, mentioned in the passage.

1 \_\_\_\_\_ 2 \_\_\_\_\_

1

(b) Describe how the **p53** gene prevents cells forming cancerous tumours.

\_\_\_\_\_  
\_\_\_\_\_

1

(c) Explain how cells with a faulty **p53** gene may form cancerous tumours.

\_\_\_\_\_  
\_\_\_\_\_

1

(d) Why should the new **p53** drug be a safer alternative than present treatments?

\_\_\_\_\_  
\_\_\_\_\_

1

(e) Give **two** reasons why the first trials will be on patients suffering from head and neck cancers.

1 \_\_\_\_\_

2 \_\_\_\_\_

1

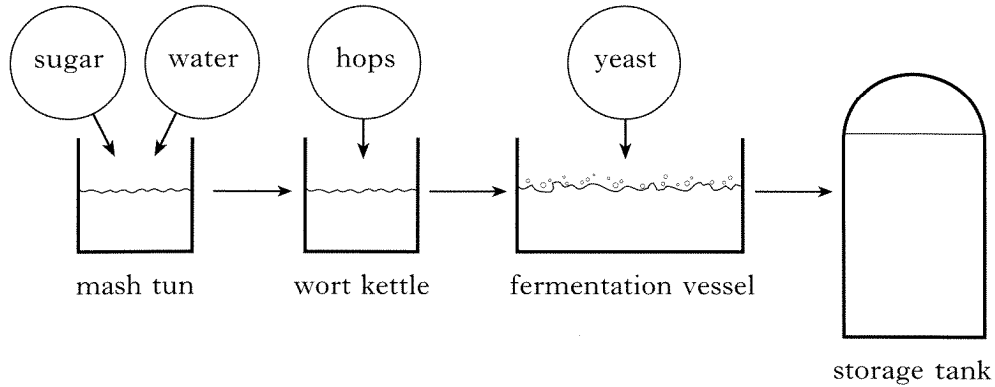
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1		



Marks

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11. (a) The diagram below shows stages in the brewing of beer.

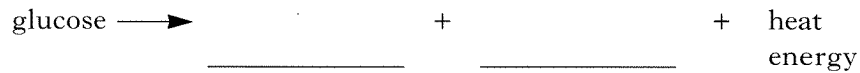


(i) What is the source of the sugar for the brewing of beer?

\_\_\_\_\_

1

(ii) During fermentation, yeast carries out anaerobic respiration. Complete the following word equation for anaerobic respiration in yeast.



1

(iii) Explain why the fermentation vessel often has to be cooled during beer production.

\_\_\_\_\_

1

(b) Brewing is a batch process.

Which of the following are typical features of batch processing?

*Tick (✓) the correct box or boxes.*

Immobilised cells or enzymes are used

Product is mixed with cells or enzymes

Reaction is stopped and vessel is cleaned between production runs

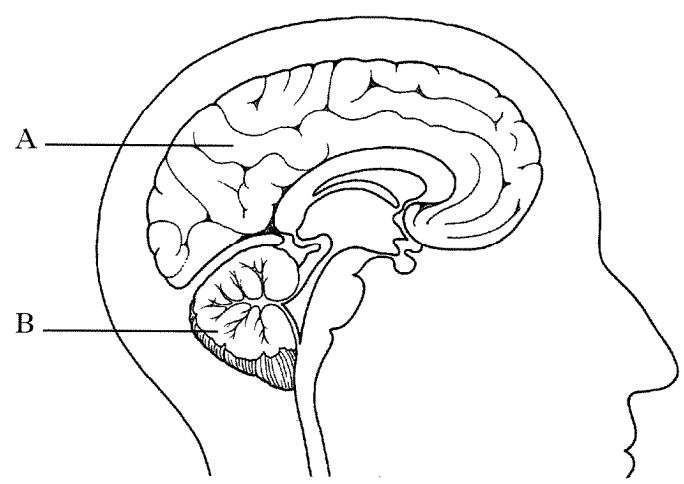
Cells or enzymes can be re-used

1

[Turn over

Marks	KU	PS
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1		
1		

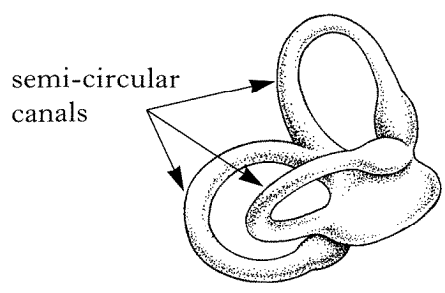
12. (a) The diagram shows a side view of the human brain.



Complete the table by naming parts A and B, and giving **one** function of each.

Part	Name	Function
A		
B		

(b) The diagram shows the semi-circular canals from the human ear. The canals detect movements of the head.



Describe the arrangement of the semi-circular canals and explain how this arrangement helps to detect head movements.

Description \_\_\_\_\_

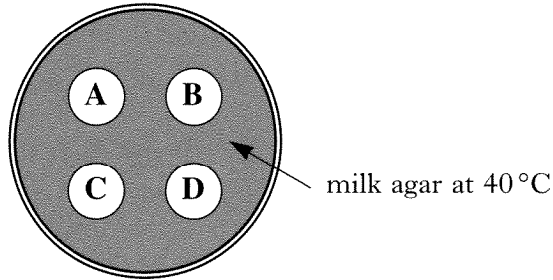
Explanation \_\_\_\_\_

\_\_\_\_\_

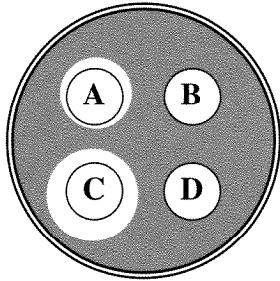
Marks

KU PS

13. In an experiment to investigate washing powders, a pupil set up a petri dish as shown below. Four wells were cut in the milk agar using a cork borer. Milk agar contains protein which makes the agar cloudy.



Four drops of washing powder solutions A, B and C were put into the corresponding wells. Four drops of distilled water were put into well D. After two hours, clear zones were visible around the wells as shown below.



- (a) (i) Suggest how the reliability of the results could be improved.
- \_\_\_\_\_
- (ii) Well D is a control. What is the purpose of the control?
- \_\_\_\_\_
- \_\_\_\_\_
- (iii) Washing powders A and C were biological detergents. Suggest why clear zones were produced around wells A and C only.
- \_\_\_\_\_
- \_\_\_\_\_
- (b) Give **one** advantage of using biological detergents in the home, rather than non-biological detergents.
- \_\_\_\_\_

1

1

1

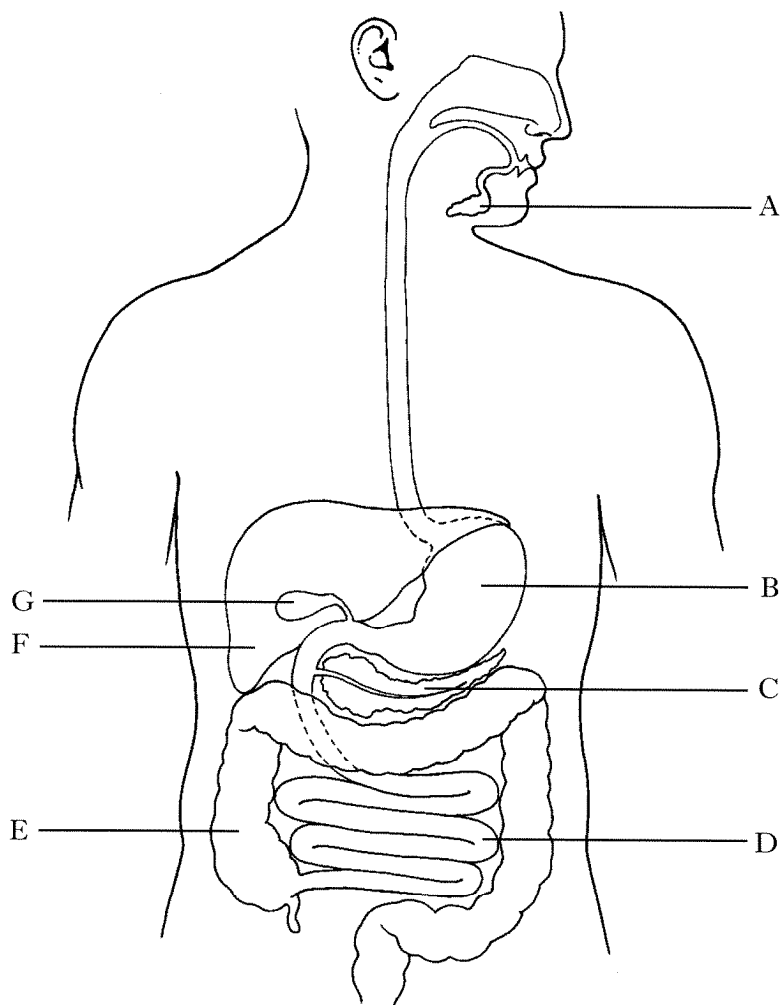
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Marks

KU PS

14. The diagram shows part of the human digestive system.



(a) Use letters from the diagram to identify where the named digestive juices are **produced**.

<i>Digestive juice</i>	<i>Letter</i>
pancreatic juice	
saliva	
gastric juice	
bile	

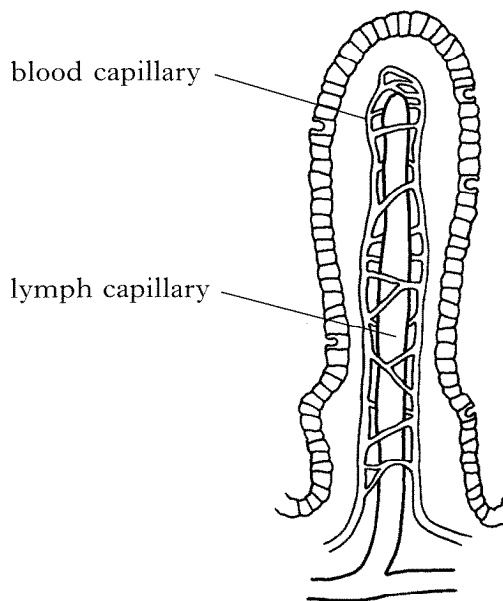
2

Marks

KU PS

14. (continued)

(b) A villus from region D is shown below.



Describe **two** ways in which a villus is adapted for its role in the absorption and transport of food.

- 1 \_\_\_\_\_  
\_\_\_\_\_
- 2 \_\_\_\_\_  
\_\_\_\_\_

2

[Turn over

Marks

KU	PS
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15. The nitrogen cycle describes the essential movement of nitrogen between living organisms and their environment.

The grid below lists some of the ways in which this is achieved.

A	nitrification	B	denitrification	C	decay and decomposition
D	nitrogen fixing	E	eating	F	uptake by roots

Use a letter from the grid to identify each of the following.



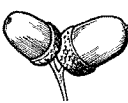

- (a) Protein in plants becomes animal protein. \_\_\_\_\_
- (b) Nitrates in soil become plant protein. \_\_\_\_\_
- (c) Atmospheric nitrogen becomes nitrates in soil. \_\_\_\_\_
- (d) Nitrates in soil become atmospheric nitrogen. \_\_\_\_\_
- (e) The stage in which fungi are most important. \_\_\_\_\_

3

Marks 

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16. The following table gives information about some common plants and their fruits or seeds.

<i>Plant</i>	<i>Description of flower</i>	<i>Diagram of fruit or seed (not drawn to same scale)</i>
Bramble	bright white petals and sweet scented	
Thistle	bright purple petals with nectar	
Oak	small green petals and unscented	
Ash	brown petals and no scent or nectar	

Complete the table below by ticking the correct boxes.

<i>Plant</i>	<i>Method of pollination</i>		<i>Method of seed dispersal</i>	
	<i>wind</i>	<i>insect</i>	<i>wind</i>	<i>animal</i>
Bramble				
Thistle				
Oak				
Ash				

2

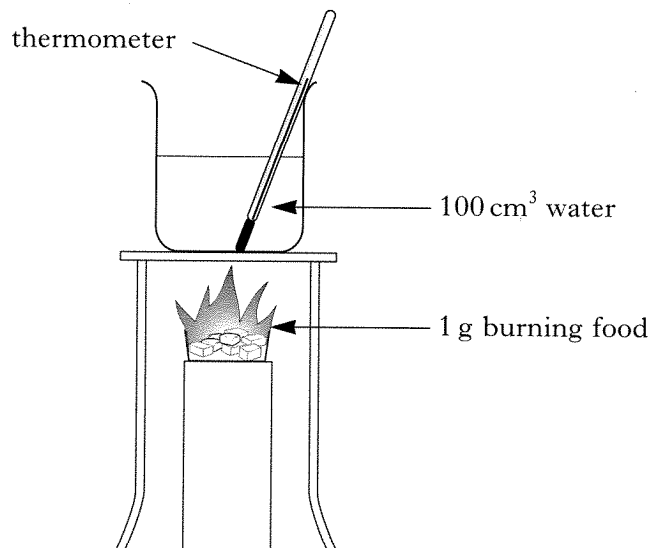
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17. The diagram shows the apparatus used to investigate the energy contents of different foods.

1 g of each food was burned under a beaker containing 100 cm<sup>3</sup> of water. The rise in water temperature was measured using a thermometer.



The energy content of the food can be calculated using the equation

$$\text{energy content} = \text{temperature rise} \times 420 \text{ (joules/gram)}$$

- (a) Complete the table of results to show the energy content for protein.

*Space for calculation*

Food	Temperature rise (°C)	Energy content (joules/g)
Fat	25	10 500
Carbohydrate	12	5040
Protein	13	

- (b) Suggest a reason why the energy contents found in this investigation were lower than the expected values.

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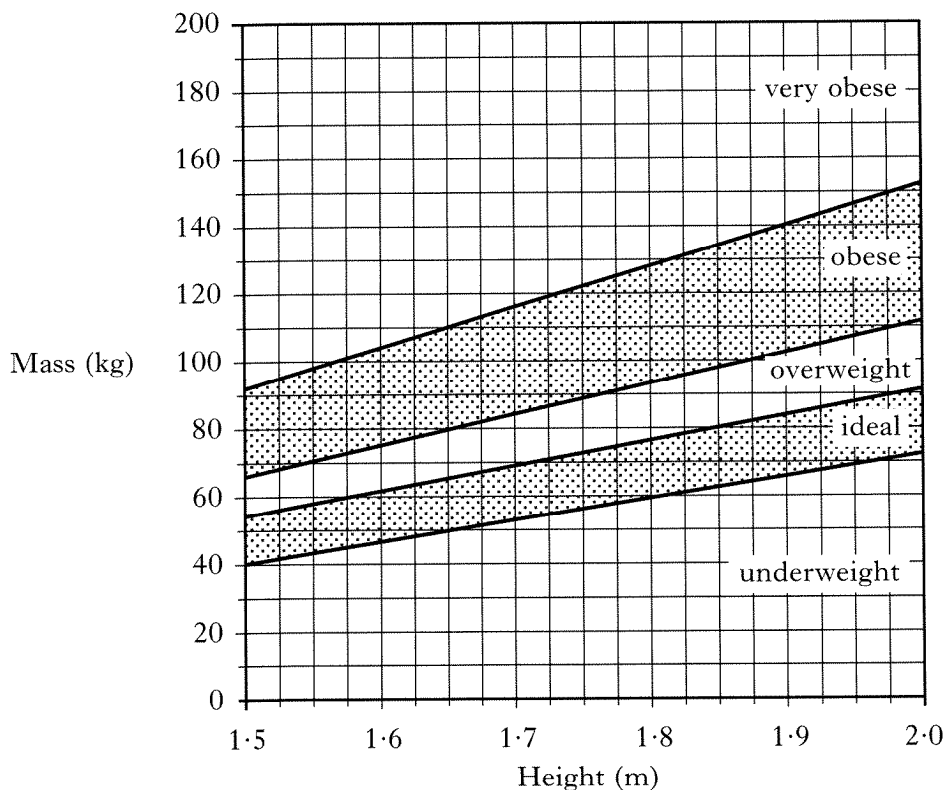
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Marks

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18. The graph below describes weight categories for British adults.



(a) An adult man is 1.8 metres tall and weighs 80 kg.  
Use the graph to describe his weight category.

\_\_\_\_\_

1

(b) A woman of 1.65 metres in height weighs 40 kg.  
Calculate the minimum weight she needs to gain to reach an ideal weight.

*Space for calculation*

\_\_\_\_\_ kg

1

(c) The number of obese people in the UK has increased dramatically in recent years.  
Suggest a possible reason for this trend.

\_\_\_\_\_  
\_\_\_\_\_

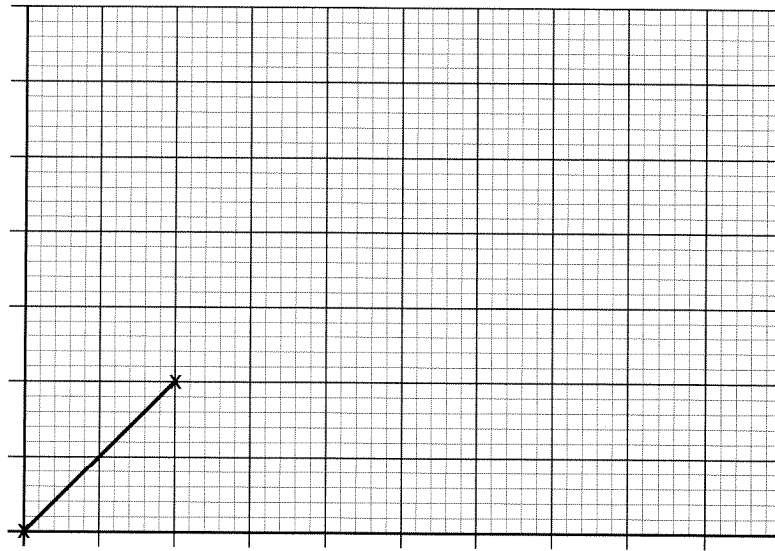
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[END OF QUESTION PAPER]

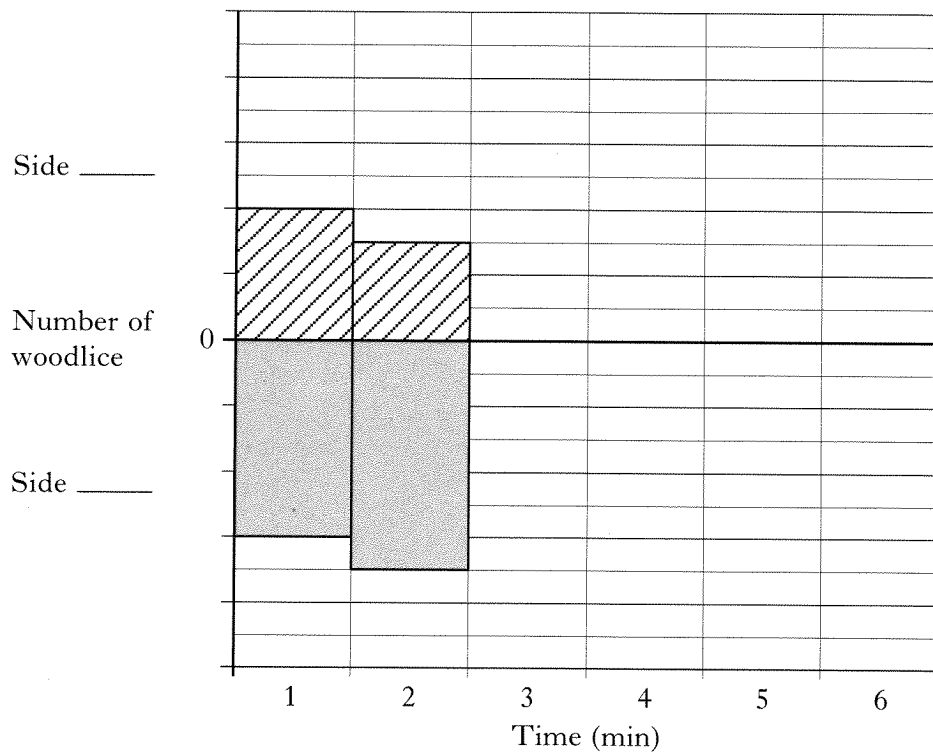
SPACE FOR ANSWERS  
AND FOR ROUGH WORKING

ADDITIONAL GRAPH PAPER FOR QUESTION 2(a)(i)

Gain in dry mass  
(g/day)

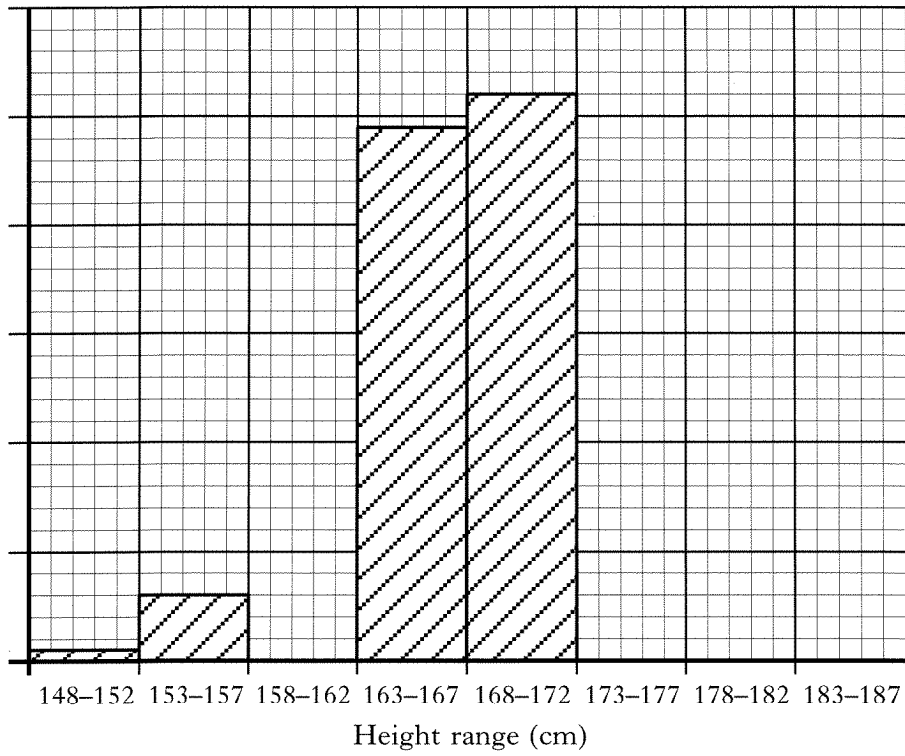


ADDITIONAL GRID FOR QUESTION 4(a)



SPACE FOR ANSWERS  
AND FOR ROUGH WORKING

ADDITIONAL GRID FOR QUESTION 7(a)



SPACE FOR ANSWERS  
AND FOR ROUGH WORKING

3. (a) The statements below refer to factors which affect the level of the hormone ADH in the blood.

- 1 Drinking a large volume of water
- 2 A low water concentration in the blood
- 3 Losing sweat when running
- 4 A high water concentration in the blood

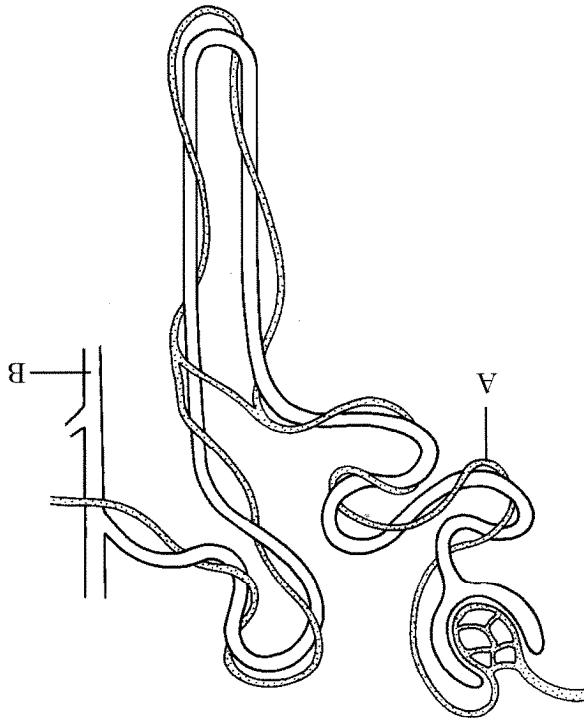
Which **two** factors would bring about a **decrease** in the level of ADH in the blood?

Tick the correct box.

<input type="checkbox"/>	1 and 2 only	<input type="checkbox"/>	1 and 4 only
<input type="checkbox"/>	2 and 3 only	<input type="checkbox"/>	3 and 4 only

1

(b) The diagram below represents a kidney nephron.



Complete the table below to show the names and functions of the labelled parts of the nephron.

Letter	Name	Function
	collecting duct	
		transports reabsorbed glucose

2

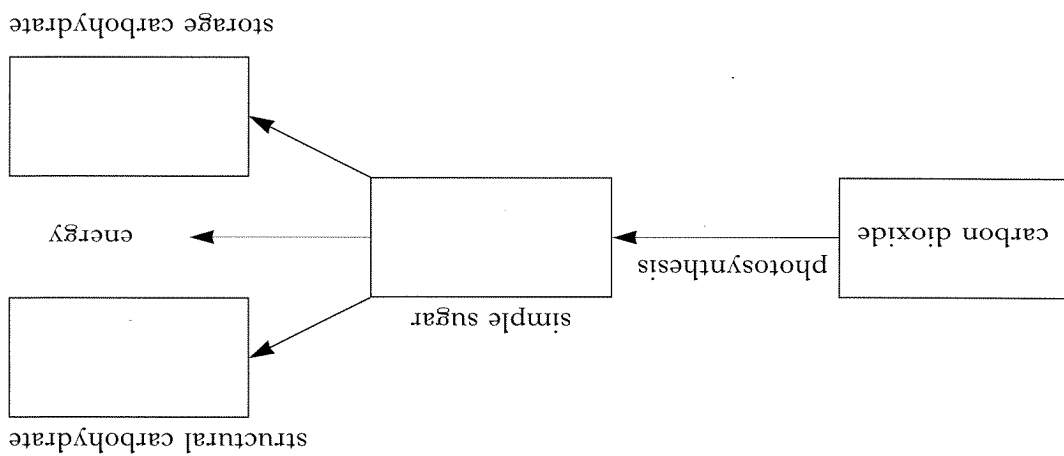
2. (a) (continued)

(iv) At concentrations above 0.12%, carbon dioxide was no longer a limiting factor in the growth of the plants. Suggest another possible limiting factor.

(b) (i) Name the layer of closely packed cells which carry out most of the photosynthesis in a leaf.

(ii) What feature of the internal structure of a leaf allows carbon dioxide to diffuse from the stomata to the photosynthesising cells?

(c) The diagram below shows the fate of the carbon dioxide used in photosynthesis. Complete the diagram by naming each of the carbohydrates described.



3

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