FOR OFFICIAL USE

C

KU PS

Total Marks

0300/31/01

NATIONAL QUALIFICATIONS 2012

WEDNESDAY, 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.

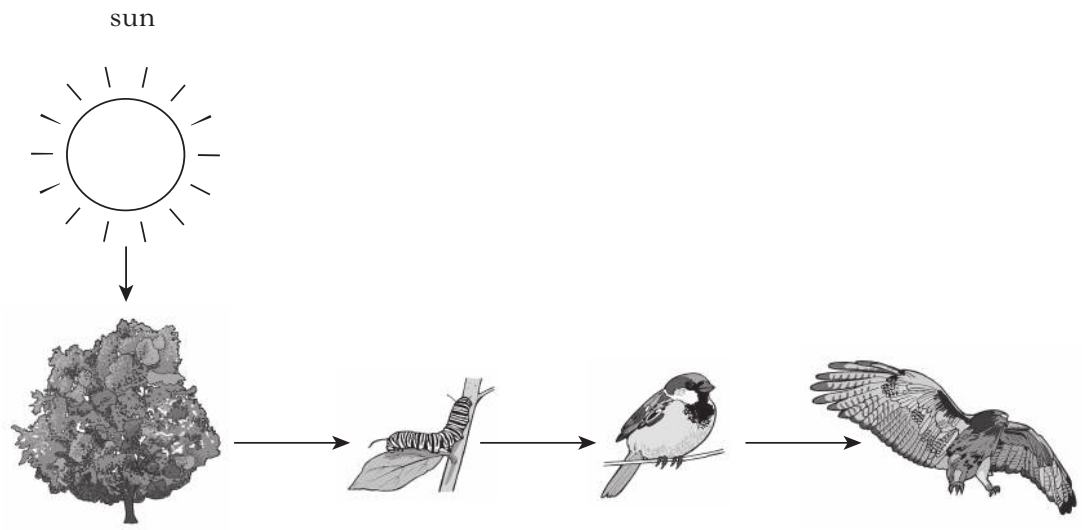
3 Rough work, if any should be necessary, as well as the fair copy, is to be written in this book. Additional spaces for answers and for rough work will be found at the end of the book. Rough work should be scored through when the fair copy has been written.

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 diagram below shows the transfer of energy through a food chain in a wood. The numbers represent the units of energy in the different populations of the food chain.



(*a*) (i) Complete the table below using information from the diagram.

Population	*Energy content* (units)
caterpillar	
	480
hawk	

2

(ii) 4% of the light energy reaching the oak tree is converted into new plant material.

How much energy did the oak tree receive?

Space for calculation

_____ units

1

DO NOT WRITE IN THIS MARGIN

1. (continued)

Marks

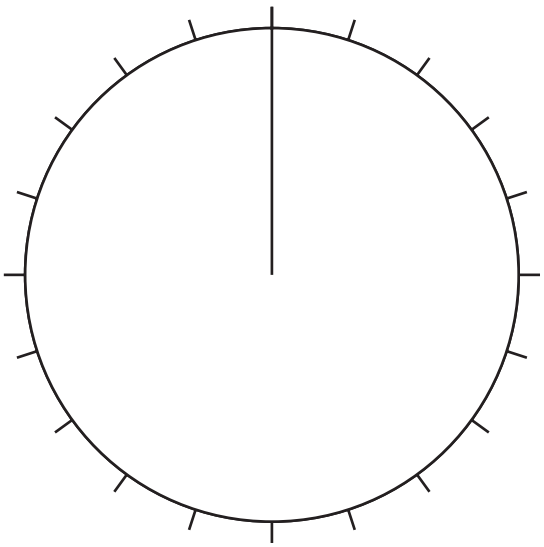
KU | PS

(*b*) The leaf litter in the woodland was sampled and the table below shows the number and types of invertebrates found.

Invertebrates	*Number found*
Woodlice	45
Snails	5
Slugs	5
Beetles	20
Centipedes	15
Other species	10

Use the information in the table to complete the pie chart below.

(An additional pie chart can be found, if required, on *Page twenty-seven*.)



2

[Turn over

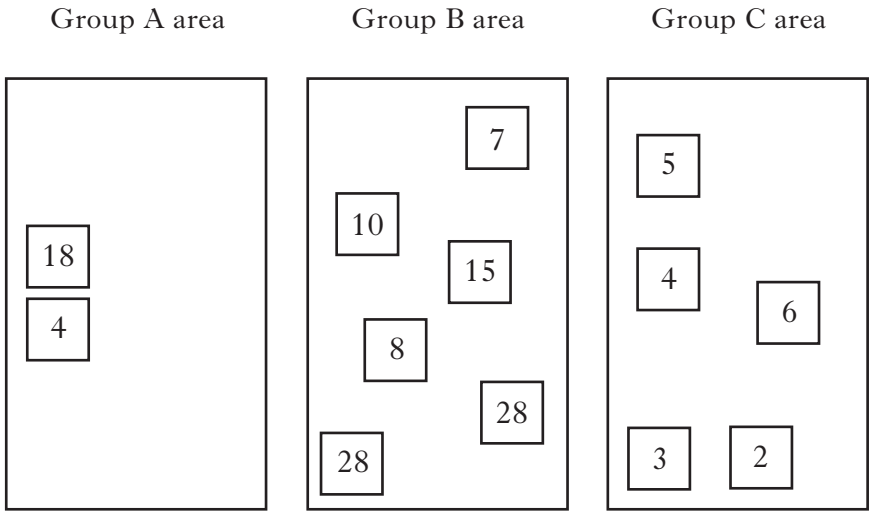
DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

2. (*a*) Three groups of students used quadrats to carry out a survey on the distribution of mussels on different areas of a shore.

Each quadrat measured 50 cm × 50 cm. (Four quadrats = 1 m^2).

The positions of the quadrats and the number of mussels found is shown below for each group.



(i) Complete the following table with the results from the area of Group C.

Space for calculation

Group	*Average number of mussels per quadrat*	*Estimated number of mussels per* m^2
A	11	44
B	16	64
C		

1

(ii) Which group has made an error in their sampling technique which makes their results less reliable than the other groups?

State the error this group has made and describe an improvement which would increase the reliability of their results.

Group _____

Error _____ **1**

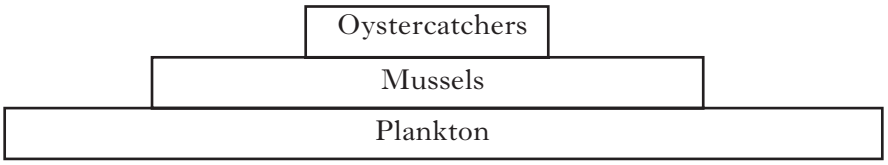
Improvement _____ **1**

DO NOT WRITE IN THIS MARGIN

2. (continued)

Marks | KU | PS

(*b*) A pyramid of biomass, including mussels, is shown below.

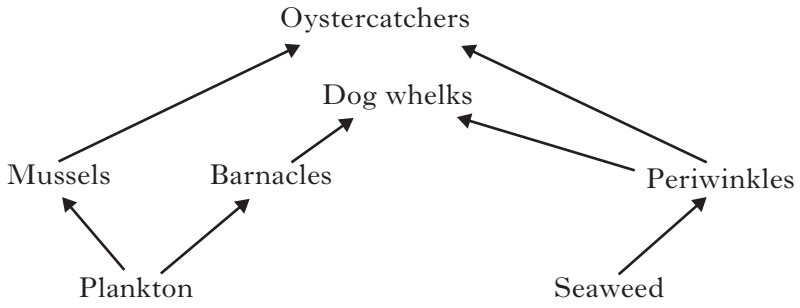


Explain what is meant by a pyramid of biomass.

_____

_____ **1**

(*c*) Part of the food web from the shore is shown below.



The numbers of mussels and periwinkles may be affected if the barnacles were removed from the food web.

(i) Underline **one** answer in the brackets and give an explanation for it.

The mussel population would { increase / decrease / stay the same } .

Explanation _____

_____ **1**

(ii) Underline **one** answer in the brackets and give an explanation for it.

The periwinkle population would { increase / decrease / stay the same } .

Explanation _____

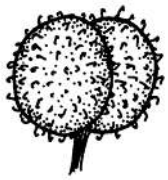
_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

3. The table below contains information about the flowers, fruits and seeds of some common plants.

The diagrams are not all the same scale.

Plant	*Flowers*	*Fruits or seeds*
Bramble	 scented white petals with nectar	 juicy
Goosegrass	 white petals with nectar	 hooked
Sycamore	 green petals and no scent or nectar	 winged

Complete the following table to show the method of pollination and seed dispersal used by each plant.

Put a tick (✓) in the correct boxes.

	Method of pollination		*Method of seed dispersal*		
Plant	*Wind*	*Insect*	*Wind*	*Animal (external)*	*Animal (internal)*
Bramble					
Goosegrass					
Sycamore					

2

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

4. (*a*) Complete the table below to show parts of the brain and their functions.

Part of brain	*Function*
Cerebrum	
Cerebellum	
	controls breathing and heart rate

2

(*b*) The following table shows the average brain and body masses of several animals.

Animal	*Average brain mass* (g)	*Average body mass* (g)	*Ratio of brain : body mass*
Monkey	100	7 000	1 : 70
Kangaroo	56	35 000	1 : 625
Cat	30	3 300	1 : 110
Racoon	39	4 290	1 : 110
Squirrel	6	900	1 : 150
Frog	0·1	18	

(i) Complete the table to show the ratio of brain : body mass for the frog.

Space for calculation

1

(ii) Of the following animals, which has the smallest brain compared to its body mass?

Tick (✓) the correct box.

Kangaroo ☐

Cat ☐

Racoon ☐

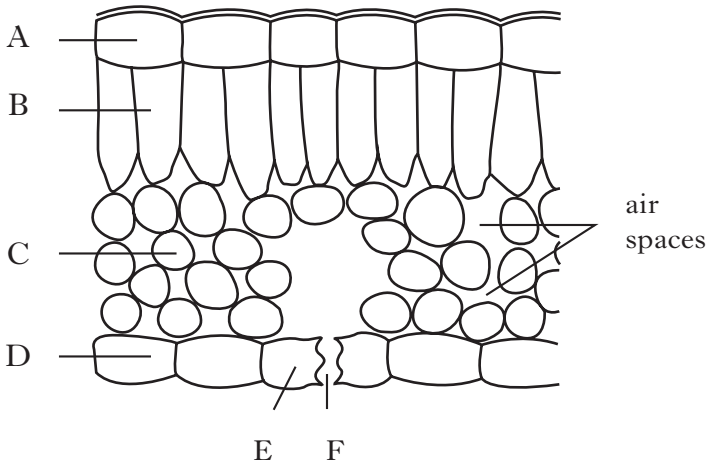
Squirrel ☐

1

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

5. (*a*) The diagram below represents part of a cross section through a leaf.



Identify **one** example of each of the cells described below by using letters from the diagram to complete the boxes.

Each letter may be used **once**, **more than once** or **not at all**.

Transparent cells ☐

Cells which carry out photosynthesis ☐

Mesophyll cells ☐

Guard cells ☐

2

(*b*) The rate of photosynthesis can be affected by several factors.

Underline the correct word in each bracket in the following sentence to explain the term *limiting factor*.

The limiting factor is the factor which is preventing the rate of photosynthesis from { increasing / decreasing } unless the supply of that factor { increases / decreases }.

1

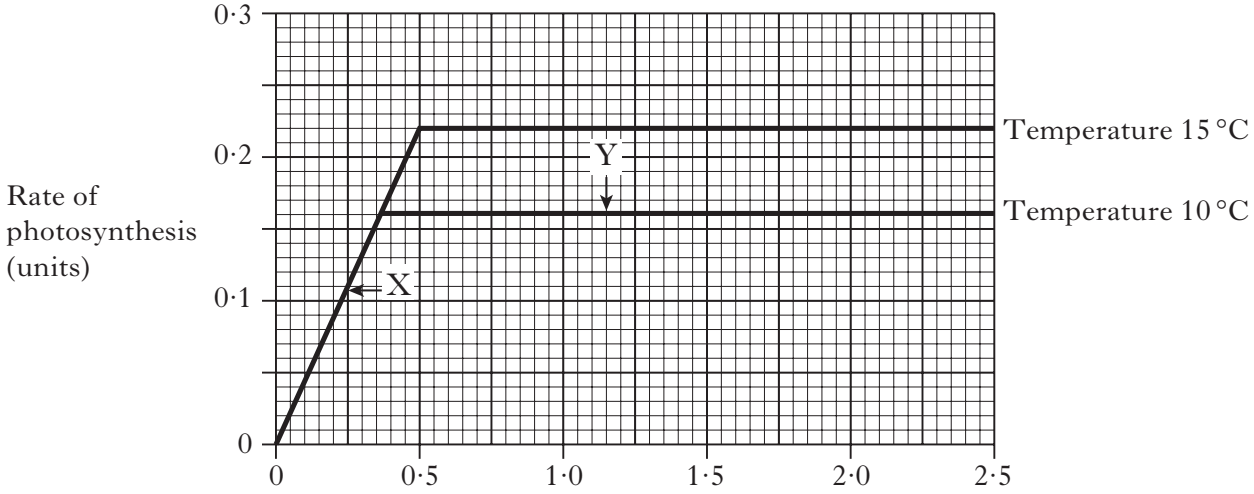
DO NOT WRITE IN THIS MARGIN

5. (continued)

Marks

KU | PS

(*c*) The following graph shows the effect of increasing carbon dioxide concentration on the rate of photosynthesis at two different temperatures. All other factors were kept constant.



From the evidence in the graph, what are the limiting factors at points X and Y?

X _____

Y _____ **1**

(*d*) Some carbon compounds found in plants are shown in the list below.

List

carbon dioxide
cellulose
glucose
starch

Complete the following table with the correct carbon compound for each of the functions.

Carbon compound	*Function*
	raw material for photosynthesis
	respiratory substrate
	storage carbohydrate

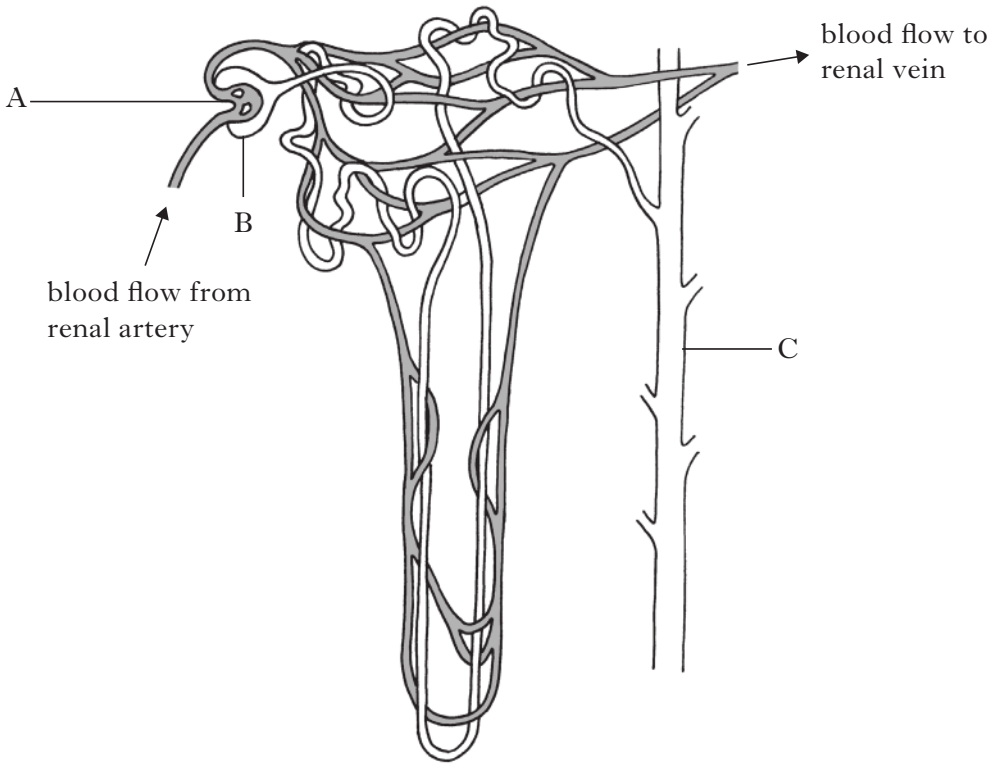
2

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

6. The diagram below represents part of a nephron from the human kidney.



(*a*) (i) Name structure A.

_____ **1**

(ii) Name the process that takes place between structures A and B.

_____ **1**

(iii) Urea is present in the liquid flowing through structure C.

1 Name **one** substance which is broken down to produce urea.

_____

2 In which organ is urea produced?

_____

3 How is urea transported to the kidneys?

_____ **2**

DO NOT WRITE IN THIS MARGIN

6. (continued) *Marks* KU PS

(*b*) The following table gives information about the concentrations of a variety of salts found in the liquids present in the nephron.

Location of liquid	*Concentration of salts* (g/100 ml)			
	sodium	*potassium*	*calcium*	*phosphate*
Structure B	0·300	0·020	0·010	0·003
Structure C	0·600	0·140	0·015	0·120

(i) How many times greater is the concentration of phosphate in C than in B?

Space for calculation

_____times **1**

(ii) The liquid in C eventually leaves the body as urine.

An adult male produced 2·5 litres of urine in 24 hours.

How much sodium was present in this urine?

Space for calculation

_____ g **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

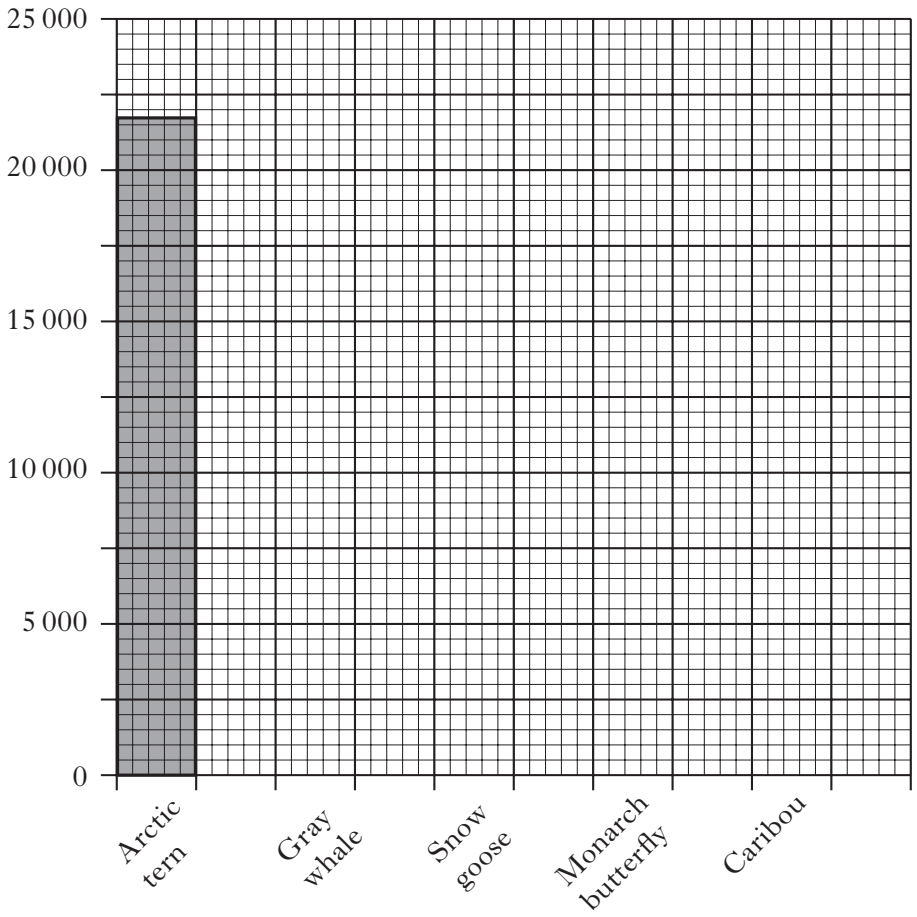
Marks | KU | PS

7. (*a*) The table below gives the total distances of the annual migration of various animals.

Animal	*Total distance of annual migration* (miles)
Arctic tern	21 750
Gray whale	12 500
Snow goose	4 500
Monarch butterfly	2 000
Caribou	750

(i) Use the information in the table to complete the bar chart below.

(An additional bar chart can be found, if required, on *Page twenty-seven*.)



2

DO NOT WRITE IN THIS MARGIN

7. (*a*) (continued)

Marks

KU	PS

(ii) Each year the Monarch butterfly migrates from North America to Mexico and back.

It flies at an average speed of 12·5 miles per hour.

Calculate how long it takes to fly the North America to Mexico stage of its migration.

Space for calculation

_____ hours **1**

(*b*) (i) Give **one** reason why animals migrate.

_____

_____ **1**

(ii) Migration is an example of a behaviour which is repeated at regular intervals.

What name is given to this type of behaviour?

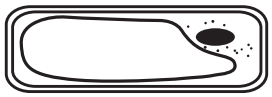
_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

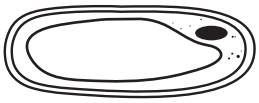
8. (*a*) The diagram below shows the appearance of a cell from an onion.



Pieces of onion were placed in three different solutions:

a 10% salt solution; a 2% salt solution and pure water.

The following diagrams show the appearance of the cells after 10 minutes.

solution X	solution Y	solution Z
		
cells swell	cells are unchanged	cell contents shrink

(i) Use the letters from the diagrams to identify the solutions.

One has been identified already.

10% salt solution _____

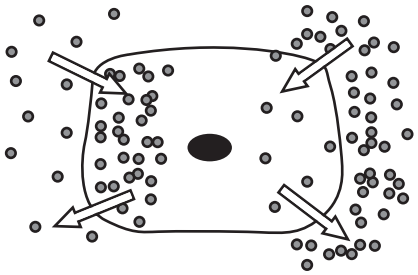
2% salt solution Y

pure water _____ **1**

(ii) Name the process by which water diffuses through a selectively permeable membrane.

_____ **1**

(*b*) The diagram below represents differences in the concentration of molecules inside and outside an animal cell, together with the direction of movement of the molecules.



Key

direction of movement

molecules

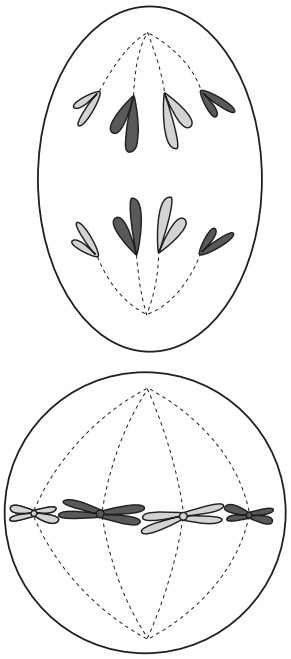
Circle the arrow on the diagram that would represent the diffusion of oxygen during respiration. **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

9. (*a*) The diagrams below show two stages of mitosis in cells.

Draw **one** straight line from each diagram to its correct description.



chromosomes shorten and thicken

chromosomes line up at the centre of the cell

chromatids are pulled to opposite ends of the cell

nuclear membrane reforms

2

(*b*) How does mitosis ensure that the daughter cells will be able to function properly?

_____

_____

1

10. Underline **one** option in each bracket to make the following sentences correct.

Bones are formed by { living cells / non-living material }. They are held together at joints.

Muscles { pull / push } on the bones through { tendons / ligaments } which are { elastic / inelastic }.

2

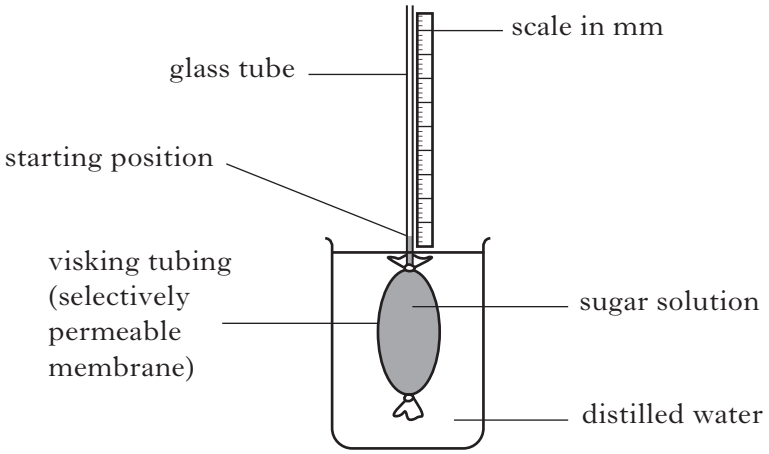
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

11. An investigation was carried out into the movement of water through a selectively permeable membrane.

The apparatus used is shown in the diagram below.



The method used in the investigation is outlined below.

- A visking tubing bag containing 50 cm^3 of 0·5% sugar solution was attached to the glass tube.
- The bag was lowered into the beaker of water.
- The starting position of the sugar solution was recorded on the scale.
- After one hour, the distance moved by the solution was recorded.
- The procedure was repeated with the same apparatus, using different concentrations of sugar solution.

The results are shown in the following table.

Concentration of sugar solution (%)	*Distance moved by sugar solution in 1 hour* (mm)
0·5	3
1·0	6
2·0	12
3·0	18
3·5	21

(*a*) Identify **one** variable, not already mentioned, that should be kept constant when carrying out the investigation.

_____ **1**

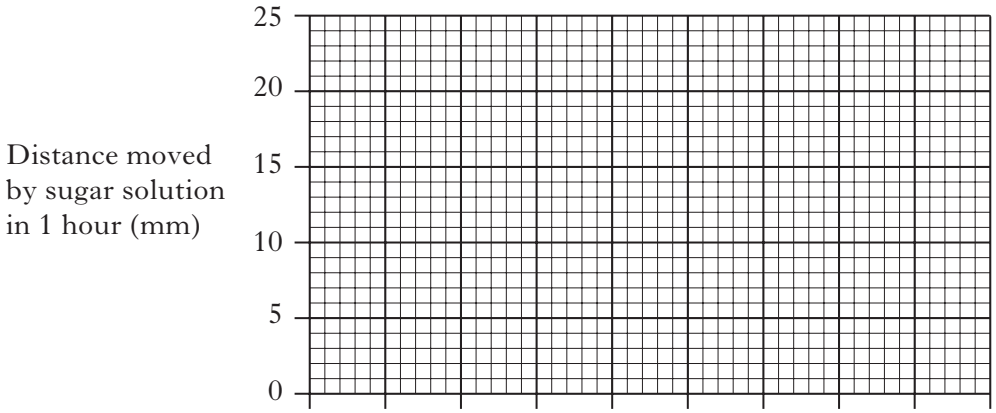
11. (continued)

Marks

KU	PS

(*b*) Use the results to plot a line graph on the grid below of distance moved by the sugar solution in one hour against the concentration of the sugar solution.

(An additional grid can be found, if required, on *Page twenty-eight*.)



2

(*c*) From the results, predict the distance moved by a 4% sugar solution in one hour and justify your prediction.

Prediction _____ mm

Justification _____

_____

1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

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

Soils

The type of soil in a particular area has a large effect on the plants growing in it. This affects the animals living there. Soil provides anchorage, nutrients and water for plants. Plant roots and other soil organisms need air to provide them with oxygen for respiration. A good soil will have plenty of air spaces.

Soil has six main constituents; mineral particles, humus, water, nutrient ions, air and living organisms. Soil is formed from rock. When rocks are weathered by wind, freezing and thawing, or by water flowing over them, they are broken down into small mineral particles. These particles are gradually colonised by lichens and mosses, and then by some flowering plants. As plants die and decay, their remains add organic materials to the mineral particles allowing other plants and animals to colonise the soil. Continued death and decay over thousands of years forms a good soil.

The size of the mineral particles in a soil is important. The smallest particles are called clay, while larger ones are called sand.

Clay soil particles pack tightly together. Clay soils do not drain well, but have the ability to retain nutrients for long periods. This stops nutrients from being washed out of the soil by rain water. In wet conditions, the spaces between the particles fill up with water so there is no room for air.

A sandy soil contains larger particles. These cannot pack very closely together, so there are large air spaces between them. As a result, sandy soils are well aerated and drain very quickly. Sand particles do not hold nutrients in the same way that clay particles do. So nutrients are washed out of a sandy soil more quickly.

Loam is a soil which contains a good mixture of sand and clay particles. If the balance is right, it will hold water and nutrient ions very well, but will not get waterlogged too easily.

(*a*) Name **three** ways in which soils provide good conditions for plant growth.

1 _____

2 _____

3 _____ **1**

DO NOT WRITE IN THIS MARGIN

12. (continued)

Marks | KU | PS

(*b*) Describe the process by which soil develops from small mineral particles into a good soil.

2

(*c*) The table below summarises features of three different types of soil.

Use words from the following list to complete the table.

Each word should be used **once** only.

List small high fast medium slow loam mixed low

Soil type	*Particle size*	*Drainage*	*Nutrient content*
Sandy	large		
Clay			
		medium	

2

(*d*) Give a reason why a good soil cannot be described as an abiotic factor.

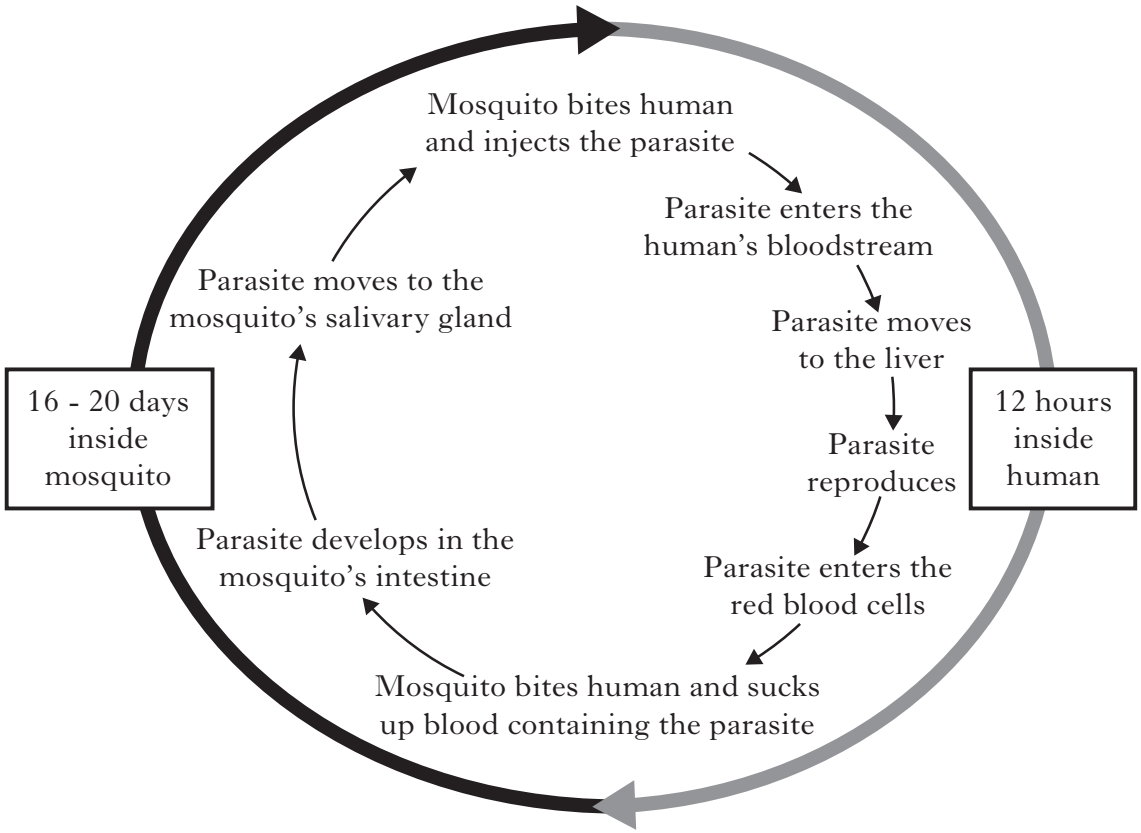
1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

13. The diagram below shows how the disease malaria is spread in humans. Malaria is caused by a micro-organism that lives as a parasite in the blood. It is spread from person to person by insects called mosquitoes.



(*a*) (i) What type of organism is the malaria parasite?

_____ **1**

(ii) How does the malaria parasite enter the blood of a human?

_____ **1**

(iii) In which part of the human body does the parasite reproduce?

_____ **1**

(iv) How long does it take the parasite to develop in the mosquito before it can affect a human?

_____ **1**

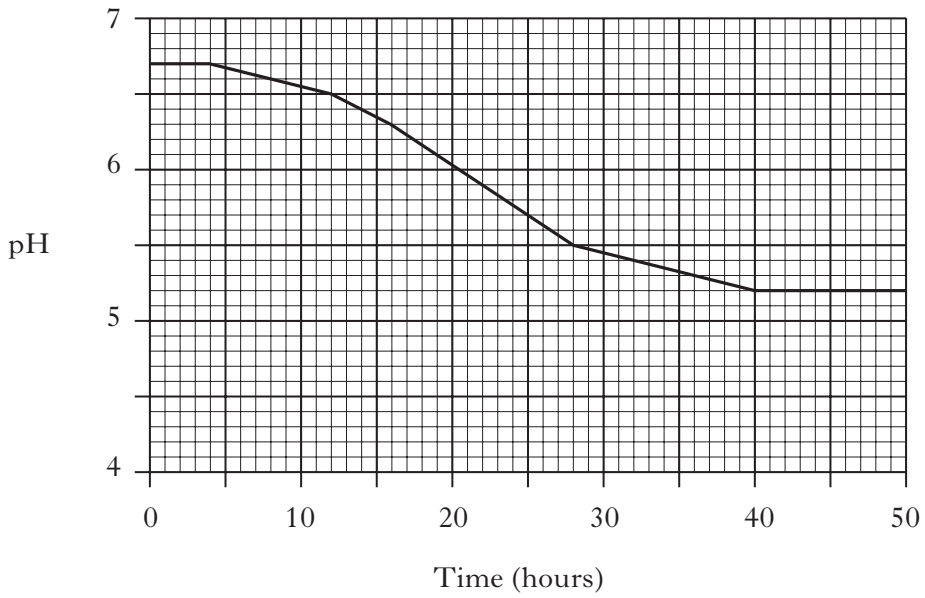
(*b*) What substance in red blood cells is responsible for the transport of oxygen?

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

14. As milk sours there is a change in pH. The following graph shows the pH changes in a sample of milk over 50 hours at a temperature of 20 °C.



(*a*) Calculate the average decrease in pH per hour.

Space for calculation

_____ pH units **1**

(*b*) Milk is considered to be too sour for human consumption when the pH is less than 6·4.

For how many hours would this sample have remained fit to drink?

_____ hours **1**

(*c*) The souring of milk is a fermentation process.

Name the substrate, product and the type of micro-organism involved.

Substrate _____

Product _____

Type of micro-organism _____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

15. (*a*) The table below shows the number of bacteria grown in a fermenter over a 24 hour period.

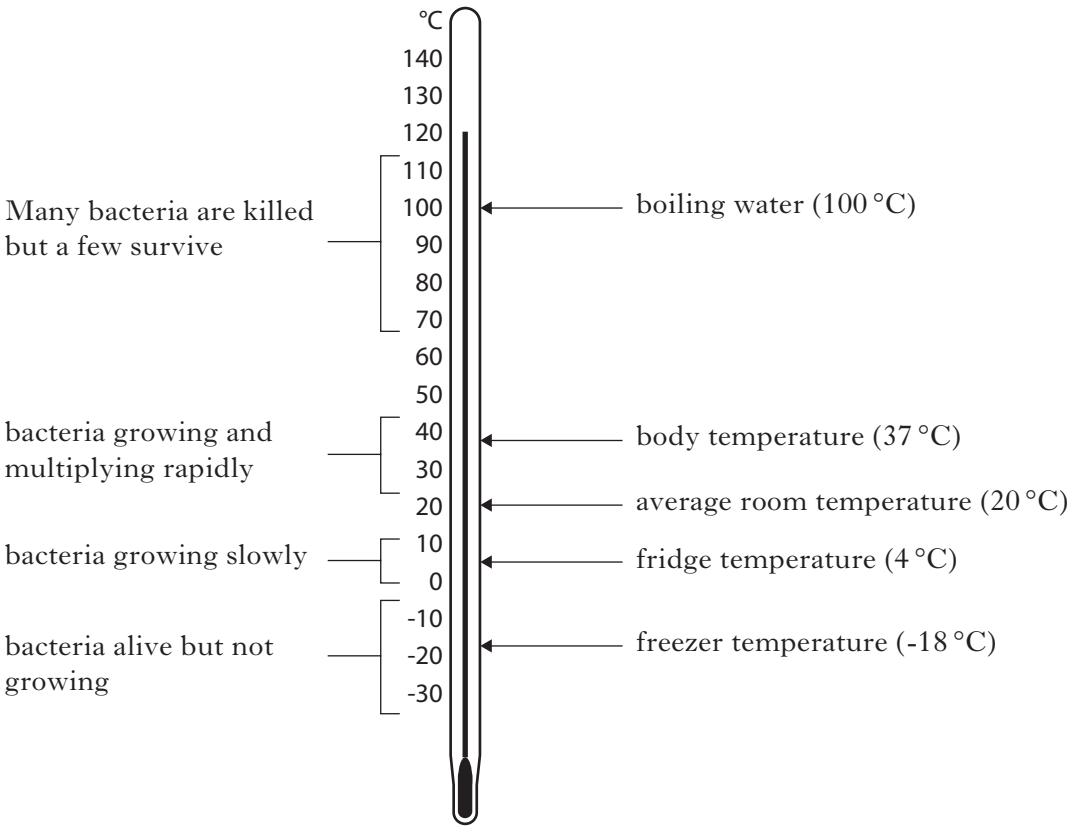
Time (hours)	*Number of bacteria* (billions/mm^3)
0	20
4	25
8	80
12	200
16	225
20	225
24	225

Describe the growth of the bacteria over the 24 hour period.

_____

_____ **2**

(*b*) The following diagram shows different temperatures and their effect on bacterial growth.



DO NOT WRITE IN THIS MARGIN

15. (*b*) (continued) *Marks* KU PS

(i) What would be a suitable temperature to provide optimum conditions for bacterial growth in a fermenter?

_____ °C **1**

(ii) Why should a fermenter be heated to 120 °C before it is set up?

_____ **1**

(iii) Explain why food should only be kept for a few days in a fridge.

_____

_____ **1**

(*c*) Micro-organisms can be grown on waste from food processing factories. They can then be harvested and used as animal feed.

Which important food component is present in increased quantities as a result of this upgrading of the waste?

_____ **1**

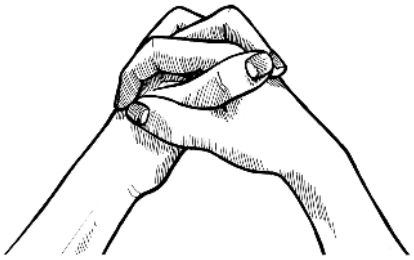
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

16. (*a*) The diagram below shows the two ways in which hands can be clasped together.

Left thumb on top



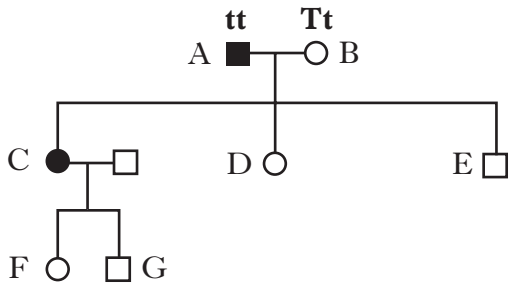
Right thumb on top

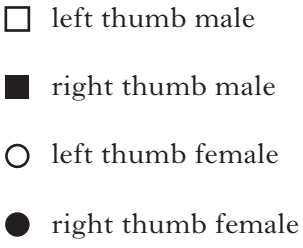
(i) This behaviour is thought to be influenced by a single gene with two forms. What term refers to the two forms of a single gene?

_____ **1**

(ii) The diagram below shows whether members of a family clasp their hands with the right or left thumb on top.

T represents the left thumb form of the gene.
t represents the right thumb form of the gene.





What information from parent B proves that the left thumb on top is the dominant form of the gene?

_____

_____ **1**

(iii) Use the information in the diagram to complete the following table.

Person	*Genotype*
C	
E	
F	

2

DO NOT WRITE IN THIS MARGIN

16. (*a*) (continued)

Marks

KU | PS

(iv) If person D has a child with a man with the same genotype, what is the chance of their first child clasping their hands with the left thumb on top?

Space for working

_____

1

(v) When 1000 people were surveyed, 625 people were found to clasp their hands with the left thumb on top.

What is the simple whole number ratio of left to right thumb people?

Space for calculation

_____ : _____

left thumb : right thumb **1**

(*b*) The following table shows the stages of a selective breeding programme to produce sheep with soft wool. The stages are not in the correct order.

Stage	*Description*
A	The selected sheep are mated.
B	Lambs are born.
C	Sheep with soft wool are selected.
D	The best young female sheep are used to breed more sheep.
E	Sheep are checked to see which have the softest wool.

Put the stages into the correct order by completing the boxes below. The first and last stages have been completed for you.

Order	1st	2nd	3rd	4th	5th
Stage	C				D

1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

17. (*a*) Biological washing powders contain enzymes. Explain how these enzymes work to remove stains.

_____

_____

_____ **2**

(*b*) In an investigation, identical pieces of cloth with identical stains were placed in solutions of biological or non-biological washing powders. They were left for one hour and the cloths were then examined. This was repeated at different temperatures and the results are shown in the table below.

Type of washing powder	*Appearance of cloth after soaking for 1 hour*		
	40 °C	60 °C	90 °C
Biological washing powder	clean	clean	clean
Non-biological washing powder	stained	clean	clean

(i) Name **two** variables, not already mentioned, which would need to be kept the same to ensure the investigation was valid.

1 _____

2 _____ **1**

(ii) What steps should be taken to reduce the effect of any unusual results.

_____ **1**

(iii) Describe **one** advantage of using biological washing powders.

_____ **1**

(*c*) Biological washing powders contain different enzymes.

Explain why this is necessary.

_____

_____ **1**

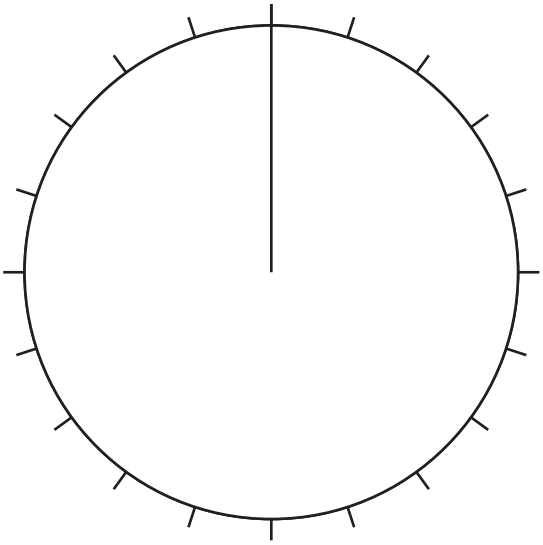
[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

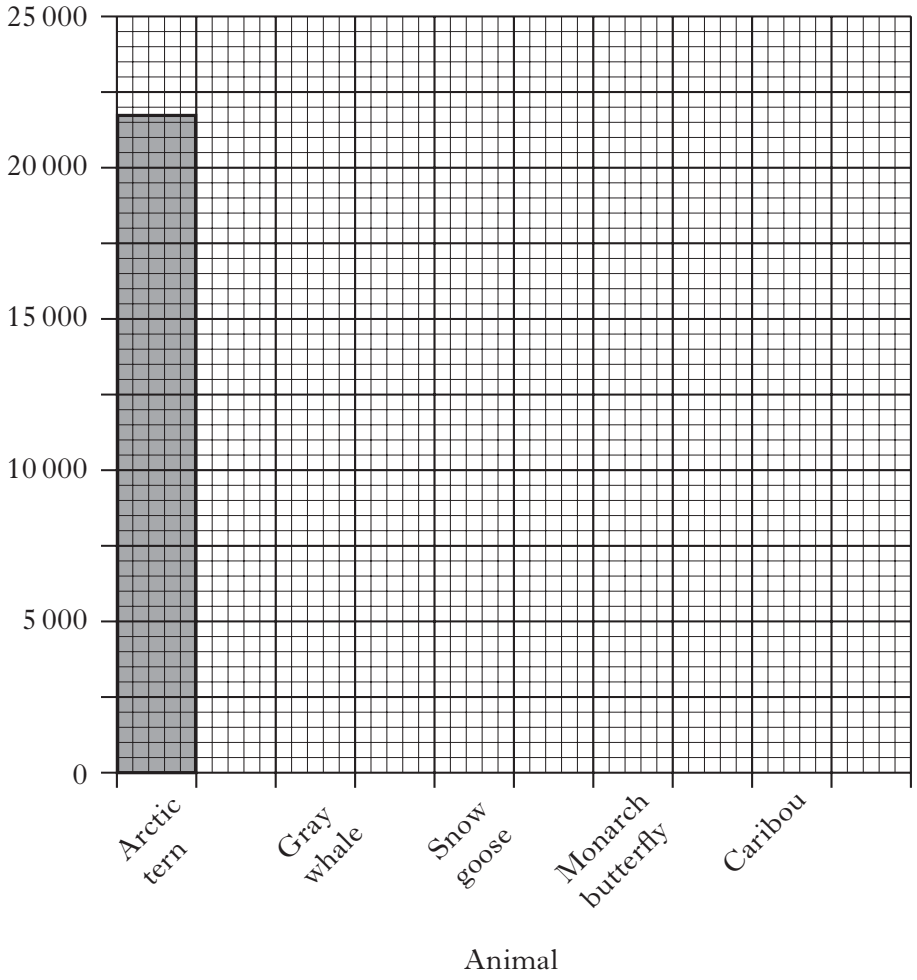
KU	PS

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

ADDITIONAL PIE CHART FOR QUESTION 1(*b*)



ADDITIONAL BAR CHART FOR QUESTION 7(*a*)(i)

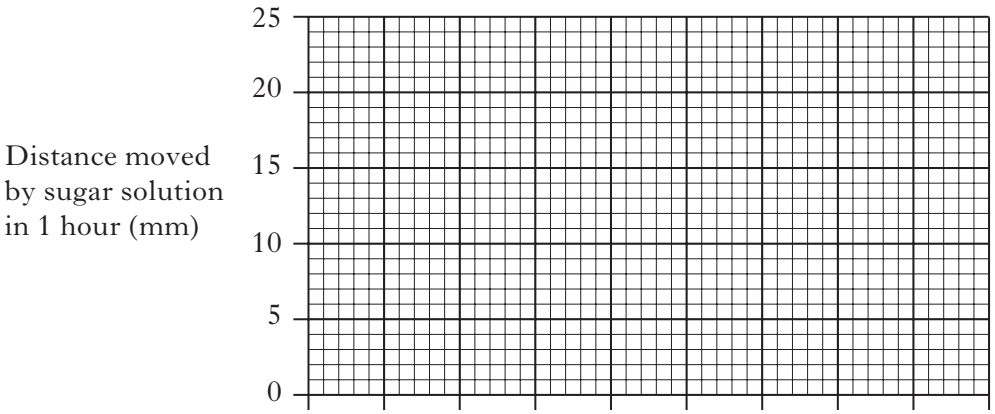


DO NOT WRITE IN THIS MARGIN

KU	PS

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

ADDITIONAL GRAPH FOR QUESTION 11(*b*)



DO NOT WRITE IN THIS MARGIN

KU	PS

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

DO NOT WRITE IN THIS MARGIN

KU	PS

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

[BLANK PAGE]

[BLANK PAGE]