FOR OFFICIAL USE

C

KU	PS

Total Marks

0300/402

NATIONAL QUALIFICATIONS 2008

TUESDAY, 27 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.

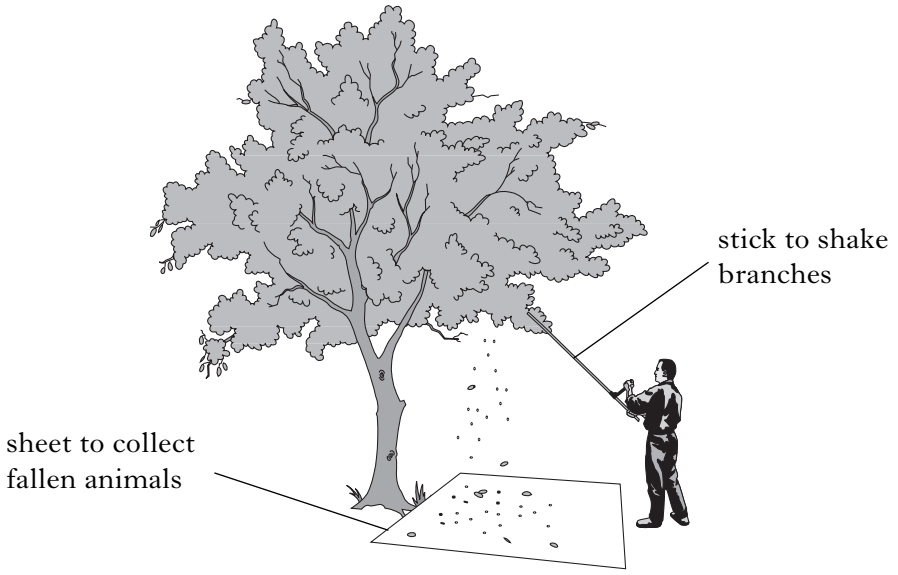
4 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

1. (*a*) A comparison was made between the types of invertebrate animals living on the branches and leaves on an oak tree with those living on a beech tree.

Samples were collected as shown below.



(i) Give **two** variables which should be kept constant to make the comparison valid when using this technique.

1 _____

2 _____ **1**

(ii) The samples collected were not representative of all the invertebrates living on the trees. Suggest a reason for this.

_____ **1**

(iii) Measurement of abiotic factors such as light intensity may be recorded at the same time as sampling. Identify a possible source of error for a **named** measurement technique and explain how it might be minimised.

Measurement technique _____

Source of error _____

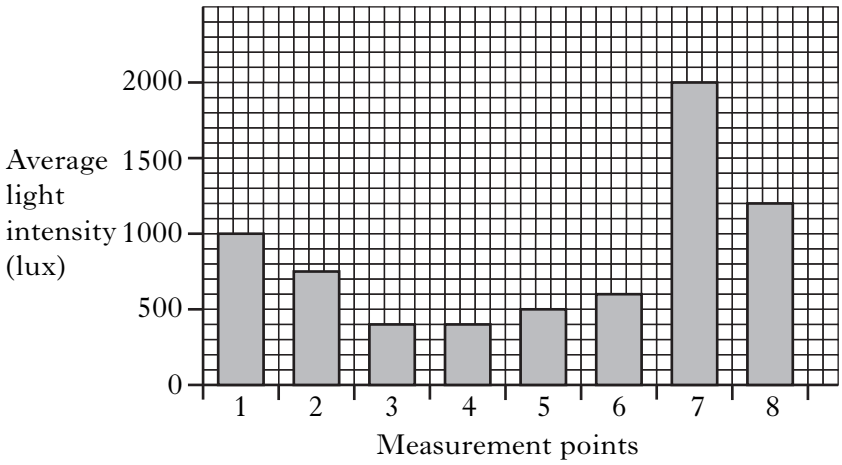
How to minimise it _____

_____ **1**

1. (continued)

(*b*) An investigation was carried out into the effect of light intensity on the distribution of a plant species. At eight different measurement points in a garden, the average light intensity was measured and the percentage ground cover of the plant was recorded.

The results are shown below.



Measurement points	*Ground cover of the plant* (%)
1	85
2	65
3	20
4	20
5	30
6	35
7	100
8	90

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

(i) 1 What is the light intensity in the garden where the ground cover of the plant was 100%?

_____ lux **1**

2 What was the percentage ground cover of the plant when the light intensity was 750 lux?

_____ % **1**

(ii) What is the relationship between light intensity and percentage ground cover of the plant?

1

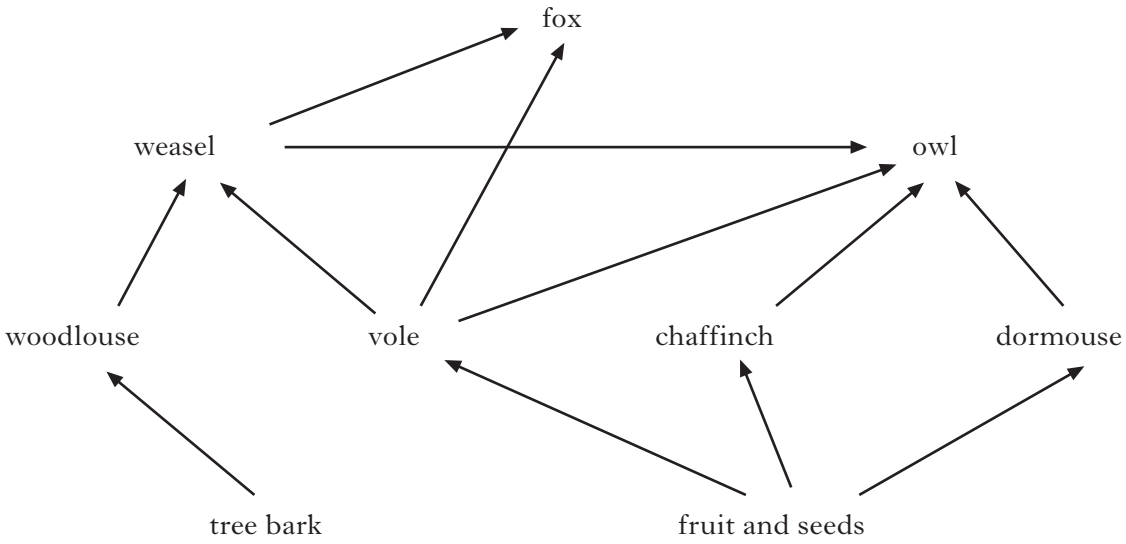
(*c*) Explain how light intensity affects the distribution of the plants in the garden.

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

2. (*a*) The diagram shows part of a food web from a forest.



(i) The numbers of dormice and owls may be affected if the chaffinches were removed from the food web.

1 Underline **one** answer in the brackets and give an explanation.

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

Explanation _____

1

2 Underline **one** answer in the brackets and give an explanation.

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

Explanation _____

1

(ii) Select a food chain from the web which is made up of four stages.

. → . → . → .

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

2. (continued)

(*b*) A food chain from the ocean is shown below.

plankton → krill → blue whale

Which population in the food chain has the smallest biomass?

1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

3. (*a*) The grid contains the names of some components of food.

carbon A	hydrogen B	amino acids C
nitrogen D	simple sugar E	glycerol F
fatty acids G	oxygen H	water I

Use letters from the grid to identify the following:

(i) The sub-units of protein molecules _____ **1**

(ii) The sub-units of fat molecules _____ and _____ **1**

(iii) An element found in protein but not in starch _____ **1**

(*b*) Name the structures in the small intestine which provide an increased surface area for absorption.

_____ **1**

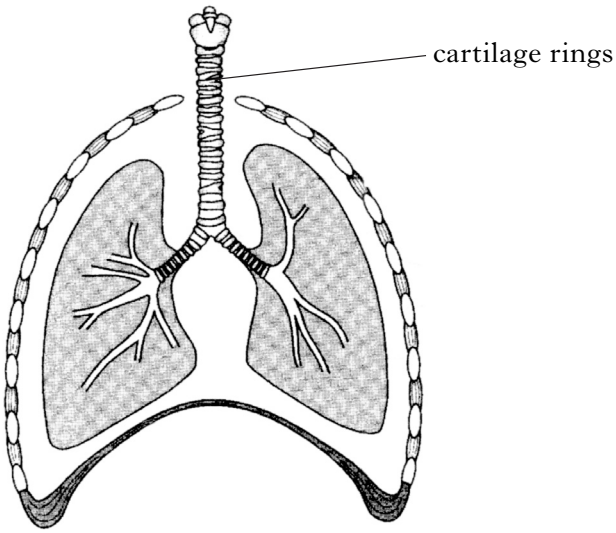
(*c*) Urea is produced in the liver from the breakdown of digested food molecules. From which food molecules is urea produced?

_____ **1**

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

4. (*a*) The diagram shows part of the human breathing system.



Describe the function of the cartilage rings.

1

(*b*) (i) Name the sticky substance that traps inhaled dust particles.

1

(ii) Explain how the trapped particles are removed from the breathing system.

1

(*c*) As blood passes through capillary networks in the lungs, oxygen and carbon dioxide are exchanged between the blood and the air sacs.

(i) Describe **one** feature of a capillary network which allows efficient gas exchange.

1

(ii) Name the structures in blood that contain haemoglobin.

1

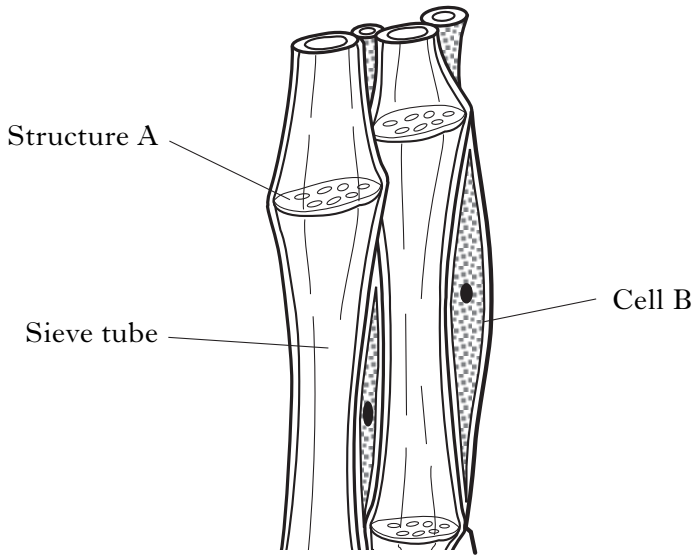
(iii) Explain the function of haemoglobin in the transport of oxygen.

1

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

5. (*a*) The diagram represents phloem tissue from the stem of a plant.



(i) Name Structure A and Cell B.

Structure A

Cell B

2

(ii) State the function of phloem.

1

(*b*) (i) Name the leaf tissue where stomata are found.

1

(ii) Name the cells which control the opening and closing of stomata.

1

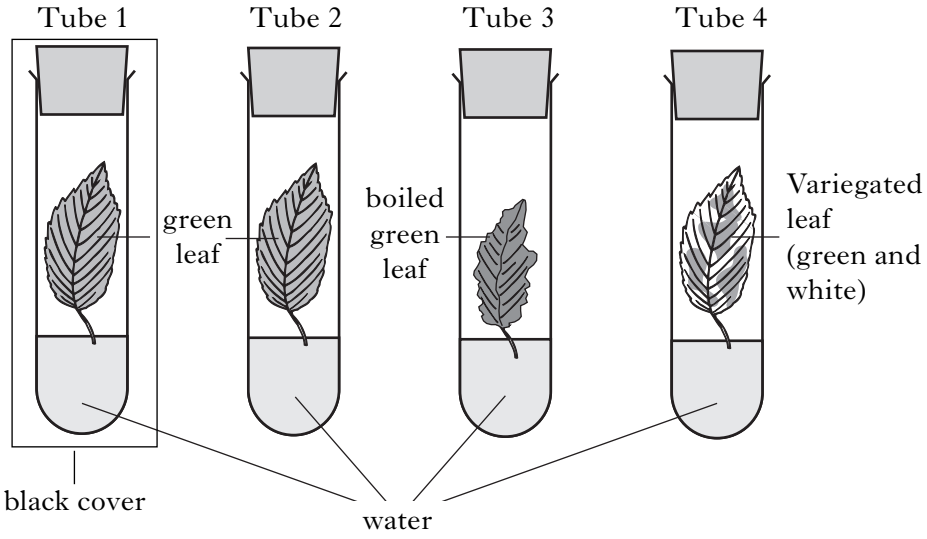
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

5. (continued)

(*c*) Leaves were placed in tubes as shown below.

The tubes were left in bright light.



For each of the tubes, tick (✓) the appropriate box in the table to indicate which processes will take place in the leaves.

Process / *Tube*	*Only photosynthesis*	*Only respiration*	*Both*	*Neither*
1	☐	☐	☐	☐
2	☐	☐	☐	☐
3	☐	☐	☐	☐
4	☐	☐	☐	☐

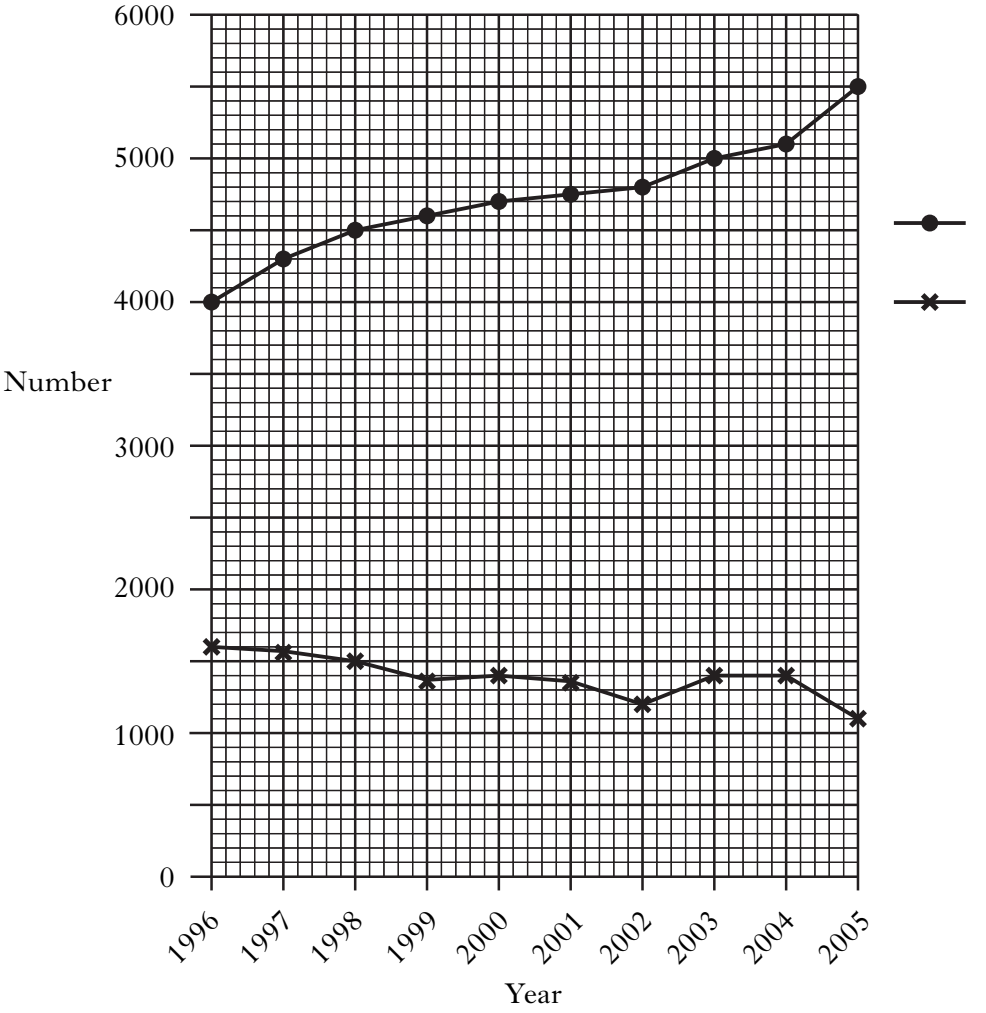
2

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

6. (*a*) The graph shows the number of kidney transplants carried out and the number of patients waiting for a transplant in the UK between 1996 and 2005.



(i) Calculate the average yearly increase in the number of patients waiting for a transplant from 2000 to 2005.

Space for calculation.

Average yearly increase ____ patients per year. **1**

6. (*a*) (continued)

Marks | KU | PS

(ii) Calculate the simple whole number ratios of patients waiting for a transplant to the number of kidney transplants carried out for 1996 and for 2005.

Space for calculation.

1996 ____ : ____

2005 ____ : ____ **1**

patients waiting for a transplant : transplants carried out

(iii) The following statements refer to the data in the graph.

Tick (✓) the box(es) of the correct statement(s).

The number of patients waiting for a transplant increased every year. ☐

The number of transplants carried out decreased every year. ☐

The difference between the number of patients waiting for a transplant and the number of transplants carried out increased every year. ☐ **1**

(*b*) Give **one** advantage and **one** disadvantage of treating kidney failure by transplant compared to treatment using a dialysis (kidney) machine.

Advantage _____

1

Disadvantage _____

1

[Turn over

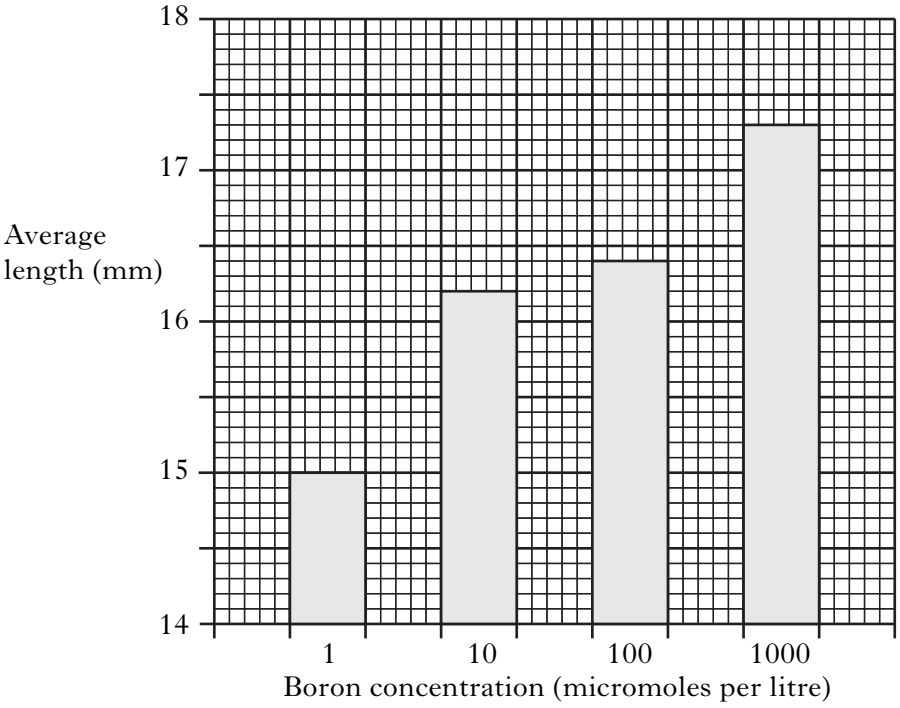
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

7. An investigation was carried out into the effect of the mineral boron on the growth of young trout.

Immediately after fertilisation, trout eggs were placed in distilled water containing different concentrates of boron.

After hatching, young trout survive on food from their yolk sac for a maximum of four weeks. The graph below shows the average lengths of the young trout three weeks after hatching.



(*a*) Describe the relationship between boron concentration and the length of the young trout.

1

(*b*) Calculate the percentage change in the average fish length when the boron concentration is increased from 1 micromole per litre to 10 micromoles per litre.

Space for calculation.

% **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

7. (continued)

(*c*) Distilled water is the purest form of water available. Give a reason for using distilled water in this investigation.

1

(*d*) Explain why the results would not be valid if the fish were measured more than four weeks after hatching.

1

[Turn over

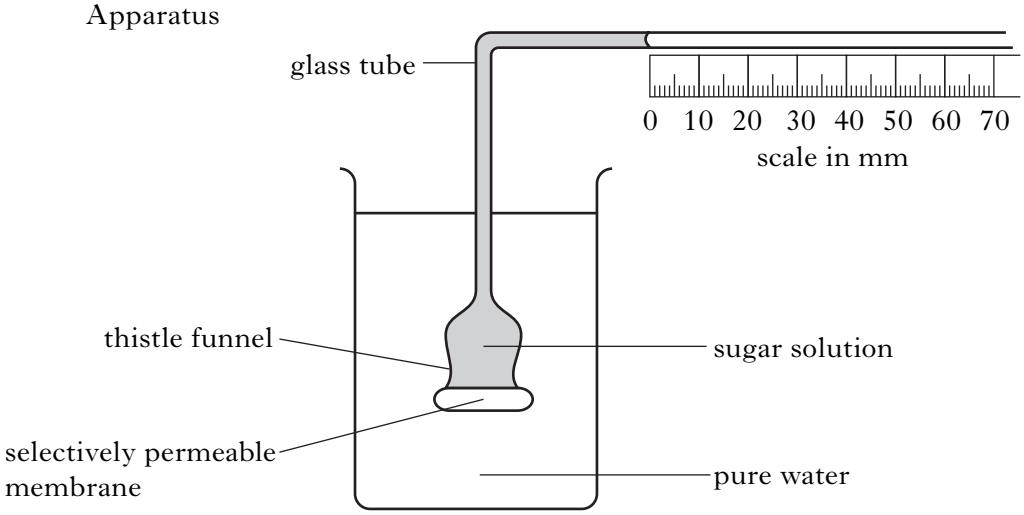
DO NOT WRITE IN THIS MARGIN

KU	PS

8. An investigation was carried out into the effect of water concentration on the rate of osmosis.

Details of the apparatus, method used and results are given below.

Apparatus



Method

1 A thistle funnel containing 50 cm^3 of 0·5% sugar solution was covered with selectively permeable membrane.
2 The funnel was placed in a beaker of pure water.
3 The scale was positioned with the sugar solution at zero on the scale.
4 The position of the sugar solution was recorded after 30 minutes.
5 The procedure was repeated using 1·0%, 2·0% and 3·0% sugar solutions.

Results

Concentration of sugar solution (%)	*Distance moved by sugar solution in 30 minutes* (mm)
0·5	4·5
1·0	9·0
2·0	18·0
3·0	27·0

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

8. (continued)

(*a*) Identify **two** variables not already mentioned that should be kept constant when setting up the investigation.

1

2

2

(*b*) Explain the movement of the sugar solution in terms of water concentrations.

1

(*c*) From the results, predict the distance moved by a 3·5% sugar solution in 30 minutes and justify your prediction.

Prediction _____ mm **1**

Justification _____

1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

9. (*a*) The diagram below contains some of the stages of cell division by mitosis.

Describe **Stages 2** and **5** in the spaces provided.

Stage 1

Chromosomes become visible as pairs of identical chromatids.

↓

Stage 2

1

↓

Stage 3

The spindle fibres contract pulling the chromatids of each chromosome to opposite poles of the cell.

↓

Stage 4

A nuclear membrane forms around each nucleus.

↓

Stage 5

1

(*b*) Mitosis ensures that all daughter cells in a multicellular organism have the same number and type of chromosomes.

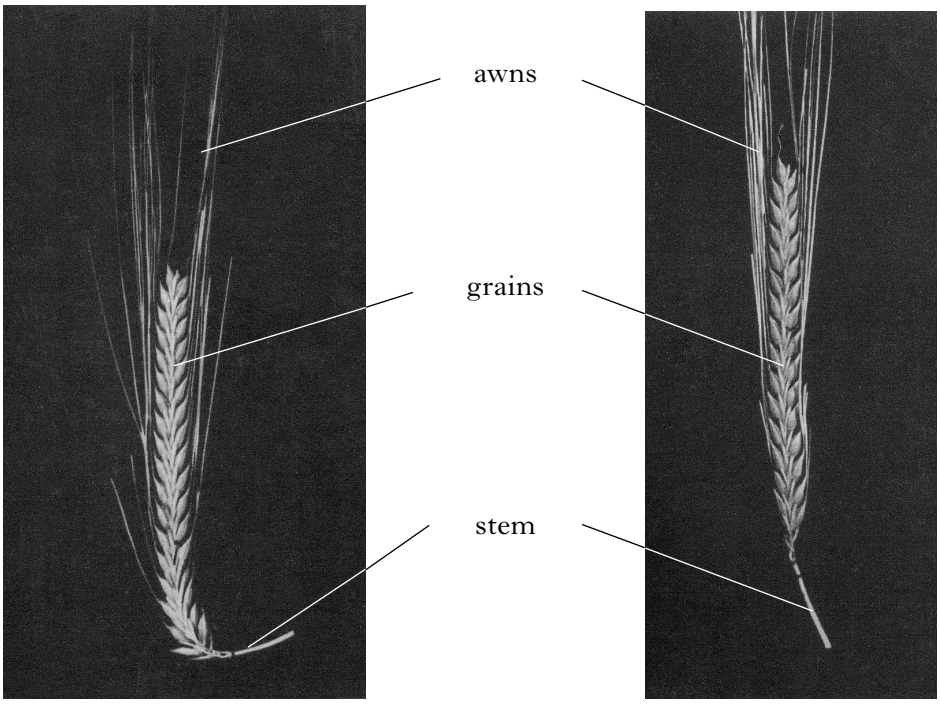
Explain why this is necessary.

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

10. (*a*) Barley is a plant grown for use in the brewing industry. The photographs below show two varieties of barley that have been produced by selective breeding.



Proctor barley Rika barley

Describe **one** difference between these two varieties of barley.

1

(*b*) (i) Explain why barley must be malted before use in the brewing process.

1

(ii) Describe how brewers ensure that the yeast carries out fermentation on the sugars extracted from the malted barley.

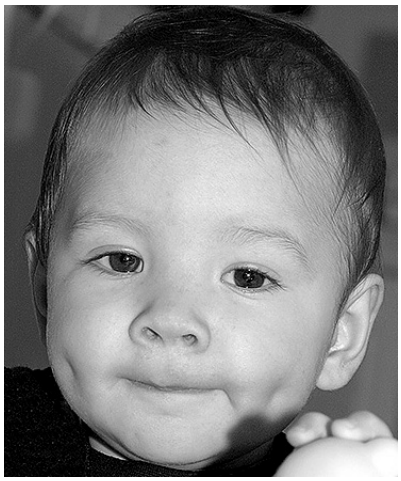
1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

11. (*a*) The photograph shows a child with dimples. Dimples are small indentations in the cheeks. Their presence is controlled by a single gene which has two forms. The dominant form (**D**) gives dimples. The recessive form (**d**) gives no dimples.



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

1

(ii) The parents of the child are known to have the following genotypes.

DD × dd

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

The parents have {the same / different} phenotypes and

{the same / different} genotypes.

1

(iii) What is the genotype of this child?

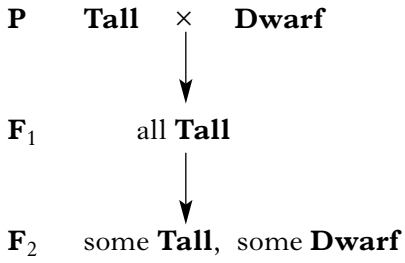
1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

11. (continued)

(*b*) The diagram shows a cross between tall and dwarf pea plants.



(i) What would be the predicted ratio of **Tall** to **Dwarf** plants in the $\mathbf{F_2}$ generation?

_____ : _____
Tall **Dwarf**

1

(ii) The observed ratio of **Tall : Dwarf** plants was different from the expected ratio.

Give an explanation for this difference.

1

(iii) Identify the true-breeding plants from the above cross.

Tick (✓) the box(es) of the correct plant(s).

Tall P ☐

Dwarf P ☐

Tall $\mathbf{F_1}$ ☐

1

[Turn over

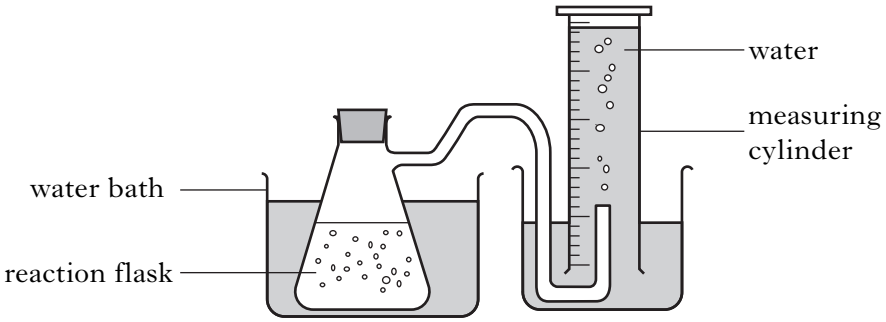
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

12. An investigation was carried out into the effect of temperature on the rate of respiration by yeast.

Details of the apparatus, method used and results are given below.

Apparatus



Method

1 Water baths were set up over a range of temperatures.
2 100 cm^3 of glucose solution and 50 cm^3 of yeast suspension were allowed to reach the same temperature as the water bath.
3 The glucose solution and the yeast suspension were mixed in the reaction flask.
4 After 1 hour, the volume of gas in the measuring cylinder was measured.

Results

Temperature (°C)	10	20	30	40	50
Volume of gas produced in 1 hour (cm^3)	9	18	36	48	5

(*a*) Ethanol was formed in the reaction flask.

What cell process produced this?

1

(*b*) Describe the relationship between the temperature and the volume of gas produced in one hour.

2

DO NOT WRITE IN THIS MARGIN

12. (continued)

Marks | KU | PS

(*c*) Predict the volume of gas which would be collected in one hour if the investigation was repeated at 60 °C. Give an explanation for your answer.

Prediction _____ cm^3 **1**

Explanation _____

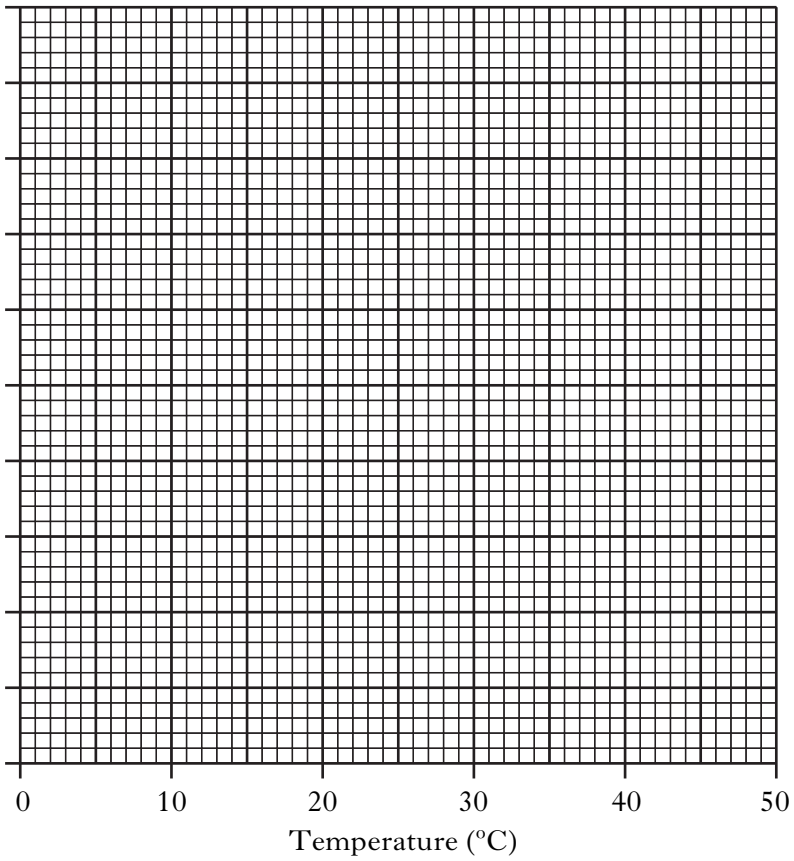
_____ **1**

(*d*) Describe the control flasks that would be set up to show that the gas was produced due to activity of the yeast and to no other factor.

_____ **2**

(*e*) Use the results to complete a line graph to show the volumes of gas produced in one hour over the range of temperatures.

(An additional grid, if needed, will be found on page 27.)



2

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

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

Adapted from ***GM Organisms*** by John Pickrell, www.newscientist.com

Genetic modification (GM) of crops began with the discovery that the soil bacterium *Agrobacterium* could be used to transfer useful genes from unrelated species into plants. The Bt gene is one of the most commonly inserted. It produces a pesticide toxin that is harmless to humans but is capable of killing insect pests. Many new crop types have been produced. Most of these are modified to be pest, disease or weedkiller resistant, and include wheat, maize, oilseed rape, potatoes, peanuts, tomatoes, peas, sweet peppers, lettuce and onions.

Supporters argue that drought resistant or salt resistant varieties can flourish in poor conditions. Insect-repelling crops protect the environment by minimising pesticide use. Golden rice with extra vitamin A or protein-enhanced potatoes can improve nutrition.

Critics fear that GM foods could have unforeseen effects. Toxic proteins might be produced or antibiotic-resistance genes may be transferred to human gut bacteria. Modified crops could become weedkiller resistant "superweeds". Modified crops could also accidentally breed with wild plants or other crops. This could be serious if, for example, the crops which had been modified to produce medicines bred with food crops.

Investigations have shown that accidental gene transfer does occur. One study showed that modified pollen from GM plants was carried by the wind for tens of kilometres. Another study proved that genes have spread from the USA to Mexico.

(*a*) What role does the bacterium *Agrobacterium* play in the genetic modification of crops?

1

(*b*) Crops can be genetically modified to make them resistant to pests, diseases and weedkillers. Give another example of genetic modification that has been applied to potatoes.

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

13. (continued)

(*c*) Explain why a plant, which is modified to be weedkiller resistant could be:

(i) useful to farmers.

1

(ii) a problem for farmers.

1

(*d*) Give **one** example of a potential threat to health by the use of GM crops.

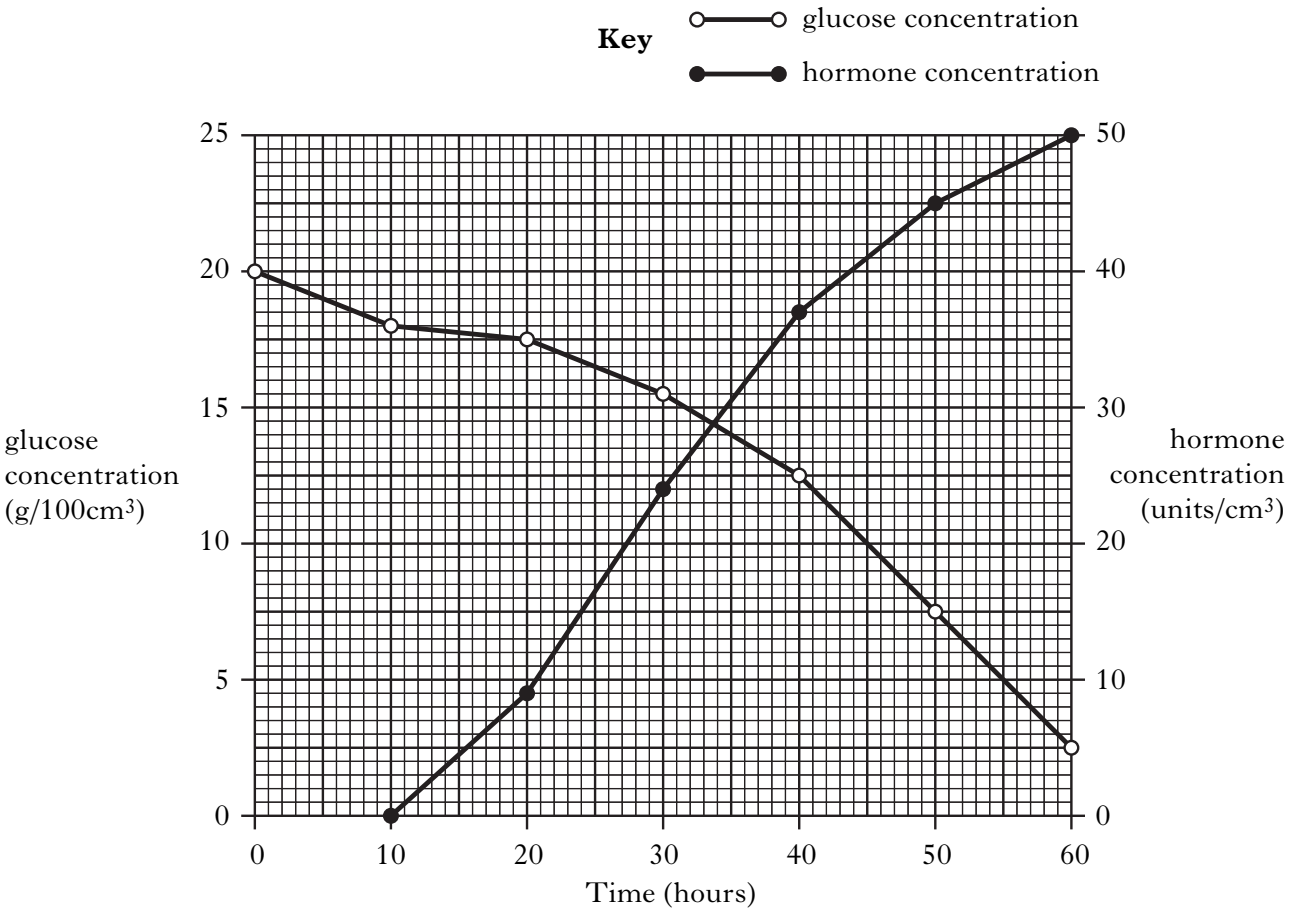
1

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

14. (*a*) In a commercial process, a bacterial species is provided with glucose and produces a hormone. The bacteria release the hormone into surrounding liquid. The graph shows changes in the glucose concentration and the hormone concentration during a 60 hour period.



(i) How many hours did it take for 50% of the glucose to be used up by the bacteria?

_____ hours **1**

(ii) During which 10 hour period was secretion of hormone the greatest?

Tick (✓) the correct box.

☐ 20 – 30 hours

☐ 30 – 40 hours

☐ 40 – 50 hours

☐ 50 – 60 hours **1**

DO NOT WRITE IN THIS MARGIN

	Marks	KU	PS

14. (*a*) (continued)

(iii) Calculate the decrease in glucose concentration over the 60 hour period.

Space for calculation.

g/100 cm^3 **1**

(iv) If glucose continues to be used at the same rate as between 50 and 60 hours, predict how many more hours it would be before all the glucose would be used up.

Space for calculation.

hours **1**

(v) During the first 10 hours of the process, energy was being used for functions other than the synthesis of the hormone.

Give **two** pieces of evidence from the graph to support this statement.

1

2 **1**

(*b*) Glucose is a carbohydrate component of food. Which food component contains most energy per gram?

1

[Turn over for Question 15 on *Page twenty-six*

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

15. (*a*) In a sewage works, micro-organisms cause the decay of the sewage. What is the benefit to the micro-organisms in carrying out this process?

1

(*b*) What type of respiration must be carried out by the micro-organisms to ensure complete breakdown of the sewage?

1

(*c*) Sewage contains a wide range of materials. What ensures that all these materials are broken down?

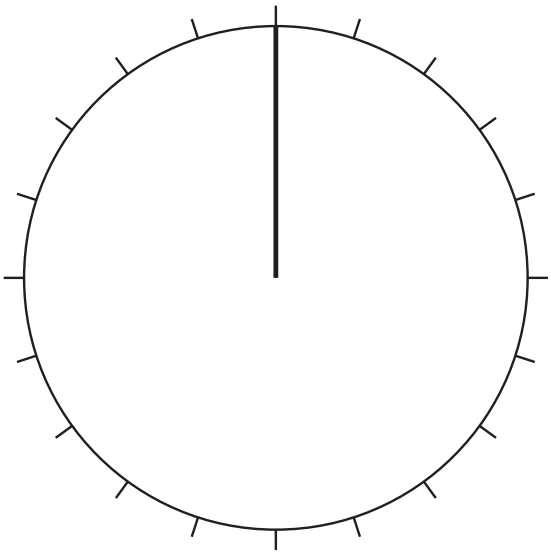
1

(*d*) The table shows the methods of disposal of the sludge obtained from sewage treatment.

Method of disposal of sludge	*Percentage*
Spread on farmland	50
Landfill	10
Dumped at sea	15
Incinerated	20
Other disposal	5

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

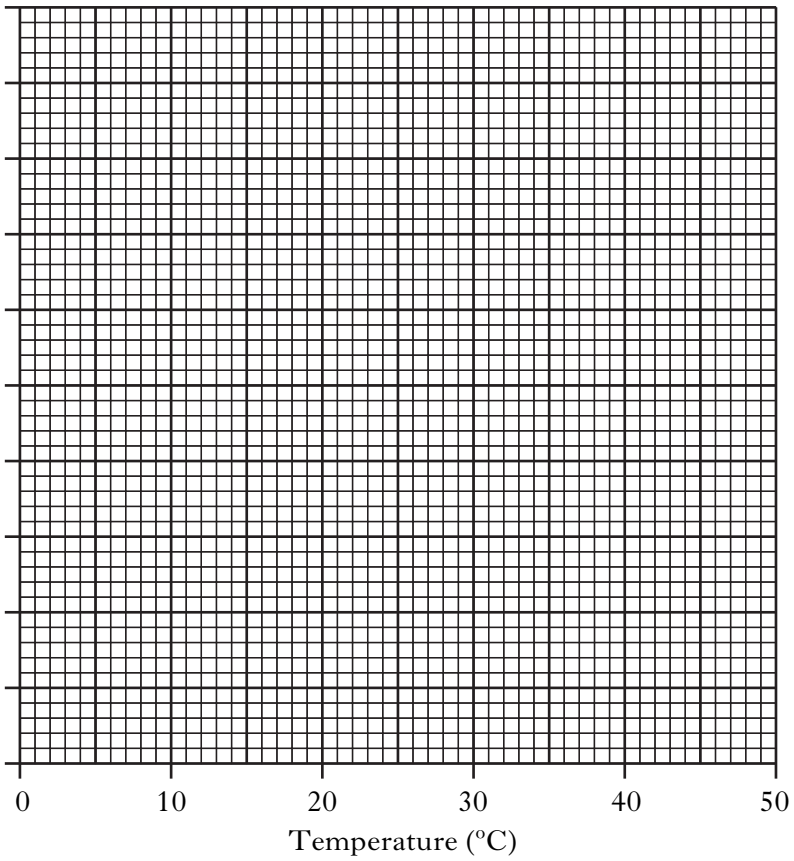
(An additional chart, if needed, will be found on page 27.)



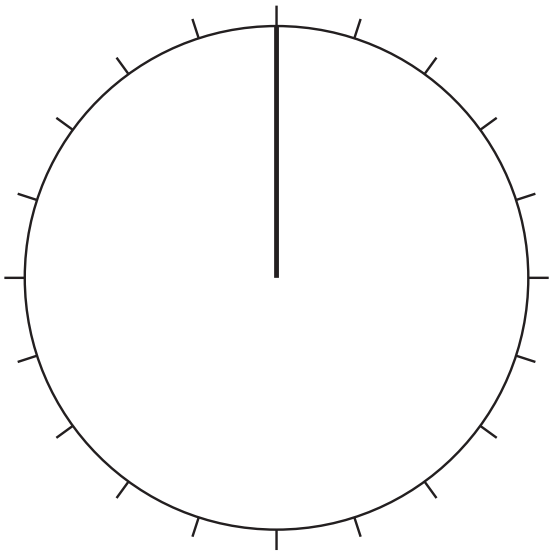
2

[*END OF QUESTION PAPER*]

ADDITIONAL GRAPH PAPER FOR QUESTION 12(*e*)



ADDITIONAL PIE CHART FOR QUESTION 15(*d*)



SPACE FOR ANSWERS
AND FOR ROUGH WORKING