FOR OFFICIAL USE

C

KU PS

Total Marks

0300/402

NATIONAL QUALIFICATIONS 2003

MONDAY, 26 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.

LIB 0300/402 6/3/27170

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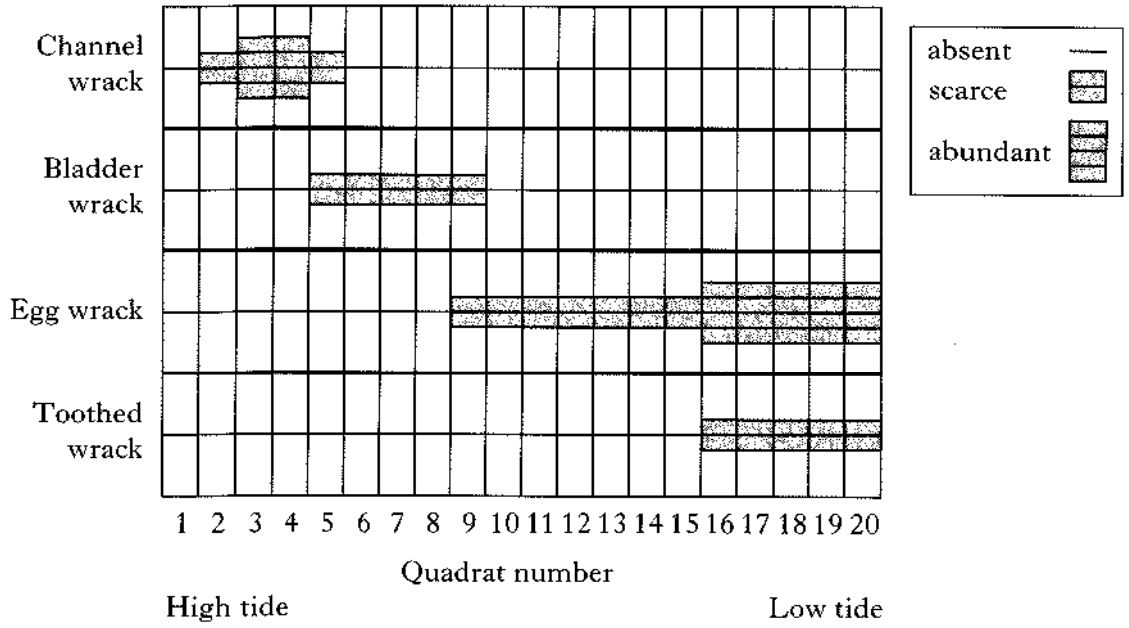
Marks | KU | PS

1. The diagram shows the results of a survey of seaweeds on a rocky Scottish shore. Starting at the highest tide level, square quadrats were placed every 5 metres in a line down the shore. Four species of seaweed were rated as absent, scarce or abundant in each quadrat.



(*a*) (i) How many species of seaweed were found in quadrat number 9?

_____ **1**

(ii) How many of the quadrats contained more than one species of seaweed?

_____ **1**

(iii) Which species of seaweed spends least time covered by water?

_____ **1**

(iv) What percentage of all the quadrats included egg wrack?

Space for calculation

_____% **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

1. (continued)

(*b*) Suggest **one** abiotic factor that might affect the distribution of the seaweed species on the shore.

_____ **1**

(*c*) Suggest **one** possible source of error in the sampling procedure and explain how it might be minimised.

Source of error _____

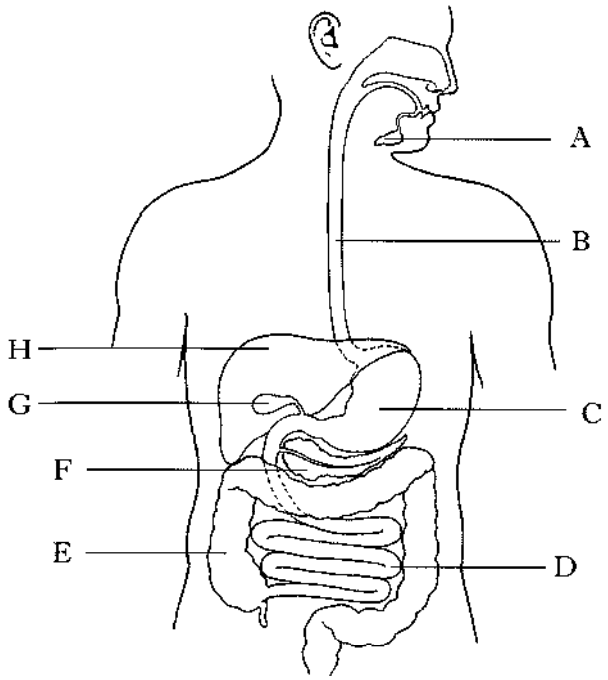
How to minimise it _____ **2**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

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



(*a*) Use letters from the diagram to answer the following.

(i) Where is saliva produced? _____ **1**

(ii) Where is bile produced? _____ **1**

(*b*) Name an enzyme responsible for:

(i) the breakdown of fat. _____ **1**

(ii) the breakdown of protein. _____ **1**

(*c*) Explain how contraction of muscles in the stomach wall speeds up digestion.

_____ **1**

(*d*) The following statements refer to the process of peristalsis.

Tick the boxes of ***two*** *correct statements.*

Muscles in front of the food contract. ☐

Muscles in front of the food relax. ☐

Muscles behind the food contract. ☐

Muscles behind the food relax. ☐ **1**

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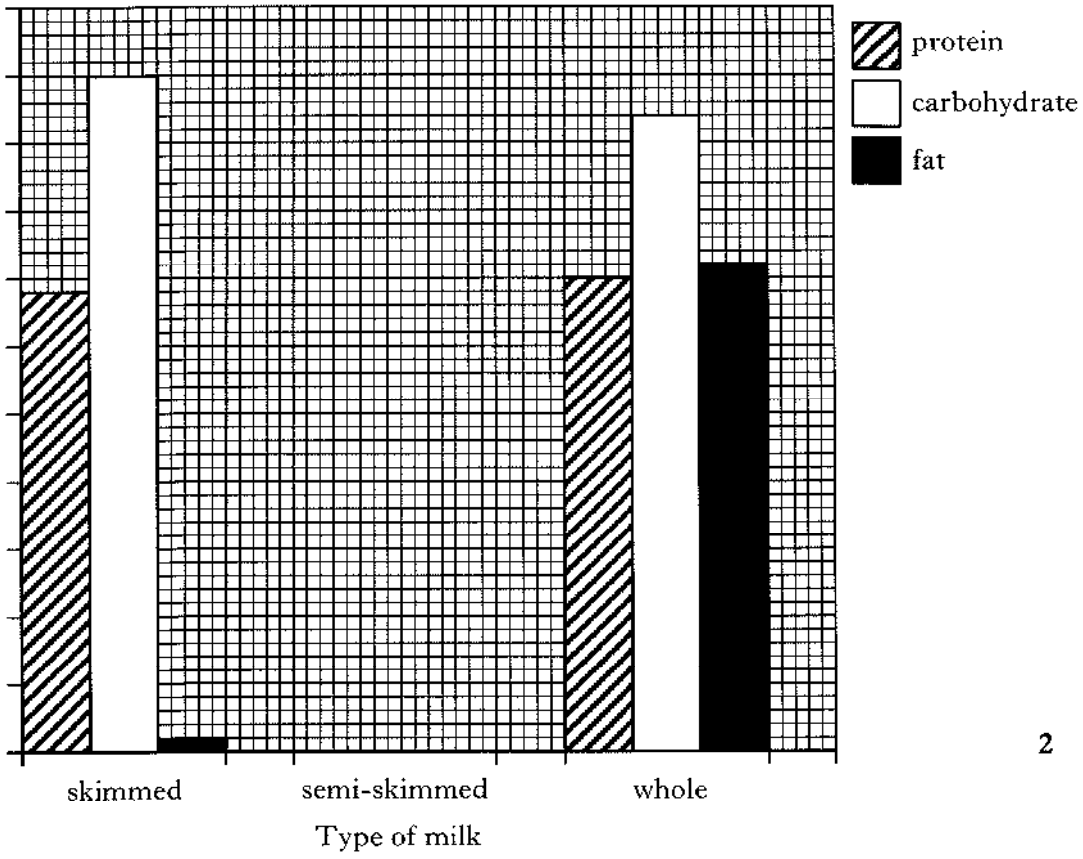
Marks	KU	PS

3. The table gives the partial composition of various types of milk.

Type of milk	*Mass of component per 100 cm³*			
	Protein (g)	*Carbohydrate* (g)	*Fat* (g)	*Calcium* (mg)
Skimmed	3·4	5·0	0·1	124
Semi-skimmed	3·4	5·0	1·7	122
Whole	3·5	4·7	3·6	119

(*a*) (i) Use the information from the table to complete the bar chart below.
(An additional grid, if required, will be found on page 24.)



2

(ii) Which component shows the greatest variation in composition among the three types of milk?

_____

1

(*b*) The recommended daily intake of calcium is 800 mg. What percentage of this is supplied by 100 cm³ of skimmed milk?

Space for calculation

_____ %

1

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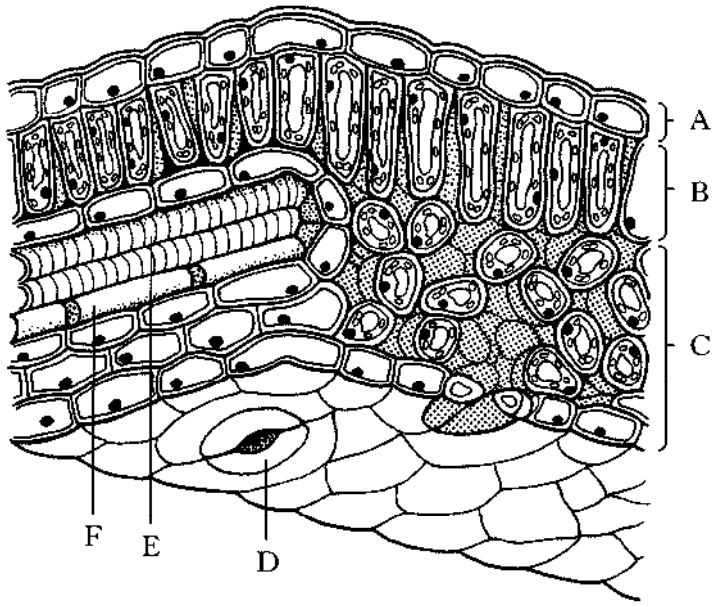
4. The diagram shows a magnified view of the structure of a leaf.



(*a*) Complete the following table that describes some features of the leaf.

Letter	*Name*	*Function*
A		Cells that form upper surface of the leaf
B	Palisade mesophyll	
C		Exchanges gases between air and leaf cells
D		Controls the size of the stoma
E	Xylem	
F		Transports glucose from the leaf

3

(*b*) During photosynthesis, carbon dioxide is converted into glucose.

(i) Name the structural carbohydrate, formed from glucose, that is the main component of cell walls.

_____ **1**

(ii) Give **one** use the plant makes of the glucose, other than the formation of structural materials.

_____ **1**

(*c*) Name the structural material that strengthens xylem vessels.

_____ **1**

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Marks	KU	PS

4. (continued)

(*d*) The rate of photosynthesis can be limited by different factors.

Draw one line from each set of conditions to the factor that would be limiting photosynthesis.

Set of conditions	*Factor limiting photosynthesis*
High on a mountain on a sunny winter day	Light intensity
The middle of a corn field on a warm bright day with no wind	Wind speed
	Carbon dioxide availability
Late evening of a warm breezy summer day in a forestry plantation	Temperature

2

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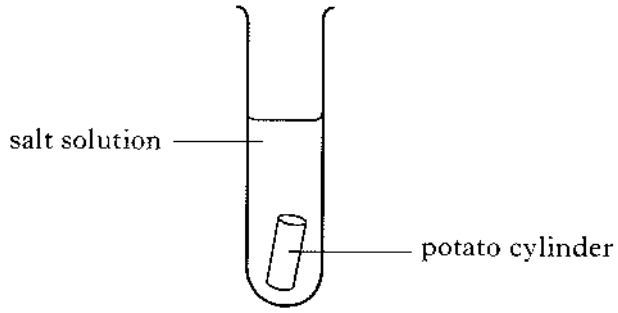
5. Potato cylinders of equal mass were placed in separate test tubes, as shown in the diagram.



The tubes contained salt solutions of 0·5%, 1·0%, 1·5%, 2·0% and 3·0% concentrations.

After two hours the change in mass of each cylinder was measured. The results are shown in the table.

Tube	*Change in mass* (g)	*Salt solution* (%)
A	–0·6	
B	–0·5	
C	–0·2	1·5
D	+0·1	
E	+0·2	

(*a*) Complete the table by adding the correct concentration of the salt solution in each tube. **1**

(*b*) Which tube contained a solution with a water concentration closest to that of the potato cell sap?

Tube _____ **1**

(*c*) The original mass of each potato cylinder was 5 g.
Calculate the percentage change in mass for the cylinder in tube D.
Space for calculation

_____ % **1**

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5. (continued)

(*d*) Underline **one** alternative in each bracket to explain the results for Tube C.

Water moved { into / out of } the potato by osmosis from a higher water concentration { inside / outside } the potato to a lower water concentration { inside / outside } the potato. **2**

(*e*) Why would it be good experimental technique to blot the potato cylinders dry before each weighing?

_____

_____ **1**

(*f*) How could the results of the experiment be made more reliable?

_____ **1**

[Turn over

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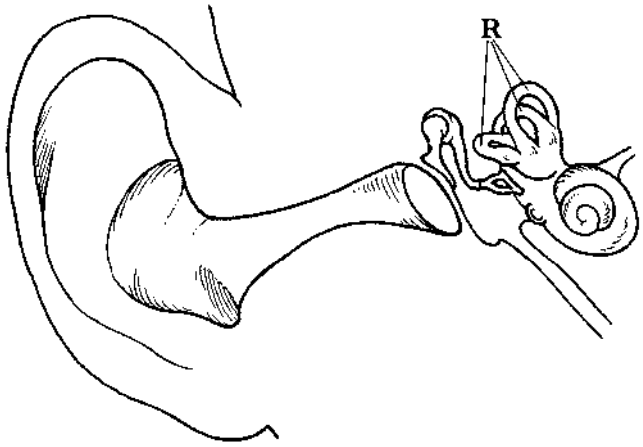
6. The following is a diagram of the human ear.



(*a*) The structures labelled **R** detect movements of the head.

(i) Give the name of these structures.

_____ **1**

(ii) Describe the arrangement of the structures labelled **R** and explain how this arrangement helps with their function.

Arrangement _____

_____ **1**

Explanation _____

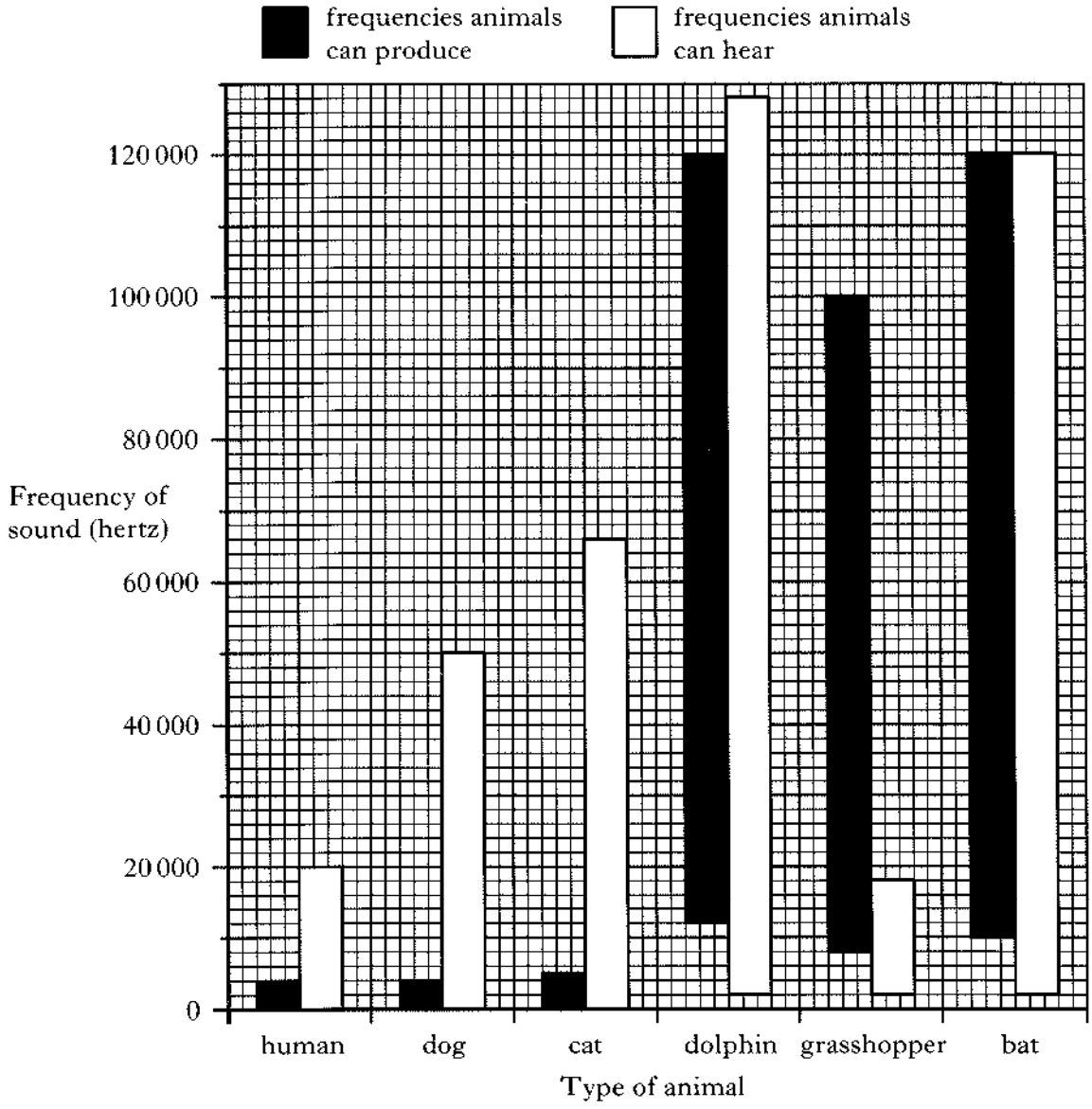
_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

6. (continued)

(*b*) The following bar chart shows sound frequencies some animals can produce and hear.



Use information from the bar chart to answer the following questions.

(i) Which animal can hear the greatest range of sound frequencies?

_____ **1**

(ii) What is the lowest frequency of sound that can be heard by a bat?

_____ hertz **1**

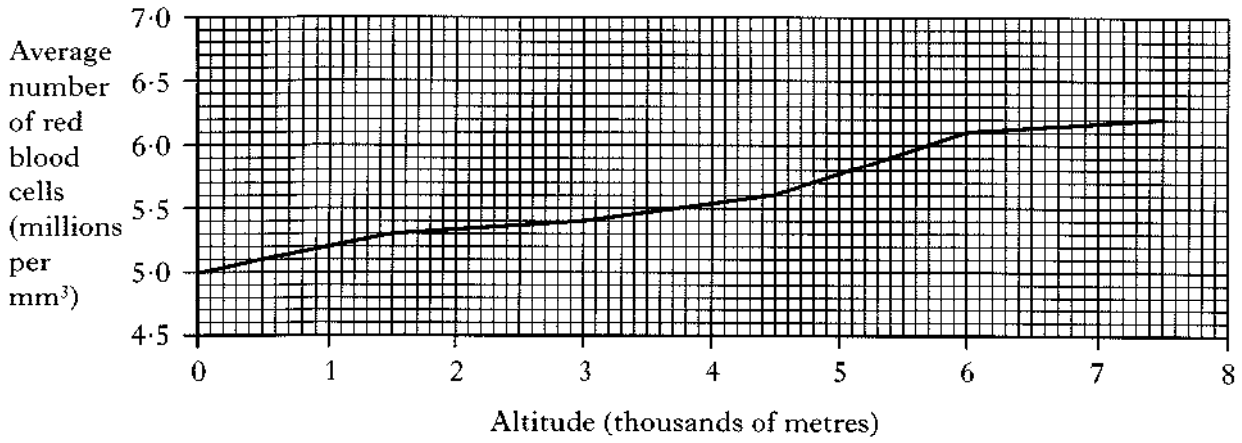
(iii) Name **all** the animals that can produce sounds which humans **cannot** hear.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

7. Groups of ten people who normally live at an altitude of zero metres were taken to stay at higher altitudes. The line graph shows the average number of red blood cells in each group after 100 days.



(*a*) (i) What was the highest average number of red blood cells per mm^3?

_____ **1**

(ii) Describe the relationship between the average number of red blood cells and the altitude.

_____

_____ **1**

(*b*) Red blood cells contain haemoglobin. What is the function of haemoglobin?

_____ **1**

(*c*) Capillaries allow exchange of substances between the blood and the body tissues. Give **two** features of capillary networks that make this exchange efficient.

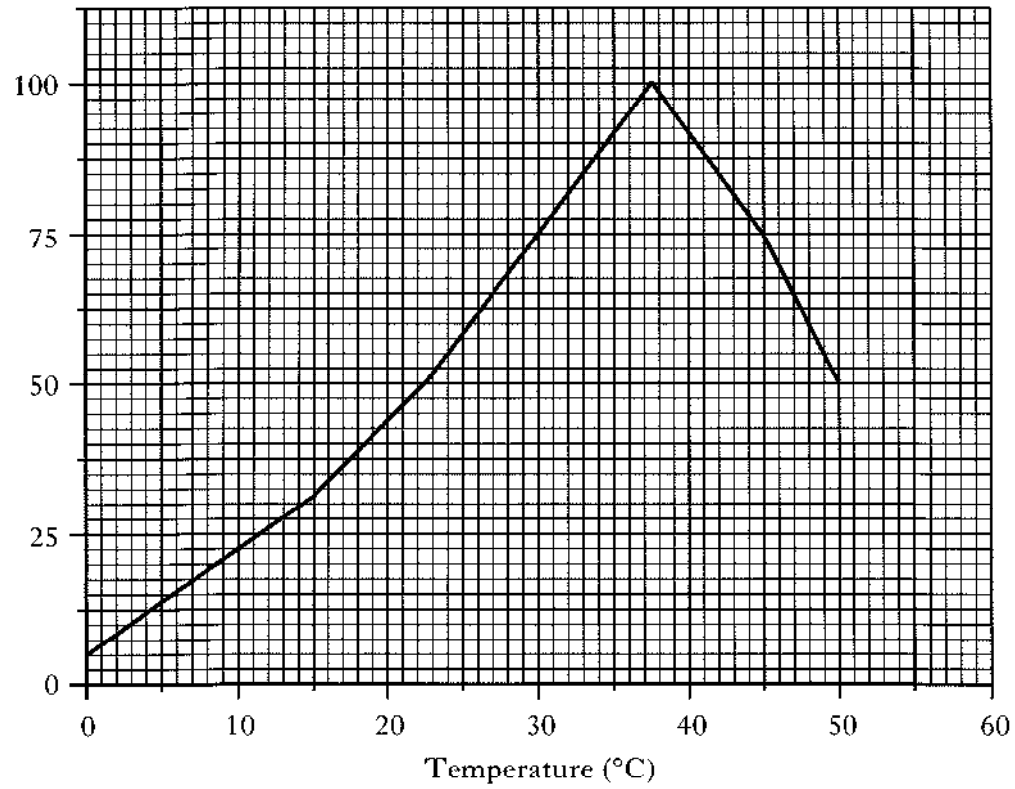
1 _____

2 _____ **2**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

8. The graph shows the effect of temperature on the enzyme catalase.



(*a*) Between which **two** temperatures was there the greatest overall increase in enzyme activity?

Tick the correct box.

0 °C to 10 °C ☐

10 °C to 20 °C ☐

20 °C to 30 °C ☐

30 °C to 40 °C ☐

1

(*b*) At which **two** temperatures was the enzyme activity 75% of its maximum?

_____ °C and _____ °C **1**

(*c*) From the graph, predict the temperature at which the enzyme activity will reach zero.

_____ °C **1**

(*d*) Catalase will only work on one substrate.

What word is used to describe this feature of an enzyme?

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

9. The following cross was carried out using plants with either red or white coloured flowers.

P red flower × white flowers

↓

F_1 all red flowers

F_1 × **F_1**

↓

F_2 red and white flowers

(*a*) Complete the table using the words **all**, **some** or **none** to show the extent to which each generation contains true breeding plants.

Generation	*True breeding*
P	
F_1	
F_2	

1

(*b*) (i) Predict the expected number of white flowered **F_2** plants that would have been produced if 1488 red flowered plants were produced.

Space for calculation

_____ white flowered plants 1

(ii) The actual number of white flowered **F_2** plants was different from the expected. Suggest a reason why this happened.

_____

_____ 1

(*c*) Using the letters **R** for red flowers and **r** for white flowers, give the genotypes of the plants in the table below.

Plant	*Genotype*
red flowered **F_1**	
white flowered **F_2**	

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

9. (continued)

(*d*) **R** and **r** represent two forms of the same gene.

What are the two forms of a gene called?

_____ **1**

(*e*) Flower colour is an example of discontinuous variation.

What is meant by the term "discontinuous variation"?

_____

_____ **1**

[Turn over

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Marks	KU	PS

10. Read the following passage and answer the questions that follow.

Great Oaks from Little Acorns Grow, adapted from the Royal Horticultural Society's Encyclopaedia of Practical Gardening

Seeds are a resting and survival stage in a plant's life cycle. A seed consists of an embryo, a food supply and a seedcoat.

There are a number of distinctions that can be made among seeds. Seeds vary in size from small, dust-like seeds, such as those from rhododendrons and lobelia, to large seeds, such as acorns, chestnuts and hazelnuts. The enormous variation in the size of seeds influences the success of their growth. Large seeds are produced in small numbers, germinate satisfactorily and establish well. Dust-like seeds have lower survival rates.

Seeds also vary in the materials used as a food store. Seeds that store food as carbohydrates, such as elderberries, marigolds and laburnum, are generally stable, long-lived and will withstand drying. Seeds that store food as fats or oils, for example peony, magnolia and chestnut seeds, do not survive storage or drying very well.

Survival of drying, however, is not just affected by the stored food. It also reflects the condition of the seedcoat and its ability to protect the seed. Plants, such as willows, with very poorly developed seedcoats survive for only very short periods, while those plants, such as sweet peas, laburnum and lupin, with very hard, impermeable seedcoats usually survive for considerable periods in a wide variety of conditions. Seeds of the Indian lotus have germinated after 1000 years in a peat bog.

(*a*) How would the number of seeds produced by rhododendrons, and their survival rate, compare with those of chestnuts?

Number of seeds _____

Survival rate _____ **1**

(*b*) Give all the information contained in the passage about the seeds of laburnum.

_____

_____ **2**

(*c*) Which would contain more stored energy per gramme of its food store, marigold or magnolia? Give a reason for your answer.

Seed _____

Reason _____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

10. (continued)

(*d*) What factor, other than the nature of the food store, does the passage mention as important in allowing seeds to survive dry conditions?

_____ **1**

(*e*) What may be deduced about the seedcoats of the Indian lotus?

_____ **1**

(*f*) Use the information **in the passage** to complete the table below by entering a tick to describe the size and type of food store for each seed. The line for acorns has been completed.

Seed	*Size*			*Food store*		
	large	*small*	*no information*	*carbohydrate*	*fat*	*no information*
Acorn	✓					✓
Chestnut						
Elderberry						
Lobelia						
Peony						

2

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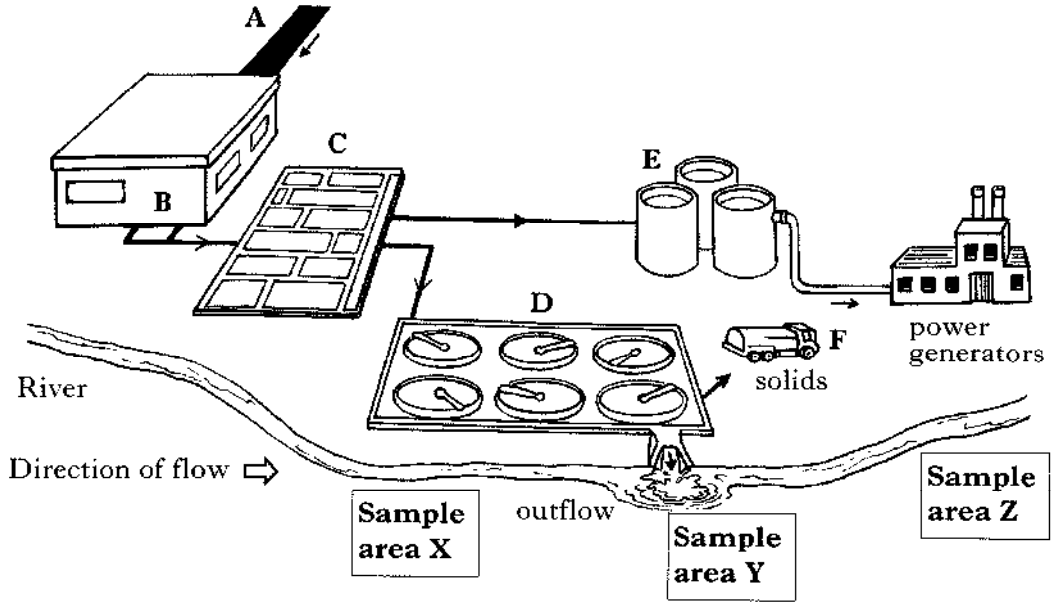
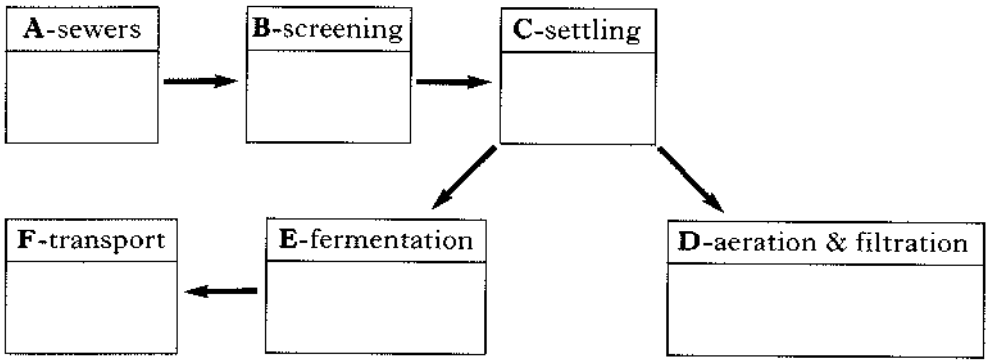
Marks	KU	PS

11. The diagram and table describe part of a sewage treatment works.



Number	*Process*
1	Large pieces removed by mesh filter.
2	Solid material separated from liquid by allowing solids to settle.
3	Bacteria feed on solid organic material and produce biogas.
4	Wide range of micro-organisms feed on liquid waste material in aerobic conditions and decompose it to harmless products.
5	Waste materials from homes and factories.
6	Remaining solids dried and taken away to be used as fertiliser.

(*a*) Complete the flow chart below by inserting the correct number from the table at each stage.



2

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Marks	KU	PS

11. (continued)

(*b*) (i) Why is it important for aerobic conditions to be present during process 4?

_____

_____ **1**

(ii) Explain why a range of micro-organisms is needed to decompose sewage.

_____

_____ **1**

(*c*) The local authority checks for possible pollution caused from the sewage works by measuring the oxygen concentration of the river water and by monitoring indicator organisms.

(i) Which of the sample areas shown in the diagram would have the highest oxygen concentration if organic matter was present in the outflow?

Tick the correct box.

Sample area X ☐

Sample area Y ☐

Sample area Z ☐ **1**

(ii) Explain what is meant by an indicator species.

_____

_____ **1**

[Turn over

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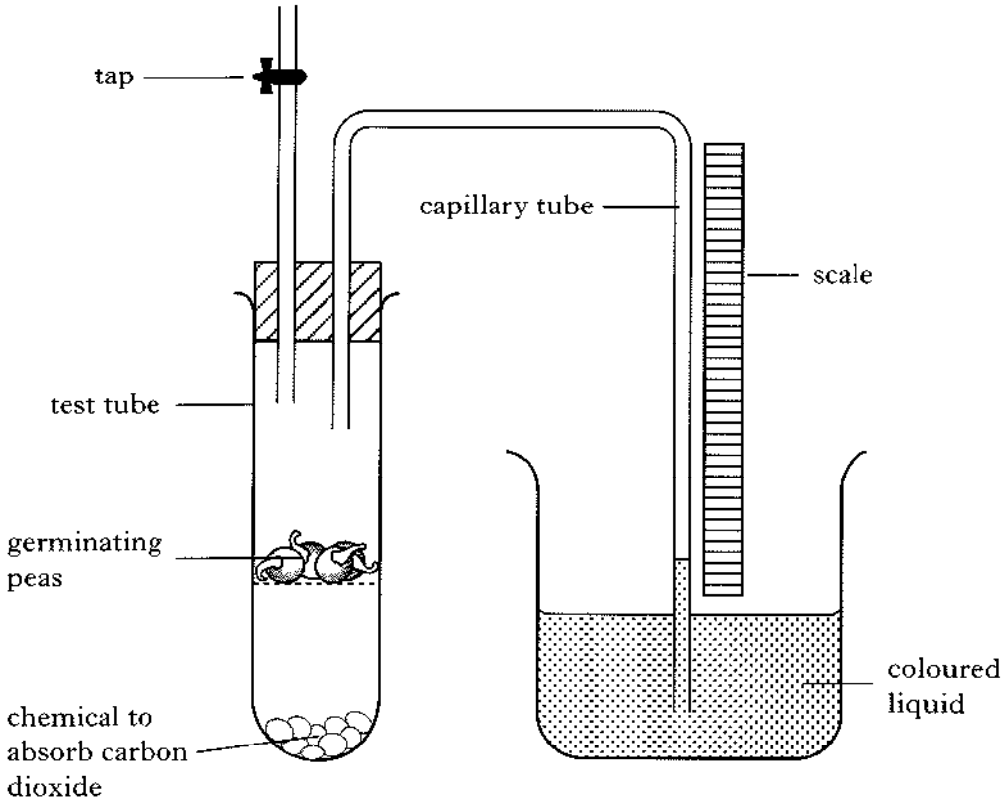
12. The apparatus shown below was used to investigate the effect of temperature on the rate of respiration in germinating peas.



The test tube was placed in a water bath at 5 °C. The volume of oxygen used in respiration was measured by the movement of the coloured liquid in the capillary tube.

The experiment was repeated at different temperatures. The results are shown in the table.

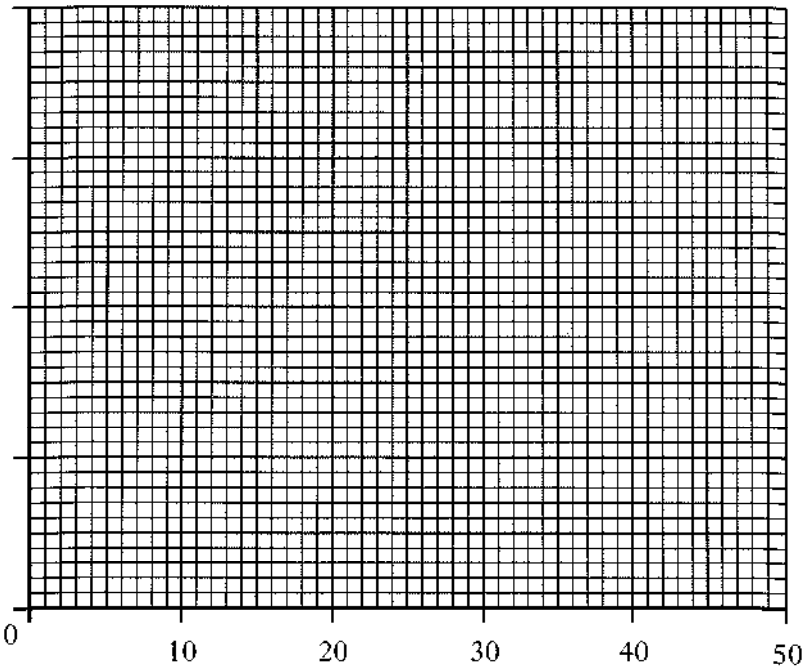
Temperature (°C)	*Rate of respiration* (cm^3 oxygen used per hour)
5	0·10
10	0·30
15	0·45
20	0·65
25	0·90
30	1·15
35	1·50
40	1·20
50	0·20

DO NOT WRITE IN THIS MARGIN

12. (continued)

Marks | KU | PS

(*a*) Draw a **line graph** of the results using an appropriate scale to fill most of the graph paper.
(Additional graph paper, if required, will be found on page 24.)



2

(*b*) From the results, describe the relationship between temperature and the rate of respiration.

_____

_____ **2**

(*c*) A control experiment for this investigation used peas that had been boiled and then cooled.

(i) Explain the need for this control experiment.

_____

_____ **1**

(ii) Describe the expected results for the control experiment.

_____

_____ **1**

(*d*) If fresh plant leaves had been used instead of germinating peas, in the investigation, explain why the test tubes should be covered with black plastic.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

13. In cheese making both bacteria and fungi may be used.

(*a*) Underline **one** word in each bracket to explain what happens during the souring of milk for cheese making.

The pH of the milk { rises / falls } due to bacteria fermenting { lactose / glucose / maltose } sugar and producing { citric / lactic / nitric } acid. **1**

(*b*) Blue cheese is made using a fungus that must be allowed to respire aerobically.

Other than carbon dioxide, which substance would be produced if the fungus respired anaerobically.

_____ **1**

(*c*) Temperature and pH are carefully controlled during cheese making to provide the optimum conditions for the enzymes involved.

Explain the meaning of the term "optimum conditions".

_____

_____ **1**

(*d*) The table gives information about five different cheeses.

Type of cheese	*Acid composition* (%)
Cheddar	0·60 – 0·70
Cheshire	0·60 – 0·70
Leicester	0·55 – 0·60
Stilton	1·10 – 1·30
Wensleydale	0·52 – 0·62

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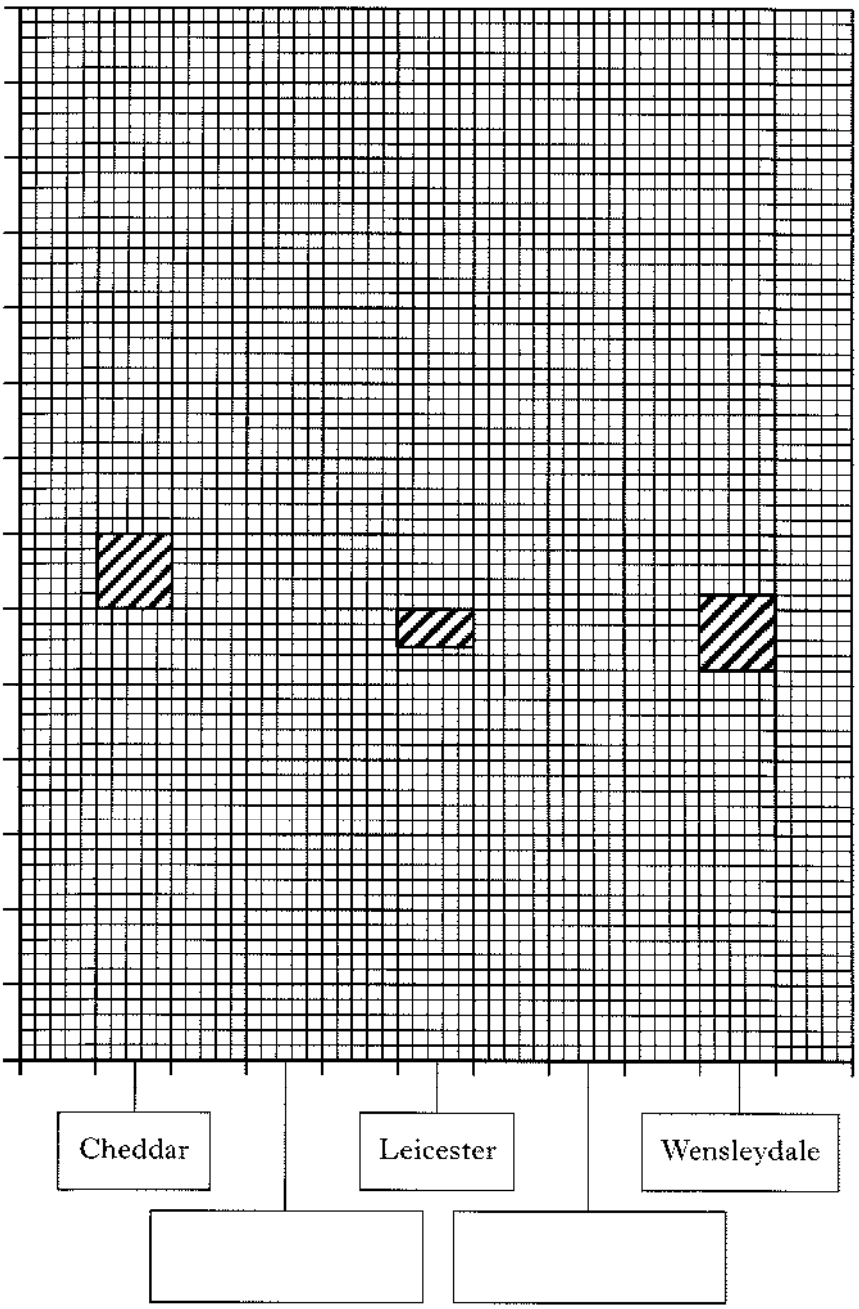
Marks	KU	PS

13. (*d*) (continued)

(i) Complete the chart below using information from the table.
(An additional grid, if required, will be found on page 25.)



2

(ii) Which cheese has the lowest pH?

_____

1

[END OF QUESTION PAPER]

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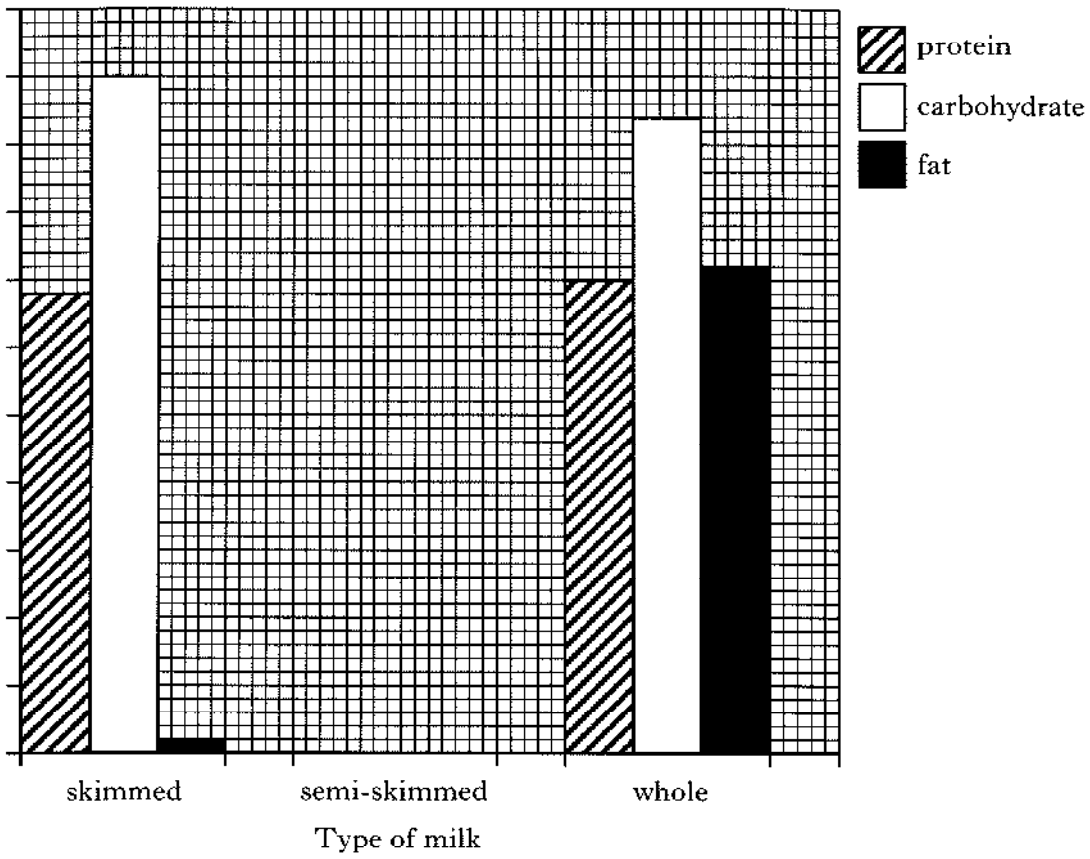
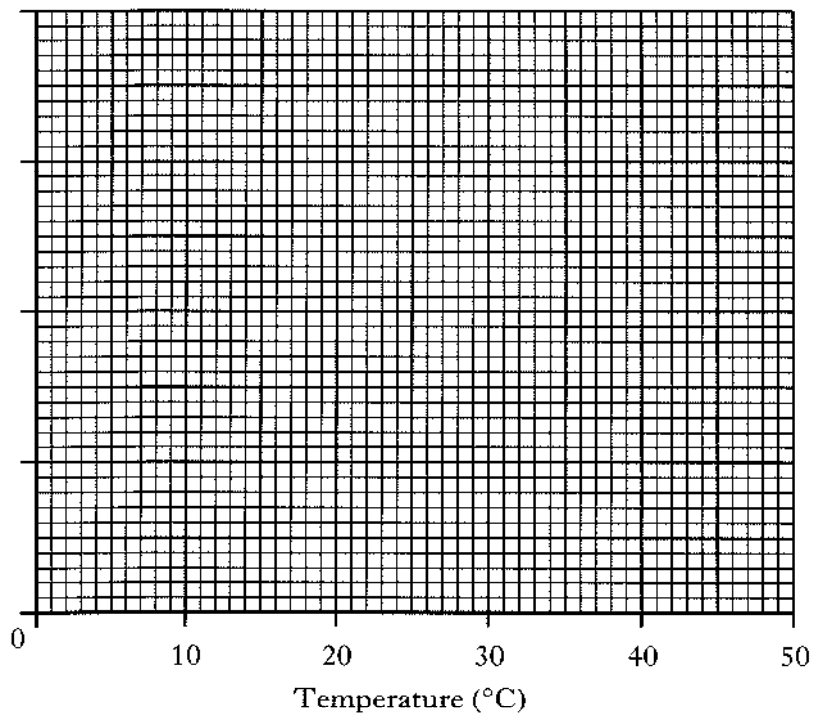
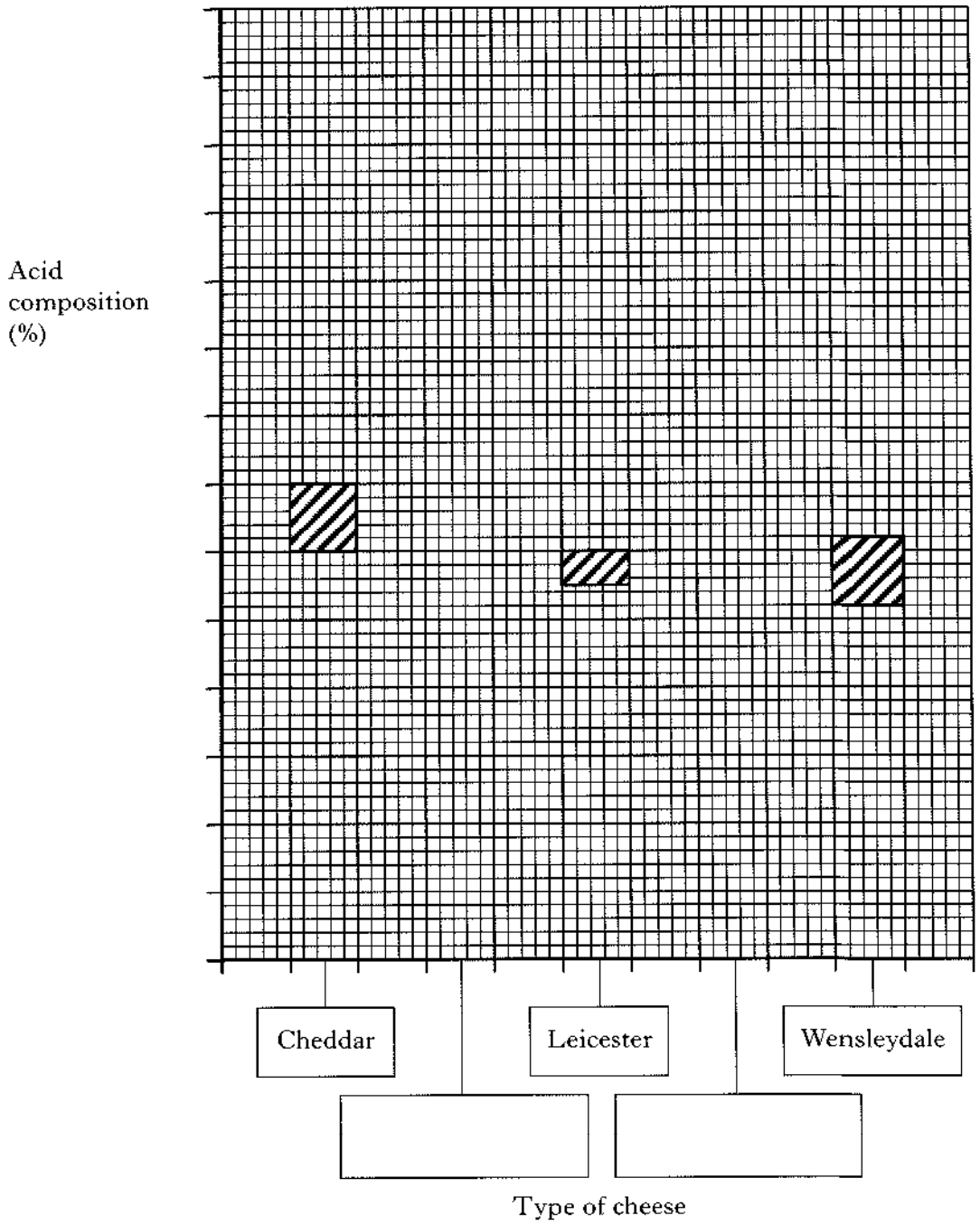
ADDITIONAL GRID FOR QUESTION 3(*a*)(i)



ADDITIONAL GRAPH PAPER FOR QUESTION 12(*a*)



ADDITIONAL GRID FOR QUESTION 13(*d*)(i)



SPACE FOR ANSWERS
AND FOR ROUGH WORKING

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

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