FOR OFFICIAL USE

C

KU	PS

Total Marks

0300/402

NATIONAL QUALIFICATIONS 2001

MONDAY, 21 MAY
10.50 AM – 12.20 PM

BIOLOGY
STANDARD GRADE
Credit Level

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

1 All questions should be attempted.

2 The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.

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

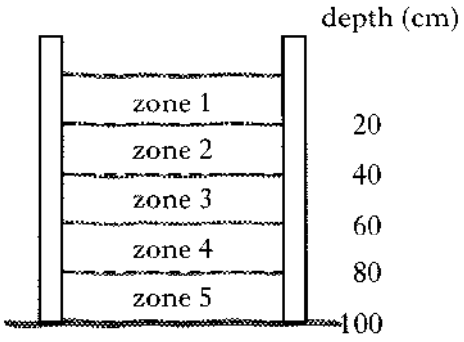
4 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

SCOTTISH QUALIFICATIONS AUTHORITY

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

1. A garden compost heap was marked off into five zones as shown below.



Three samples were removed from each zone and the average biomass of animals was calculated.

The results are shown in the table below.

Animal	*Average biomass of animals* (mg/l)				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Earthworms	300	114	96	51	36
Slugs	258	63	54	0	0
Woodlice	204	87	75	33	6
Centipedes	9	18	18	15	12
Insects	6	6	3	0	0
Mites	12	12	6	3	3
Total	789	300	252	102	57

(*a*) Which animal contributes most biomass to the whole compost heap?

_____ **1**

(*b*) What percentage of the total animal biomass of the compost heap is composed of insects?

Space for calculation

_____ % **1**

(*c*) Why were three samples taken from each zone?

_____ **1**

(*d*) What trend is shown by the total animal biomass as the depth increases?

_____ **1**

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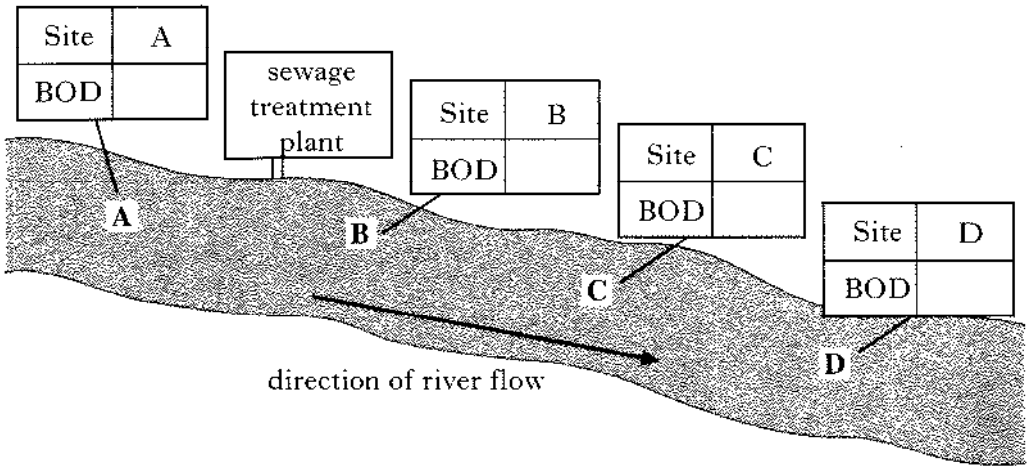
2. The Biochemical Oxygen Demand (BOD) indicates the level of the organic matter in water samples. The more organic matter present, the higher the BOD.

The diagram shows four sites on a river where water was sampled and the BOD measured. The sewage treatment plant was not working and untreated sewage was flowing into the river.

The following BODs were obtained: 8, 30, 93 and 126.

(*a*) Complete the diagram by writing the correct BOD at each sample site.



1

(*b*) The BOD measures how much oxygen is used by microorganisms in the water.

Explain why a high organic matter content in the water will result in a high BOD.

_____

_____

2

(*c*) What term is used for a type of organism whose presence or absence gives information about pollution levels?

_____

1

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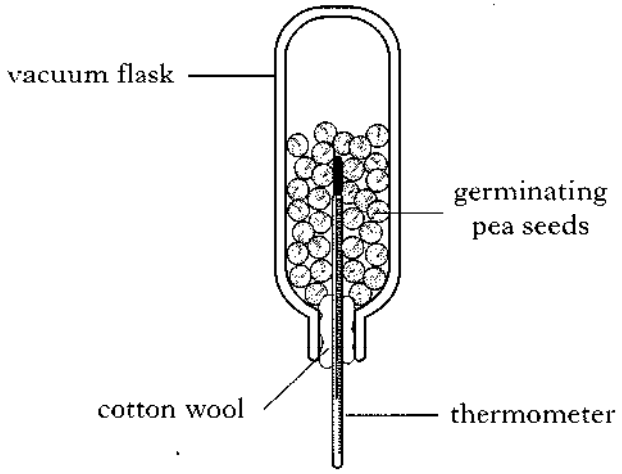
Marks	KU	PS

3. The diagram below represents part of an investigation into heat production by germinating pea seeds.



The temperature inside the flask was recorded for 72 hours.

The results are shown below.

Time (hours)	*Temperature* (°C)
0	18
12	26
24	40
36	48
48	50
60	52
72	54

(*a*) Calculate the average temperature rise per hour.

Space for calculation

Average temperature rise _____ °C per hour **1**

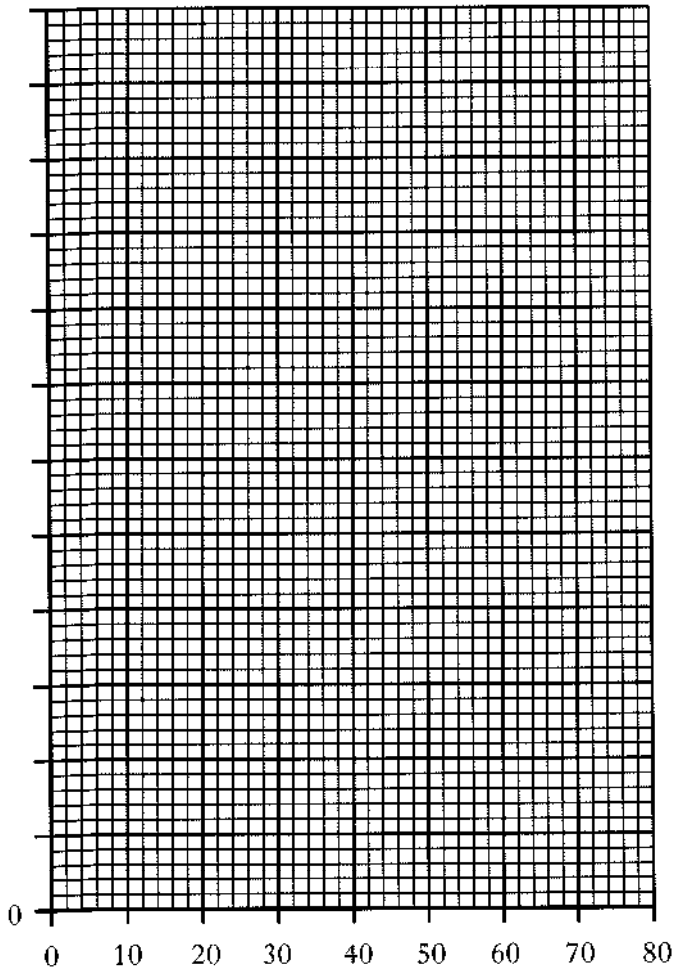
DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

3. (continued)

(*b*) On the grid below, complete the Y-axis and plot a **line graph** of the results.

(Additional graph paper, if required, will be found on page 27.)



2

(*c*) It was concluded that germinating seeds release heat energy.

Describe **one** way in which a control experiment should be kept the same as the first experiment, and **one** way in which it should differ, to make this conclusion valid.

Kept the same _____

Made different _____ 2

[Turn over

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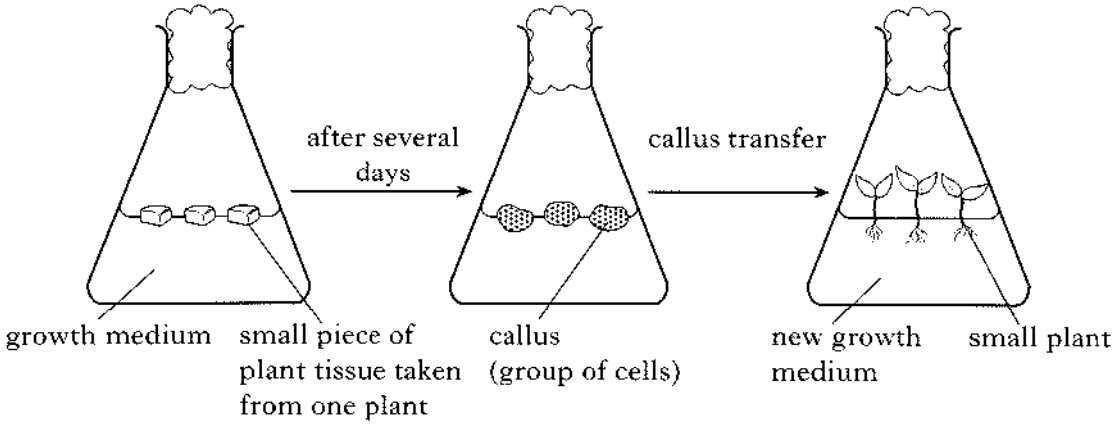
4. After a new variety of rose has been developed, large numbers are produced for sale by artificial propagation techniques involving asexual reproduction.

The diagram shows artificial propagation by tissue culture.



(*a*) What method of reproduction would have been used to develop the new variety of rose?

_____ **1**

(*b*) What name is given to a group such as the small plants produced by tissue culture?

_____ **1**

(*c*) Runners and tubers are examples of natural asexual reproduction.

Describe an advantage of asexual reproduction to plants.

_____

_____ **1**

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5. The diagrams below show villi in the small intestine of a mammal.

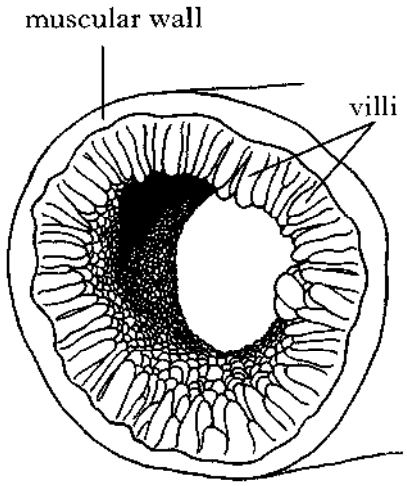


Diagram A
Section through the small intestine

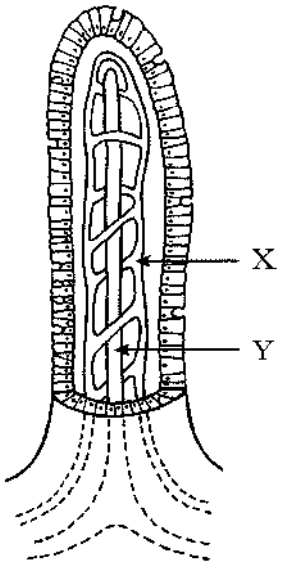


Diagram B
A single villus

(*a*) State how the arrangement of villi, shown in **Diagram A**, increases the efficiency of absorption of digested foods.

_____ **1**

(*b*) Name the two structures, labelled X and Y on **Diagram B**, which transport digested food away from the intestine.

X _____ **1**

Y _____ **1**

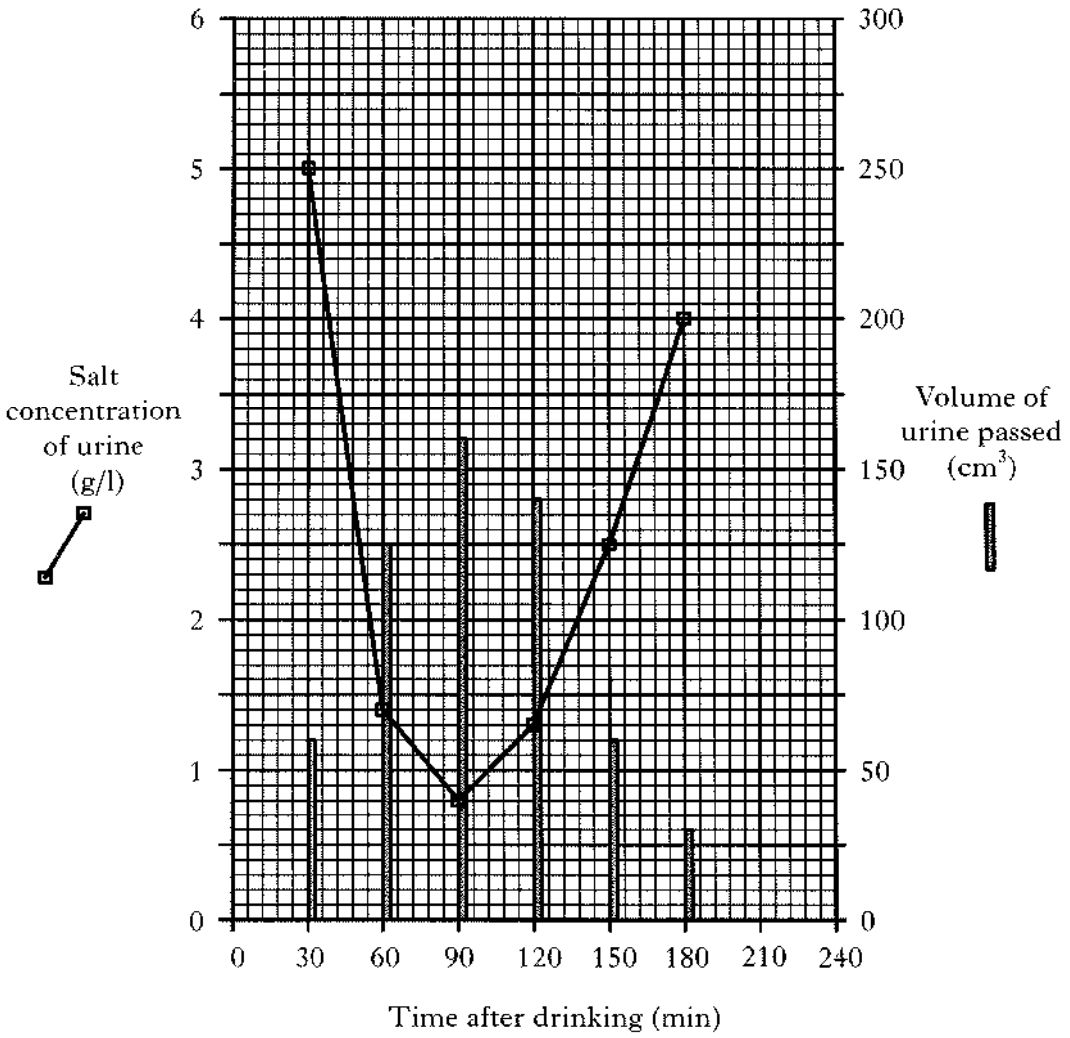
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

6. A volunteer was given 1 litre of water to drink. Every 30 minutes for the next three hours, urine was collected and its volume and salt concentration were measured.

The results are shown on the graph below.



(*a*) What was the total volume of urine passed during this investigation?
Space for calculation

_____ cm^3 **1**

(*b*) Using the data in the diagram, predict the salt concentration of a urine sample taken at 210 minutes.

Predicted salt concentration _____ g/l **1**

DO NOT WRITE IN THIS MARGIN

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6. (continued)

(*c*) Between which two sample times would the volunteer's blood have contained the lowest concentration of ADH?

Tick the correct box.

0 – 30 minutes ☐

30 – 60 minutes ☐

60 – 90 minutes ☐

90 – 120 minutes ☐ **1**

(*d*) Describe the relationship between the volume of urine passed and its salt concentration.

_____

_____ **1**

[Turn over

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Marks	KU	PS

7. Pike, roach and trout are freshwater fish which reproduce by external fertilisation of their eggs.

Adult pike range from 100–150 cm in length and each female produces an average of 100 000 eggs which are each 2·5 mm in diameter.

Adult trout and roach are each from 25–40 cm long. Roach produce the same number of eggs as pike on average, whilst trout produce only 1000 eggs per female.

Trout produce the biggest eggs at 5 mm diameter, whilst roach eggs are only 1 mm.

(*a*) Complete the following table by adding suitable column headings and data using the above information.

Fish			
Pike			
Trout			
Roach			

3

(*b*) Which species has the greatest chance of successful development?
Give a reason for your answer.

Species _____

Reason _____

_____

2

(*c*) Fertilisation in land living animals is internal.
Explain the importance of this.

_____

_____

1

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

8. Read the passage below and answer the questions which follow it.

Birds migrate for the breeding season to areas with good food supplies and nesting places. They go elsewhere for the winter because conditions are no longer suitable. We see millions of insect-eaters such as swifts and swallows moving into Britain in summer, but migrating south to warmer climates in winter because they cannot survive without insect food. Resident species such as robins and blackbirds eat insects in summer and switch to a different food resource in winter and so do not migrate.

Some wildfowl and waders need to leave Britain in summer to breed but migrate here in winter to feed on the invertebrates present in our estuaries. Other migrants, both in spring and autumn, use our islands as stopovers to feed during their long migrations north and south.

There have been changes in bird distribution relating to factors like climatic changes. This has probably been responsible for redwings and fieldfares, which are normally migrants, establishing resident populations in Britain.

(*a*) Give **one** reason why some birds migrate to Britain to breed.

_____ **1**

(*b*) Give **one** reason why some birds migrate to Britain for the winter.

_____ **1**

(*c*) Name one resident and one migrant species which eats insects.

Resident species _____

Migrant species _____ **1**

(*d*) Explain why some species may be seen in Britain for short periods at two different times of the year.

_____ **1**

(*e*) What explanation is suggested in the passage for the resident populations of redwings and fieldfares in Britain?

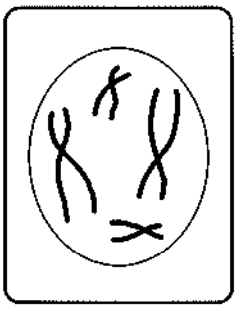
_____ **1**

[Turn over

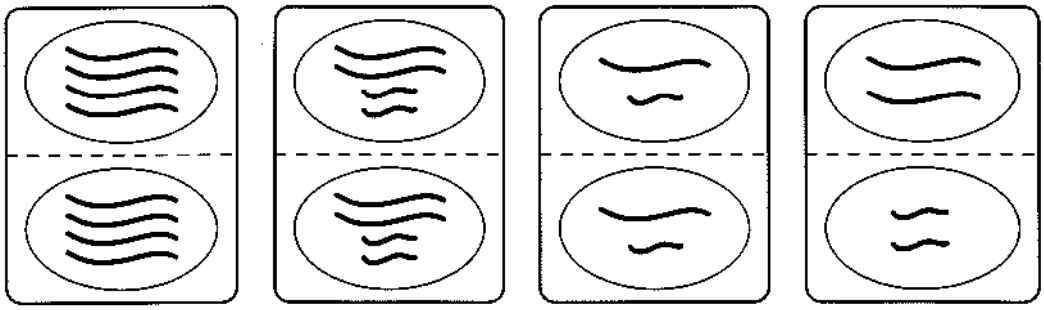
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

9. The diagram below represents a cell in an early stage of mitosis.



Which of the following diagrams represents the chromosomes you would expect to find in the nuclei of the daughter cells at the end of mitosis?
Tick the correct box.



☐ ☐ ☐ ☐

1

DO NOT WRITE IN THIS MARGIN

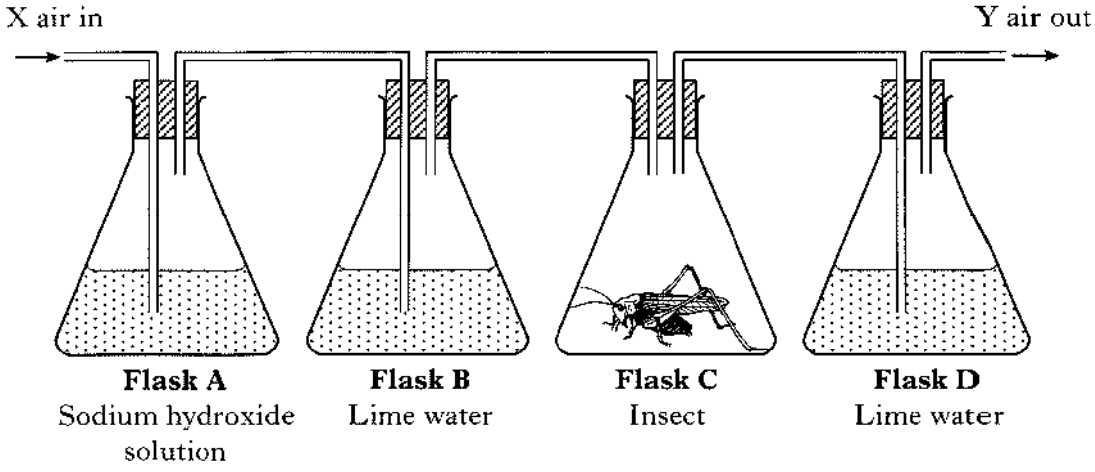
Marks	KU	PS

10. The following experiment was set up.

Sodium hydroxide solution absorbs carbon dioxide from air.

Lime water turns from clear to cloudy in the presence of carbon dioxide.

Air is drawn through the apparatus from X to Y, passing through each flask in turn.



(*a*) What should happen to the lime water in Flask B?

_____ **1**

(*b*) (i) The lime water in Flask D turned cloudy after one hour.
Give a valid conclusion which could be drawn from this result.

_____

_____ **1**

(ii) Predict how the results would differ if two insects were put into Flask C.

_____ **1**

[Turn over

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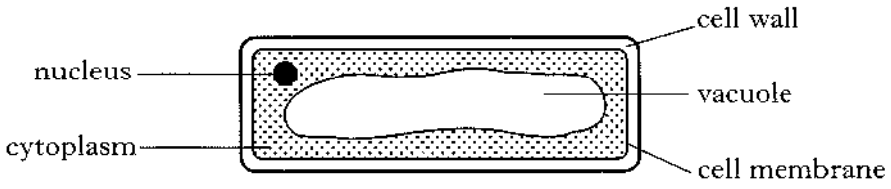
Marks	KU	PS

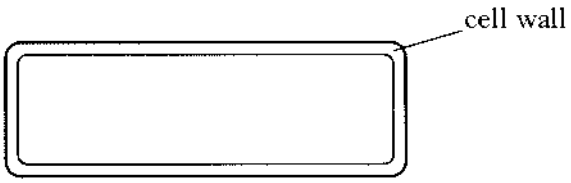
11. (*a*) (i) Tissue from an onion root was placed in water. The diagram below represents a cell from the tissue.



The tissue was then transferred into a very concentrated salt solution for one hour.

Complete the diagram below to show the appearance of the onion cell contents after this time.

(An additional diagram is available, if required, on page 27.)



1

(ii) Underline **one** alternative in each group to make the following sentence correct.

In concentrated salt solution, water passes { *into* / *out of* } an onion cell from a region of { *high* / *low* } water concentration, to a region of { *high* / *low* } water concentration with the cell membrane acting as a { *selectively* / *fully* } permeable membrane.

2

(*b*) Explain the importance of diffusion for an onion root cell.

_____

_____

1

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

11. (continued)

(*c*) Five cylinders of potato tissue were weighed and each was placed into a salt solution of a different concentration.

The cylinders were reweighed after one hour and the results are shown in the following table.

Salt solution	**A**	**B**	**C**	**D**	**E**
Initial mass of potato cylinder (g)	10	10	10	10	10
Final mass of potato cylinder (g)	12·6	11·2	10·1	9·4	7·0

(i) The potato cylinders were blotted dry before each weighing. Suggest a reason for this.

_____

_____ **1**

(ii) Which salt solution had the highest water concentration?

Salt solution _____ **1**

(iii) Calculate the percentage decrease in mass of the potato cylinder in salt solution D.

Space for calculation

_____% **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

12. (*a*) The grid below is about breathing and lungs.

A trachea	B mucus	C diaphragm	D cilia
E air sacs	F bronchi	G rib cage	H capillaries

Use letters from the boxes to complete the following.

(i) Identify two structures which are supported by rings of cartilage.

Letter _____ and letter _____ **1**

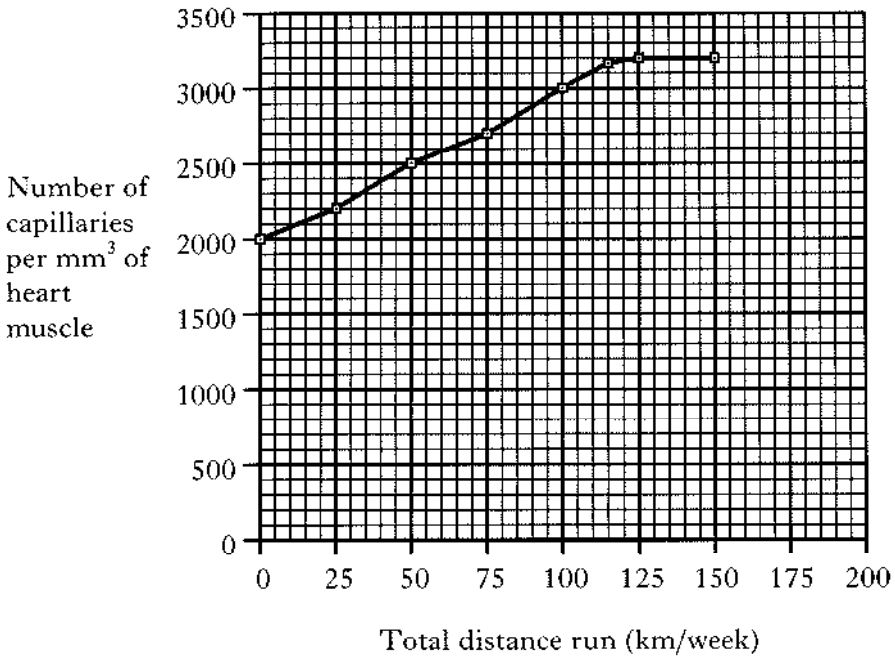
(ii) Identify two structures which are used to change the volume of the lungs during breathing.

Letter _____ and letter _____ **1**

(iii) Identify two features which can help prevent dust from reaching the air sacs.

Letter _____ and letter _____ **1**

(*b*) The following graph shows the effect of a training programme on the number of blood capillaries in the heart muscle of an athlete.



DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

12. (*b*) (continued)

(i) Describe the relationship between the distance run per week and the number of capillaries in the heart muscle.

_____

_____ **2**

(ii) What was the percentage increase in the number of capillaries per mm^3 of heart muscle when the distance run each week was increased from 50 to 100 km?

Space for calculation

_____ % **1**

(*c*) (i) Training increases the efficiency of the heart.
Explain how an increased number of capillaries in the heart muscle contributes to its efficiency.

_____

_____ **1**

(ii) In addition to improving the blood circulation, state **one** other way in which training improves the efficiency of the body.

_____ **1**

[Turn over

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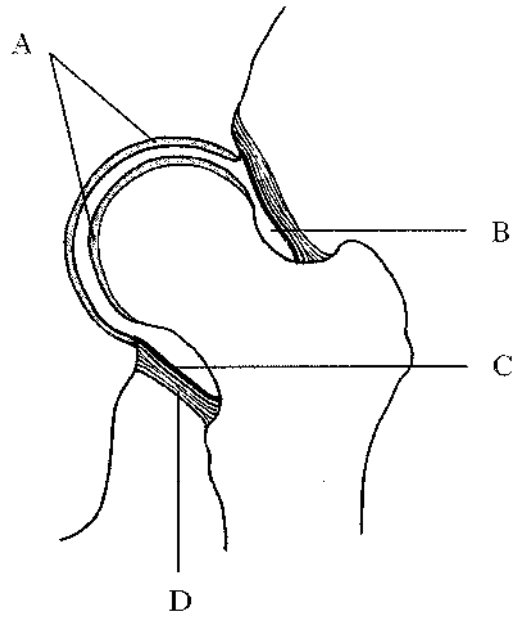
Marks	KU	PS

13. The diagram shows a ball and socket joint.



Complete the table with the letters, names and functions of the labelled structures in the joint.

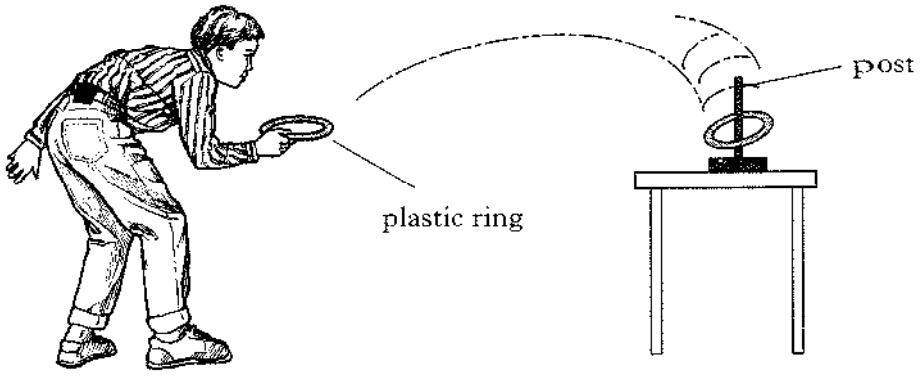
Letter	*Name of structure*	*Function*
	synovial fluid	
C		produces synovial fluid
A		cushions the joint
		holds bones together

3

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

14. An investigation was carried out to test the hypothesis that using both eyes increases the ability to judge distances.



Four volunteers threw plastic rings at a post.

Each volunteer had 20 throws with no eyes covered, with one eye covered and with both eyes covered.

The results are shown on the table below.

Volunteer	*Number of successes out of 20 throws*			
	no eyes covered	*right eye covered*	*left eye covered*	*both eyes covered*
1	8	3	3	1
2	12	4	3	2
3	6	2	3	0
4	8	5	4	0
Average	8·50	3·50	3·25	

(*a*) Complete the table to show the average result with both eyes covered. **1**

Space for calculation

(*b*) Name two variables concerning the apparatus for the experiment which must be kept the same throughout the investigation. **2**

1 _____

2 _____

(*c*) Underline **one** alternative in each group to make the following statements correct. **1**

The variable tested in the investigation was the

{ *diameter of the hoops* / *number of successful throws* / *number of eyes used* } . The hypothesis should be { *accepted* / *rejected* / *modified* }.

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

15. (*a*) In an investigation into the inheritance of height in pea plants, true-breeding tall plants were crossed with true-breeding dwarf plants.

All the F_1 plants were tall.

(i) Using the symbols **T** and **t** for the alleles, complete the following diagram with the genotypes of the parents and the offspring.

Parental phenotypes **Tall** × **Dwarf**

Parental genotypes _____ _____

F_1 phenotype **Tall**

F_1 genotype _____ **1**

(ii) If a second generation of pea plants was produced by allowing the F_1 generation to self-cross, what would be the expected ratio of phenotypes?

Space for working

Expected F_2 ratio **Tall** : **Dwarf**

_____ : _____ **1**

(iii) When the F_2 plants were counted, there were 720 tall plants and 180 dwarf plants.

Calculate the actual ratio of tall plants to dwarf plants.

Space for calculation

Actual F_2 ratio **Tall** : **Dwarf**

_____ : _____ **1**

(iv) Explain why these results differ from the expected ratio.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

15. (continued)

(*b*) Tallness and dwarfness in pea plants is an example of *discontinuous variation*. Explain the meaning of this term.

_____

_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

16. (*a*) The following list describes some of the stages in the production of human insulin by genetically engineered bacteria.

Stage 1 _____

_____

Stage 2 Insertion of the insulin gene into the chromosomal material of suitable bacteria.

Stage 3 Bacteria reproduce rapidly, passing on the insulin gene.

Stage 4 _____

_____

Stage 5 Extraction and purification of the insulin.

(i) In the spaces provided, describe stages 1 and 4. **2**

(ii) Explain why there is an ever increasing need for insulin produced by bacteria.

_____

_____ **1**

(*b*) Compared to selective breeding, state **one** advantage of genetic engineering as a way of improving the characteristics of a species.

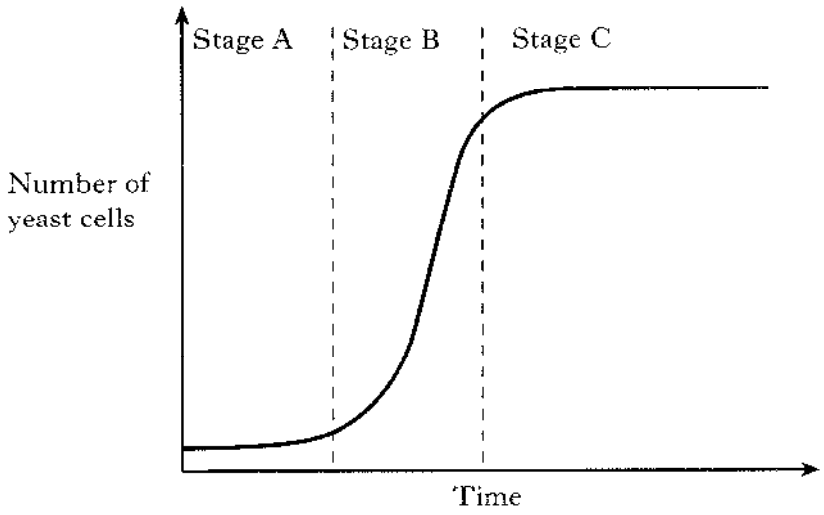
_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

17. The graph shows the population growth of yeast cells in a fermenter.



(*a*) Which stage on the graph shows the fastest population growth?

Stage _____ **1**

(*b*) Describe the changes in population growth shown in Stage C on the graph, and give a reason for the changes.

Changes _____

_____ **1**

Reason _____ **1**

(*c*) The fermenter was cleaned by steam sterilisation at 121 °C before it was used.

Name the structures, produced by bacteria and fungi, which could have survived if boiling water had been used for cleaning.

_____ **1**

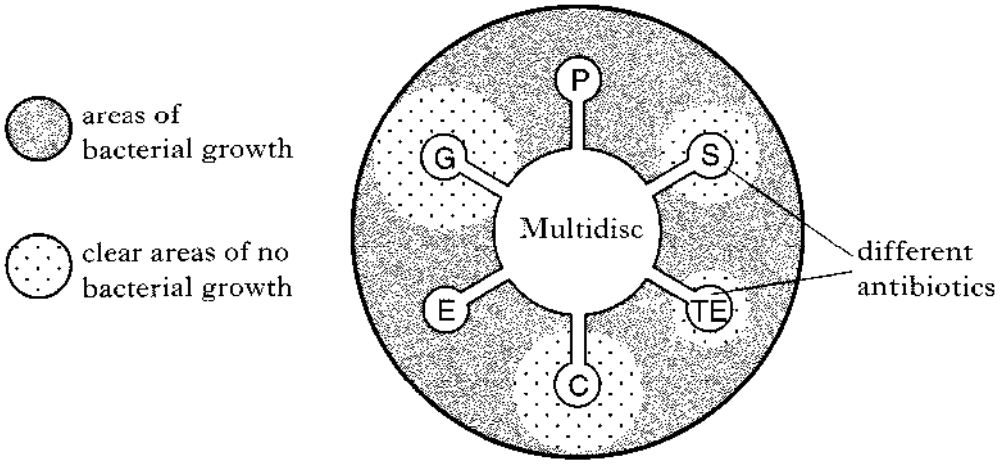
[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

18. A suspension of bacteria was spread evenly over the surface of a nutrient agar in a petri dish.

A multidisc containing six different antibiotics was placed on the agar. The diagram below shows the appearance of the petri dish after it had been incubated for two days.



(*a*) Complete the table below to record the effectiveness of each antibiotic.

Antibiotics which had some effect	*Antibiotics which had no effect*

1

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

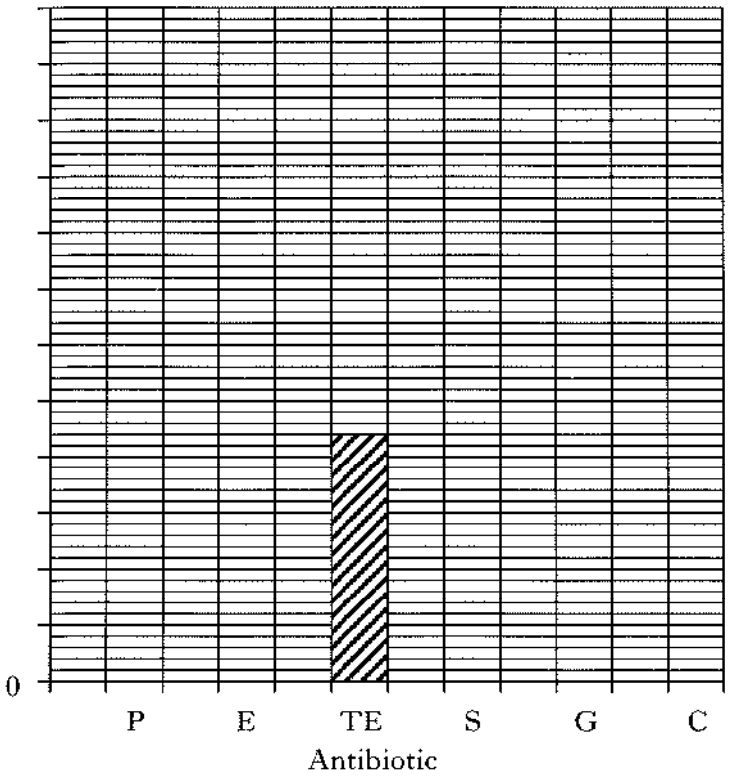
18. (continued)

(*b*) The table below shows the results from a similar investigation with a different bacterium.

Antibiotic	*Diameter of clear area* (mm)
P	0
S	4·1
TE	2·2
C	5·0
G	4·3
E	0·5

(i) Use the information from the table to complete the Y-axis and plotting of the bar chart on the grid below.

(An additional grid is available, if required, on page 28.)



2

(ii) Suggest the most effective antibiotic to use in the treatment of a patient infected with this bacterium.

Antibiotic _____ **1**

(*c*) Explain why a range of antibiotics is needed in the treatment of bacterial diseases.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

19. (*a*) Commercial brewers provide the best growing conditions for yeast.
Draw clear lines to link the growing condition required by yeast with the method used to provide it.

Growing condition	***Method***
Food supply	sterilisation
Suitable temperature	thermostats
Lack of competition	germinating barley grains

1

(*b*) Yeast cells can be measured in micrometres.
1 millimetre (mm) = 1000 micrometres (μm).
If 20 yeast cells together measure 1 mm, what is the average size **in micrometres** of **one** yeast cell?

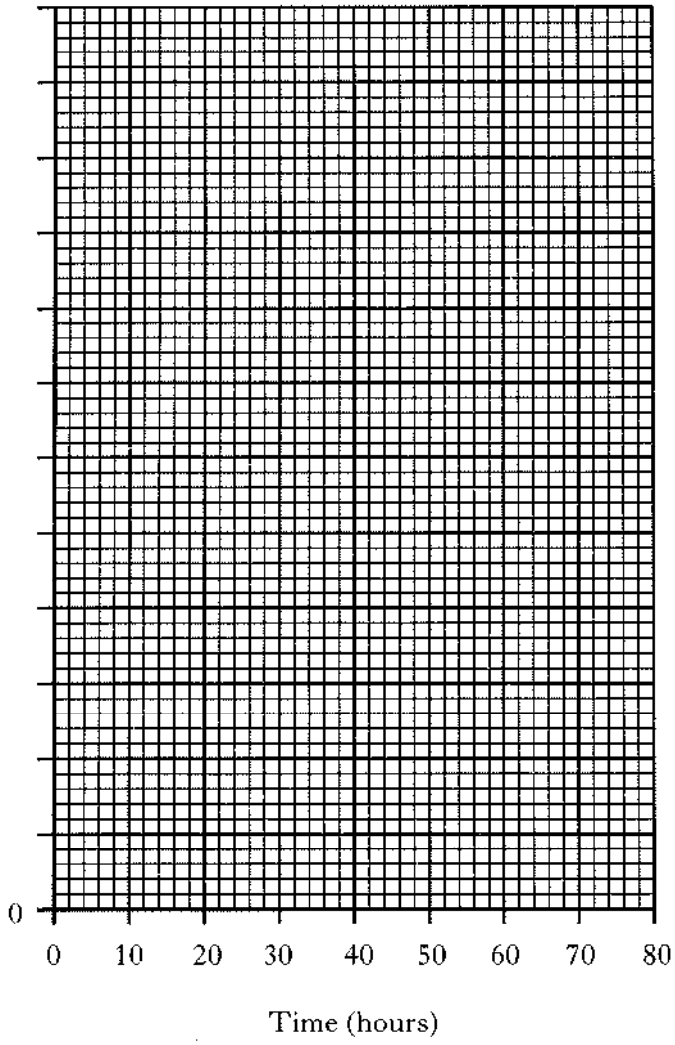
Space for calculation

_____ μm

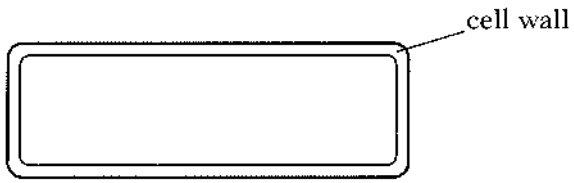
1

[*END OF QUESTION PAPER*]

ADDITIONAL GRAPH PAPER FOR QUESTION 3(*b*)



ADDITIONAL DIAGRAM FOR QUESTION 11(*a*)(i)



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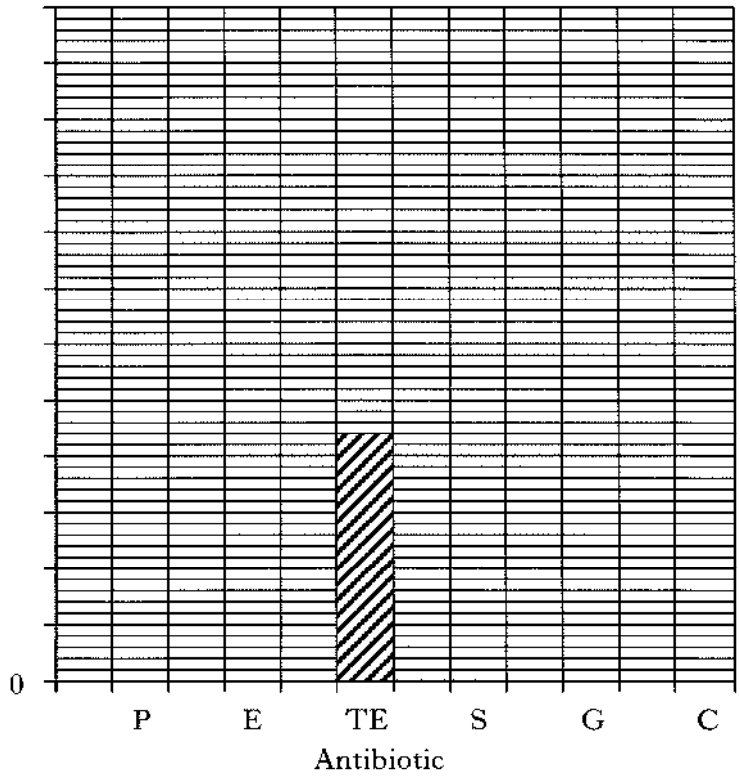
ADDITIONAL GRID FOR QUESTION 18(*b*)(i)



SPACE FOR ANSWERS
AND FOR ROUGH WORKING

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

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