FOR OFFICIAL USE

C

KU	PS

Total Marks

0300/402

NATIONAL QUALIFICATIONS 2010

THURSDAY, 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.

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1. (*a*) Two groups of pupils set pitfall traps in the school gardens to sample invertebrates living there. All traps were left for the same length of time. The results are shown in the following tables.

Group A	*Pitfall trap number*	*Number of each type of invertebrate caught*				
		spider	beetle	snail	earthworm	woodlouse
	1	2	1	2	0	1
	2	3	2	1	0	0

Group B	*Pitfall trap number*	*Number of each type of invertebrate caught*				
		spider	beetle	snail	earthworm	woodlouse
	1	2	3	2	1	1
	2	2	0	3	1	2
	3	0	2	1	1	1
	4	3	2	1	0	1
	5	3	1	1	2	1

(i) How many types of invertebrate did Group A find?

_____ types **1**

(ii) Calculate the average number of spiders found in Group B's traps.

Space for calculation

_____ spiders **1**

(iii) Explain why conclusions made by Group B from their results would be more reliable than conclusions made by Group A.

_____

_____ **1**

(iv) Give **one** precaution which must be taken when setting up a pitfall trap, or other named sampling technique, and explain the reason for it.

Sampling technique _____

Precaution _____

_____ **1**

Reason _____

_____ **1**

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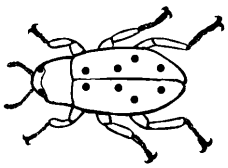
1. (continued)

(*b*) The diagrams below show the invertebrates collected by the pupils. They are not drawn to scale.

Earthworm

Snail

Spider



Beetle

Woodlouse

(i) Complete the following key using information from the diagrams.

1 Legs ..... Go to 2

No legs ..... Go to [ ] **1**

2 12 legs or more ..... *Woodlouse*

Fewer than 12 legs ..... Go to 3

3 Spots on body ..... *Beetle*

No spots on body ..... [ ] **1**

4 Shell ..... *Snail*

[ ] ..... [ ] **1**

(ii) Give **three** features of the beetle mentioned in the key.

1 _____

2 _____

3 _____ **1**

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2. (*a*) Electricity can be generated by using fossil fuels or nuclear fuels as energy sources.

Give **one** disadvantage of using each type of fuel.

Fossil fuel _____

_____ **1**

Nuclear fuel _____

_____ **1**

(*b*) (i) Micro-organisms can obtain their energy by feeding on organic waste such as sewage.

Explain why each of the following events occurred after raw sewage was accidentally released into a river.

1 The number of micro-organisms in the river increased.

_____

_____ **1**

2 The number of fish in the river decreased.

_____

_____ **1**

(ii) A group of students monitored the river using indicator species.

What is meant by the term "indicator species"?

_____

_____ **1**

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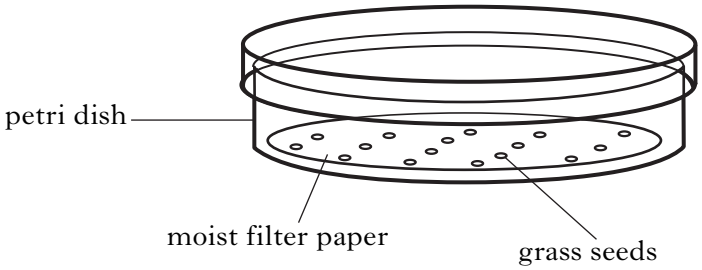
3. (*a*) An investigation was carried out into the effect of temperature on the germination of grass seeds.



Five identical petri dishes, each containing 20 seeds, were set up as shown in the diagram. Each dish was left in the dark at a different temperature. After seven days the percentage germination in each dish was calculated. The results are shown in the table below.

Temperature (°C)	10	18	27	36	45
Percentage germination	45	65	80	70	40

(i) From the results, what is the optimum temperature for the germination of this species of grass?

_____ °C **1**

(ii) Name **one** factor, not already mentioned, which should be kept the same for all the dishes.

_____ **1**

(iii) What feature of the investigation was designed to increase the reliability of the results?

_____ **1**

(*b*) Describe the changes in the percentage germination of seeds that occur over a range of temperatures.

_____

_____ **2**

[Turn over

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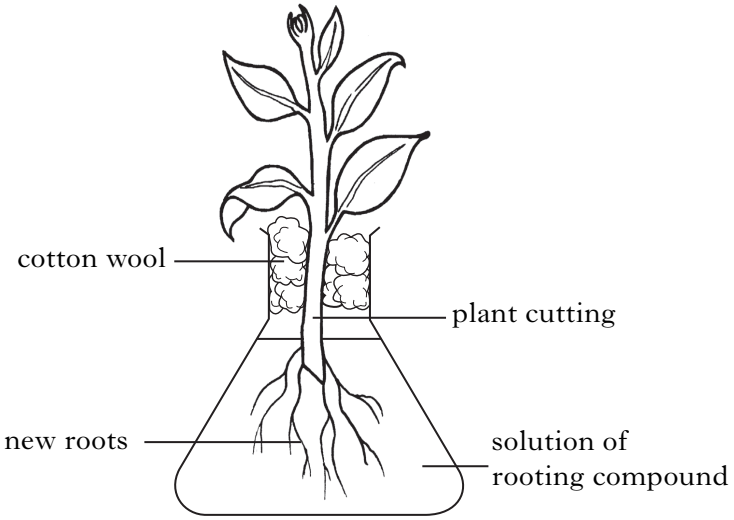
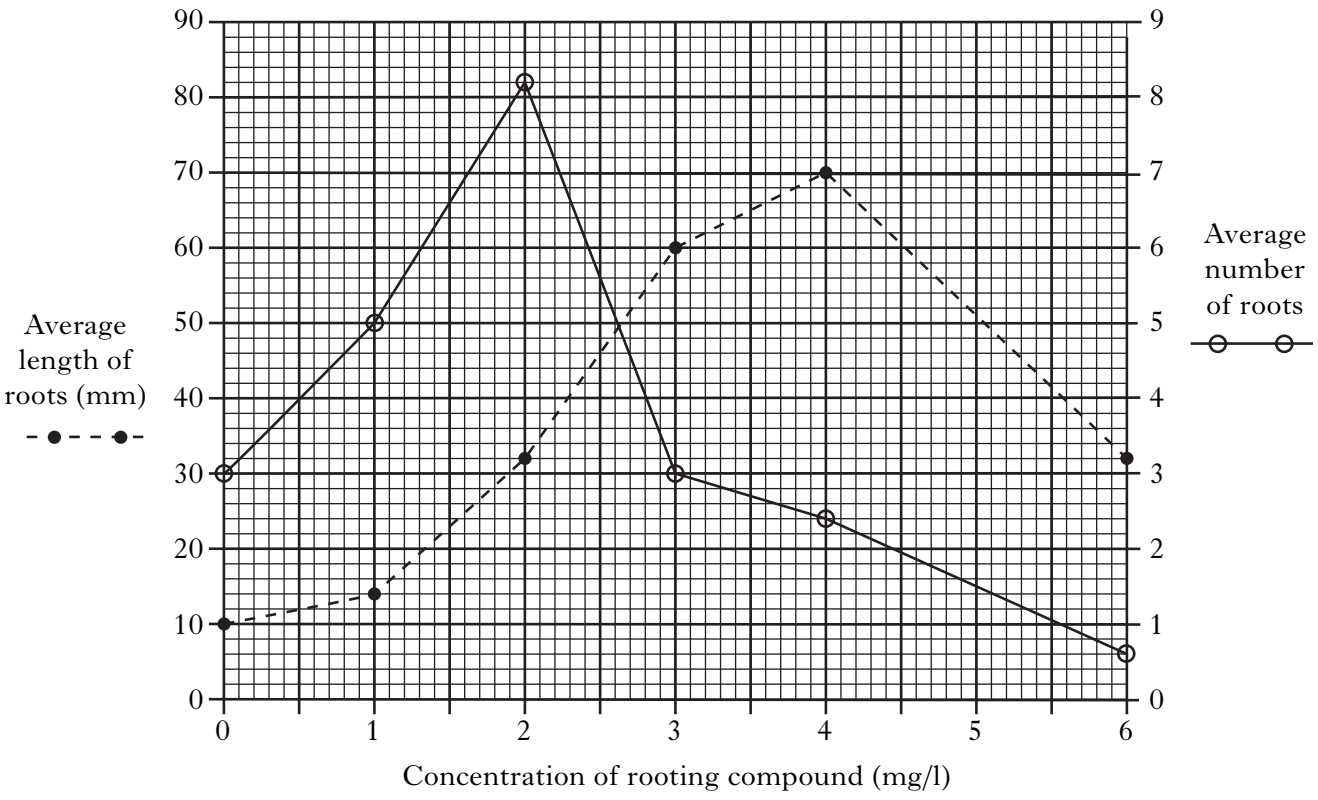
4. Rooting compound helps plant cuttings to produce new roots. The diagram below shows the apparatus used to find out how the concentration of rooting compound affects this.

Six flasks were set up, each with a different concentration of rooting compound.



After 21 days the number of roots and the lengths of the roots on each cutting were measured.

The results are shown on the following graph.



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4. (continued)

(*a*) (i) Which **two** concentrations of rooting compound, used in the investigation, produced the same average root length?

_____ mg/l and _____ mg/l **1**

(ii) Using information from the graph, predict the average length of roots on cuttings grown in a concentration of 2·5mg/l.

_____ mm **1**

(iii) Which concentration of rooting compound produces the greatest number of roots per cutting?

_____ mg/l **1**

(iv) Describe how the average length of the roots on one cutting would be calculated.

_____

_____

_____ **1**

(*b*) Give **one** advantage to a gardener of producing plants from cuttings rather than from seeds.

_____ **1**

(*c*) What term is given to a group of plants grown from cuttings taken from a single plant?

_____ **1**

[Turn over

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5. (*a*) The following table gives information about reproduction in various animals.

	Average number of eggs or young produced per year	*Type of fertilisation*	*Where development takes place*
cod	6 million	external	water
frog		external	water
blackbird	5	internal	inside eggshell
stoat	4	internal	inside female

(i) A female frog produces a total of 4000 eggs over a five year period.

1 Complete the table to show the average number of eggs she produces per year.

Space for calculation

1

2 On average, two eggs from each female frog must survive to breeding age to keep the population constant. What percentage of this frog's **total** egg production does this represent?

Space for calculation

_____ %

1

(ii) Explain why fish such as cod must produce far more eggs than mammals such as stoats to ensure the survival of the species.

_____

_____

1

(iii) Explain the importance of internal fertilisation to land-living animals.

_____

_____

1

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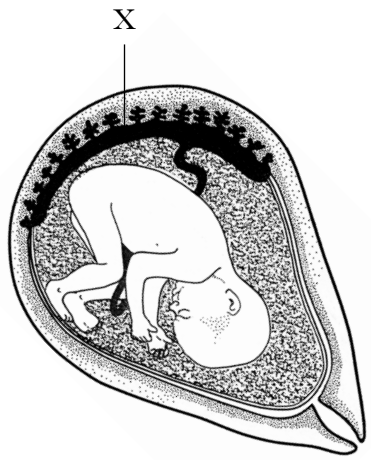
5. (continued)

(*b*) The diagram below represents a stage in the development of a human fetus.



Name structure X and give **one** of its functions.

Name _____

Function _____

_____ **2**

[Turn over

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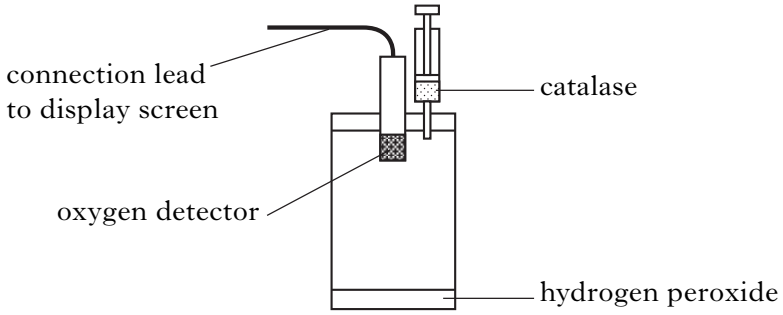
Marks | KU | PS

6. The apparatus shown below was used to study the effect of different temperatures on the activity of the enzyme catalase.



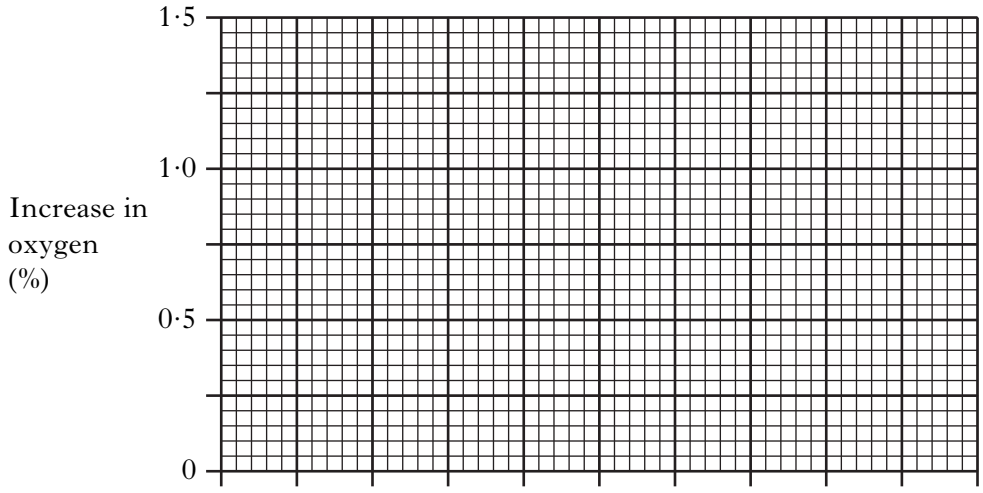
The catalase was added and reacted with the hydrogen peroxide to release oxygen. The increase in oxygen compared to the starting value was recorded as a percentage.

This was carried out at five different temperatures and the results are shown below.

Temperature (°C)	*Increase in oxygen* (%)
4	0·55
21	0·80
34	1·45
40	1·05
50	0·05

(*a*) Use the results to draw a line graph.

(An additional grid, if needed, will be found on *Page twenty-three*.)



2

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

6. (continued)

(*b*) At which temperature was the catalase most active?

_____ °C **1**

(*c*) Why was it important that the catalase and the hydrogen peroxide were both at the required temperature before the catalase was added?

_____

_____ **1**

(*d*) Explain why there was no oxygen released when the experiments were repeated with different enzymes.

_____

_____ **1**

(*e*) Calculate the simple whole number ratio of percentage increase in oxygen at 34 °C, 40 °C and 50 °C.

Space for calculation

_____ : _____ : _____
34 °C 40 °C 50 °C **1**

[Turn over

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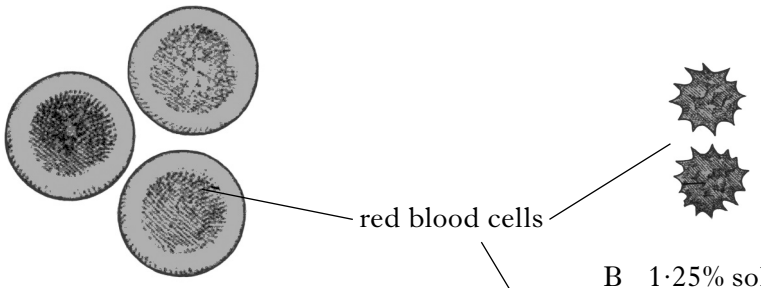
Marks	KU	PS

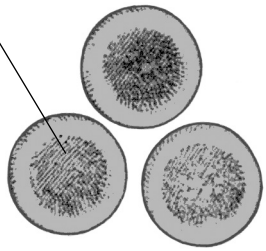
7. The diagrams below represent red blood cells in different solutions as they would appear under a microscope.



A Untreated blood

B 1·25% solute solution

C 0·25% solute solution



D 0·90% solute solution

(*a*) Use the information in the diagrams to predict the percentage solute concentration of human blood. Explain your answer.

Solute concentration _____ %

Explanation _____

_____

_____ **1**

(*b*) What has happened to the cells in diagram B? Explain the change in terms of water concentrations.

Description _____

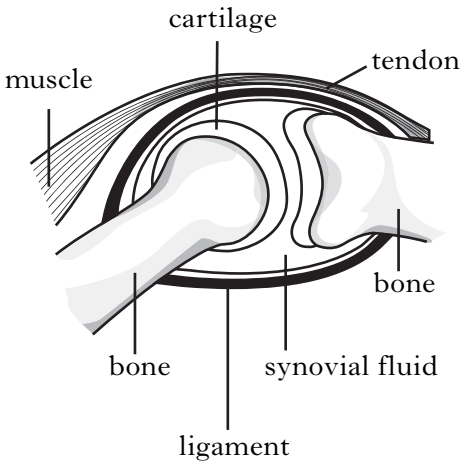
Explanation _____

_____ **2**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

8. The diagram below represents part of a finger joint.



(*a*) (i) The joint needs a second muscle and tendon to make it function properly. Explain the need for joints to have muscles which work in pairs.

_____

_____

_____ **2**

(ii) What feature of tendons ensures that all the force from a muscle contraction is transmitted to the bone?

_____ **1**

(*b*) Name **two** parts of the joint which reduce friction.

1 _____

2 _____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

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

Young at Heart?

New research shows that decades of hard-won progress in reducing the risk of heart disease in America appears to be losing pace. Recent death rates from heart disease remain almost unchanged in men and women under 55 years old.

This trend comes at a time when even young people are increasingly likely to be obese, suffer from diabetes and have high blood pressure. Each of these increases heart attack risk.

Data from 1980 to 2002 showed that the death rate from heart disease had fallen. In the whole population there was a yearly reduction of 2·9 percent during the 1980s, 2·6 percent during the 1990s and 4·4 percent from 2000 to 2002.

However the numbers told a strikingly different story for people aged 35 to 54. The yearly death rate from heart disease fell by 6·2 percent in the 1980s, by only 2·3 percent in the 1990s and showed no reduction at all between 2000 and 2002.

The message is that heart disease has not gone away, and could become an even greater problem if people fail to pay attention to known warning signs. Dr F S Ford, a medical officer for the American government said, "Young adults should take stock of their lifestyles. Don't smoke and take at least 30 minutes of exercise per day. If you need to lose weight, you must burn more energy than you take in. Good habits should start early. Changes that lead to heart disease, for example hardening of the arteries, occur at an early age. Therefore it is especially important that children and young people develop appropriate habits that minimise their risk of heart disease later in life."

(*a*) From the passage, identify **three** factors which contribute to the risk of heart disease.

1 _____

2 _____

3 _____ **1**

(*b*) Complete the table below to show the changes in death rates for the whole population and for the 35–54 age group.

	Average yearly reduction in death rate from heart disease (%)		
	1980–1989	1990–1999	2000–2002
Whole population			
35–54 age group			

2

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

9. (continued)

(*c*) According to Dr Ford, why is it important that "good habits should start early"?

_____

_____ **1**

(*d*) What cellular process is being referred to in the phrase "you must burn more energy"?

_____ **1**

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

10. A tin containing 170 g of evaporated milk has the following label.

Typical values per tin	
Energy	1156 kJ
Protein	12·75 g
Carbohydrate	17·47 g
Fat	17·45 g
Fibre	0·00 g
Salt	0·33 g

(*a*) (i) What percentage of the total contents of the tin is protein?

Space for calculation

_____ % **1**

(ii) What component of the milk would provide most energy?

_____ **1**

(*b*) Name the chemical elements present in fats.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

11. (*a*) Underline **one** option in each bracket to make the following sentence about breathing correct.

When breathing out, the lung volume { increases / stays the same / decreases } and as a result the air pressure in the lungs { increases / stays the same / decreases }. **1**

(*b*) The effect of changing the carbon dioxide concentration in inhaled air on a person's breathing was investigated.

The table below shows the average volume of air inhaled each minute at different concentrations of carbon dioxide.

Carbon dioxide concentration in inhaled air (%)	0	2	4	6	8
Average volume of air inhaled (litres per minute)	8	12	16	24	60

(i) How many times greater is the average volume of air inhaled per minute when the carbon dioxide concentration is increased from 2% to 8%?

Space for calculation

_____ times **1**

(ii) Calculate the average volume of carbon dioxide entering the lungs each minute when the carbon dioxide concentration in the air is 4%.

Space for calculation

_____ litres **1**

(iii) Calculate the increases in the average volume of air breathed per minute when the carbon dioxide changes from 0 to 2% and from 6 to 8%.

Express these increases as a simple whole number ratio.

Space for calculation

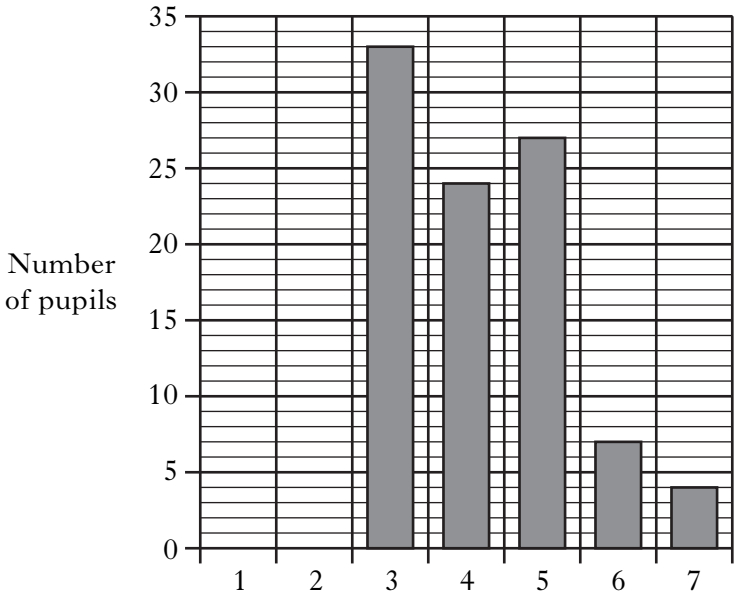
_____ : _____
0–2% : 6–8% **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

12. (*a*) School pupils each carried out an identical word processing task. The resulting level of muscle fatigue was measured on a scale from 1 (low) to 7 (severe).

The results for the 95 pupils tested are shown in the following bar chart.



(i) Medical experts using this scale classify any score of 5 or more as "requiring urgent investigation". What percentage of the pupils tested were in this category?

Space for calculation

_____ % **1**

(ii) Give **two** conclusions which can be drawn from the results of this investigation.

1 _____ **1**

2 _____ **1**

(*b*) (i) What substance, produced by anaerobic respiration, causes muscle fatigue?

_____ **1**

(ii) Explain why ensuring an adequate blood supply to muscles reduces the risk of muscle fatigue.

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

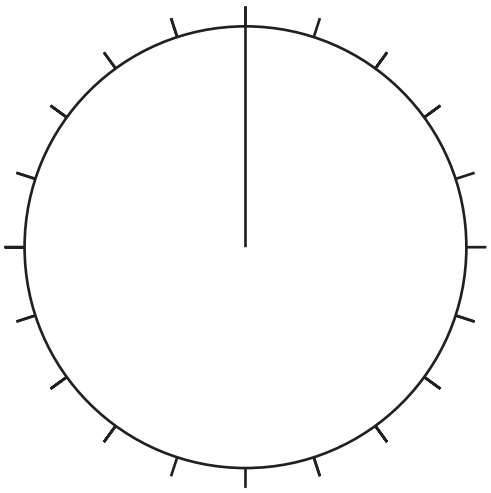
Marks | KU | PS

13. The table below refers to egg production in the UK.

Living condition of hens	*Eggs laid* (percentage of total)
Living in cages	65
Living in barns	5
Free-range	30

(*a*) (i) Use the information from the table to complete the pie chart.

(An additional chart, if needed, will be found on *Page twenty-three*.)



2

(ii) The total number of eggs laid per year in the UK is 30 million.

How many of these are laid by free-range hens?

Space for calculation

_____ eggs **1**

(*b*) Modern varieties of hens can lay up to 300 eggs per year. Their ancestral wild varieties laid about 20 eggs per year.

(i) Calculate this increase in egg production as a percentage.

Space for calculation

_____ % **1**

(ii) How has this improvement in egg production been achieved?

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

14. Polydactyly is a condition which results in extra toes in mice. It is controlled by the dominant form of a gene (**N**). The normal phenotype is controlled by the recessive form (**n**).

The diagram below shows a cross between two mice of different genotypes.

Parent 1 **NN** × Parent 2 **nn**

↓

F_1 **Nn**

↓ allowed to interbreed

F_2

F_1 gametes	**N**	**n**
N		
n	**Nn**	

(*a*) (i) Complete the diagram above to show the possible genotypes of the F_2 generation. **1**

(ii) Give the phenotypes of each of the following mice.

Parent 1 _____

Parent 2 _____

F_1 _____ **2**

(iii) What term is used to describe the type of variation shown by these phenotypes?

_____ **1**

(*b*) Why are the actual phenotype ratios in the F_2 generation often different from the predicted ones?

_____

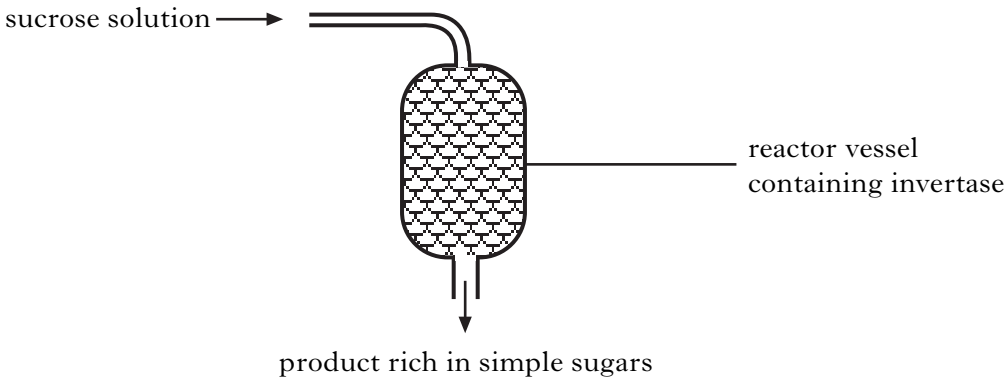
_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

15. (*a*) Sucrose can be broken down into simple sugars using the enzyme invertase. The diagram below represents how this can be done commercially.

Sucrose solution is constantly being added and the products are constantly being removed.



(i) What name is given to this type of process?

_____ **1**

(ii) Explain why the enzyme does not leave the reactor vessel along with the products.

_____ **1**

(*b*) (i) Genetic engineering techniques are used to produce enzymes which are used in biological washing powders. Which type of micro-organism is modified to produce the appropriate enzymes?

_____ **1**

(ii) What is transferred from one organism to another during genetic engineering?

_____ **1**

(*c*) During the brewing of beer, ingredients including yeast and malted barley are added to a fermentation vessel.

(i) What does the malted barley provide for fermentation which ungerminated barley does not?

_____ **1**

(ii) How does sterilising the fermentation vessel before the raw materials are added help to provide optimum conditions for the yeast?

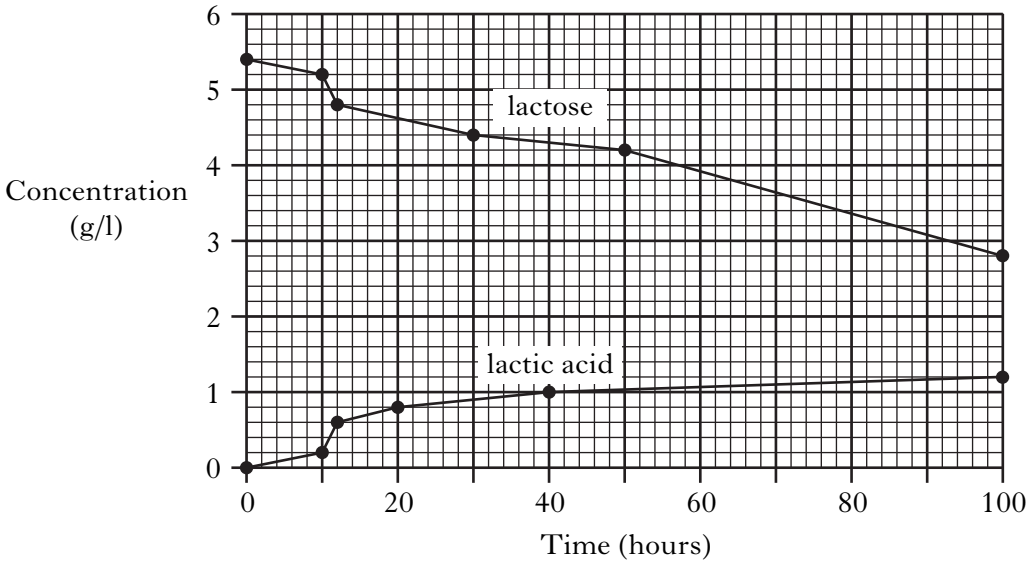
_____ **1**

[Turn over for Question 16 on *Page twenty-two*

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

16. The concentrations of lactic acid and lactose in a milk sample were measured every two hours for 100 hours. The results are shown in the graph below.



(*a*) (i) What evidence from the graph suggests that lactose is converted into lactic acid?

_____

_____ **1**

(ii) What evidence from the graph supports the theory that lactose is being converted into compounds other than lactic acid?

_____

_____ **1**

(*b*) Calculate the average hourly rate of lactose breakdown over the 100 hours of this investigation.

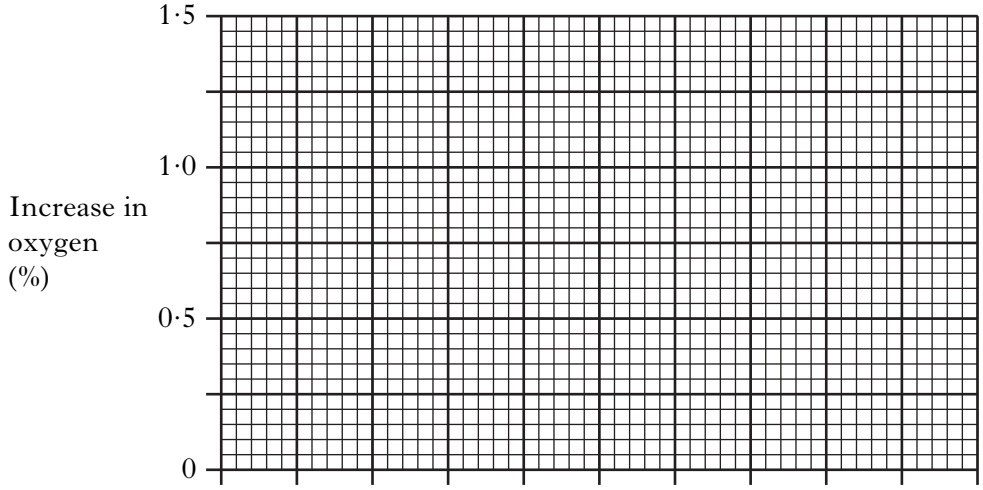
Space for calculation

_____ g/l/hour **1**

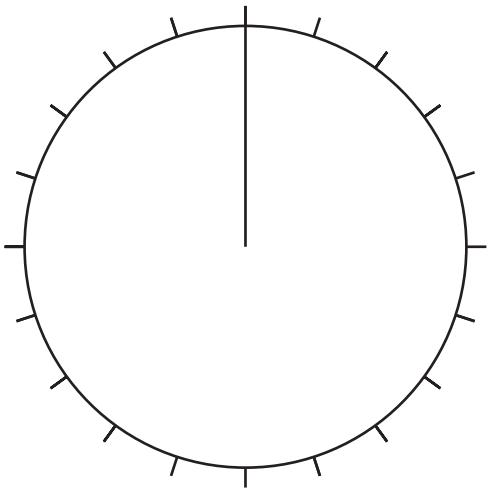
[*END OF QUESTION PAPER*]

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

ADDITIONAL GRID FOR QUESTION 6(*a*)



ADDITIONAL PIE CHART FOR QUESTION 13(*a*)(i)



SPACE FOR ANSWERS
AND FOR ROUGH WORKING