FOR OFFICIAL USE

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C

KU PS

| | |
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| | |

Total Marks

# 0300/31/01

NATIONAL QUALIFICATIONS 2013

WEDNESDAY, 15 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.

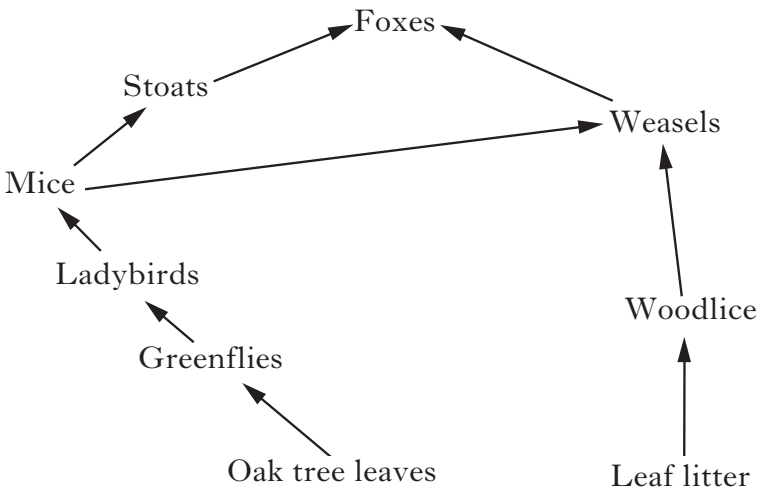
3 Rough work, if any should be necessary, as well as the fair copy, is to be written in this book. Additional spaces for answers and for rough work will be found at the end of the book. Rough work should be scored through when the fair copy has been written.

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*) The diagram below shows part of a woodland food web.




Use the words ***increase***, ***decrease*** or ***stay the same*** to describe the effect on the populations of greenflies and stoats if all the mice were killed by a disease.

Give a reason for your answer.

(i) Effect on greenfly population _____

Reason _____

_____

_____ **1**

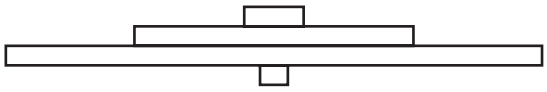
(ii) Effect on stoat population _____

Reason _____

_____

_____ **1**

(*b*) Which of the following food chains could be represented by the pyramid of numbers shown below?



Tick (✓) the correct box.

☐ grass ⟶ beetle ⟶ spider ⟶ robin

☐ oak tree ⟶ greenfly ⟶ ladybird ⟶ blackbird

☐ plant plankton ⟶ mayfly larvae ⟶ water beetle ⟶ stickleback

☐ beech tree ⟶ squirrel ⟶ fox **1**

DO NOT WRITE IN THIS MARGIN

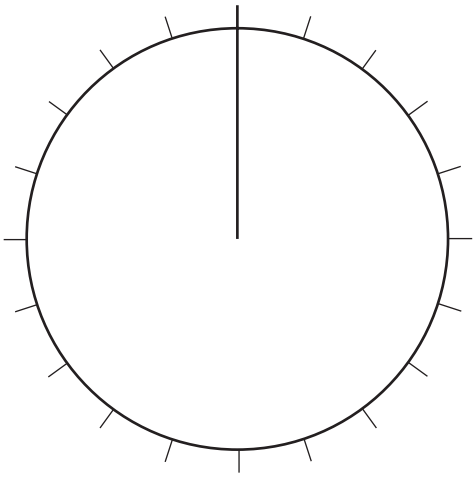
Marks | KU | PS

**2.** (*a*) The table below refers to crop production in Scotland in 2008. It shows the area of the land used to grow the five main crops as a percentage of the total.

| *Crop* | *Area of land used* (percentage) |
|---|---|
| oats | 5 |
| potatoes | 5 |
| oil seed rape | 10 |
| wheat | 25 |
| barley | 55 |

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

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



**2**

(ii) If 50 000 hectares of land is available in Scotland to grow crops, what area of land was used for wheat production?

*Space for calculation*

_____ hectares **1**

(*b*) Describe a production or refining process associated with a named crop.

Crop _____

Process _____

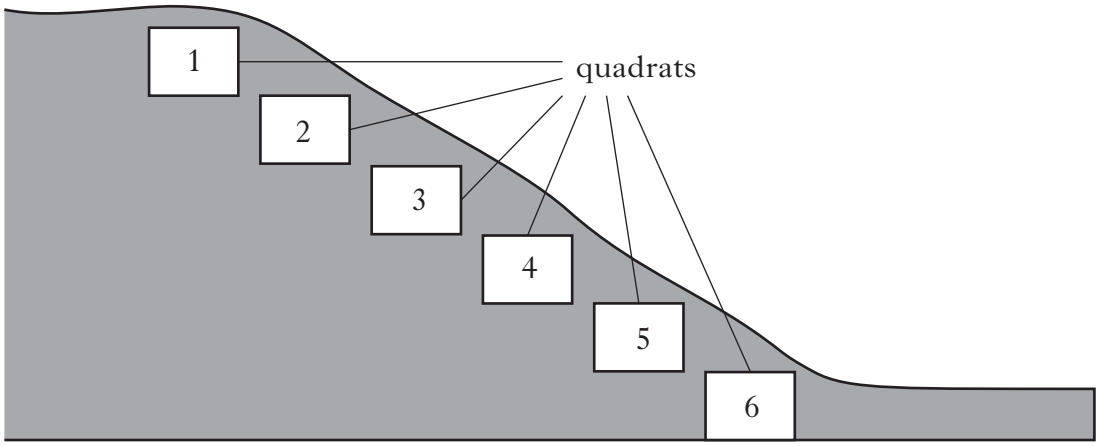
_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

**3.** (*a*) In an investigation into the distribution of heather plants, six quadrats were placed in a line from the top to the bottom of a hill.

Soil moisture, pH, surface light intensity and heather abundance score were recorded for each quadrat.




The following table shows the results.

| *Quadrat* | *Soil moisture* (%) | *Surface light intensity* (lux) | *pH* | *Heather abundance score* |
|---|---|---|---|---|
| 1 | 10 | 10 000 | 5·5 | 25 |
| 2 | 15 | 11 000 | 5·4 | 22 |
| 3 | 40 | 10 000 | 5·5 | 15 |
| 4 | 63 | 10 500 | 5·5 | 9 |
| 5 | 71 | 12 000 | 5·6 | 6 |
| 6 | 81 | 11 000 | 5·4 | 0 |

(i) Describe the distribution of heather on the slope of the hill.

_____

_____ **1**

(ii) Which of the abiotic factors recorded has the greatest effect on the distribution of the heather plants?

_____ **1**

(iii) Which quadrat would be most likely to contain a species of plant which grows best in wet soil with a low pH?

Quadrat _____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

**3. (continued)**

(*b*) The following list gives some of the stages involved in the nitrogen cycle.

***List***

1 Production of plant protein

2 Absorption of nitrogen compounds into plants

3 Nitrates produced in the soil

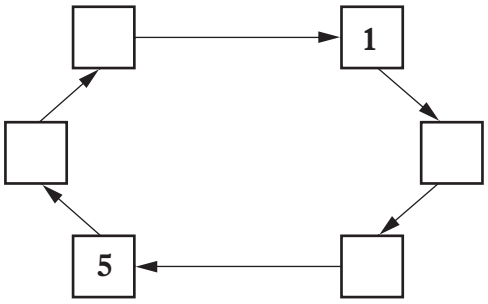
4 Ammonium compounds produced from soil organic matter

5 Nitrites produced in the soil

6 Death of plants

(i) Use the numbers from the list to show the correct sequence of the stages in the diagram below.

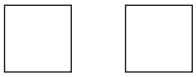
Two boxes have been completed for you.




**1**

(ii) Three of the stages involve the action of bacteria.

Write the numbers of any two of these stages in the boxes below.



**1**

(*c*) Name **one** other element which can be recycled by bacteria during the process of decay.

_____

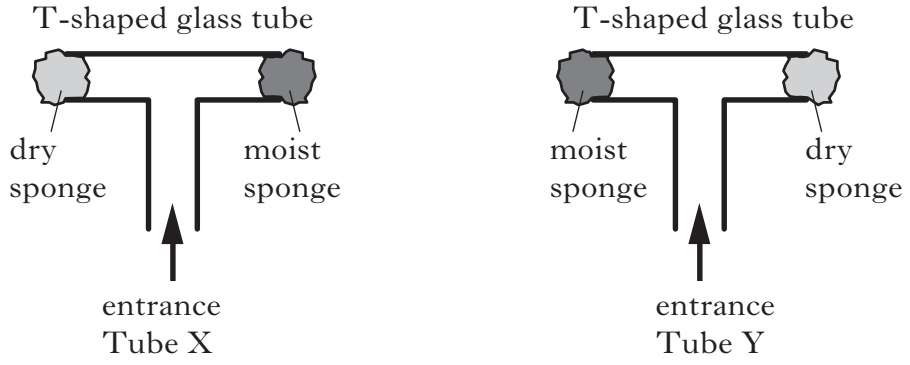
**1**

**[Turn over**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

**4.** An investigation was carried out into the response of flour beetles to humidity. Two T-shaped glass tubes were set up as shown below.




Each T-shaped tube was left for 10 minutes before one beetle was placed at the entrance.

The direction in which the beetle turned was recorded.

This was repeated for a total of 25 beetles using a different beetle and a new T-shaped tube each time.

The results for the investigation are shown in the table below.

| | *Tube* | | | |
|---|---|---|---|---|
| | X | | Y | |
| Direction turned | left | right | left | right |
| Humidity | dry | moist | moist | dry |
| Number of beetles | 21 | 4 | 5 | 20 |

(*a*) Which of the following is the best conclusion to draw from this investigation?

Tick (✓) the correct box.

- ☐ Most flour beetles turn left.
- ☐ Most flour beetles turn right.
- ☐ Most flour beetles turn to dry areas.
- ☐ Most flour beetles turn to moist areas.

1

(*b*) The diagram shows that tubes X and Y were set up differently.

How does this improve the validity of the investigation?

_____

_____

1

DO NOT WRITE IN THIS MARGIN

*Marks*

| KU | PS |
|---|---|

**4. (continued)**

(*c*) What was the purpose of leaving each tube for 10 minutes before placing a beetle at the entrance?

_____

_____ **1**

(*d*) Suggest a reason why a new T-tube was used for each beetle, rather than using the same tube repeatedly.

_____

_____ **1**

(*e*) Calculate the **total** percentage of beetles which turned towards the moist end in the investigation.

*Space for calculation*

_____ % **1**

**[Turn over**

DO NOT WRITE IN THIS MARGIN

| Marks | KU | PS |
|---|---|---|

**5.** (*a*) Two gardeners compared their tomato crops. Both grew 10 plants of the same variety in a greenhouse.

One gardener altered the environmental conditions in his greenhouse to increase the rate of photosynthesis. His plants yielded 720 tomatoes. The other gardener only produced 480 tomatoes.

(i) What was the percentage increase in the yield of tomatoes when the rate of photosynthesis was increased?

*Space for calculation*

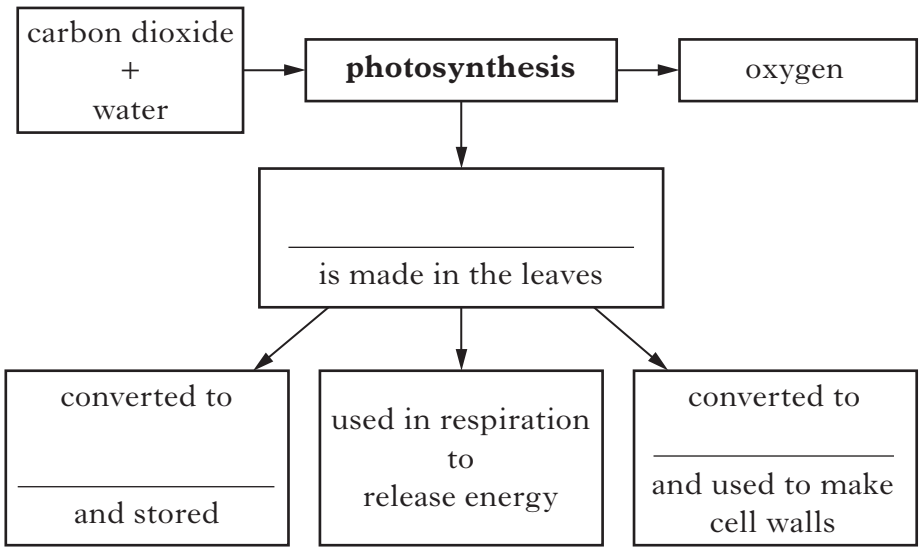
_____ % **1**

(ii) Describe **two** changes to the environmental conditions in the greenhouse which could have increased the rate of photosynthesis.

1 _____

2 _____ **1**

(*b*) (i) Complete the diagram below to show how the carbohydrate product of photosynthesis is used in a plant.




**2**

(ii) Name a tissue in the leaves of plants in which photosynthesis takes place.

_____ **1**

Marks | KU | PS

**6.** A sample of polluted water was collected from a river. Bacteria in the sample were grown in the laboratory and then examined using a variety of tests.

The results are shown in the table below.

| *Bacteria* | *Gram stain reaction* | *Shape of cells* | *Reaction to penicillin* |
|---|---|---|---|
| P | positive | round | resistant |
| Q | positive | rod | resistant |
| R | negative | rod | resistant |
| S | positive | round | sensitive |

The following key identifies the four types of bacteria.

1 Gram stain positive ..... Go to 2

Gram stain negative ..... *Escherichia*

2 Round shaped cells ..... Go to 3

Rod shaped cells ..... *Clostridium*

3 Sensitive to penicillin ..... *Micrococcus*

Resistant to penicillin ..... *Staphylococcus*

Use the key to name the four bacteria.

Bacterium P _____

Bacterium Q _____

Bacterium R _____

Bacterium S _____ **2**

**[Turn over**

DO NOT WRITE IN THIS MARGIN

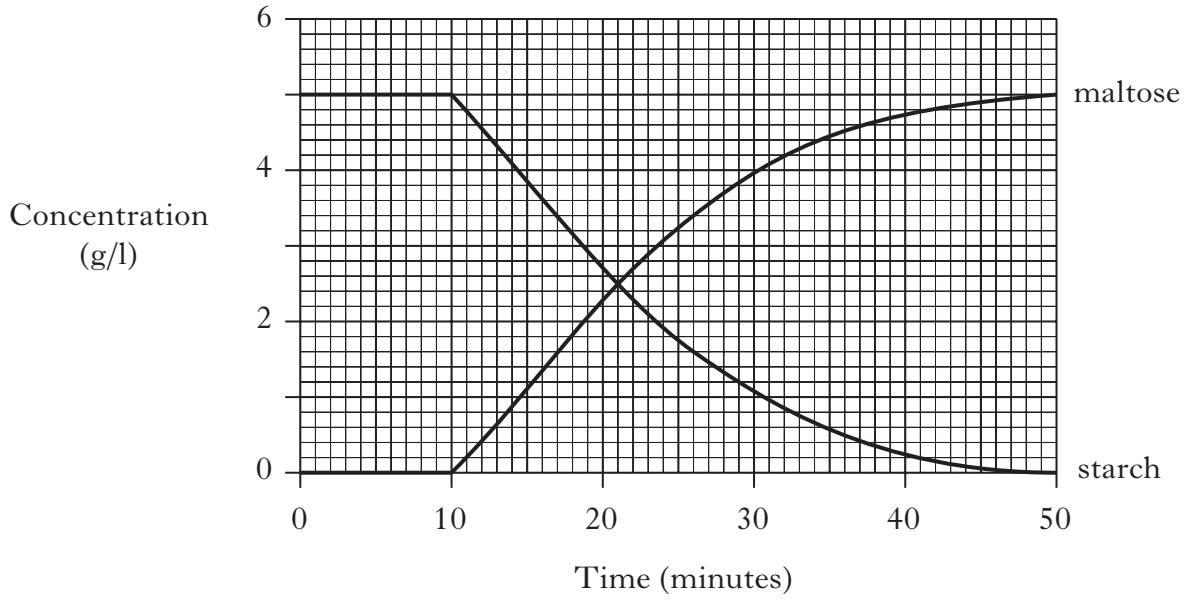
*Marks* | KU | PS

**7.** (*a*) In an investigation into the digestion of starch, a beaker containing a solution of starch was placed in a water bath at 30 °C. A test tube containing enzyme solution was also placed in the water bath.

After some time, the enzyme solution was added to the starch solution and stirred.

The concentrations of starch and maltose sugar were then measured regularly.

The results are shown on the graph below.




(i) For how long were the solutions left in the water bath before being mixed?

_____ minutes **1**

(ii) Give a reason why the solutions were left for some time before being mixed.

_____

_____ **1**

(iii) At what time into the investigation was exactly half of the starch digested?

_____ minutes **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

**7. (*a*) (continued)**

(iv) What evidence from the results shows that the maltose was produced from the starch?

_____

_____ **1**

(v) Name the enzyme used in the investigation.

_____ **1**

(*b*) (i) Name **one** part of the digestive system that produces a digestive juice which breaks down starch to sugars.

_____ **1**

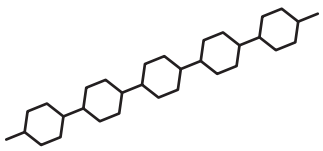
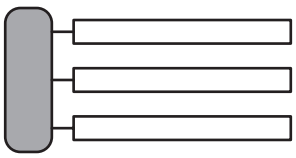
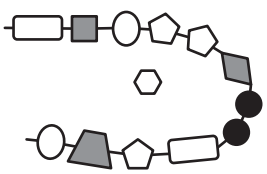
(ii) State **two** properties of simple sugar molecules which allow them to be absorbed from the digestive system into the blood.

1 _____

2 _____ **1**

(*c*) The following table refers to the major food groups.

Complete the table with the missing information.

| *Food group* | *Structure* | *Basic units* | *Elements present* |
|---|---|---|---|
| carbohydrate |  | simple sugars | |
| |  | | carbon<br>hydrogen<br>oxygen |
| protein |  | | |

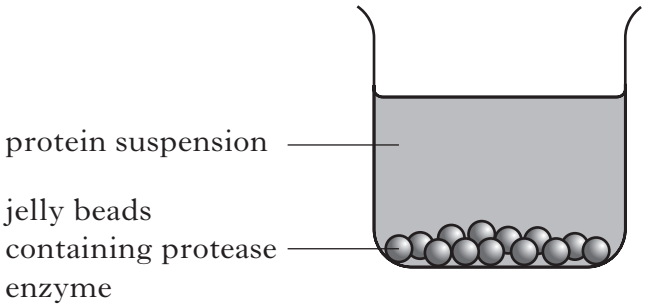
**3**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

**8.** (*a*) In an investigation into the digestion of protein, two groups of pupils made jelly beads containing a protease enzyme. The beads were then left in a beaker of cloudy protein suspension for 20 minutes.

The contents of the beaker became clear as the protein was digested.




(i) Name the technique used to trap the enzyme in the jelly beads.

_____ **1**

(ii) Give **one** advantage of using this technique in commercial processes.

_____

_____

_____ **1**

(iii) Describe the contents of a beaker which would be a suitable control in this investigation.

_____

_____ **1**

(iv) Why would the protein suspension not be digested if a lipase enzyme had been used instead of a protease enzyme?

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

*Marks* | KU | PS

**8. (*a*) (continued)**

(v) While making their jelly beads one of the groups accidentally rinsed the beads in very hot water instead of cold water.

Predict the effect this would have on the results of the investigation.

Give a reason for your answer.

Prediction _____ **1**

Reason _____

_____

_____ **1**

(*b*) (i) What term is used to describe the temperature at which an enzyme works best?

_____ **1**

(ii) Name **one** factor, other than temperature, which has an effect on the activity of an enzyme.

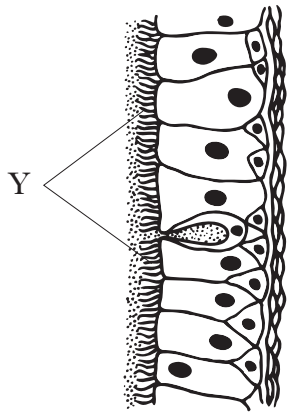
_____ **1**

**[Turn over**

DO NOT WRITE IN THIS MARGIN

| Marks | KU | PS |
|---|---|---|

**9.** (*a*) The diagram below shows some cells from the lining of a human trachea.



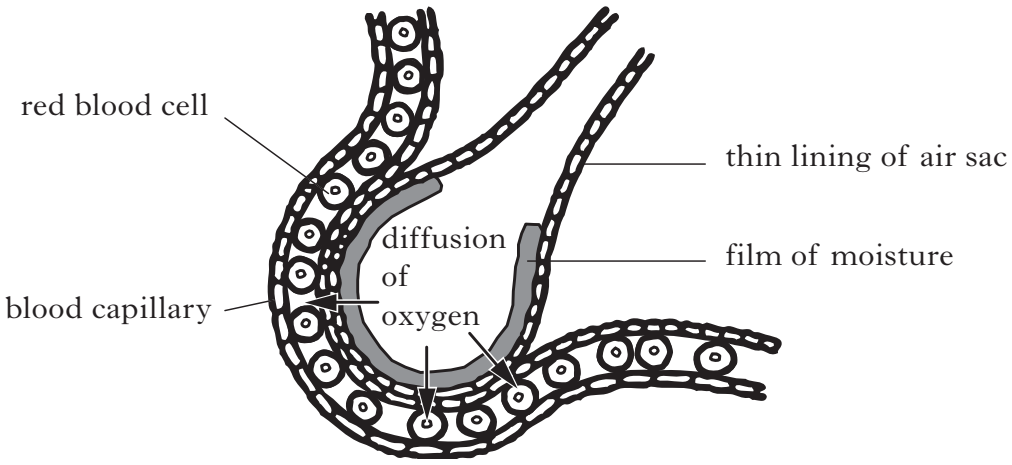

Name the microscopic hair-like structures labelled Y and describe their function.

Name _____ **1**

Function _____

_____ **1**

(*b*) The diagram below represents an air sac in a human lung.




(i) Explain why each of the following features, shown in the diagram, are needed for the efficient diffusion of oxygen.

1 Film of moisture _____

_____ **1**

2 Thin lining of air sac _____

_____ **1**

DO NOT WRITE IN THIS MARGIN

**9. (*b*) (continued)**

*Marks* | KU | PS

(ii) Describe what happens to oxygen after it enters a red blood cell.

_____

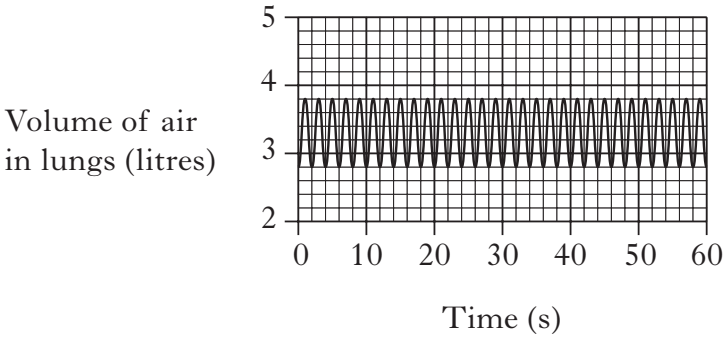
_____ **2**

(*c*) Which **three** of the following actions are involved when humans breathe in deeply?

Tick (✓) the correct boxes.

- ☐ Intercostal muscles relax
- ☐ Intercostal muscles contract
- ☐ Diaphragm relaxes
- ☐ Diaphragm contracts
- ☐ Rib cage moves upwards and outwards
- ☐ Rib cage moves downwards and inwards **1**

(*d*) The graph below shows the volume of air in the lungs of a person while breathing.




(i) What volume of air is inhaled in one breath?

*Space for calculation*

_____ litres **1**

(ii) What is the person's breathing rate?

*Space for calculation*

_____ breaths per minute **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

**10.** Read the following passage and answer the questions based on it.

**Robert Hooke (born 1635 – died 1703)**

Robert Hooke was a scientific genius. His interests included physics, astronomy, chemistry and biology.

Hooke's special contribution to biology was the invention of the many-lensed compound microscope (Figure 1). With it, Hooke observed a huge variety of organisms in great detail. He used his artistic skills to draw what he saw in his book *Micrographia*, which was published in 1665.

Figure 1

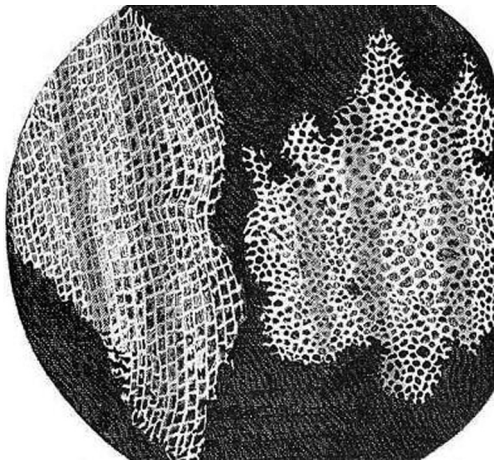


Figure 2

Probably Hooke's most famous microscopic observation was his study of thin slices of cork (Figure 2). He wrote "I could plainly see it to be all perforated and porous, much like a honeycomb, but that the pores were not regular. These microscopic pores or cells were indeed the first I ever saw, and perhaps, that were ever seen." Hooke had discovered plant cells. In fact it was Hooke who decided to call them "cells". He also reported seeing similar structures in other plants.

Hooke's microscope was a great improvement on Antony van Leeuwenhoek's single-lensed microscope. In 1678, van Leeuwenhoek wrote to the Royal Society to report his discovery of "little animals". He said "They were so small that I judged that even if 100 of these were laid end to end they would not reach the length of a millimetre." Hooke was asked by the Society to confirm van Leeuwenhoek's findings and did so successfully. As a result, Hooke became the founder of the study of cell biology and microbiology.

(*a*) What age was Robert Hooke when he published *Micrographia*?

*Space for calculation*

_____ years **1**

DO NOT WRITE IN THIS MARGIN

*Marks* | KU | PS

**10. (continued)**

(*b*) What was the main difference between Robert Hooke's compound microscope and the microscope invented by Antony van Leeuwenhoek?

_____

_____ **1**

(*c*) Give **one** similarity and **one** difference which Hooke noted between a honeycomb and cork cells.

Similarity _____ **1**

Difference _____ **1**

(*d*) What part of plant cells make up the structure of cork as seen by Robert Hooke?

_____ **1**

(*e*) We now know that the "little animals" mentioned in the passage vary from 0·002 millimetres to 0·008 millimetres.

Explain how this information proves that Leeuwenhoek's estimate of their size was correct.

*Space for calculation*

Explanation _____

_____

_____ **1**

**[Turn over**

DO NOT WRITE IN THIS MARGIN

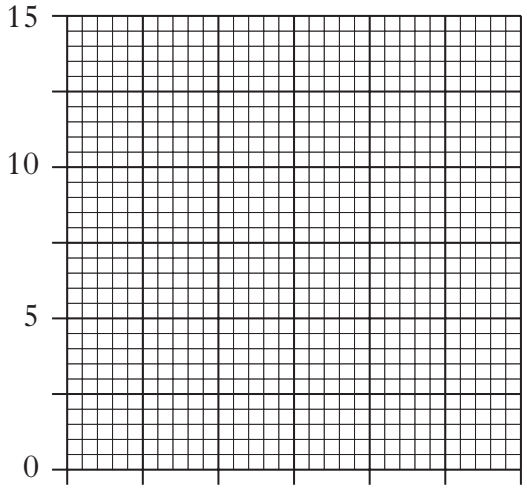
Marks | KU | PS

**11.** The table below shows the annual death rates from lung cancer of ex-smokers who had smoked for more than five years and then stopped smoking.

| *Time since ex-smokers stopped smoking* (*years*) | *Annual deaths per 10 000 of population* |
|---|---|
| 0 | 14 |
| 2 | 7 |
| 4 | 5 |
| 6 | 3 |
| 8 | 2 |
| 10 | 2 |
| 12 | 2 |

(*a*) Draw a line graph of these results on the grid below.

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




Time since ex-smokers stopped smoking
(years)

**2**

DO NOT WRITE IN THIS MARGIN

*Marks* | KU | PS

**11. (continued)**

(*b*) Underline one option in each bracket to complete the following sentences based on the data in the table.

The annual death rate from lung cancer for people who stop smoking

{ rises / stays the same / falls } . The greatest change is { 0 – 2 / 2 – 4 / 4 – 6 } years after

stopping. Within 8 years from stopping, their risk of death from lung

cancer is { 2 / 7 / 12 } times less than that of people who have just stopped

smoking. **2**

(*c*) The annual death rate from lung cancer for non-smokers is 1 per 10 000.

What evidence in the table suggests that some of the damage caused by smoking for more than five years is permanent?

_____

_____

_____ **1**

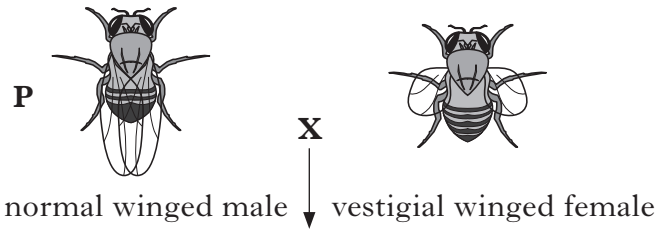
**[Turn over**

DO NOT WRITE IN THIS MARGIN

*Marks* | KU | PS

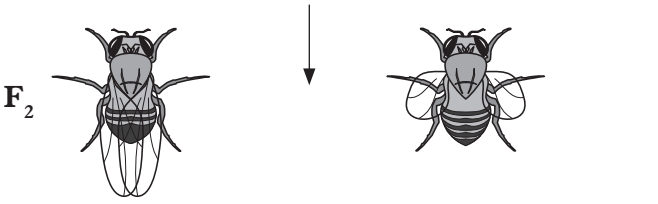
**12.** (*a*) Fruit flies show variation in wing structure which can be inherited.

Flies were crossed as shown below.





All $F_1$ flies have normal wings.
$F_1$ flies were self-crossed.




Some flies have normal wings and some have vestigial wings

(i) Using "N" for the normal form and "n" for the vestigial form, give the genotypes of each of the following:

1 Parent with normal wings _____

2 A fly from the $F_1$ generation _____

3 An $F_2$ fly with vestigial wings _____ **2**

(ii) Which of the following flies could be described as true-breeding?

Tick (✓) the correct boxes.

☐ Parent with normal wings

☐ Parent with vestigial wings

☐ $F_1$ flies

☐ $F_2$ flies with normal wings **1**

DO NOT WRITE IN THIS MARGIN

*Marks* | KU | PS

**12. (continued)**

(*b*) What term is used to describe the different forms of a gene?

_____ **1**

(*c*) Variation in a species can be caused by mutation.

(i) What is meant by the term "mutation"?

_____

_____ **1**

(ii) Give an example of a factor which can increase the rate of mutation in an organism.

_____ **1**

**[Turn over**

DO NOT WRITE IN THIS MARGIN

| Marks | KU | PS |
|---|---|---|

**13.** (*a*) A student carried out an investigation on the effect of soaking time on the cleaning ability of a biological detergent.

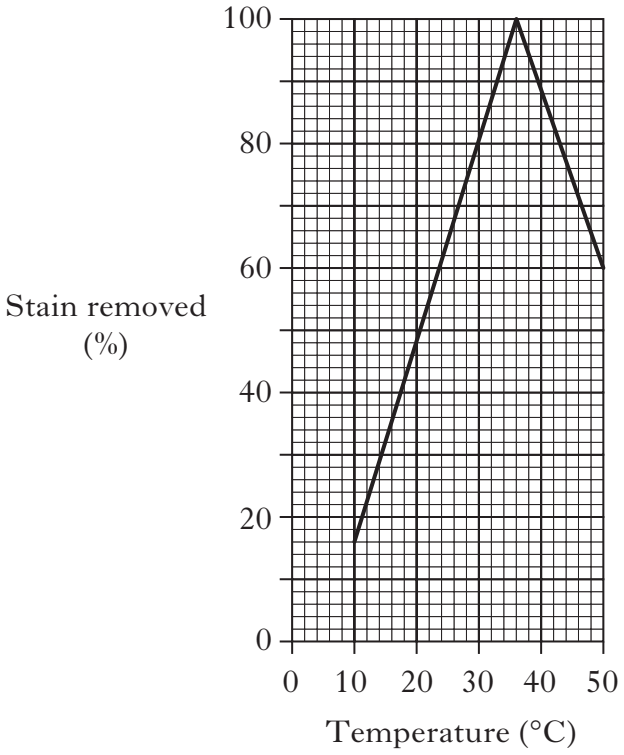
Which of the following would be part of his procedure for this investigation?

Tick (✓) the correct boxes.

- ☐ He used different types of cloths.
- ☐ He used a range of different temperatures.
- ☐ He used a biological detergent only.
- ☐ He used a non-biological detergent only.
- ☐ He used a range of soaking times.
- ☐ He used different types of stains.
- ☐ He used different volumes of stain.

**2**

(*b*) The line graph shows the results of an investigation into the effectiveness of a detergent at different temperatures.



DO NOT WRITE IN THIS MARGIN

*Marks* | KU | PS

**13. (*b*) (continued)**

(i) Describe the effect of temperature on stain removal when using this detergent.

_____

_____

_____ **2**

(ii) A washing machine has four temperature settings:

20 °C 30 °C 40 °C 50 °C

Which setting would produce the best results using this detergent?

_____ °C **1**

(iii) How many times more effective was this detergent when the temperature was increased from 10 °C to 30 °C?

*Space for calculation*

_____ times **1**

(*c*) Decide if each of the following statements is **True** or **False** and tick (✓) the appropriate box.

If the statement is **False**, write the correct word in the **Correction** box to replace the word <u>underlined</u> in the statement.

| *Statement* | ***True*** | ***False*** | ***Correction*** |
|---|---|---|---|
| <u>Algae</u> are used in the production of biological detergents | | | |
| Biological detergents contain <u>enzymes</u> to help remove stains | | | |

**2**

**[Turn over**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

**14.** (*a*) Insulin is used to treat people with diabetes. It can be manufactured by genetically-engineered bacteria using the steps described below.

A Bacteria are grown in a fermenter and produce insulin.

B The human insulin gene is isolated.

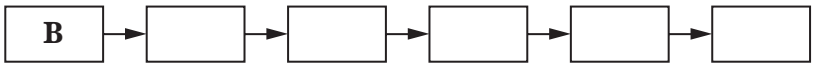
C Plasmids are removed from bacteria.

D Human insulin is purified and used to treat people with diabetes.

E The human insulin gene is inserted into a plasmid.

F Altered plasmids are put into bacteria.

Arrange the steps into the correct order by putting the appropriate letter into each empty box.

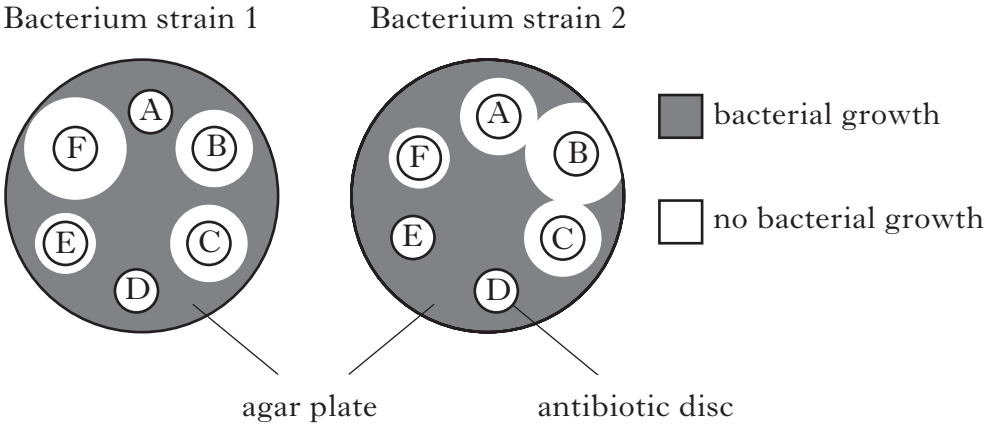



**1**

(*b*) Strains of two different bacteria were grown on agar plates.

The sensitivity of each strain to a variety of antibiotics was tested.

Discs soaked in six different antibiotics were placed on the plates.




(i) Identify the antibiotic to which strain 1 is most sensitive.

Antibiotic _____ **1**

(ii) Identify the antibiotics which prevent the growth of one strain of bacteria, but not the other strain.

Antibiotics _____ **1**

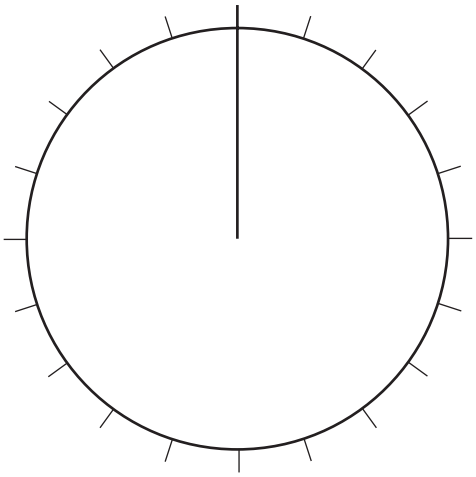
[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

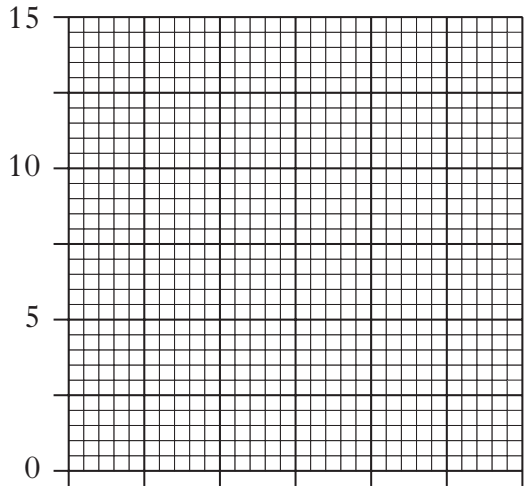
| KU | PS |
|---|---|
| | |

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

ADDITIONAL CHART FOR QUESTION 2(*a*)(i)



ADDITIONAL GRID FOR QUESTION 11(*a*)




Time since ex-smokers stopped smoking
(years)

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

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