

FOR OFFICIAL USE

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C

KU PS

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Total Marks

**0300/402**

NATIONAL  
QUALIFICATIONS  
2011

MONDAY, 9 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

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Scottish candidate number

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Number of seat

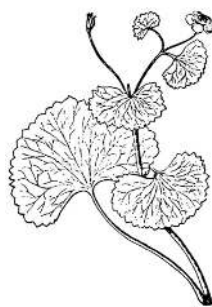
- All questions should be attempted.
- The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.
- Rough work, if any should be necessary, as well as the fair copy, is to be written in this 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.
- 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.



Marks

KU	PS

1. Marsh marigold is a waterside plant which grows beside burns.



The abundance of marsh marigolds was estimated in five sampling areas beside a burn in the Scottish borders. Average values of three abiotic factors were also calculated for each area.

The results are shown in the table below.

Sample area	1	2	3	4	5
Abundance of marsh marigold	zero	high	high	medium	low
Average soil pH	5.6	6.7	7.1	6.5	6.4
Average soil nitrate concentration (ppm)	4	10	7	6	5
Average soil water content (units)	8	4	9	3	5

(a) Name **one** abiotic factor which does not affect the abundance of marsh marigolds.

\_\_\_\_\_

1

(b) The soil pH for each sampling area was measured using a pH meter with a probe which was pushed into the soil to obtain each reading.

(i) Identify a possible source of error in measuring a **named** abiotic factor and suggest how to minimise it.

Abiotic factor \_\_\_\_\_

Source of error \_\_\_\_\_

How to minimise it \_\_\_\_\_

\_\_\_\_\_

2

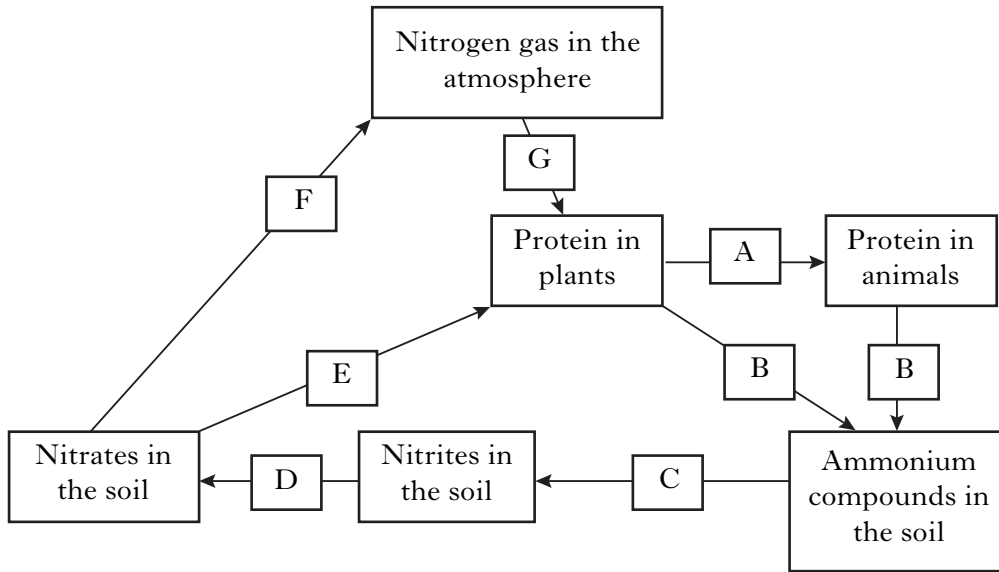
(ii) How was the measurement of the abiotic factors in this survey carried out to reduce the effect of atypical results?

\_\_\_\_\_

1

Marks	Marks	
	KU	PS

2. The diagram below represents part of the nitrogen cycle.



- (a) (i) Use letters from the diagram to identify the following.  
Each letter may be used once, more than once or not at all.

Decay of dead material	<input type="text"/>
Nitrification	<input type="text"/> <input type="text"/>
Nitrogen fixing	<input type="text"/>

- (ii) Which type of organism is responsible for process D?

\_\_\_\_\_

- (b) In an investigation, wild rabbits were found to eat an average of 600 g of grass per day. This grass contains 450 g of water. The dry weight of the grass contains 20% protein.

Calculate how much protein a rabbit eats per day.

*Space for calculation*

\_\_\_\_\_ g

[Turn over

Marks

KU	PS

3. The diagrams below show two types of flower.

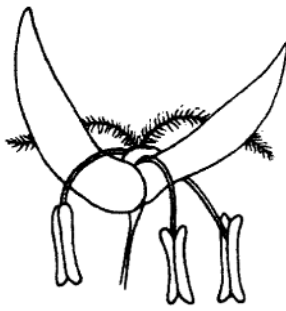


Diagram A

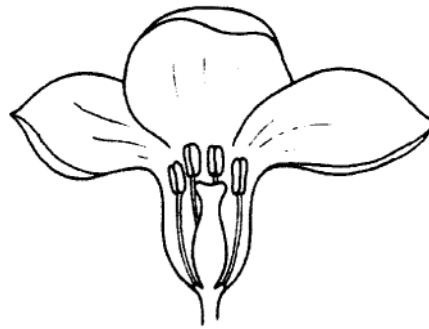


Diagram B

(a) (i) Identify the insect pollinated flower, by putting a tick (✓) in the box.

Diagram A

Diagram B

1

(ii) Wind pollinated flowers produce larger quantities of pollen than those pollinated by insects. Explain why this is necessary.

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1

(b) The table shows when some wind pollinated species start to produce pollen. Pollen production then continues for an average of five weeks.

<i>Plant</i>	<i>Start of pollen production</i>
Alder	February
Willow	March
Silver birch	April
Oak	April
Grasses	May

From the information given, why is May likely to be a particularly difficult month for people with pollen allergies?

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1

Marks

KU	PS

3. (continued)

- (c) (i) Sexual and asexual reproduction in plants have different advantages. For **each** advantage described in the table below, identify the method of reproduction involved.

Tick (✓) the correct box.

<i>Advantage</i>	<i>Method of Reproduction</i>	
	<i>sexual</i>	<i>asexual</i>
Variation exists amongst the offspring		
Germination is not required		
Desirable characteristics are maintained		
Seeds are produced which can be dispersed		

2

- (ii) Underline the correct word in brackets to complete the sentence below.

A group of plants which are genetically identical is known as a

{ clone  
species  
genotype } .

1

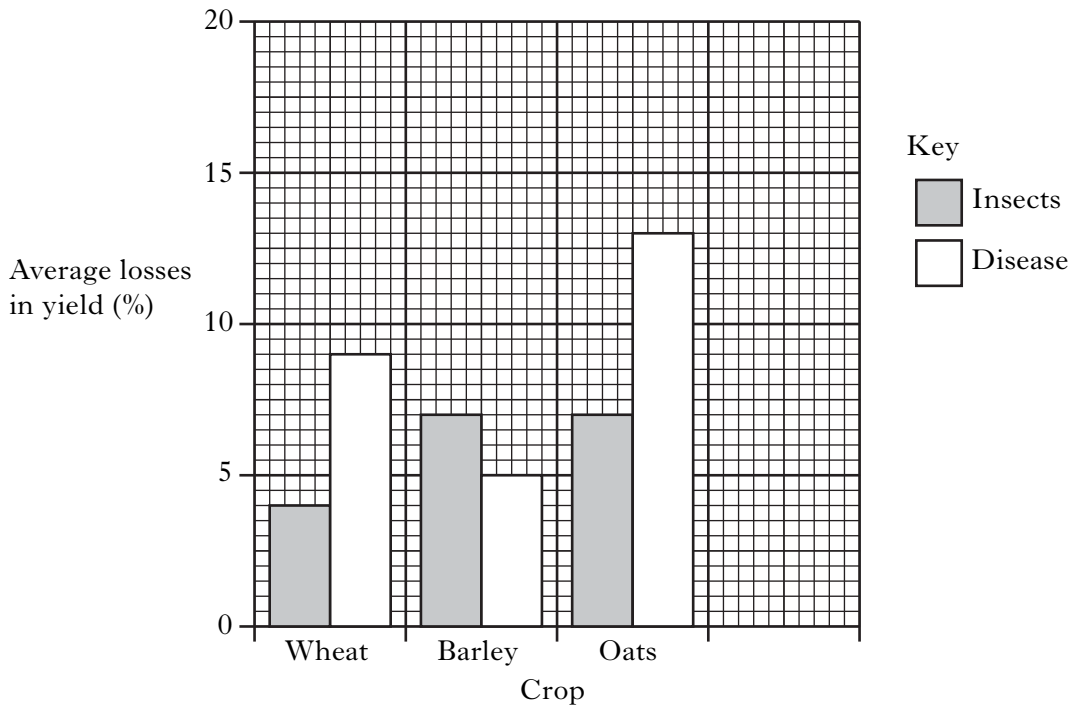
[Turn over



Marks

	KU	PS
1		
1		
1		
1		

5. The bar chart shows the average annual losses in yield caused by insects and disease in the production of three crops in Scotland.



- (a) (i) Which crop has the lowest combined percentage loss from these two causes?

\_\_\_\_\_

1

- (ii) The total crop of oats harvested was 130 000 tonnes. Calculate the yield of oats which would have been produced if insects and disease had not affected the plants.

*Space for calculation*

\_\_\_\_\_ tonnes

1

- (iii) Explain why it would **not** be a valid conclusion to say that disease caused more tonnes of oats to be lost than any of the other crops named.

\_\_\_\_\_  
\_\_\_\_\_

1

- (b) Oilseed rape is a common crop which has average annual losses of 9% to insects and 12% to disease.

Use this information to complete the bar chart by adding a label and bars in the space provided.

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

1

Marks

6. Read the passage below and use the information to answer the questions which follow. (Adapted from *Hostile Habitats*, Scottish Mountaineering Trust, 2006).

As you climb a mountain or hill, the vegetation gradually changes. In Scotland, trees and tall grasses in the glens are replaced on the mountain tops by lichens and dwarf mosses less than a centimetre high. The treeline is the maximum altitude at which trees can grow. Scottish hills have relatively little tree cover and so the treeline is not always obvious but it does form a real ecological boundary. If trees had not been cleared by humans in past centuries, the slopes below the treeline would be covered in forest. Low growing vegetation is dominant on the higher slopes.

The factors which produce the treeline are not clearly understood but the average temperature during the growing season seems to be important. Under colder conditions, trees are at a disadvantage compared to low growing, denser vegetation. The growing tips of trees are fully exposed to high winds which cause physical damage and slow down growth of shoots by drying them out. High winds in wet conditions cause wind chill which can further damage shoots. In the case of low growing plants, these effects are reduced as their growing shoots are protected by the surrounding vegetation.

The treeline in Scotland is generally lower than in other countries a similar distance from the equator. The exact height of the treeline varies across Scotland. The wet and windy conditions in the west of Scotland produce a treeline between 200m and 450m above sea level. In the east of Scotland, the treeline is between 500m and 650m above sea level. Other types of vegetation show similar effects, with mountain plants being found at lower levels on the west coast.

- (a) Give **two** types of plants you might expect to find growing on mountain tops in Scotland.

1 \_\_\_\_\_

2 \_\_\_\_\_

1

- (b) Most hills in Scotland do not have woodland present up to the potential treeline. Why is this?

\_\_\_\_\_  
\_\_\_\_\_

1

- (c) According to the passage, what factor might be important in determining how high up a hill trees can grow?

\_\_\_\_\_

1

- (d) What **two** factors are needed to produce wind-chill?

1 \_\_\_\_\_

2 \_\_\_\_\_

1

KU	PS



Marks

KU	PS

**6. (continued)**

- (e) The passage states that, “Low growing vegetation is dominant on the higher slopes”. What advantage does this type of vegetation have which allows it to grow at higher altitudes than trees?

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**1**

- (f) In summer, red deer migrate to graze above the treeline. In which part of Scotland would they have to go higher to do this?

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**1**

**[Turn over**

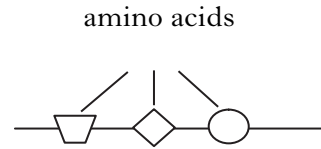
Marks

7. (a) Draw **one** line from each food component to the diagram which represents its basic structure.

*Food component*

*Basic structure diagram*

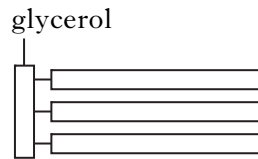
carbohydrate



fat



protein



2

- (b) The following list contains structures associated with digestion.

*Structures associated with digestion*

- A gall bladder
- B large intestine
- C liver
- D pancreas
- E salivary glands
- F oesophagus

Use letters from the list to identify the structures which carry out the functions described below.

Each letter can be used once, more than once or not at all.

*Function*

*Structures*

Carry out peristalsis

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Produce amylase enzymes

--	--

Produces digestive juices which are not enzymes

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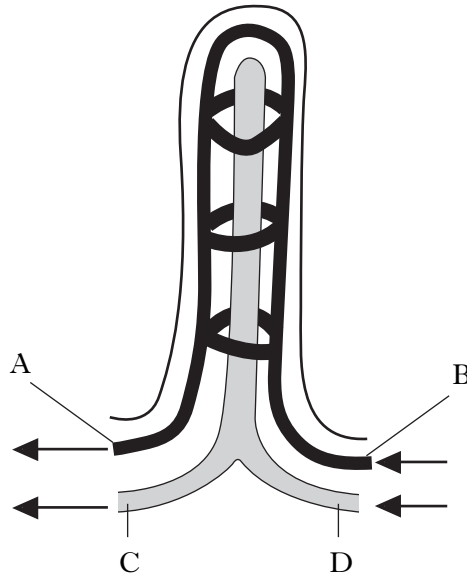
2

Marks

KU PS

7. (continued)

(c) The diagram below represents a structure found in the small intestine. The arrows show the direction of the flow of fluids through the structure.



(i) What is the name of this structure?

\_\_\_\_\_

1

(ii) Which letter identifies the position of the fluid with the highest glucose content, after the absorption of digested food?

\_\_\_\_\_

1

(iii) Which letter identifies the position of the fluid with the highest fat content, after the absorption of digested food?

\_\_\_\_\_

1

[Turn over

Marks	KU	PS
	2	
1		

8. (a) The process of diffusion is important to organisms.

From the list below, select a substance which is involved in diffusion and answer the questions which follow.

**List**

oxygen                  glucose                  carbon dioxide

Substance selected \_\_\_\_\_

(i) Explain why its diffusion is important.

\_\_\_\_\_

\_\_\_\_\_

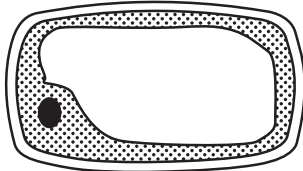
(ii) Where does its diffusion take place?

\_\_\_\_\_

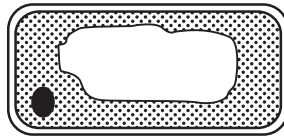
\_\_\_\_\_

(b) Cells from the same plant tissue were placed in three different liquids, left for 20 minutes and then examined using a microscope.

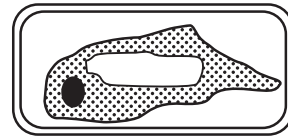
The following diagrams represent cells from each liquid.



Cell A



Cell B



Cell C

Which cell is most likely to have been placed in pure water?

Give a reason for your answer.

Cell \_\_\_\_\_

Reason \_\_\_\_\_

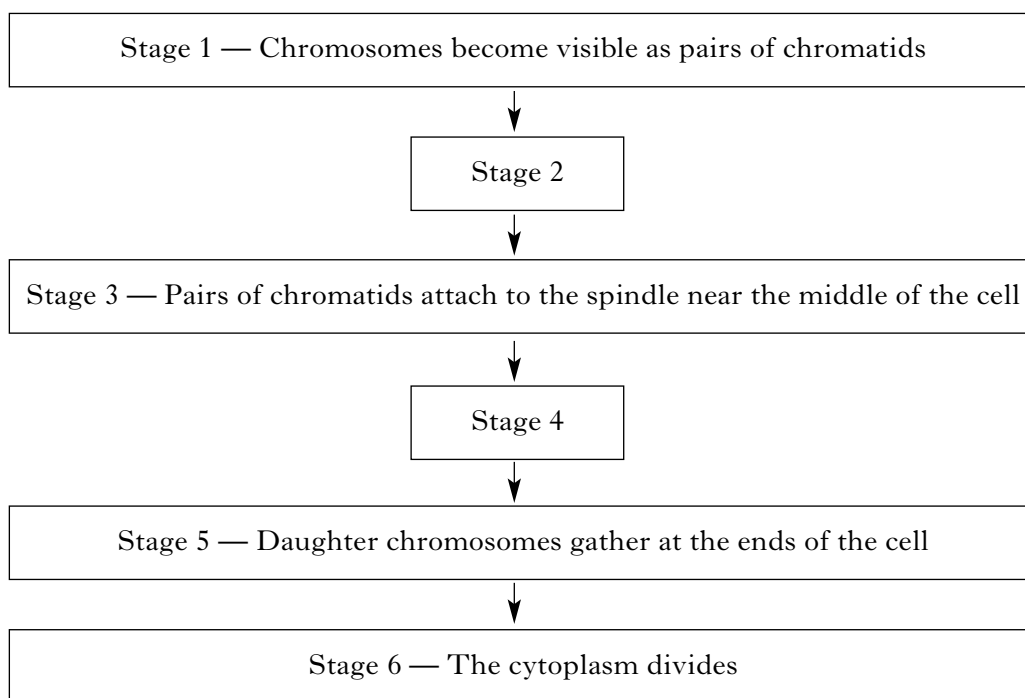
\_\_\_\_\_

\_\_\_\_\_

Marks	KU	PS
2		
1		

8. (continued)

(c) The following is a description of the stages of mitosis.



Describe stages 2 and 4 in the spaces below.

Stage 2 \_\_\_\_\_  
\_\_\_\_\_

Stage 4 \_\_\_\_\_  
\_\_\_\_\_

(d) Daughter cells produced by mitosis each have the same chromosome complement as the original cell. Why is this important?

\_\_\_\_\_  
\_\_\_\_\_

[Turn over

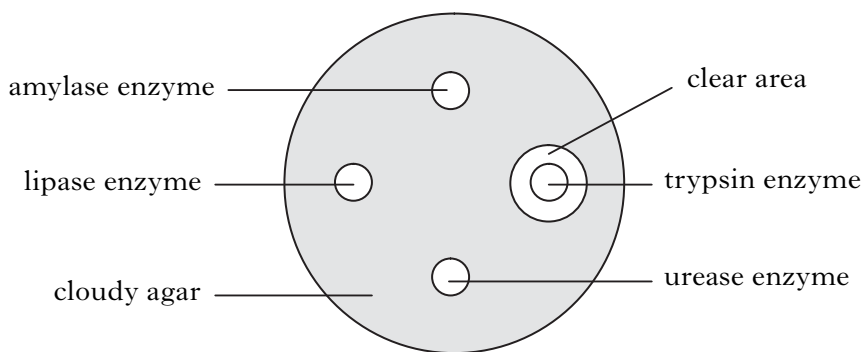
Marks

KU	PS

9. An investigation was carried out into digestion of a protein.

The protein was mixed with agar gel in a petri dish. Four holes were cut in the gel and a different enzyme was placed in each hole. The dish was left for two days. Where digestion of the protein had taken place, a clear area developed in the gel around the hole. The diameter of the clear area was measured. The experiment was carried out four times.

The diagram below represents the appearance of one of the petri dishes after two days.



(a) Explain why trypsin digested the protein but no other enzyme did.

\_\_\_\_\_

1

(b) The table below shows the results for each dish.

<i>Petri dish</i>	<i>Diameter of clear area (mm) around trypsin enzyme</i>
1	4.7
2	3.9
3	4.2
4	4.4
Average	

Complete the table by calculating the average diameter of the clear area.

*Space for calculation*

1

(c) Give **two** precautions, **not already mentioned**, that would have to be taken each time the experiment was carried out, to ensure validity of the results.

1 \_\_\_\_\_

2 \_\_\_\_\_

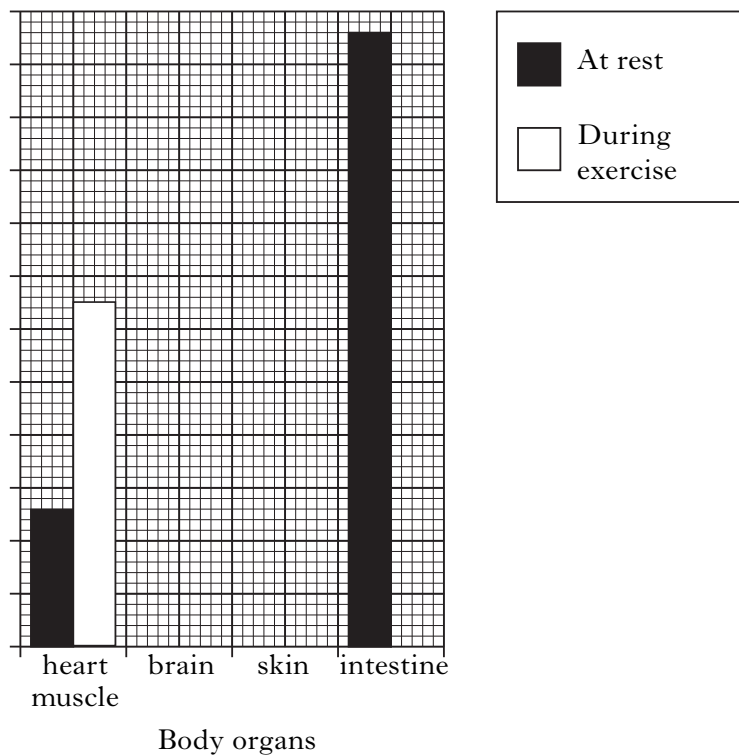
2

10. The following table shows the changes in the flow of blood through the capillaries in some body organs at rest and during exercise.

Marks

Body organs	Capillary blood flow (cm <sup>3</sup> /min)	
	At rest	During exercise
heart muscle	260	650
brain	760	760
skin	380	1200
intestine	1160	540

- (a) Use the information from the table to complete the bar chart below.  
(An additional chart can be found, if required, on *Page twenty-six.*)



- (b) How does the capillary blood flow through the heart muscle at rest compare to that during exercise, expressed as a simple whole number ratio?

*Space for calculation*

\_\_\_\_\_ : \_\_\_\_\_  
at rest            during exercise

- (c) Suggest a reason for the decrease in blood flow to the intestine during exercise.

\_\_\_\_\_  
\_\_\_\_\_

- (d) Blood carries heat away from the muscles during exercise. What evidence from the table suggests that this heat is lost from the skin?

\_\_\_\_\_

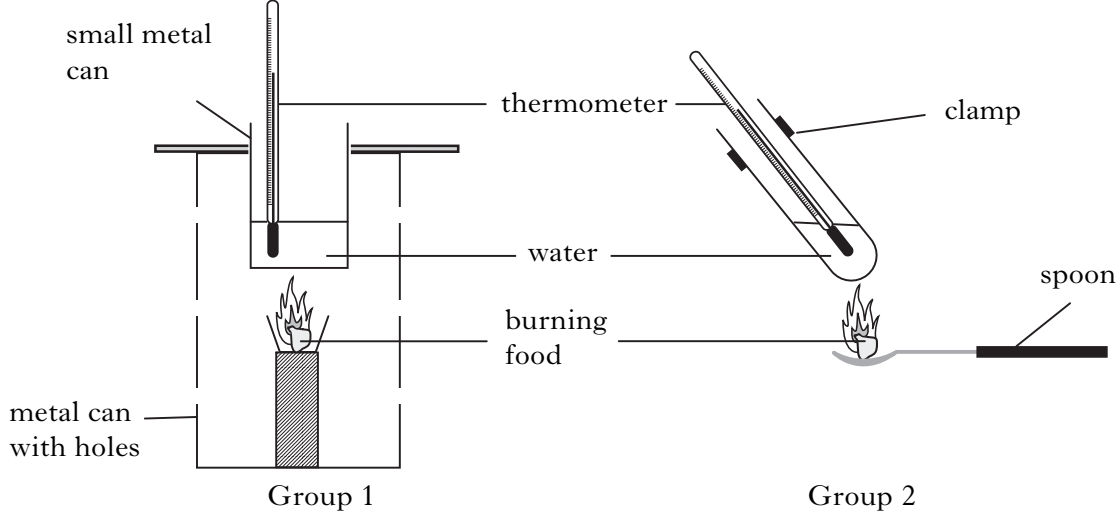
KU	PS
2	
1	
1	
1	

Marks

KU	PS

11. In an investigation into the energy content of a food, several samples were weighed before being burned. The heat energy given out was measured by noting the rise in temperature of the water.

Different methods were used by two different groups. The apparatus used by each group is shown below.



Both groups used the same mass of the same food.

(a) Group 2 found that the rise in temperature they recorded was less in every case than the results obtained by group 1.

With reference to their method, suggest a reason for this.

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1

(b) Although they used different methods to investigate the energy content of the food, suggest a variable, **not already mentioned**, which both groups should have kept constant to allow a valid comparison.

---

1



Marks

KU	PS
1	
1	

12. The effect of practice on performance was investigated. The total score of a dart player with 3 darts was recorded for several attempts.

The scores are shown in the table below.

<i>Attempt</i>	<i>Total score</i>
1	32
2	36
3	43
4	58
5	65
6	64
7	65
8	64

- (a) Describe the relationship between the number of attempts and performance.

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- (b) How could this investigation have been made more reliable?

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[Turn over

Marks

KU	PS
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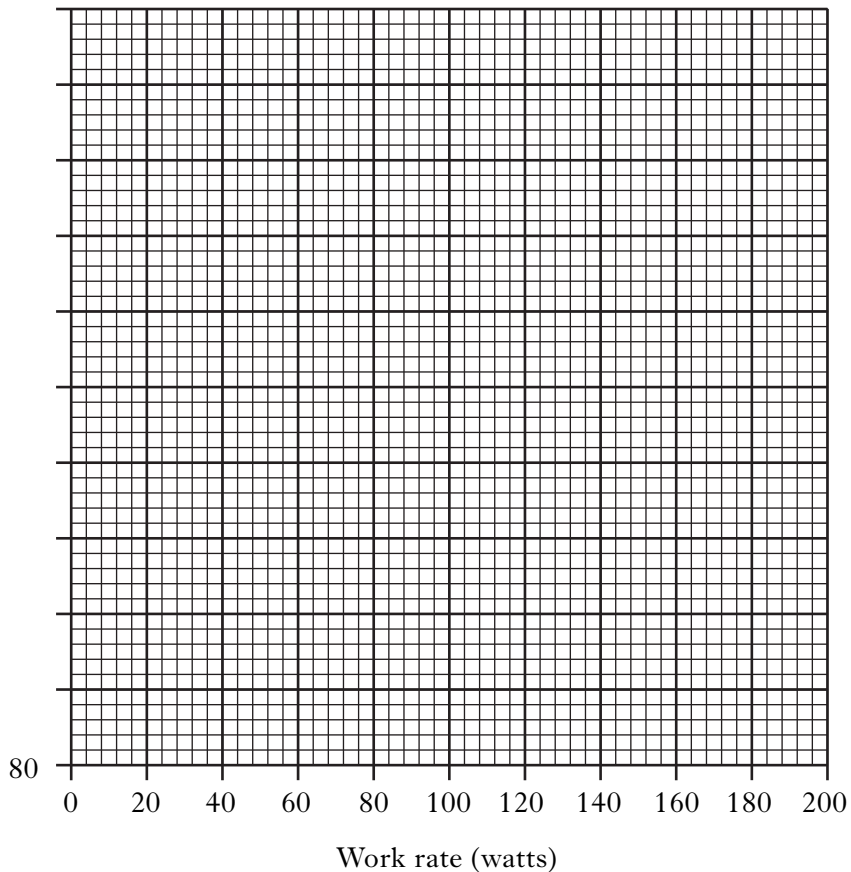
13. A pupil carried out an investigation into the effect of exercise on the body's heart rate. Using an exercise bike, he pedalled at different work rates for three minutes with a one minute rest between each exercise period.

During the exercise periods his heart rate was measured. The results are shown in the table.

<i>Work rate</i> (watts)	<i>Heart rate</i> (beats per minute)
0 (at rest)	80
60	104
80	110
120	128
140	140
160	158
200	180

- (a) Use the results to complete a line graph of the pupil's heart rate over the range of work rates.

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



2

Marks

KU	PS

**13. (continued)**

- (b) Calculate the percentage increase in his heart rate from his resting state to a work rate of 200 watts.

*Space for calculation*

\_\_\_\_\_ %

**1**

- (c) Training through exercise improves the efficiency of the heart and other muscles. What other organs become more efficient as a result of training through exercise?

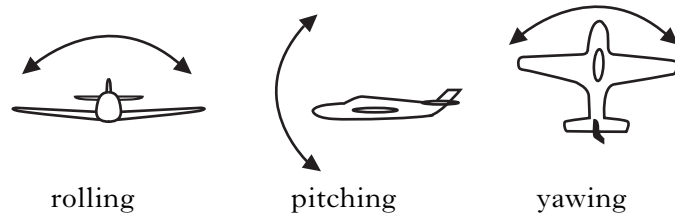
\_\_\_\_\_

**1**

**[Turn over**

Marks

14. (a) An aircraft pilot must be able to sense accurately the movement of the aircraft when it is rolling, pitching or yawing, as shown below.



- (i) Which structures in the pilot's inner ear can detect these movements?

\_\_\_\_\_

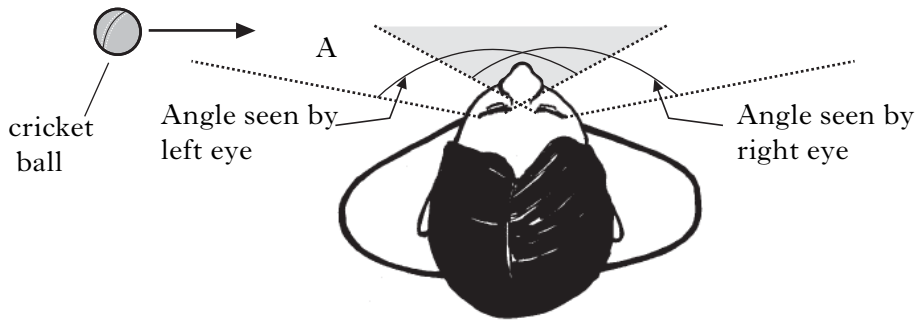
1

- (ii) How does the arrangement of these structures make it possible to detect movement in these different directions?

\_\_\_\_\_

1

- (b) The following diagram shows the field of vision of a cricket batsman viewed from above. The shaded section shows the area which can be seen by both eyes at the same time.



What would be the advantage to the cricket batsman of turning his head towards the bowler so that a ball coming towards him appears in the shaded zone even though he could see it clearly in area A?

\_\_\_\_\_  
\_\_\_\_\_

1

- (c) The grid below shows structures related to the nervous system.

A	B	C	D
relay nerve cell	muscle	motor nerve cell	sensory nerve cell

Complete the sequence below, using letters from the grid, to show the order of the structures through which a nerve impulse travels in a reflex action.

stimulus → touch receptor → \_\_\_\_\_ → \_\_\_\_\_ → \_\_\_\_\_ → \_\_\_\_\_ → response

1

Marks

KU	PS

15. The difference between blue and green feather colour in budgerigars (budgies) is determined by a single gene. The allele for green (G) is dominant and the allele for blue (g) is recessive.

True-breeding blue males were allowed to breed with true-breeding green females. The offspring were allowed to interbreed to produce a second generation.



(a) Explain what is meant by the term “true-breeding”, in terms of the alleles present.

\_\_\_\_\_

1

(b) Give the genotype(s) and phenotype(s) of the F<sub>1</sub> generation.

genotype(s) \_\_\_\_\_

phenotype(s) \_\_\_\_\_

1

(c) In 1974, a mutation occurred in a budgie which gave rise to one chick with a speckled pattern of wing feathers never before seen. Such birds are called “spangles”. It is now 37 years since the hatching of the first chick, and the number of spangles now living is estimated to be 80 000 in a total population of 30 million captive budgies.

(i) In which structures in the nucleus of a cell do mutations arise?

\_\_\_\_\_

1

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

\_\_\_\_\_

1

(iii) Calculate the average yearly increase of spangles. Express your answer to the nearest whole number.

*Space for calculation*

\_\_\_\_\_

1

(d) Many varieties of budgies have been developed as a result of humans making a careful choice of which birds were allowed to breed over many generations. What name is given to this process?

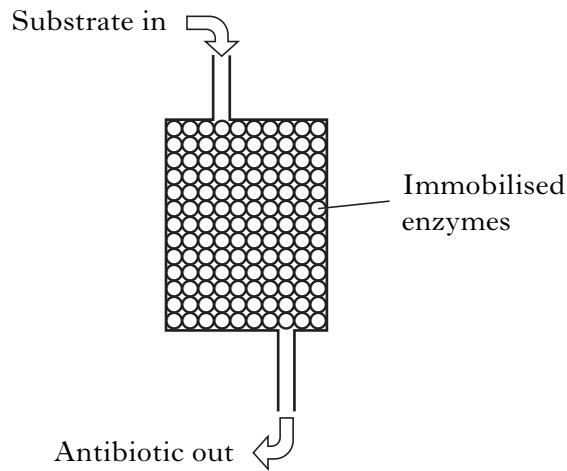
\_\_\_\_\_

1

Marks

	KU	PS
1		
2		
1		
1		

16. Antibiotics can be produced using immobilised enzymes.



(a) (i) What name is given to a process such as this where the product is collected without interruption for as long as the substrate is supplied?

\_\_\_\_\_

(ii) Give **two** advantages of using immobilised enzymes in this system.

1 \_\_\_\_\_

2 \_\_\_\_\_

(iii) This process was carried out at the optimum temperature for the enzyme. However, the antibiotic collected was not pure as it was mixed with some substrate.

Suggest a way to overcome this problem.

\_\_\_\_\_

(b) Several different antibiotics can be produced in this way. Why is it necessary to have a range of different antibiotics?

\_\_\_\_\_

\_\_\_\_\_

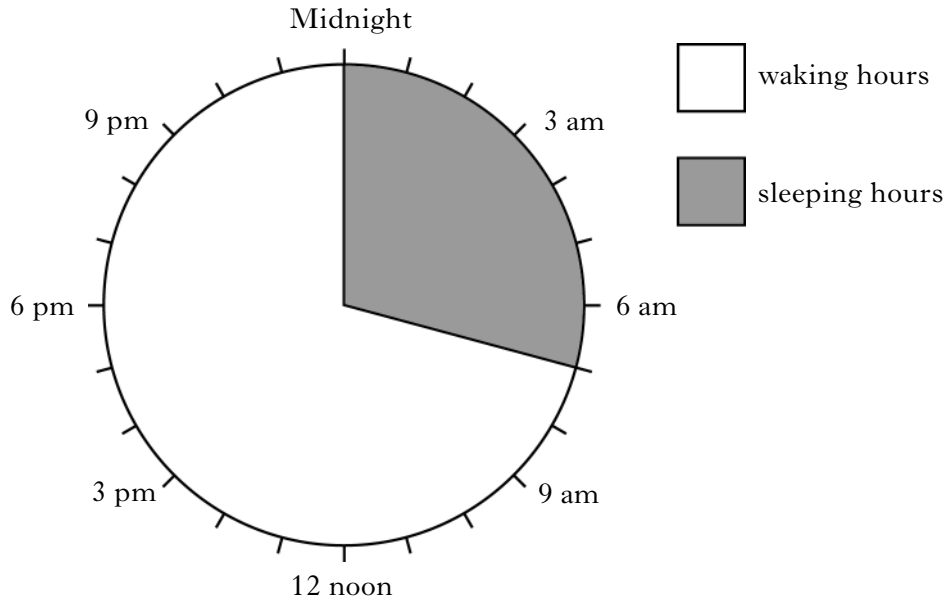
Marks

KU	PS

16. (continued)

(c) When antibiotics are prescribed, they need to be taken at **regular** intervals.

The pie chart below shows a 24 hour period, indicating sleep and waking hours.



(i) If a patient took an antibiotic on waking, and required two more that day, at what times should he take them to maintain a constant level in the body over 24 hours.

*Space for calculation*

1st \_\_\_\_\_ 2nd \_\_\_\_\_ 3rd \_\_\_\_\_

1

(ii) If the patient was given 3 grams of the antibiotic 3 times a day for a week, how much antibiotic was taken in total?

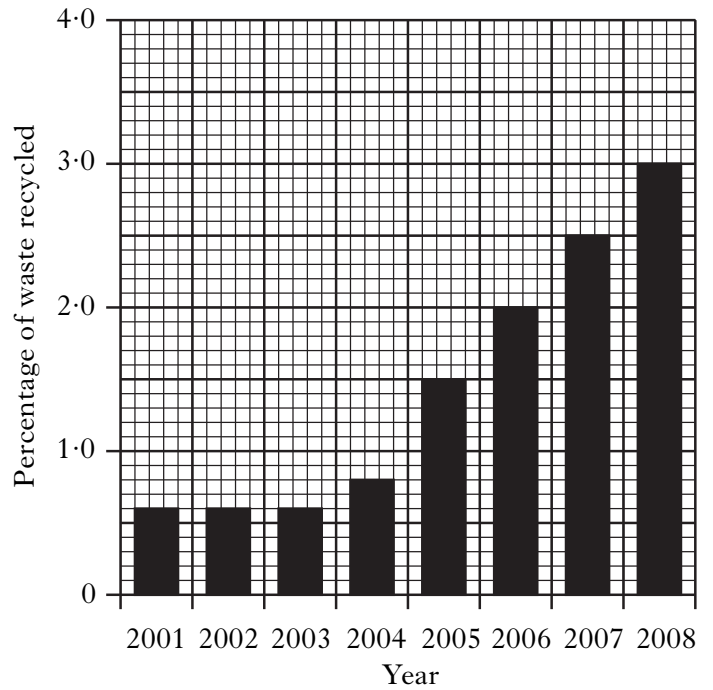
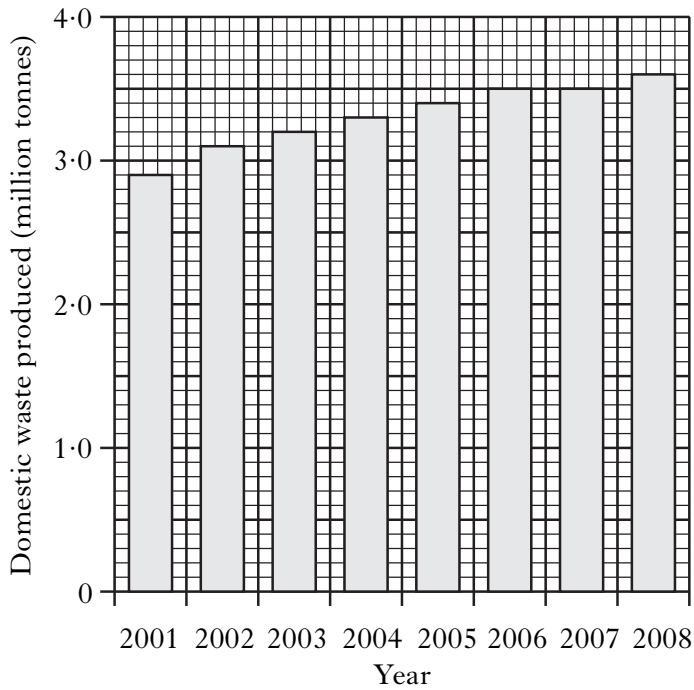
*Space for calculation*

\_\_\_\_\_ grams

1

[Turn over

17. The bar charts below show the mass of domestic waste produced and the percentage of that waste which was recycled in Scotland from 2001–2008.



(a) Calculate the average yearly increase in production of domestic waste between 2001 and 2008.

*Space for calculation*

\_\_\_\_\_ million tonnes

(b) (i) Describe the percentage of domestic waste recycled in Scotland from 2001 to 2008.

\_\_\_\_\_  
\_\_\_\_\_

(ii) How many million tonnes of domestic waste were recycled in 2006?

*Space for calculation*

\_\_\_\_\_ million tonnes

DO NOT  
WRITE IN  
THIS  
MARGIN

Marks	Marks	
	KU	PS
1		
2		
1		



Marks

KU	PS

**17. (continued)**

- (c) (i) Organic waste can be composted. This helps to recycle plant nutrients such as nitrates and minerals. Name **one** other element or compound, important for plant growth, which is recycled during decay processes such as composting.

\_\_\_\_\_

**1**

- (ii) After the manufacture of the compost is complete it may be treated with steam at 120 °C before it is sold. Explain the purpose of this treatment.

\_\_\_\_\_

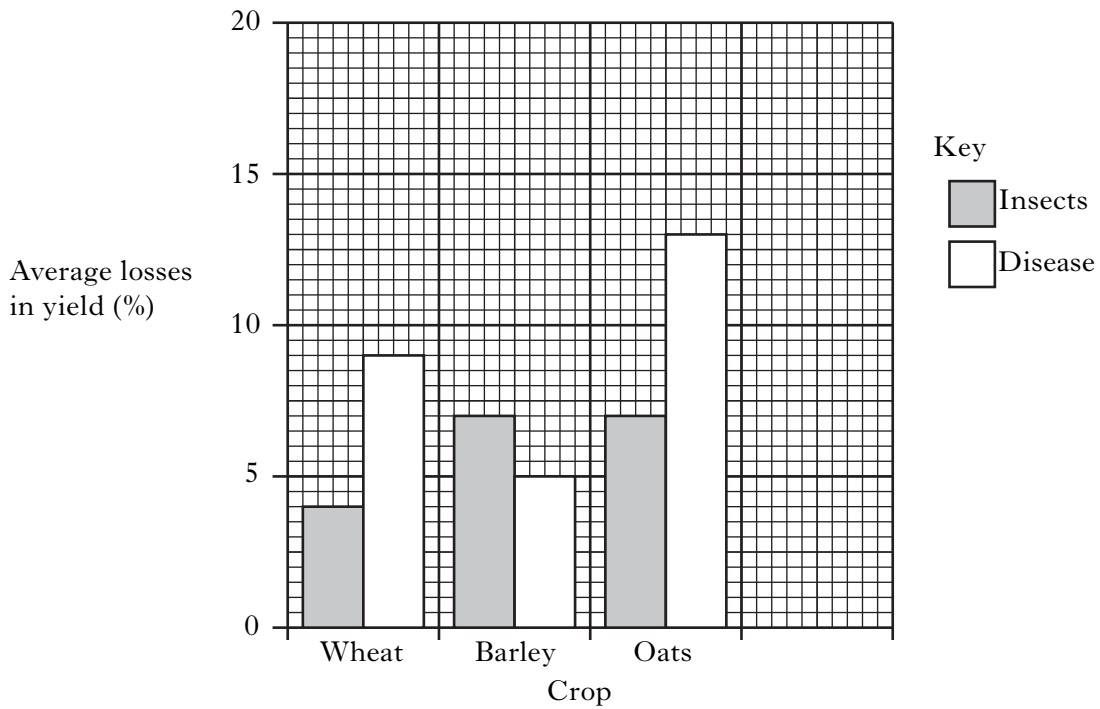
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**1**

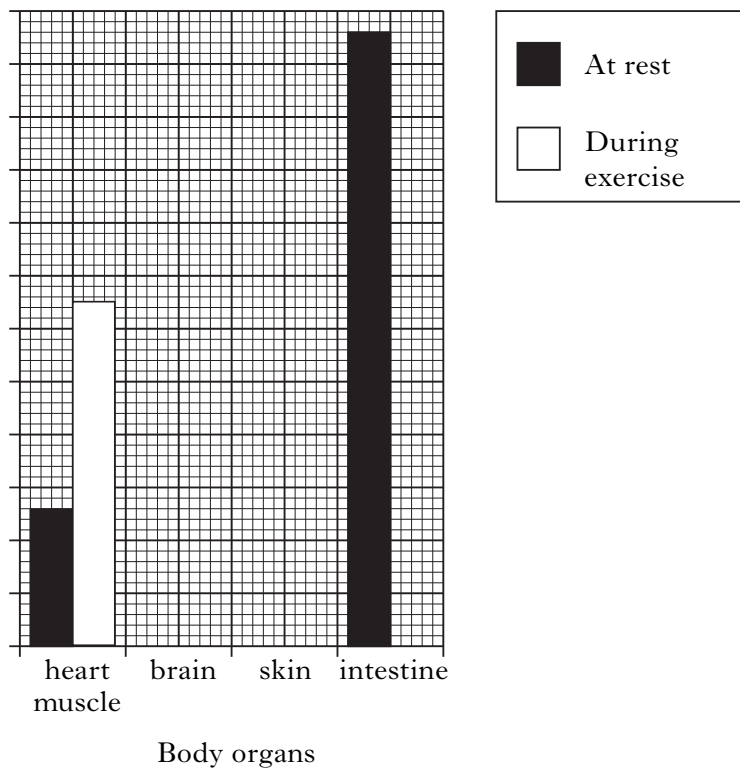
[END OF QUESTION PAPER]

SPACE FOR ANSWERS  
AND FOR ROUGH WORKING

ADDITIONAL CHART FOR QUESTION 5(b)

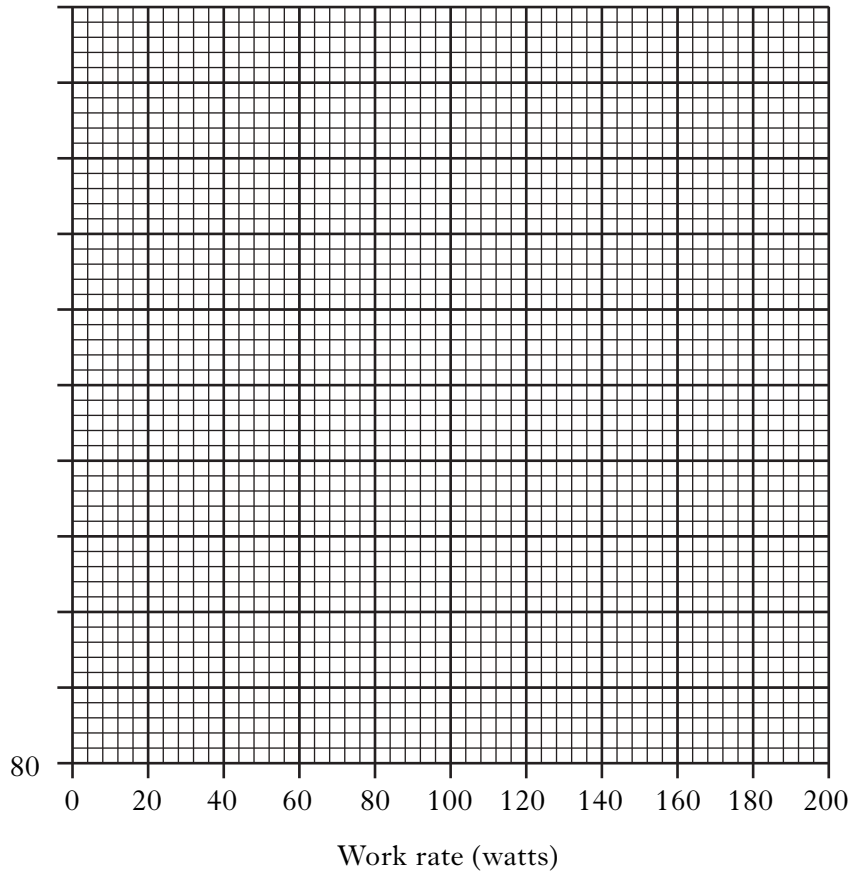


ADDITIONAL CHART FOR QUESTION 10(a)



SPACE FOR ANSWERS  
AND FOR ROUGH WORKING

ADDITIONAL GRID FOR QUESTION 13(a)



SPACE FOR ANSWERS  
AND FOR ROUGH WORKING

## ACKNOWLEDGEMENTS

Question 6—Extract is adapted from *Hostile Habitats by the Scottish Mountaineering Trust, 2006, ISBN 9780907521938*. Reproduced by kind permission of Scottish Mountaineering Trust Publications Ltd.