AQA

General Certificate of Education
Advanced Level Examination
June 2011

Biology

BIO6X/TN

Unit 6X   A2 Externally Marked Practical Assignment

Teachers' Notes

Confidential

A copy should be given immediately to the teacher(s) responsible for GCE Biology

Open on receipt

BIO6X/TN

Task 2

Materials

In addition to access to general laboratory equipment, each candidate needs

- the maze they made in Task 1
- access to at least 50 maggots
- access to a supply of cotton buds
- plastic teaspoon

Managing the investigation

The whole maze is used in Task 2.

The task must be trialled before use.

In this task teachers must not give candidates the following information

- how many maggots to use
- how often to use each maggot.

Turn over ▶

Pattern for Maze

Attach this end to **B**   Attach this end to **A**

Tab

Tab

Tab

A

B

C

Tab

Tab   Tab

Tab
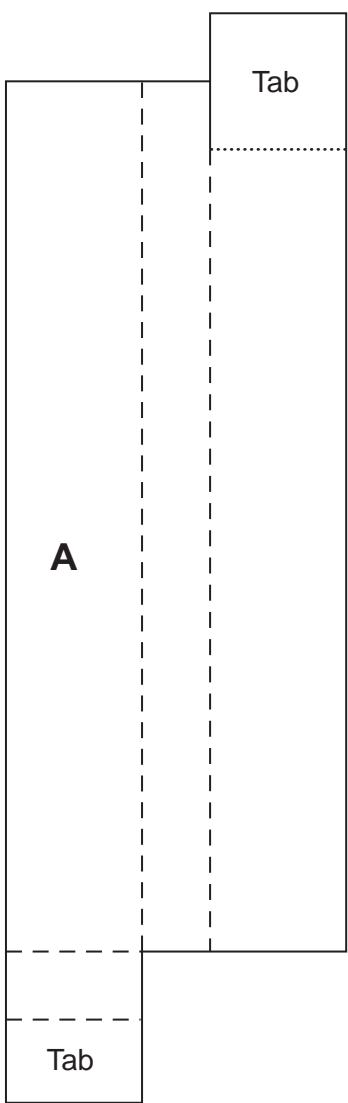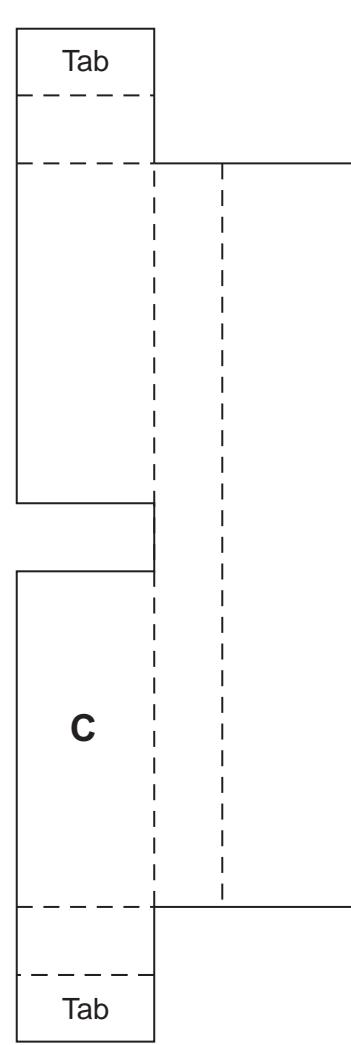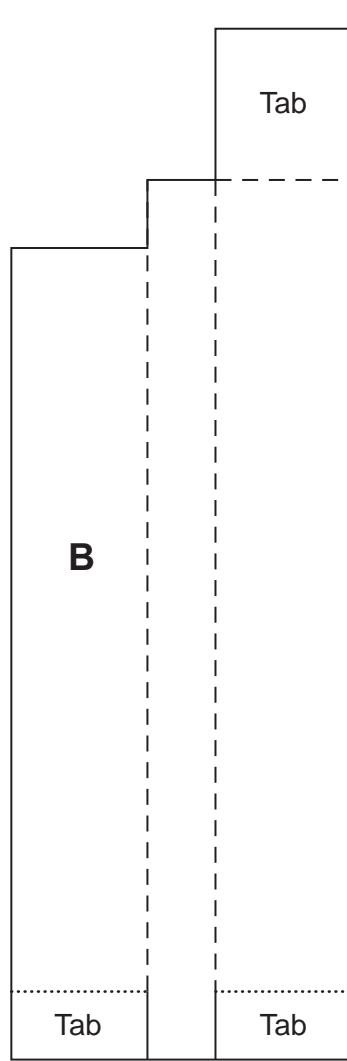
Attach this end to **C**

D
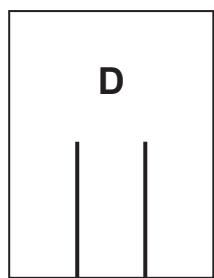
Barrier

- Cut along all solid lines.

- Fold along dashed and dotted lines, keeping dashed lines on the inside and dotted lines on the outside.

Centre Number					Candidate Number				

Surname	
Other Names	
Candidate Signature	

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June 2011

Biology BIO6X/PM1

Unit 6X   A2 Externally Marked Practical Assignment
Task Sheet 1

To be completed before Task Sheet 2.

For submission by 15 May 2011

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Turning behaviour in maggots

Introduction

You are going to investigate the behaviour of maggots.

In Task 1 you will investigate whether maggots turn left or right more often when given the choice.

Materials

You are provided with

- a maze printed on card
- scissors
- glue
- 10 maggots
- 5 cotton wool buds
- a plastic teaspoon

You may ask your teacher for any other apparatus you require.
You may ask for help in constructing the maze (Steps 1–4 of the method).

Outline method

Read these instructions carefully before you start your investigation.

1. Cut out pieces **A**, **B** and **C** from the card by cutting along all the solid lines.
2. Fold along the dashed and dotted lines, keeping dashes on the inside and dots on the outside.
3. Glue the tabs to form the maze shown in **Figure 1**.

Figure 1
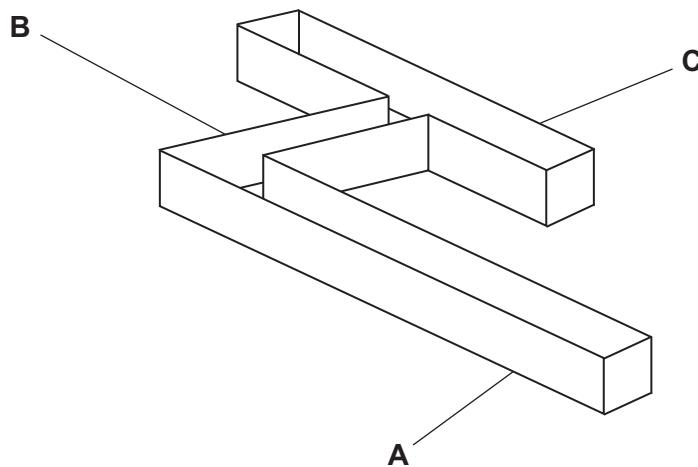
4. Cut out the barrier (piece **D**) and place it at the position shown in **Figure 2**.

Figure 2
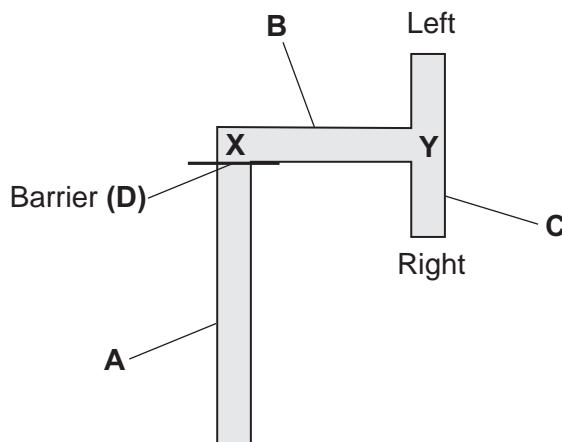
5. Place a maggot at point **X** using the plastic teaspoon.
6. Record in the table provided whether the maggot turns left or right when it reaches the junction at **Y**.

Maggot number	Direction of turning
1	
2	
3	
4	
5	

7. Remove the maggot from the maze.
8. Wipe the inside of the maze with a cotton wool bud.
9. Repeat steps 5 to 8 until you have results for 5 maggots.
10. If a maggot stops moving, remove it from the maze and carry out another trial.

Turn over ▶

Questions on Task 1

Answer **all** questions in the spaces provided.

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1   You were told to wipe the inside of the maze between trials. Suggest why.

2   Light intensity affects the behaviour of maggots. Describe how you might use a lamp to minimise the effect of changes in light intensity. Explain your answer.

3   Temperature also affects the behaviour of maggots. Describe how you would find out if there were temperature changes that could have affected the behaviour of maggots in your investigation.

4   Is it possible to conclude from your data that maggots turn left or right at random when given the choice? Explain your answer.

5   The maggots used for the investigation should be as similar as possible. Describe **two** ways in which the maggots should be similar.

END OF TASK 1

Centre Number					Candidate Number				
Surname									
Other Names									
Candidate Signature									

For Examiner's Use

Total Task 2

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Advanced Level Examination
June 2011

Biology   BIO6X/PM2

Unit 6X   A2 Externally Marked Practical Assignment
Task Sheet 2

To be completed before the EMPA Written Test.

For submission by 15 May 2011

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Turn alternation in maggots

Introduction

Many animals show behaviour called turn alternation. This means if the animal is forced to turn in one direction it is more likely to turn in the opposite direction next time it has a choice. In this part of the investigation, you will investigate whether maggots show turn alternation.

Task 2

Materials

You are provided with

- the maze you made in Task 1
- maggots
- cotton wool buds
- a plastic teaspoon

You may ask your teacher for any other apparatus you require.

Method

Read these instructions carefully before you start your investigation.

1. Use the maze you made in Task 1, with barrier **D** removed.

Plan of the maze
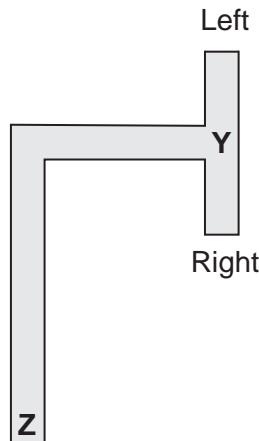
2. Place a maggot at point **Z** in the maze.
3. Record whether the maggot turns left or right when it reaches the junction at **Y**.
4. Repeat steps 2 and 3 until you have sufficient data to carry out a statistical test.

You will need to decide for yourself

- how many maggots to use
- how often to use each maggot.

Presenting data

Record your raw data in an appropriate table in the space below.

Processing your data

6   Use a statistical test to analyse your data and test your null hypothesis. You may use
        a calculator and the Students' Statistics Sheet that is provided in this booklet.

        You are provided with a sheet of graph paper. You may use this if you wish.

6 (a) State your null hypothesis.

6 (b) Give your choice of statistical test.

6 (c) Give a reason for your choice of statistical test.

6 (d) Carry out the statistical test and calculate the test statistic. Show your working.

6 (e) Interpret the test statistic in relation to your null hypothesis.
        Use the words *probability* and *chance* in your answer.

END OF TASK 2

AQA Students' Statistics Sheet (version 3)

What sort of data will you obtain from your investigation?

Measurements
Will your investigation involve taking measurements?

Frequencies
Will your investigation involve finding the number of individuals in particular categories?

Will your investigation involve looking for **associations** between different measurements from the same sample?

Will your investigation involve looking for **differences** between mean values?

χ² test

Spearman rank correlation

Standard error and 95% confidence limits

Standard error and 95% confidence limits

Calculate standard error, SE, for each sample from the following formula

$$SE = \frac{SD}{\sqrt{n}}$$

where SD = standard deviation
and n = sample size

95% confidence limits = $2 \times SE$ above and below the mean

For use in the ISA and EMPA assessment

The χ^2 test

The chi-square (χ^2) test is based on calculating the value of χ^2 from the equation

$$\chi^2 = \Sigma \frac{(O-E)^2}{E}$$

where O represents the results you observe in the investigation
and E represents the results you expect.

Table showing the critical values of χ^2 at P = 0.05 for different degrees of freedom

Degrees of Freedom	Critical value
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92
10	18.31

Spearman rank correlation test

Calculate the value of the Spearman rank correlation, r_s, from the equation

$$r_s = 1 - \left[\frac{6 \times \Sigma D^2}{n^3 - n} \right]$$

where n is the number of pairs of items in the sample and D is the difference between each ranked pair of measurements.

Table showing the critical values of r_s at P = 0.05 for different numbers of paired values

Number of pairs of measurements	Critical value
5	1.00
6	0.89
7	0.79
8	0.74
9	0.68
10	0.65
12	0.59
14	0.54
16	0.51
18	0.48

For use in the ISA and EMPA assessment

Turn over ▶

Centre Number					Candidate Number					

Surname	
Other Names	

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Examiner's Use
Total EMPA mark

Examiner's Initials

Section	Mark
Task 1	
Task 2	
Section A	
Section B	
TOTAL EMPA MARK	

AQA

General Certificate of Education
Advanced Level Examination
June 2011

Biology

BIO6X

Unit 6X   A2 Externally Marked Practical Assignment

For submission by 15 May 2011

For this paper you must have:
- Task Sheet 2, including your results and statistical calculations
- a ruler with millimetre measurements
- a calculator.

Time allowed
- 1 hour 15 minutes

Instructions:
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 34.
- You will be marked on your ability to:
  – organise information clearly
  – use scientific terminology accurately.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐   No ☐

Teacher Declaration:
I confirm that the candidate has met the requirements of the practical skills verification (PSV) in accordance with the instructions and criteria in section 3.8 of the specification.

Practical Skills Verification	**Yes**	☐

Signature of teacher .... Date ....

Section A

These questions relate to your investigation into turning behaviour of maggots.

Use your Task Sheet 2, your results and your statistical calculations to answer them.

Answer **all** questions in the spaces provided.

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7   What sample size did you use in your investigation? Give **two** reasons why you used this sample size.

8   Did you use a maggot more than once in your investigation? Give a reason for your answer.

9   A student carried out an investigation similar to the one you carried out in Task 2. He obtained the following data.

Number of maggots that turned left after a forced right turn	Number of maggots that turned right after a forced right turn
15	1

He decided that the one maggot that turned right was an anomaly.
Was he correct to do so? Explain your answer.

10 (a)   What is a taxis?

10 (b)   Describe how you could try to ensure that the response of the maggots in your investigation was **not** a taxis in response to light. Explain your answer.

11   Maggots detect the presence of food by its scent. Describe how you could use the maze to investigate whether maggots detect the scent of raw meat.
You may assume that all confounding variables are controlled.

Turn over ▶

Resource Sheet

Resource A

A student investigated the effect of distance from a forced turn on the direction woodlice turned when next given a choice. **Figure 3** shows her results.

Figure 3

Percentage of woodlice turning in the opposite direction to the forced turn

Distance between the forced turn and second turn / cm
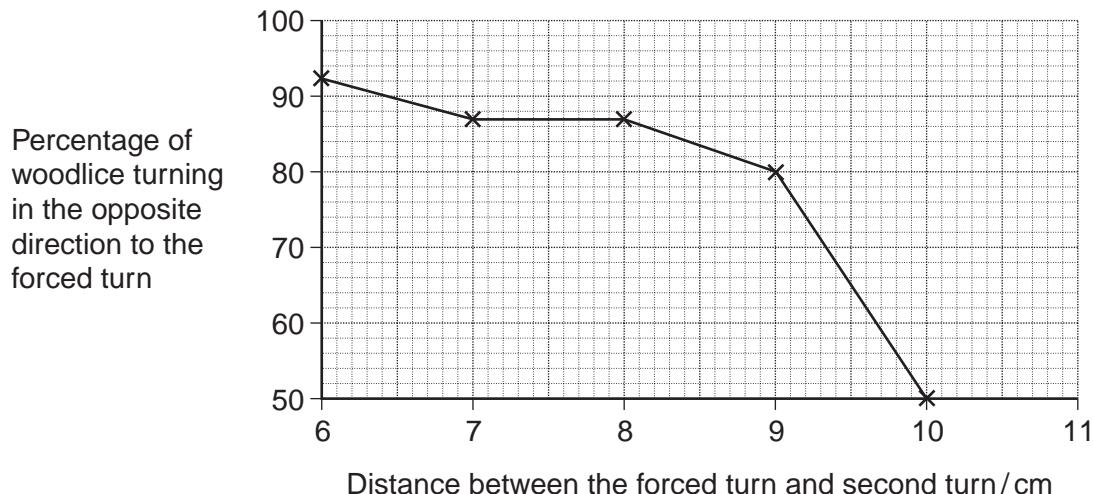
Resource B

Scientists investigated the effect of relative humidity on the activity of woodlice. They set up a Petri dish as shown in **Figure 4**.

In the bottom half they put a substance which absorbs water. Different concentrations of this substance produced different humidities in the air above the mesh.

Figure 4


Woodlice

Lid

Petri dish

Substance which absorbs water

Mesh
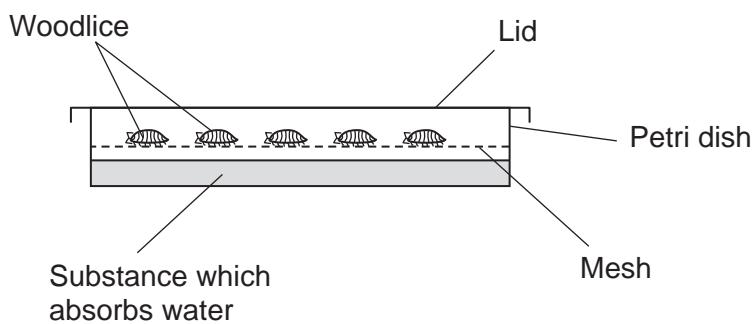
The scientists
- placed 10 woodlice in the top half of the dish
- replaced the lid and left the apparatus for 15 minutes in the laboratory
- recorded the number of woodlice **not** moving during the next 30 seconds
- repeated the experiment to obtain data for 100 woodlice
- repeated the experiment at different humidities.

The results are shown in **Figure 5**.

Figure 5

Relative humidity / %
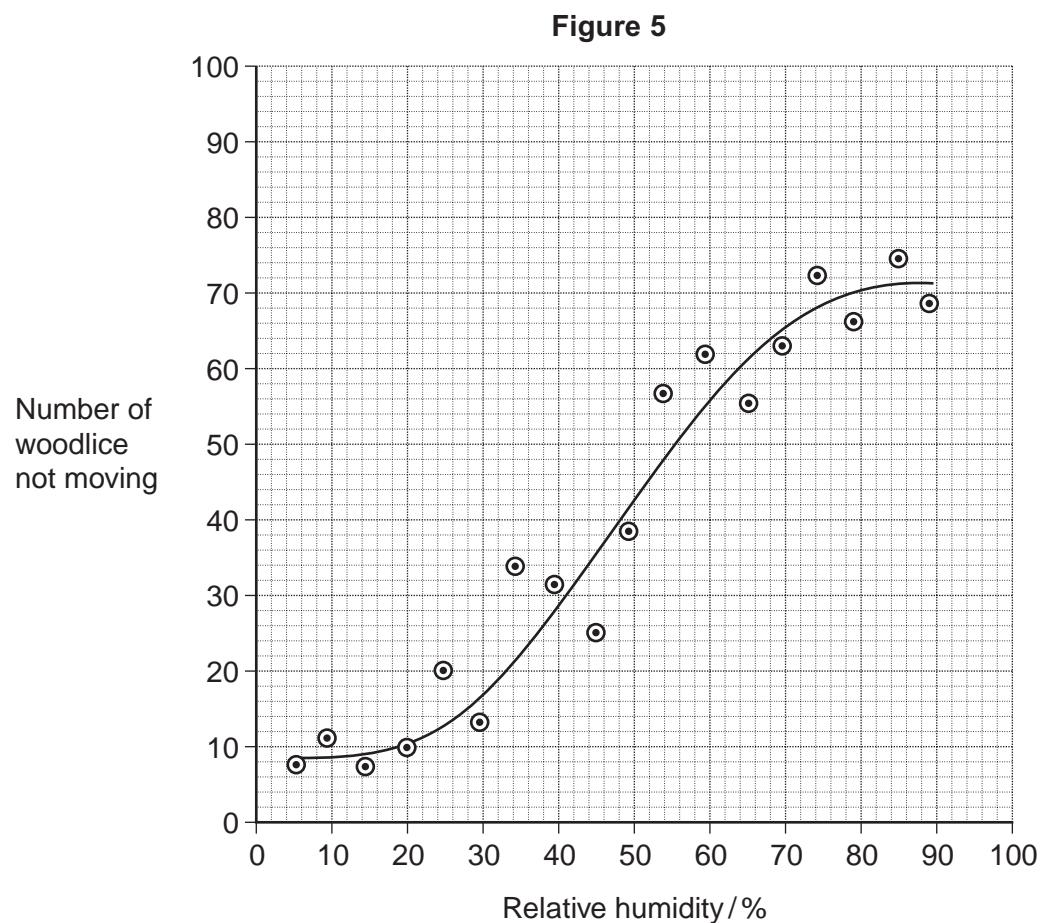
Resource C

Woodlice use gills for gas exchange. These gills are situated on the outside of the animal so water loss occurs from the gill surface. When a number of woodlice occur together they often form a 'clump' with individual woodlice touching each other.

A student investigated the effect of clumping on the rate of water loss from the woodlice. The student divided the 12 woodlice into two groups. He allowed the woodlice in group **A** to clump together, but kept the woodlice in group **B** separate from each other.
Figure 6 shows the mean mass of the woodlice in each group.

Figure 6

Time / minutes	Mean mass of woodlice / g	
	Group **A**	Group **B**
0	0.180	0.175
20	0.170	0.130
40	0.165	0.110
60	0.160	0.090
80	0.160	0.080

Turn over ▶

Section B

Use the information in the **Resource Sheet** to answer the questions.

Answer **all** questions in the spaces provided.

Use **Resource A** to answer Questions **12** to **15**.

12   Describe the response of woodlice to increased distance between turns.

13   Can you conclude that woodlice show turn alternation behaviour when the distance between the forced turn and the second turn was 10 cm?
Explain your answer.

14   The student suggested that the difference in turning behaviour of the woodlice in her investigation was due to the distance between the first and second turn. Her friend suggested that it was due to the time taken to get from the first to the second turn and **not** the distance. Suggest how you could investigate which of these two possibilities is more likely.

15   Woodlice usually live in areas where stones and twigs form obstacles. Obstacles in the path of woodlice cause them to make forced turns. The more obstacles there are in the path, the shorter the distance between the forced turns.

Use the data in **Figure 3** to explain how the behaviour of woodlice results in them moving rapidly out of unfavourable areas.

Use **Resource B** to answer Questions **16** to **18**.

16   The woodlice were left for 15 minutes before their movement was recorded. Give **two** reasons for this.

17   It is **not** possible to conclude that the change in the behaviour of the woodlice shown in **Figure 5** is caused by changes in humidity. Explain why.

18   The points in **Figure 5** do not all fall on the curve. Suggest why.

Use **Resource C** to answer Question **19**.

19 (a)   Calculate the percentage loss in the mean mass of the woodlice in Group **A** during the investigation. Show your working.

19 (b)   Woodlice in Group **B** had a greater percentage loss in mean mass during the investigation than woodlice in Group **A**. Explain why.

19 (c)   It would be useful to give the loss in mean mass as a percentage in this investigation. Explain why.

20   The movement of the woodlice in low relative humidity is an advantage to their survival. Explain how.

END OF QUESTIONS