

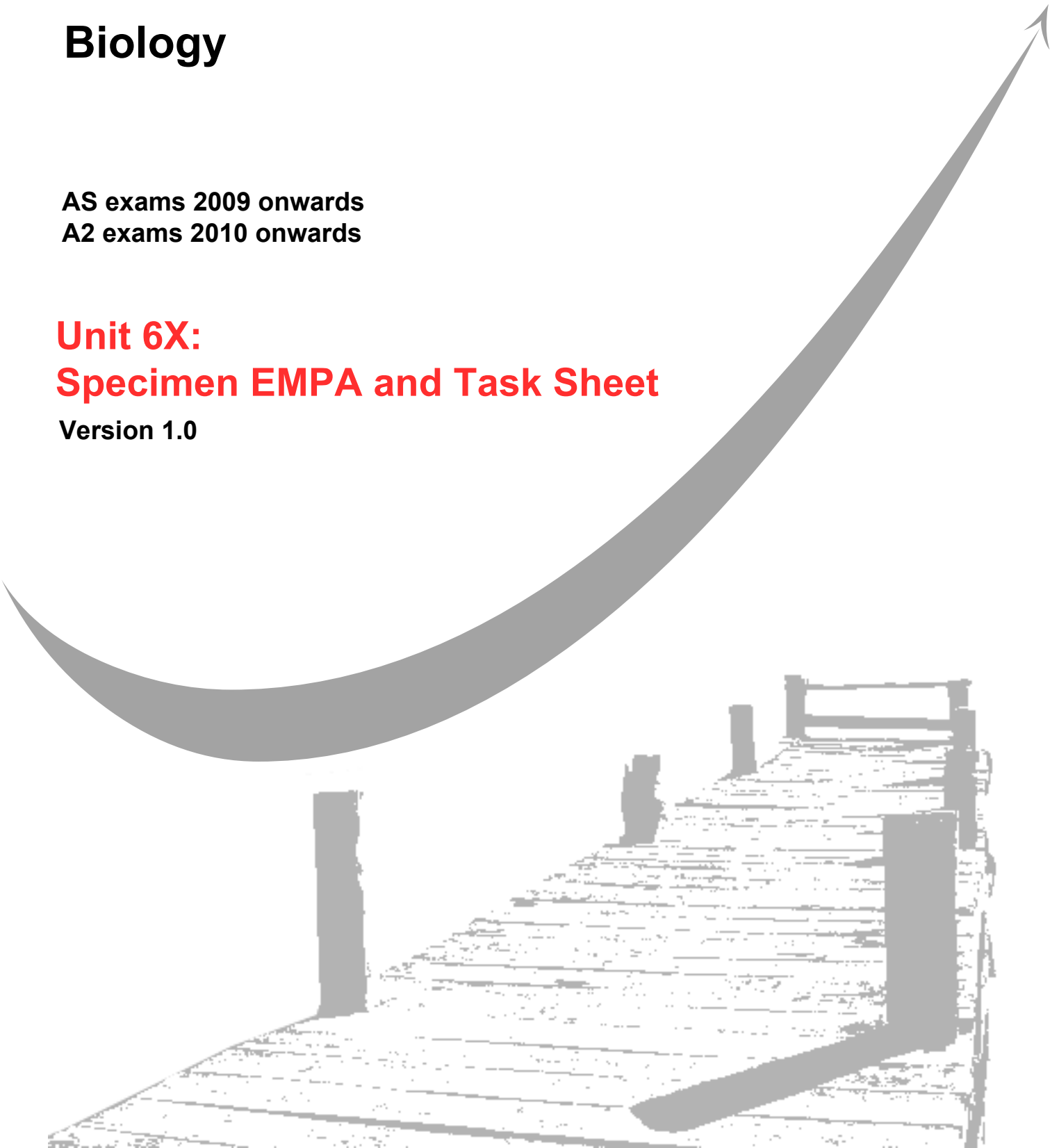
**GCE**  
**AS and A Level**

# **Biology**

**AS exams 2009 onwards**  
**A2 exams 2010 onwards**

## **Unit 6X:** **Specimen EMPA and Task Sheet**

**Version 1.0**



### Your TASK

Blowflies are insects that lay their eggs in meat. These eggs develop into larvae, called maggots, which feed on meat.

A group of students performed an ecological investigation near their school. One of the students noticed the carcass of a dead animal near his group's line transect. The carcass was being eaten by maggots. Each time the student moved the carcass, he saw that the maggots moved back to it.

You are going to investigate the rate of movement of maggots towards food. This task is divided into 3 steps.

### TASK 1

You will be provided with a group of maggots, some agar plates and some meat extract.

You must devise a hypothesis about the rate at which maggots move.

You must make sure that you can test your hypothesis using the materials provided.

You will be provided with information about handling maggots. You will also be provided with written guidelines about how to conduct your experiment. You will be required to adapt these written guidelines so that you can perform a valid investigation of your hypothesis about the directional movement of maggots.

### TASK 2

You will be required to perform your investigation, collect and present data from your investigation and then to select and use a suitable statistical method to test a suitable null hypothesis. You will be awarded marks for the quality of your practical work.

### The EMPA Test

You will be given some questions to answer. Some of these questions will be about the method you used in your investigation, about the results you obtained and about your conclusions. There will also be questions involving other experimental data.

**You will have 1 hour 15 minutes to answer these questions.**

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## GCE BIOLOGY 2411

### SPECIMEN PAPER

### EMPA: BIO6X

### TASK SHEET 1

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#### A

You are provided with

- maggots
- a solution of meat extract
- covered Petri dishes containing agar (i.e., agar plates)
- a cork borer for cutting small wells in the agar
- a pair of forceps
- a fine paintbrush
- a ruler and fine-tipped, permanent marker pen
- an acetate sheet
- a method of generating random numbers
- a stop watch
- access to a calculator

You may decide not to use all the materials provided.

You may use any other materials available in your laboratory if you require them.

#### B

A maggot has a tough external cuticle, which means that you will not damage it if you handle it gently. You may pick up a maggot by hand. However, in this investigation, you are required to pick them up by carefully using a pair of forceps or by using a paintbrush. Practise using the forceps or paintbrush to pick up a maggot, so that you become confident you will not damage these animals.

#### C

Use the materials provided to devise a way to investigate the effect of food on the rate of movement by maggots. Adapt the following guidelines to suit your investigation.

- Use the cork borer to cut a small well in the centre of the agar in each Petri dish you intend to use. You will place samples of the meat extract into this well.
- Decide how you will remove any bias in the way in which you place a maggot onto the agar. If necessary, adapt the materials you have been given so that you can carry out your chosen method.
- A maggot might have the ability to learn from experience. Devise a way to ensure that this does not influence your experiment.
- Decide how you will measure the movement of the maggots in response to the test material. Bear in mind that you need to be able to record your raw data and to summarise them.

**QUESTIONS ON TASK 1**

**Answer the questions in the space provided.**

**You may do this during or at the end of your investigation.**

- 1** You should always replace the lid of the Petri dish when you are recording movement of a maggot. This will prevent maggots crawling out of the Petri dish. Suggest one other reason for replacing the lid of the Petri dish.

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*(1 mark)*

- 2** How will you remove any personal bias in the way in which you place the maggots on to the agar?

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.....  
.....  
.....  
*(3 marks)*

- 3** How will you overcome any effect of learning by the maggots.

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.....  
*(1 mark)*

4 You need to measure the movement of the maggots.

(a) What will you measure?

.....  
.....  
*(1 mark)*

(b) How will you ensure the accuracy of your measurements?

.....  
.....  
*(1 mark)*

5 How will you set up a control for your experiment?

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.....  
.....  
*(2 marks)*

6 Give **one** further way in which you can ensure your method will produce reliable results.

.....  
.....  
*(1 mark)*

10
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**END OF QUESTIONS**

**SPECIMEN PAPER      EMPA: BIO6X**

**TASK SHEET 2**

**TASK 2**

- Place a sample of your test material in the well in an agar plate. Use the method you have devised to record the movement of a maggot in this Petri dish. Always replace the lid of the Petri dish after putting the maggot on the agar.
- When you are measuring the movement of a maggot, only move the maggot if it crawls up the side of the Petri dish to the underside of the lid. If this happens, use the paintbrush to place the maggot on the agar surface directly below where it was on the lid and start recording its movement again.
- Continue until you have completed your investigation.

- 1 Record the data you have collected from your investigation in a table on your *Candidate Result Sheet*. Perform any calculations you need to complete your table.

(4 marks)

The Analyses of data from **TASK 2** will take place in a separate session.

- 2 Use your chosen statistical method to analyse your data and test your null hypothesis. You may use a calculator and the statistical sheet that has been provided to perform this test. On your *Candidate Result Sheet* state your null hypothesis, explain your statistical test and show how you have used it to test your hypothesis.

(6 marks)

**GCE BIOLOGY 2411**

**ISA BIO6X SPECIMEN**

**Candidate Results Sheet TASK 2**



Centre Number

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Candidate Name .....

Candidate number

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**Results**

Present your results in an appropriate form in the space below.





Surname					Other Names				
Centre Number					Candidate Number				
Candidate Signature									

General Certificate of Education  
Advanced Level Examination



**BIOLOGY 2411**  
**Externally Marked Practical Assignment (EMPA)**  
**Board Assessed Unit**

**BIO6X**

Draft Specimen Paper

To be conducted between 1 March 2008 and 31 May 2008 (*provisional*)

For submission in May XXXX

**In addition to this paper you will require**

- task sheets and your Candidate Results Sheets

You may use a calculator.

Time allowed: 1 hour 15 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 40.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in all answers.

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**The EMPA Test A2 SPECIMEN**

**SECTION A**

These questions are about your investigation into the movement of maggots.

When you answer these questions you should use your copy of Task Sheets 1 and 2, *Candidate Results Sheet* containing your table and the results of your statistical analysis.

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

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**1** You were asked to devise a way in which you could remove personal bias when placing the maggots on the agar surface.

(a) Explain why it was necessary to remove personal bias.

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*(1 mark)*

(b) Explain why you chose the method you used.

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*(1 mark)*

**2** You chose a method of measuring the movement of the maggots. Explain your choice.

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.....  
*(2 marks)*

Figures 1, 2, 3 and 4 are graphs drawn by a student who had completed a similar investigation to yours. She measured the distance between the well in the agar plate and the position in which she placed the maggot. She also measured the time each maggot took to get to the well.

Figure 1

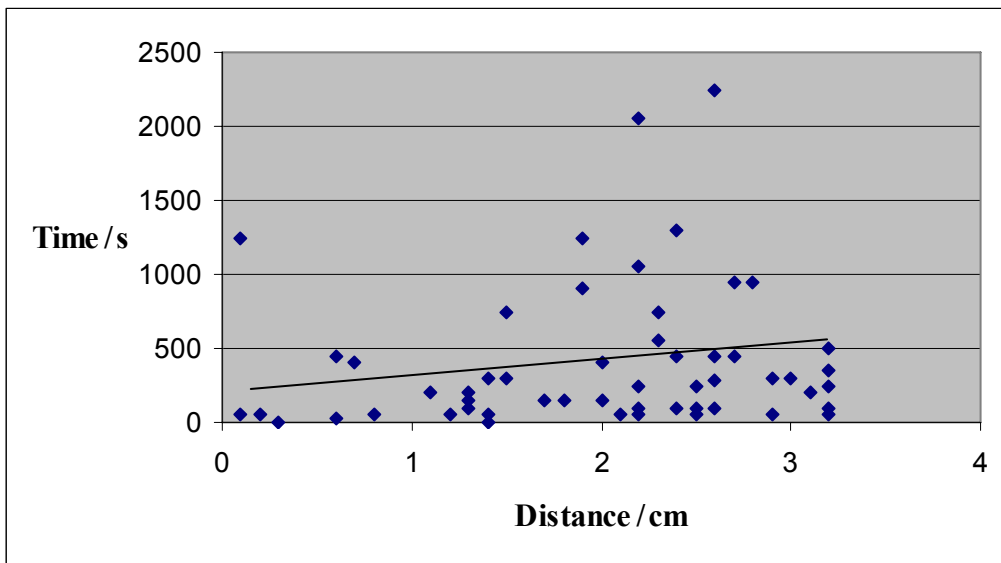
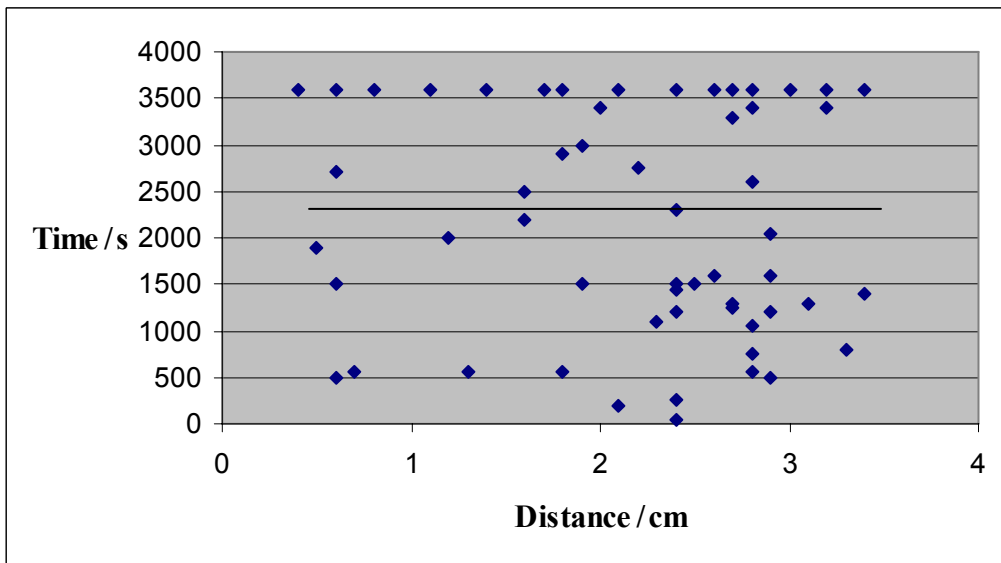
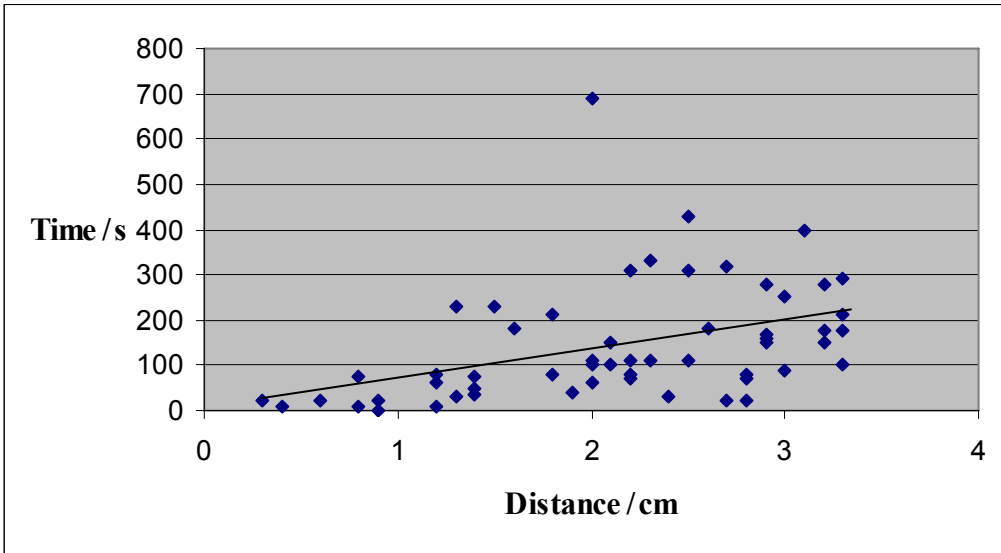


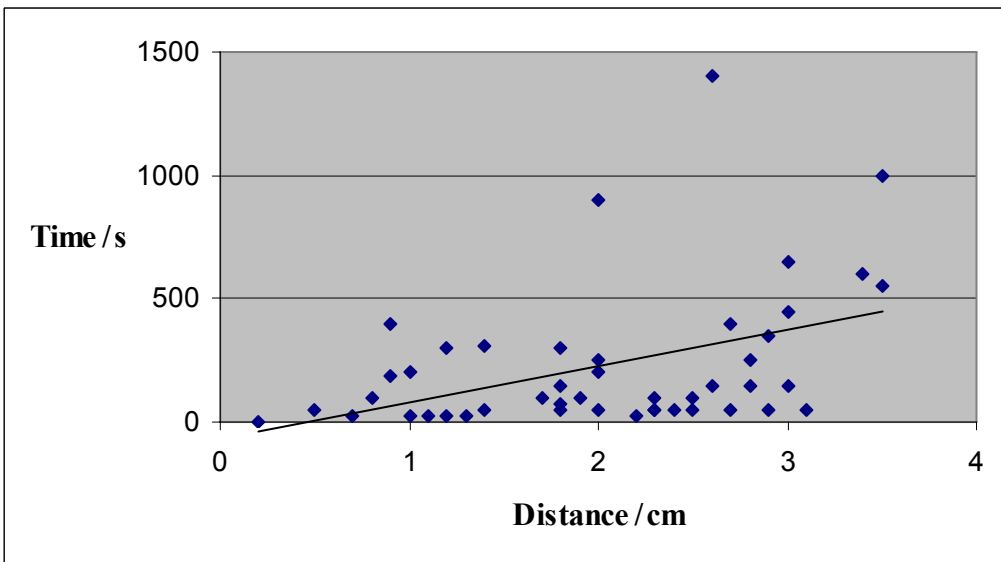
Figure 2



**Figure 3**



**Figure 4**



3 (a) **Figure 1** shows the results obtained when raw meat was placed in the well of each agar plate. **Figure 2** shows the results when water was placed in the well of agar plate. The curves are the lines of best fit drawn by the student.

(i) Time is usually plotted on the x-axis of a graph. This student plotted time on the y-axis of **Figure 1**. Explain why.

.....  
.....

*(2 marks)*

(ii) **Figure 2** shows the results of the student's control experiment.

Using evidence from **Figure 1** and **Figure 2**, give **two** conclusions that can be drawn about the effect of meat on the movement of maggots.

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*(4 marks)*

- 4 The student repeated her experiment but she replaced the raw meat in the well with a feeding maggot or with the fluid produced from meat which had been partly digested by maggots. **Figure 3** shows the results obtained when actively feeding maggots were placed in the well of each agar plate. **Figure 4** shows the results when the partially digested fluid produced by the maggots feeding on meat are placed in the well in each agar plate.

Use the evidence from all four graphs to identify which factor is the most important in affecting movement of maggots. Explain your answer.

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*(2 marks)*

- 5 The student performed a statistical test on her results. She obtained a value of  $p = 0.0362$ . Explain the significance of this result.

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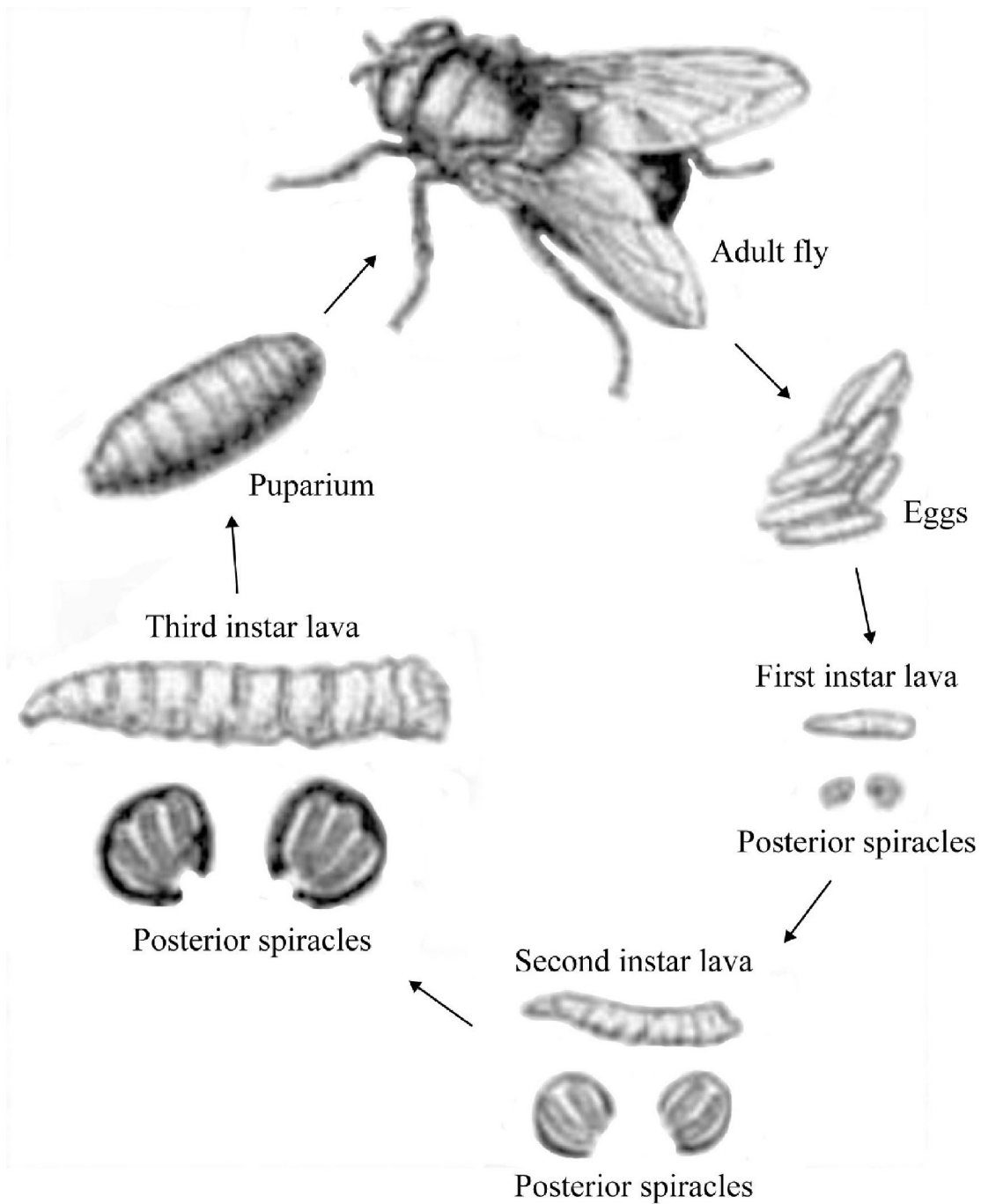
*(2 marks)*

SECTION B

RESOURCE SHEET

Resource A

The diagram shows the life cycle of a fly. The first, second and third instar larvae are commonly called maggots. Although the adults of each species of fly might look very different from each other, the larvae and pupae of these species look identical.



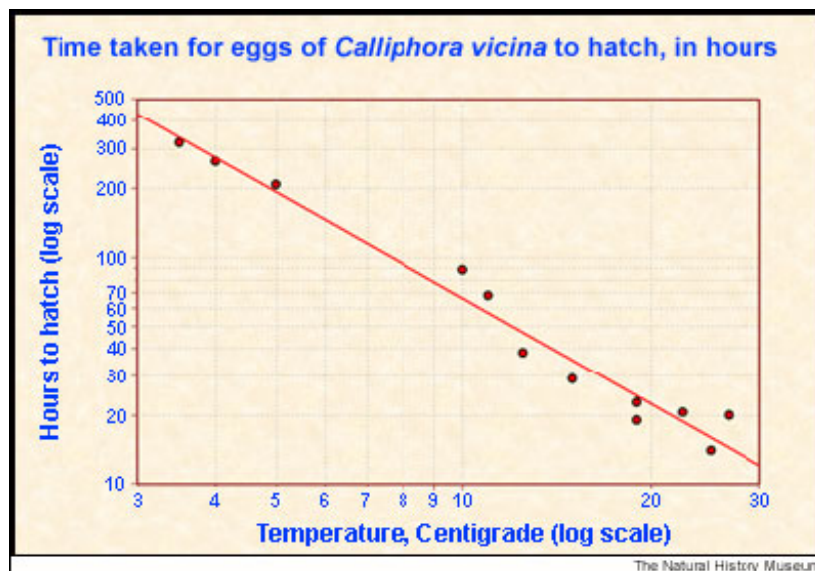
## Resource B

In one experiment, cages containing carrion (a dead animal) were left open to flies. One cage was left open for two days before it was closed to flies. A second cage was left open for five days before it was closed to flies. The table shows the stages of the life cycle of two species of fly in the cages. Under favourable conditions, a single female *Anatalanta aptera* lays between 100 and 300 eggs in one egg-laying cycle; a female *Calliphora vicina* lays up to 60 eggs

Species of fly	Stage of life cycle	Number of animals found in soil litter and in carrion					
		Cage opened for 2 days			Cage opened for 5 days		
		Soil litter	Carrion	Total	Soil litter	Carrion	Total
<i>Anatalanta aptera</i>	2 <sup>nd</sup> instar larva	0	9	371	13	17	2693
	3 <sup>rd</sup> instar larva	189	173		2373	290	
	Pupae	0	0		0	0	
<i>Calliphora vicina</i>	2 <sup>nd</sup> instar larva	0	0	388	0	0	375
	3 <sup>rd</sup> instar larva	290	8		364	1	
	Pupae	88	2		10	0	

## Resource C

The graph shows the effect of temperature on the hatching of eggs of *Calliphora vicina*.



## Resource D

Female *Calliphora vicina* are active during the day whereas female *Anatalanta aptera* are active during the night.



**SECTION B**

You should use the information on the resource sheet to answer the questions.

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

Forensic scientists are often called to the scene of a crime. When a human body has been found at the scene of a crime, forensic scientists try to estimate when death occurred. In some cases, they are able to estimate the time of death from evidence provided by maggots feeding on the human remains. To do this, forensic scientists use knowledge gained from experiments on maggots. Resources **A**, **B**, **C** and **D** provide results from some of these investigations. Use these resources to answer the questions below.

**6** Use Resource **A** and Resource **B** to answer this question.

(a) Suggest why no eggs or 1<sup>st</sup> instar larvae of either species were found in the cages.

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(2 marks)

(b) What do the data suggest about

(i) the timing of egg-laying of female *Calliphora vicina*? Explain your answer.

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(ii) the behaviour of the larvae when they prepare to pupate? Explain your answer.

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(4 marks)

(c) The larvae of *Anatalanta aptera* are saprophagous. This means that they can feed on fluids that soak into the soil underneath a decomposing animal. Use the data in the table to support this statement.

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(2 marks)

7 Explain why the scientists used logarithmic scales in **Resource C**.

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(2 marks)

8 Wardens found the decomposing body of an animal belonging to a protected species on their nature reserve. The animal had been shot. Two forensic scientists estimated the time of death using evidence from the maggots feeding on the dead animal. Their estimates differed by one day.

(a) Select relevant information from Resources **A**, **B**, **C** and **D** to identify **three** reasons to explain the different estimates of time of death.

1.....

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2.....

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3.....

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(3 marks)

(b) For each of your answers above, suggest one way in which the forensic scientists could improve the accuracy of their estimates.

1.....

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2.....

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3.....

.....

*(3 marks)*

**16**

**END OF QUESTIONS**