

# Forensics

## Question Paper

<b>Level</b>	International A Level
<b>Subject</b>	Biology
<b>Exam Board</b>	Edexcel
<b>Topic</b>	Microbiology, Immunity and Forensics
<b>Sub-Topic</b>	Forensics
<b>Booklet</b>	Question paper

**Time Allowed:** 79 minutes

**Score:** /66

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

1 The photograph below shows a giant panda.

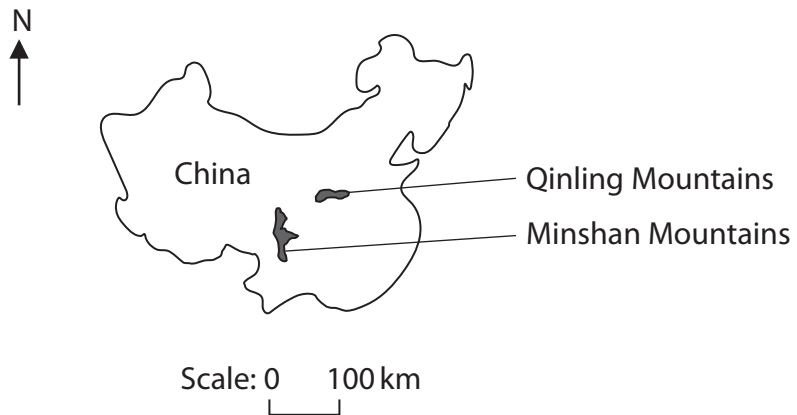


Magnification  $\times 0.03$

The giant panda is an endangered species of bear, native to China.

Giant pandas were once found throughout the lowland forests of southeast China.

Now they are found only in isolated patches of forest in the mountains. The majority of giant pandas are found in the Minshan Mountains, the rest are in the Qinling Mountains, which are shown in the map below.







(ii) Explain how the results of this DNA analysis can be used to estimate the number of giant pandas in the wild.

**(3)**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

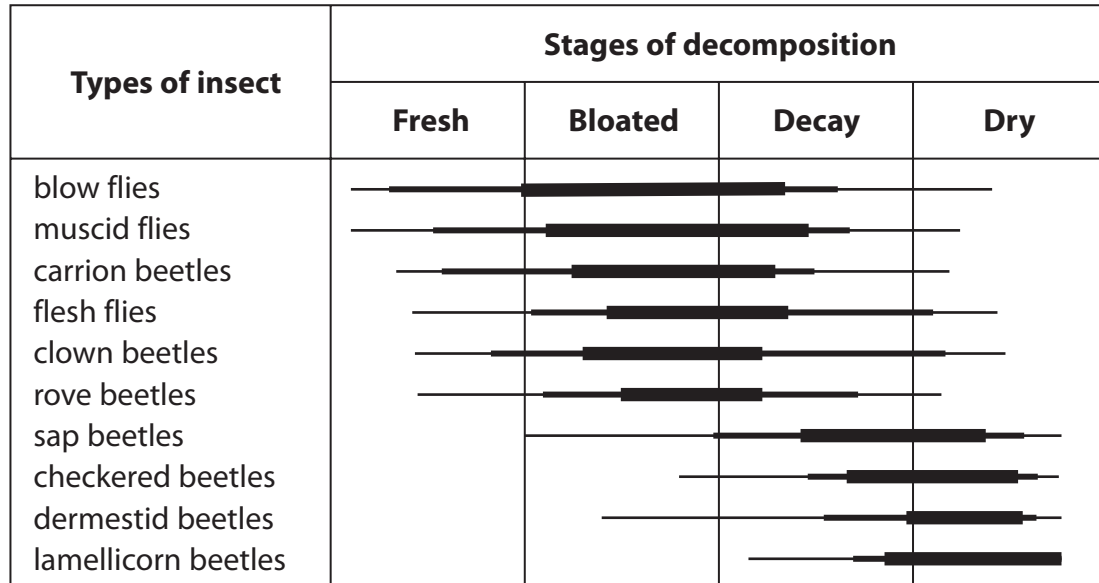
.....

**(Total for Question 1 = 13 marks)**

2 The time of death of a mammal can be estimated using a number of methods.

There are changes in the numbers and types of insects found on the body of a decomposing mammal.

These changes are shown below.



— a small number of individuals present  
 = a moderate number of individuals present  
 ■ a large number of individuals present

(a) Place a cross ☒ in the box next to the term that describes these changes in the types of insect on a dead mammal.

(1)

- A dendrochronology
- B pathology
- C rigor mortis
- D succession

(b) Place a cross ☒ in the box next to the term for studying insects on a dead mammal.

(1)

- A dendrochronology
- B forensic entomology
- C proteomics
- D succession



3 A pathologist can use a number of methods to estimate the time of death of a body found at a crime scene.

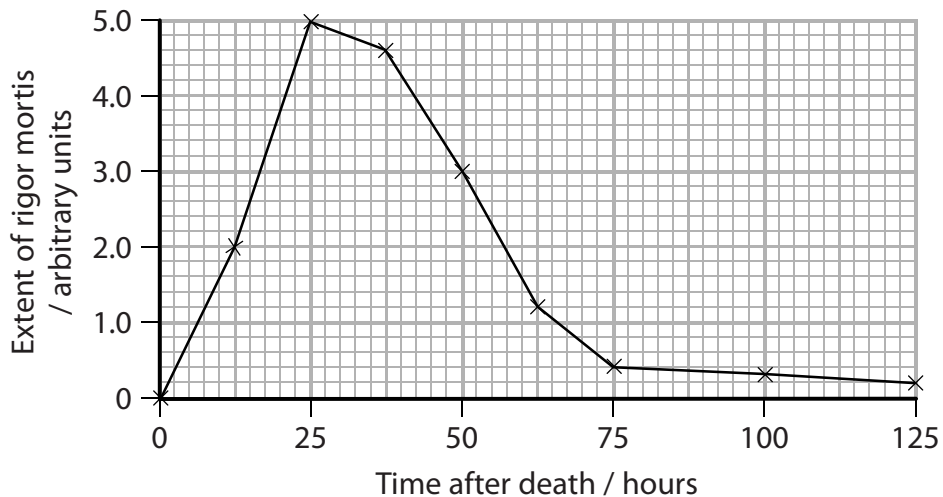
The extent of rigor mortis is one method that the pathologist can use to estimate the time of death.

(a) Place a cross ☒ in the box next to the correct description of rigor mortis.

(1)

- A bloating of the abdomen
- B paling of the skin
- C settling of the blood
- D stiffening of the muscles

(b) The graph below shows how the extent of rigor mortis changes with time after death.



(i) The pathologist assessed the extent of rigor mortis of the body as 2.0 arbitrary units. He used the information in the graph to estimate how long the body had been dead.

Calculate the difference between his lower and upper estimates.

(2)

Answer = ..... hours



(ii) Explain how the pathologist could use the core temperature of the body and the ambient temperature to make this estimate more accurate.

(2)

.....

.....

.....

.....

.....

.....

.....

(iii) State **one** other factor that could affect the pathologist’s estimate. Explain how this factor could affect the estimate.

(2)

.....

.....

.....

.....

.....

.....

.....

\* (c) Forensic entomologists use information on insect life cycles to estimate the time of death. The hister beetle is an insect that may be found on a body.

The life cycle of this beetle consists of five stages:

- egg
- first instar larva
- second instar larva
- pupa
- adult beetle.

The time taken for each of these stages depends on temperature.

Describe an investigation that could be carried out to study the effect of temperature on each of these stages.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(Total for Question 3 = 12 marks)**



(b) An enzyme is used in the amplification process. Describe **two** properties of this enzyme that are relevant to its biological activity in this process.

(2)

.....

.....

.....

.....

.....

.....

(c) Temperature is an important variable in the PCR.

Choose **one** step in the process you described in part (a) and explain why changing the reaction temperature might reduce the production of DNA in this reaction.

(2)

Step .....

Explanation .....

.....

.....

.....

.....

.....

.....

(d) Suggest an explanation for each of the following statements.

- (i) The scientists collected and analysed samples from more than one individual of each species.

(2)

.....

.....

.....

.....

.....

.....

- (ii) For each sample, the scientists examined the DNA sequence of **five** different genes.

(2)

.....

.....

.....

.....

.....

.....

**(Total for Question 4 = 13 marks)**

- 5 Grey tree frogs are found in the USA.

The photograph below shows a grey tree frog.



Magnification  $\times 1$

Cope's grey tree frog and the eastern grey tree frog are both found in the USA.

These species of grey tree frog are very similar in appearance, but have different mating calls.

A number of scientists believe that the eastern grey tree frog evolved from Cope's grey tree frog during the last ice age.

These species have different numbers of chromosomes in their nuclei. Cope's grey tree frog has two copies of each chromosome. The eastern grey tree frog has four copies of each chromosome. As a result, the cells of the eastern grey tree frog are larger.



(ii) Suggest how these DNA profiles were compared.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

(b) Scientists in different parts of the USA are investigating the possibility that the difference in cell size is responsible for the different mating calls. This is contributing to an understanding of the evolution of grey tree frogs.

Suggest **two** ways in which the results of their investigations can be shared.

(2)

.....

.....

.....

.....

---

**(Total for Question 5 = 11 marks)**



- 6 The time of death of a person can be estimated using a number of different methods. One of these methods uses the degree of muscle contraction (rigor).

The graph below shows the extent of rigor in the muscles of a human body after death.



- (a) Using the information in the graph, describe the relationship between time after death and the extent of rigor.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) A pathologist examined a dead body. She immediately measured the body temperature by inserting a temperature probe into the liver.

The temperature probe read 34°C. She used this reading to estimate that death had occurred eight hours previously.

Explain why the pathologist inserted the temperature probe into the liver immediately.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) On further examination of the dead body, it was found that the extent of rigor was 100 au. The pathologist concluded that the body had been stored in a different place before being discovered.

Explain why the pathologist came to this conclusion.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(Total for Question 6 = 10 marks)**