

Write your name here

Surname

Other names

Pearson
Edexcel GCE

Centre Number

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Candidate Number

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Biology

Advanced

Unit 4: The Natural Environment and Species

Survival

Thursday 16 June 2016 – Afternoon

Time: 1 hour 30 minutes

Paper Reference

6BI04/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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PEARSON

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 As part of the immune response, a B cell has to be activated. It then divides to form a clone of cells. These cells then differentiate into plasma cells, which produce antibodies.

(a) Describe how a B cell is activated.

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(b) (i) Name the type of division that occurs when B cells are cloned.

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(ii) Suggest how a microscope slide could be prepared to observe cell division in B cells.

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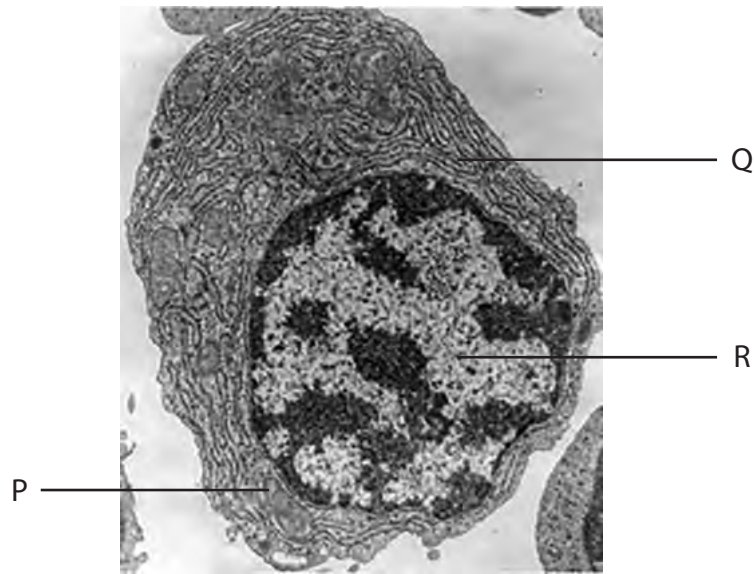
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- (c) The electronmicrograph below shows a plasma cell. Some structures inside this cell have been labelled.



Magnification $\times 10\,000$

Place a cross in the box to identify each of the following structures.

- (i) Structure P

(1)

- A** chloroplast
 B Golgi apparatus
 C mitochondrion
 D nucleus

- (ii) Structure R

(1)

- A** cytoplasm
 B lysosome
 C nucleus
 D vacuole



(iii) Name structure Q.

(1)

(iv) Describe the role of structure Q in the production of antibodies.

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(Total for Question 1 = 13 marks)

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- 2 Infection with human immunodeficiency virus (HIV) can lead to the condition known as AIDS. Patients with AIDS are very susceptible to infections caused by bacteria and viruses.

(a) The table below shows some features of bacteria and viruses.

For each feature, place **one** cross in the appropriate box, in each row, to show whether it is found in bacteria only, in viruses only or in both bacteria and viruses.

(3)

Feature	Bacteria only	Viruses only	Both bacteria and viruses
Cytoplasm	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Nucleic acids	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Protein coat (capsid)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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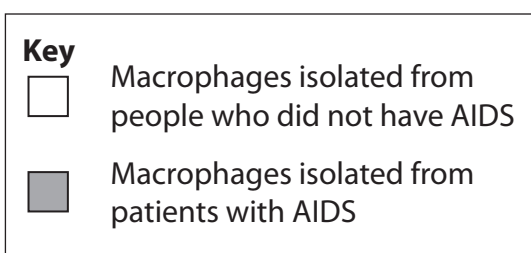
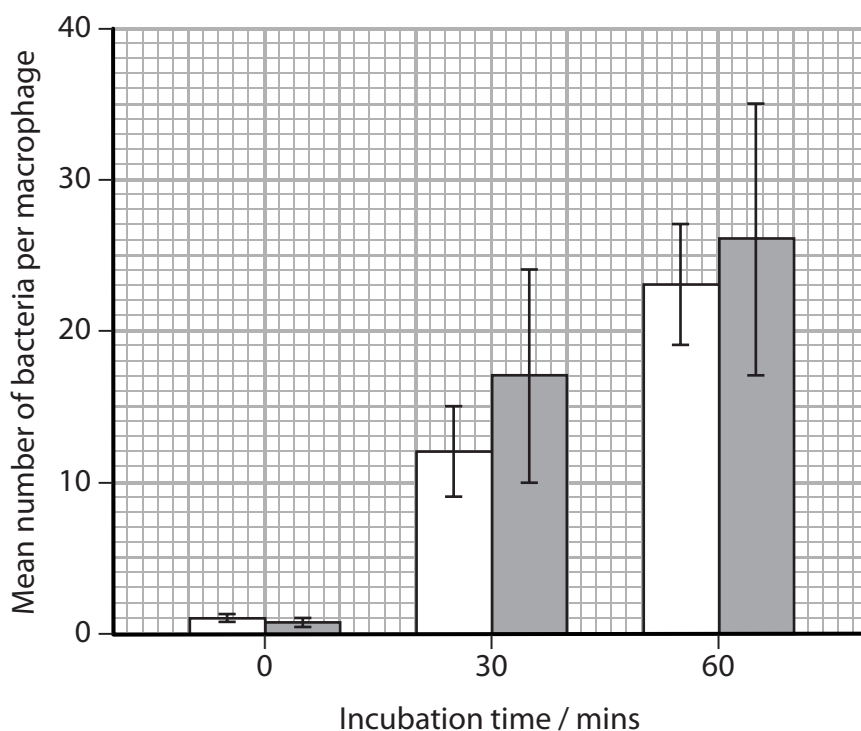
(b) Phagocytosis by macrophages is a non-specific response to infection.

The ability of macrophages to carry out phagocytosis of bacteria was investigated.

Macrophages from patients with AIDS were compared with macrophages from people who did not have AIDS.

These macrophages were obtained from the lungs of the individuals and incubated with bacteria for 60 minutes. The mean number of bacteria per macrophage was recorded at the start of the incubation period, after 30 minutes and after 60 minutes.

The results of this investigation are shown in the graph below.



(i) It was concluded that there was no significant difference in the ability of these macrophages to carry out phagocytosis.

Using the information in the graph, suggest why this conclusion was made.

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(ii) Using the fluid mosaic model of cell membranes, explain how a macrophage carries out phagocytosis of bacteria.

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(c) Antibiotics can be used to treat bacterial infections of patients with AIDS.

(i) Distinguish between a bacteriostatic antibiotic and a bactericidal antibiotic.

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(ii) Suggest why antibiotics are not used to treat infections caused by viruses.

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(Total for Question 2 = 12 marks)

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3 Gross primary productivity (GPP) is affected by temperature and precipitation, which includes rain and snow.

The table below shows the mean annual temperature range and mean annual precipitation range in some ecosystems. The table also shows the GPP range in these ecosystems.

Ecosystem	Mean annual temperature range / °C	Mean annual precipitation range / cm	GPP range / kJ m ⁻² year ⁻¹
Tropical rainforest	20 to 28	240 to 440	24 500 to 29 000
Temperate forest	1 to 20	50 to 240	15 000 to 27 000
Temperate grassland	-8 to 20	20 to 130	1 700 to 11 000
Tundra	-14 to -8	10 to 110	850 to 2 500

(a) Explain the meaning of the term **gross primary productivity (GPP)**. (2)

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(b) Using the information in the table, describe and explain the effects of temperature and precipitation on GPP. (5)

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(c) A desert has a mean annual temperature range of -8°C to 20°C and a mean annual precipitation range of 0 to 20 cm.

Suggest a range for the GPP in this desert. Give reasons for your answer.

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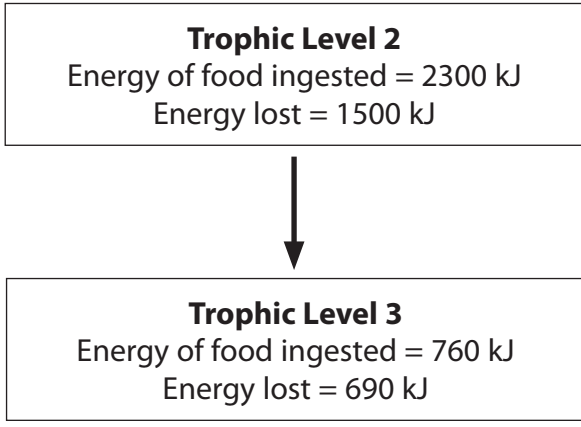
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(d) The diagram below shows the flow of energy in part of an ecosystem.



Calculate the percentage of energy from trophic level 2 that would be available for trophic level 4.

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(Total for Question 3 = 13 marks)



- 4 An experiment was carried out to investigate the effect of temperature on the activity of the enzyme RUBISCO. This enzyme is involved in the light-independent reaction of photosynthesis.

The RUBISCO was isolated from cotton plants and its activity measured.

The results of this experiment are shown in the table below.

Temperature / °C	Activity of RUBISCO / arbitrary units
25	2.3
30	3.2
35	4.2
40	5.0
45	4.4
50	1.7

- (a) Using the information in the table, explain the effects of temperatures above 40 °C on the activity of RUBISCO.

(5)

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(b) Name the **two** substrates that would have been used in this experiment.

(1)

(c) Place a cross ☒ in the box to complete the following sentences.

(i) The pH was kept constant to make the experiment

(1)

- A accurate
- B precise
- C reliable
- D valid

(ii) The optimum temperature of RUBISCO can be determined by

(1)

- A measuring the activity at 1°C intervals between 35°C and 40°C
- B measuring the activity at 1°C intervals between 40°C and 45°C
- C measuring the activity at 1°C intervals between 35°C and 45°C
- D repeating the experiment at 35°C, 40°C and 45°C three more times

(Total for Question 4 = 8 marks)

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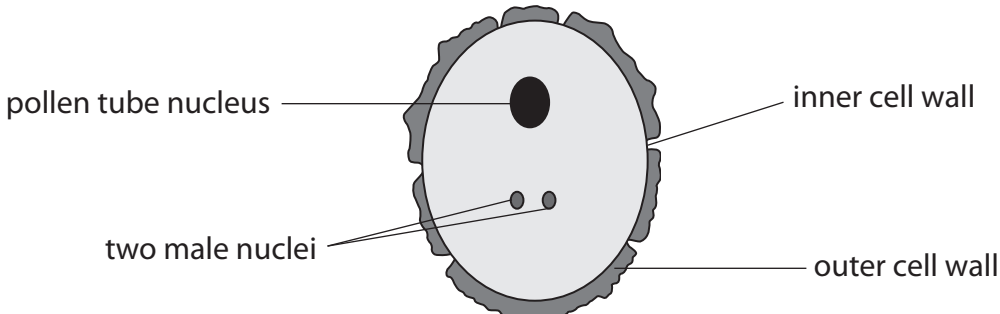
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5 Analysis of pollen in peat bogs can provide evidence for global warming.

Peat is acidic and has low levels of oxygen. As a result, pollen is preserved in the peat for many years.

The diagram below shows the structure of a pollen grain.



The inner cell wall contains cellulose and the outer cell wall contains sporopollenin. Sporopollenin is chemically stable and very resistant to decomposition.

(a) Describe the structure of cellulose in cell walls.

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(b) Suggest why pollen in peat bogs is preserved for many years.

(4)

(c) Describe the role of each of the male nuclei in the process of fertilisation in flowering plants.

(4)

(Total for Question 5 = 12 marks)

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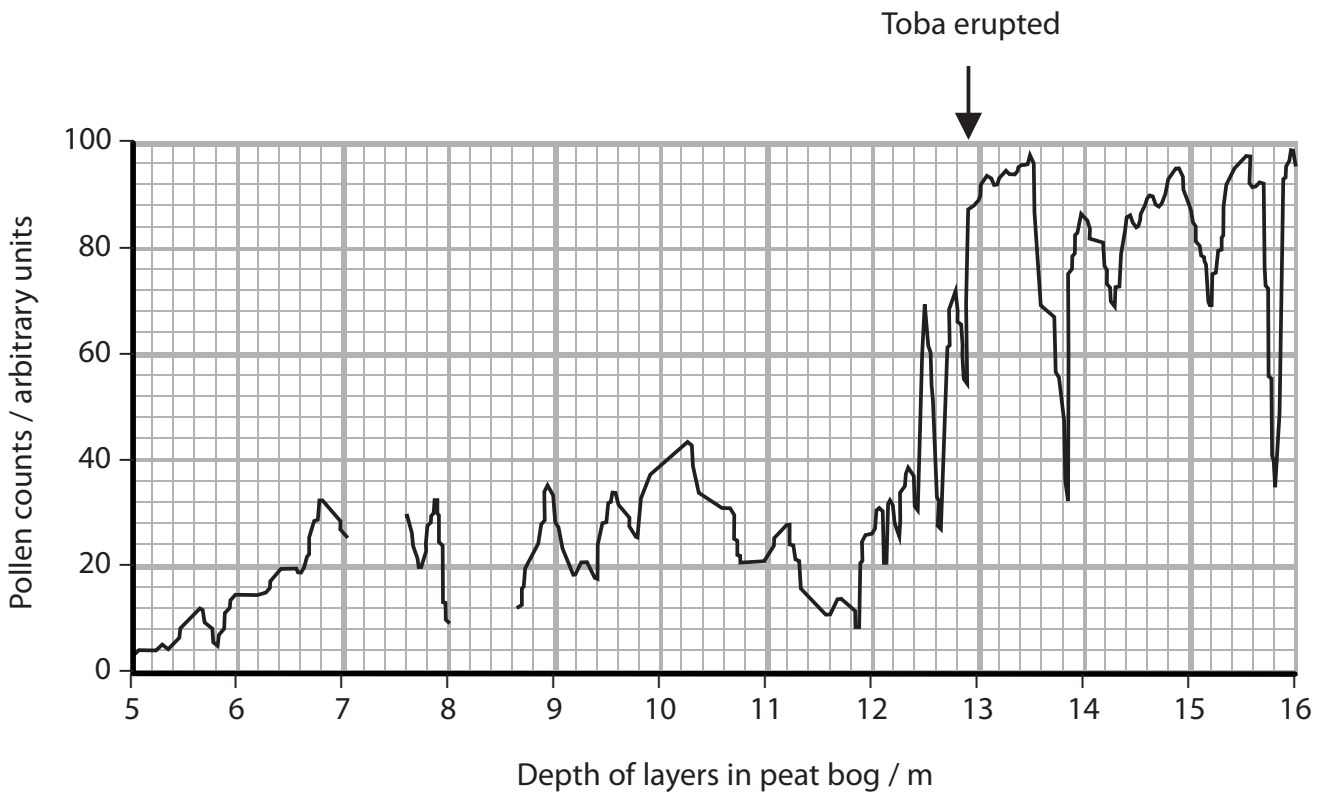
6 Volcanic eruptions have had an effect on the climate and temperature of the Earth.

Analysis of pollen in peat bogs and changes in sea levels give evidence for climate change.

Toba is a volcano in Sumatra that erupted approximately 70 000 years ago. The map below shows the location of Sumatra.



The graph below shows the result of pollen counts at different depths in a peat bog in France.



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(a) Using the information in the graph, describe the changes in the pollen count in the layers of peat from a depth of 12.5 m to a depth of 13.5 m.

(3)

(b) Suggest why there is no data for some of the depths.

(1)

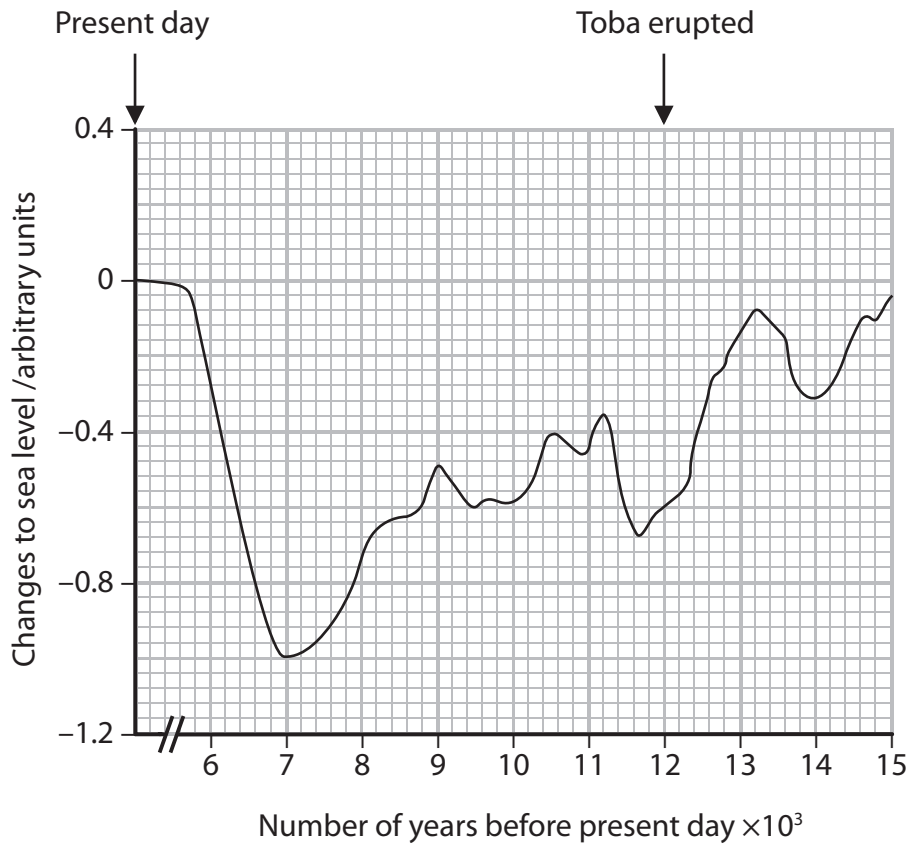
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(c) The graph below shows changes to sea levels, compared to the present day, in the oceans around Greenland.



Suggest why temperature changes affect sea level.

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(d) It is claimed that the volcanic eruption of Toba caused a change in world climate.

(i) Using the information in both graphs, describe the evidence that supports this claim.

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(ii) Using the information in both graphs, suggest why this claim may not be true.

(3)

(Total for Question 6 = 11 marks)

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

(a) The pathologist will measure the body temperature and the temperature of the surroundings.

Explain why it is necessary to take these two measurements as soon as possible.

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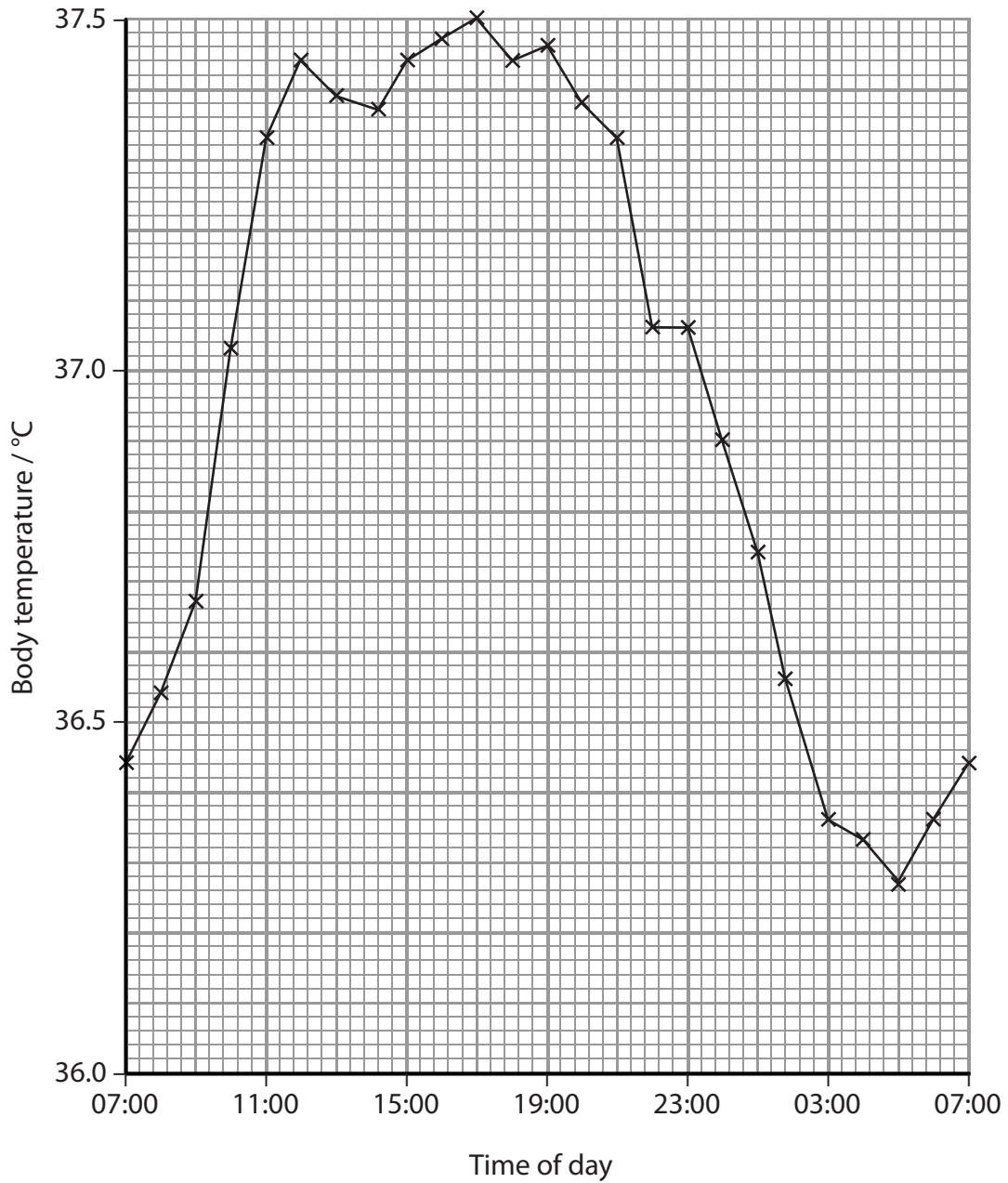
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(b) The graph below shows variation in the body temperature of a living person over a period of 24 hours.



(i) Using the information in the graph, calculate the maximum change in body temperature over this period of 24 hours. (2)

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(ii) Suggest how a pathologist could use the information in this graph to estimate the time of death of a body at a crime scene. (2)

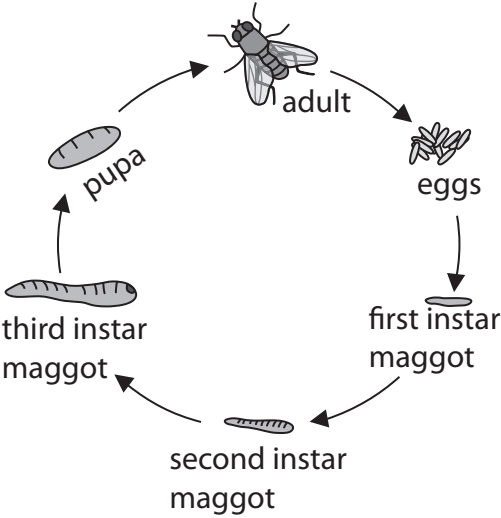
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*(c) A pathologist can also use forensic entomology to estimate the time of death of a body.
The diagram below shows the life cycle of a fly.



Describe an investigation that could be carried out to study the effect of temperature on the time taken for the first instar maggot to become a pupa.

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(Total for Question 7 = 12 marks)



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8 One gene can give rise to more than one protein.

(a) Give **three** differences between fibrous and globular proteins.

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*(b) Sex determination in *Drosophila* (fruit fly) is controlled by the *Sxl* gene that codes for the Sxl protein. The *Sxl* gene is the same in female and male *Drosophila*.

The length of the protein in the female *Drosophila* is different from the length of the protein in the male *Drosophila*.

Suggest how the same *Sxl* gene can give rise to these different proteins.

(6)

Area containing horizontal dotted lines for writing the answer.

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 90 MARKS



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