Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
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8	
9	
10	
TOTAL	

General Certificate of Education
Advanced Level Examination
June 2011

Biology BIOL5

Unit 5 Control in cells and in organisms

Wednesday 22 June 2011 9.00 am to 11.15 am

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

Time allowed
- 2 hours 15 minutes

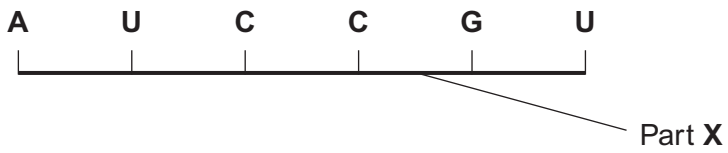
Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- You may ask for extra paper. Extra paper must be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

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- Quality of Written Communication will be assessed in all answers.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

Advice
- You are advised to spend no longer than 40 minutes on the essay.

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

1 The diagram shows part of a pre-mRNA molecule.



1 (a) (i) Name the **two** substances that make up part **X**.

..... and .....

(1 mark)

1 (a) (ii) Give the sequence of bases on the DNA strand from which this pre-mRNA has been transcribed.

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(1 mark)

1 (b) (i) Give **one** way in which the structure of an mRNA molecule is different from the structure of a tRNA molecule.

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(1 mark)

1 (b) (ii) Explain the difference between pre-mRNA and mRNA.

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(1 mark)

1 (c) The table shows the percentage of different bases in two pre-mRNA molecules. The molecules were transcribed from the DNA in different parts of a chromosome.

Part of chromosome	Percentage of base			
	A	**G**	**C**	**U**
Middle	38	20	24	
End	31	22	26	

1 (c) (i) Complete the table by writing the percentage of uracil (U) in the appropriate boxes.

(1 mark)

1 (c) (ii) Explain why the percentages of bases from the middle part of the chromosome and the end part are different.

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(2 marks)

7

Turn over for the next question

2 Different substances are involved in coordinating responses in animals.

2 (a) Hormones are different from local chemical mediators such as histamine in the cells they affect.

2 (a) (i) Describe how hormones are different in the cells they affect.

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(1 mark)

2 (a) (ii) Describe how hormones and local chemical mediators reach the cells they affect.

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(2 marks)

2 (b) Synapses are unidirectional. Explain how acetylcholine contributes to a synapse being unidirectional.

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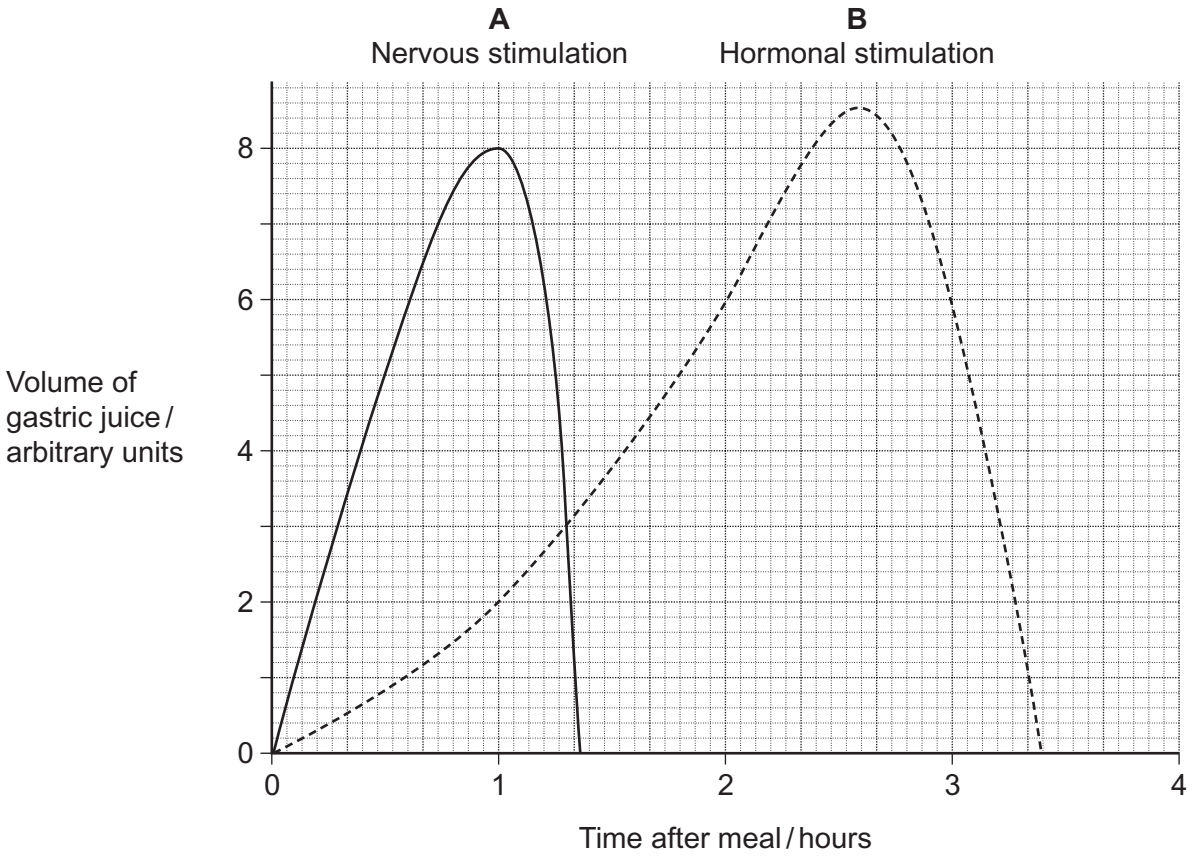
(2 marks)

2 (c) Cells in the stomach wall release gastric juice after a meal. The graph shows how the volumes of gastric juice produced by nervous stimulation and by hormonal stimulation change after a meal.



2 (c) (i) Describe the evidence from the graph that curve **A** represents the volume of gastric juice produced by nervous stimulation.

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(2 marks)

2 (c) (ii) Complete the table to show the percentage of gastric juice produced by nervous stimulation at the times shown.

	Time after meal / hours		
	1	**2**	**3**
Percentage of gastric juice produced by nervous stimulation			

(1 mark)

8

Turn over ▶

3 IAA is a specific growth factor.

3 (a) Name the process by which IAA moves from the growing regions of a plant shoot to other tissues.

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(1 mark)

3 (b) When a young shoot is illuminated from one side, IAA stimulates growth on the shaded side. Explain why growth on the shaded side helps to maintain the leaves in a favourable environment.

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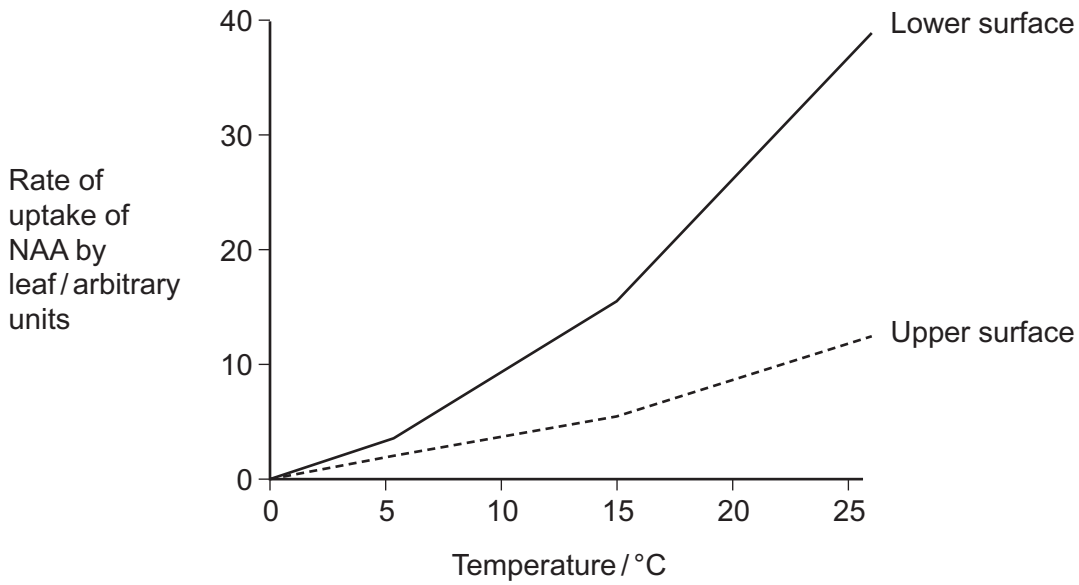
(2 marks)

NAA is a similar substance to IAA. It is used to control the growth of cultivated plants. Plant physiologists investigated the effect of temperature on the uptake of NAA by leaves. They sprayed a solution containing NAA on the upper and lower surfaces of a leaf. The graph shows their results.



3 (c) Explain the effect of temperature on the rate at which NAA is taken up by the lower surface of the leaf.

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(2 marks)

3 (d) There are differences in the properties of the cuticle on the upper and lower surfaces of leaves.

3 (d) (i) Suggest how these differences in the cuticle might explain the differences in rates of uptake of NAA by the two surfaces.

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(2 marks)

3 (d) (ii) In this investigation, the physiologists investigated the leaves of pear trees. Explain why the results might be different for other species.

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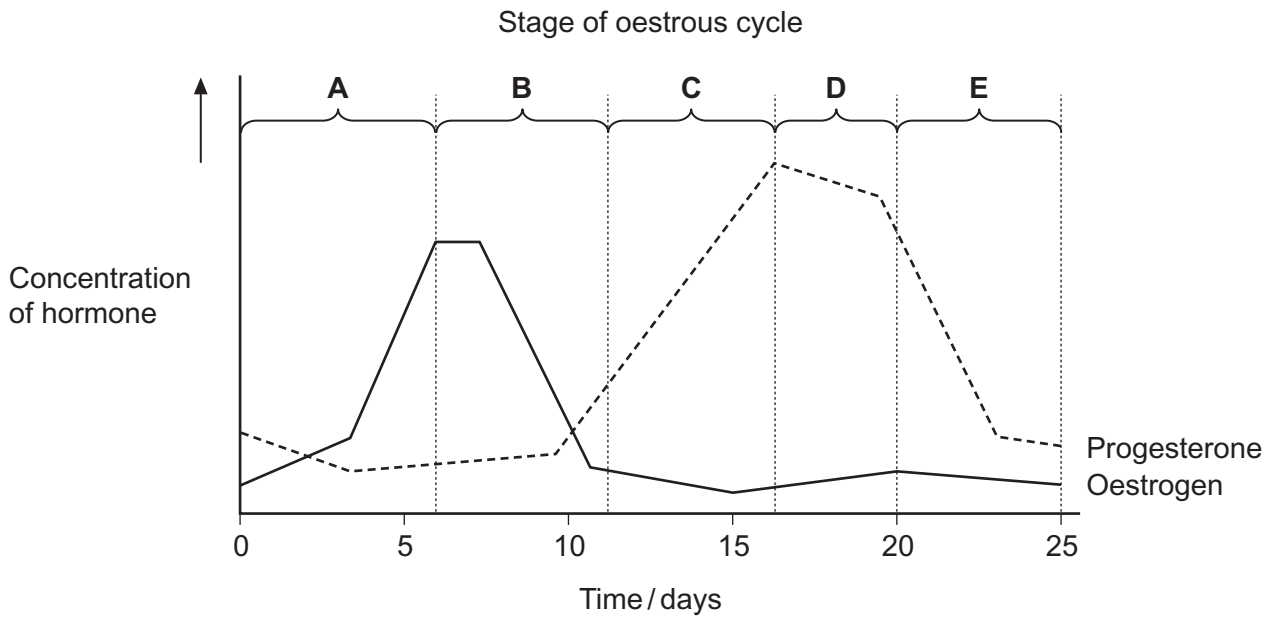
(1 mark)

8

4 The graph shows the concentrations of two hormones in the blood of an adult female pig over 25 days.



4 (a) (i) Use the graph to give the letter of the stage where ovulation occurred.

(1 mark)

4 (a) (ii) Give **one** piece of evidence from the graph that this pig was **not** pregnant at 25 days.

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(1 mark)

4 (b) The relationship between oestrogen and LH is an example of positive feedback. Explain how.

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(2 marks)

4 (c) Farmers sometimes give progesterone to sheep to prevent ovulation. Explain how progesterone prevents ovulation.

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(2 marks)

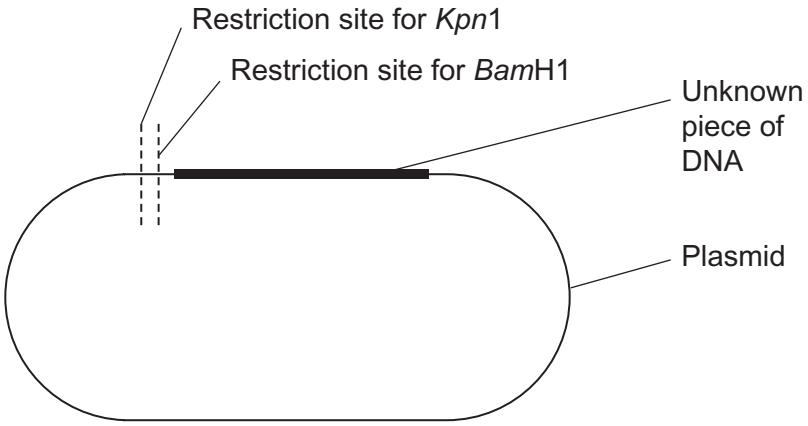
6

Turn over for the next question

5 Scientists used restriction mapping to investigate some aspects of the base sequence of an unknown piece of DNA. This piece of DNA was 3 000 base pairs (bp) long.

The scientists took plasmids that had one restriction site for the enzyme *Kpn*1 and one restriction site for the enzyme *Bam*H1. They inserted copies of the unknown piece of DNA into the plasmids. This produced recombinant plasmids.

The diagram shows a recombinant plasmid.



5 (a) When the scientists digested one of the recombinant plasmids with *Kpn*1, they obtained two fragments. One fragment was measured as 1 000 bp.
The other fragment was described as "very large".

5 (a) (i) What does this show about the base sequence of the unknown piece of DNA?

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(2 marks)

5 (a) (ii) One of the fragments that the scientists obtained was described as "very large".
What is represented by this very large fragment?

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(1 mark)

5 (b) When the scientists digested another of the recombinant plasmids with *Bam*H1, they obtained three fragments.

How many *Bam*H1 restriction sites are there in the unknown piece of DNA?

(1 mark)

5 (c) (i) Scientists can separate fragments of DNA using electrophoresis. Suggest how they can use electrophoresis to estimate the number of base pairs in the separated fragments.

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(2 marks)

5 (c) (ii) Scientists need to take precautions when they carry out restriction mapping. They need to make sure that the enzyme they have used has completely digested the DNA. One check they may carry out is to add the sizes of the fragments together. How could scientists use this information to show that the DNA has **not** been completely digested? Explain your answer.

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(2 marks)

8

6 Plant physiologists attempted to produce papaya plants using tissue culture. They investigated the effects of different concentrations of two plant growth factors on small pieces of the stem tip from a papaya plant. Their results are shown in the table.

Concentration of auxin / µmol dm^{-3}	Concentration of cytokinin / µmol dm^{-3}		
	5	25	50
0	No effect	No effect	Leaves produced
1	No effect	Leaves produced	Leaves produced
5	No effect	Leaves produced	Leaves and some plantlets produced
10	Callus produced	Leaves and some plantlets produced	Plantlets produced
15	Callus produced	Callus and some leaves produced	Callus and some leaves produced

Callus is a mass of undifferentiated plant cells.
Plantlets are small plants.

6 (a) Explain the evidence from the table that cells from the stem tip are totipotent.

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(2 marks)

6 (b) Calculate the ratio of cytokinin : auxin that you would recommend to grow papaya plants by this method.

Answer .....

(2 marks)

6 (c) (i) Papaya plants reproduce sexually by means of seeds. Papaya plants grown from seeds are very variable in their yield. Explain why.

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(2 marks)

6 (c) (ii) Explain the advantage of growing papaya plants from tissue culture rather than from seeds.

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(1 mark)

7

Turn over for the next question

7 (a) Desert iguanas are lizards that live in hot, dry conditions. Scientists measured the rate of oxygen consumption of desert iguanas at different body temperatures. Some of their results are shown in the table.

Body temperature / °C	Mean rate of oxygen consumption at rest / $cm^3\ g^{-1}\ h^{-1}$
25	0.4
30	0.7
35	1.2
40	1.5

7 (a) (i) Explain how an increase in the iguana's body temperature affects its oxygen consumption when it is at rest.

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(3 marks)

(Extra space) .....

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7 (a) (ii) The units in the table allowed the scientists to compare the oxygen consumptions of different iguanas. Explain how.

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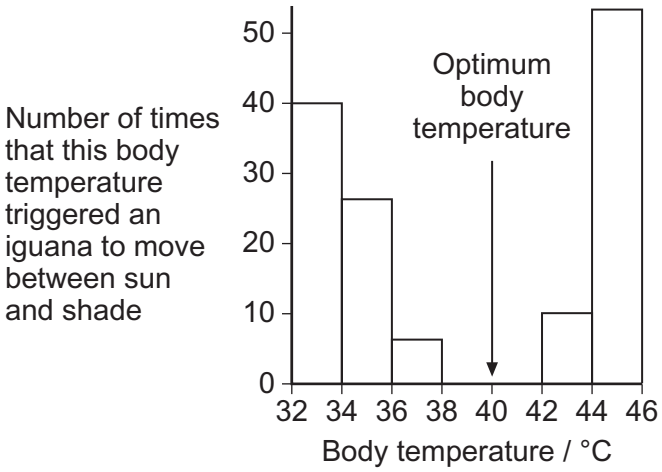
(1 mark)

7 (b) The scientists then investigated how body temperature affected the behaviour of desert iguanas. They kept the iguanas in cages. Half of each cage was in the sun and half was covered to provide shade. The scientists continuously measured the body temperature of each iguana. They also recorded the body temperature when the iguana moved between sun and shade. Their results are shown in the graph.



7 (b) (i) Describe how the movements of the iguanas between sun and shade are related to body temperature.

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(1 mark)

7 (b) (ii) The behaviour of the desert iguanas keeps their body temperatures within a narrow range. Explain how.

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(2 marks)

7 (c) At high temperatures, a desert iguana keeps its mouth wide open and breathes in and out rapidly. This is called panting. Explain how panting helps to reduce the body temperature of an iguana.

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(2 marks)

9

Turn over ▶

8 (a) Transcriptional factors are important in the synthesis of particular proteins. Describe how.

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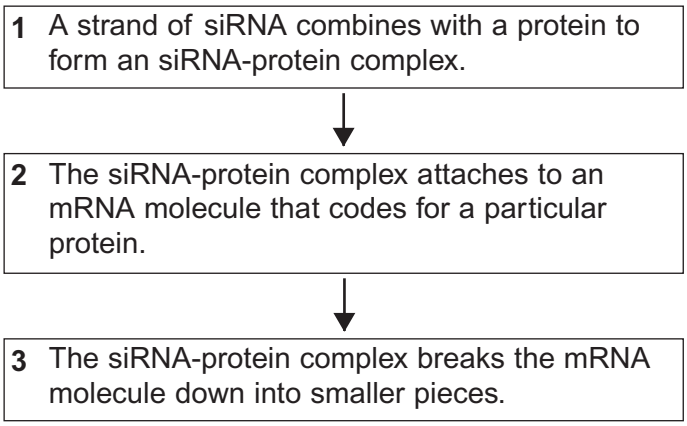
(2 marks)

8 (b) The flowchart shows how small interfering RNA (siRNA) affects the expression of a particular target gene.



8 (b) (i) The siRNA-protein complex attaches to an mRNA molecule coding for a particular protein (step **2**). Explain what causes the siRNA to attach only to one sort of mRNA molecule.

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(1 mark)

8 (b) (ii) Describe and explain how expression of the target gene is affected by siRNA.

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(2 marks)

8 (b) (iii) Scientists have suggested that siRNA may be useful in treating some diseases. Suggest why siRNA may be useful in treating disease.

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(2 marks)

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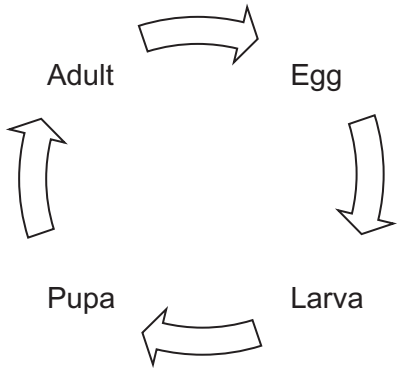
Turn over for the next question

9 The diagram shows the life cycle of a fly.



When the larva is fully grown, it changes into a pupa. The pupa does not feed. In the pupa, the tissues that made up the body of the larva are broken down. New adult tissues are formed from substances obtained from these broken-down tissues and from substances that were stored in the body of the larva.

9 (a) Hydrolysis and condensation are important in the formation of new adult proteins. Explain how.

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(2 marks)

9 (b) Most of the protein stored in the body of a fly larva is a protein called calliphorin. Explain why different adult proteins can be made using calliphorin.

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(1 mark)

The table shows the mean concentration of RNA in fly pupae at different ages.

Age of pupa as percentage of total time spent as a pupa	Mean concentration of RNA / µg per pupa
0	20
20	15
40	12
60	17
80	33
100	20

9 (c) Describe how the concentration of RNA changes during the time spent as a pupa.

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(2 marks)

9 (d) (i) Describe how you would expect the number of lysosomes in a pupa to change with the age of the pupa. Give a reason for your answer.

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(2 marks)

9 (d) (ii) Suggest an explanation for the change in RNA concentration in the first 40 % of the time spent as a pupa.

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(2 marks)

9 (e) Suggest an explanation for the change in RNA concentration between 60 and 80 % of the time spent as a pupa.

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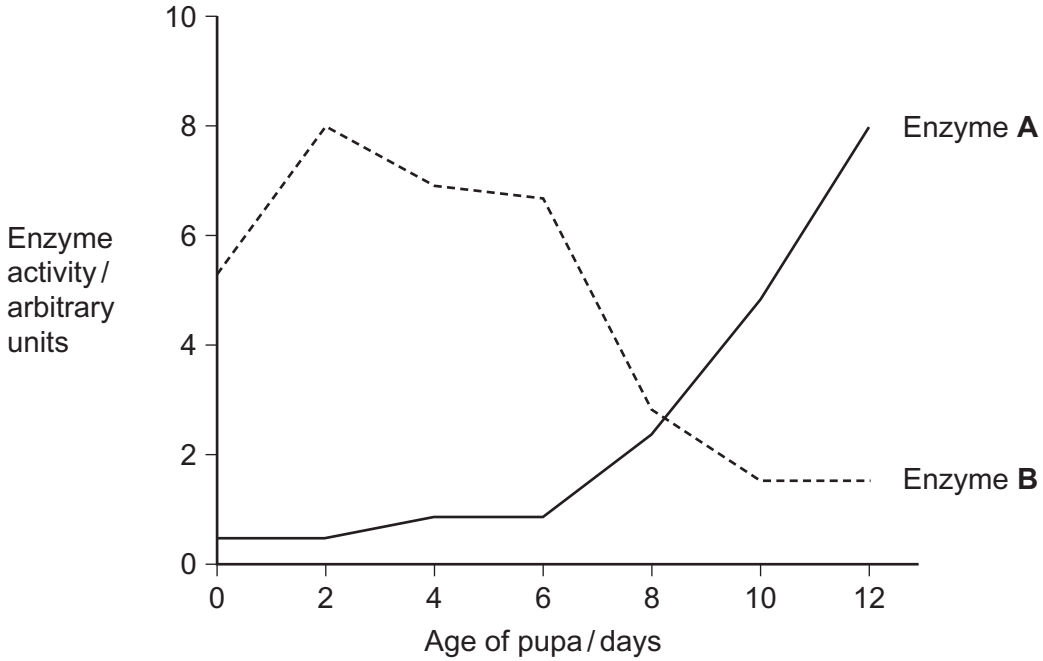
(2 marks)

Question 9 continues on the next page

9 (f) The graph shows changes in the activity of two respiratory enzymes in a fly pupa.

- Enzyme **A** catalyses a reaction in the Krebs cycle
- Enzyme **B** catalyses the formation of lactate from pyruvate



During the first 6 days as a pupa, the tracheae break down. New tracheae are formed after 6 days. Use this information to explain the change in activity of the two enzymes.

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(4 marks)

(Extra space) .....

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15

Essay

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy. It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is

Scientific content	16
Breadth of knowledge	3
Relevance	3
Quality of written communication	3

10 Write an essay on **one** of the following topics.

EITHER

10 (a) Using DNA in science and technology

(25 marks)

OR

10 (b) A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next cycle. Write an essay about cycles in biology.

(25 marks)

If you want to make a plan write it here.

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END OF QUESTIONS

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