Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2003
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY (SPECIFICATION B) BYB4
Unit 4 Energy, Control and Continuity

Monday 16 June 2003 Morning Session

In addition to this paper you will require:
- a ruler with millimetre measurements.

You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in **Section A** and **Section B** 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 81.
- Mark allocations are shown in brackets.
- Answers for **Section A** are expected to be short and precise.
- Questions in **Section B** should be answered in continuous prose where appropriate. Quality of Written Communication will be assessed in these answers.
- In addition to the mark allocations indicated within **Section B**, you will be awarded up to 1 mark for your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate. The legibility of your handwriting and the accuracy of your spelling, punctuation and grammar will also be taken into account.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
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9			
10			
QWC			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

SECTION A

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

1 (a) NAD and NADP are coenzymes used in either aerobic respiration or photosynthesis. Complete the table.

	Process	
	Respiration	**Photosynthesis**
Name of coenzyme	NAD	NADP
Stage(s) in the process where coenzyme is reduced		
Stage in the process where coenzyme is oxidised		

(3 marks)

(b) Explain how the reduced coenzyme produced in photosynthesis is used.

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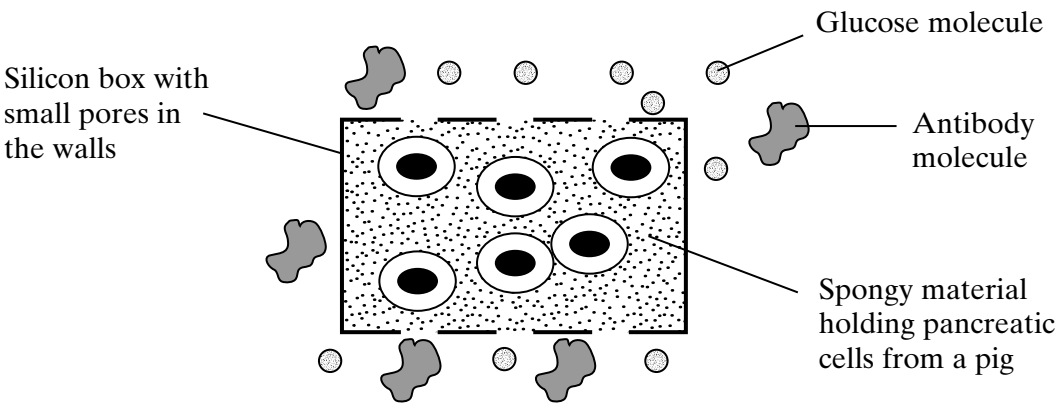
(2 marks)

5

2 Many diabetics inject insulin, because their pancreas has stopped producing it. Attempts have been made to transplant pancreatic cells from human embryos into diabetics but these foreign cells are often destroyed as a result of antibodies produced by the diabetic's immune system. The diagram shows a new type of transplant which has been tested in rats.



(a) (i) Explain why this transplant is not destroyed by the rat but can respond to changes in the rat's blood glucose concentration.

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(2 marks)

(ii) Suggest why there might be controversy if this transplant was used in humans.

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(1 mark)

(b) Explain how the cells in the transplant control the blood glucose concentration of the rat.

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(3 marks)

6

3 (a) (i) Name the three-carbon end product of glycolysis.

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(1 mark)

(ii) Describe how this product is converted into a substance that enters the Krebs cycle.

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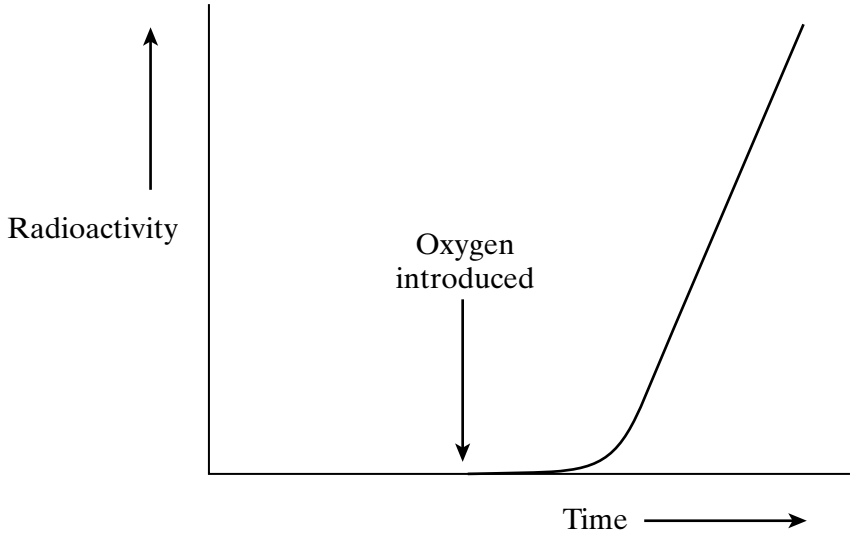
(2 marks)

(b) In an investigation, a culture medium containing glucose labelled with radioactive carbon atoms was placed in a flask. A sample of animal cells was added to this medium. The conditions in the flask at the start were anaerobic. Later, oxygen was bubbled through the medium. Samples of gas produced by the cells were tested for radioactivity at regular intervals. The graph shows the results.



Explain why radioactivity only began to appear in the gas produced by the cells after oxygen was introduced.

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(3 marks)

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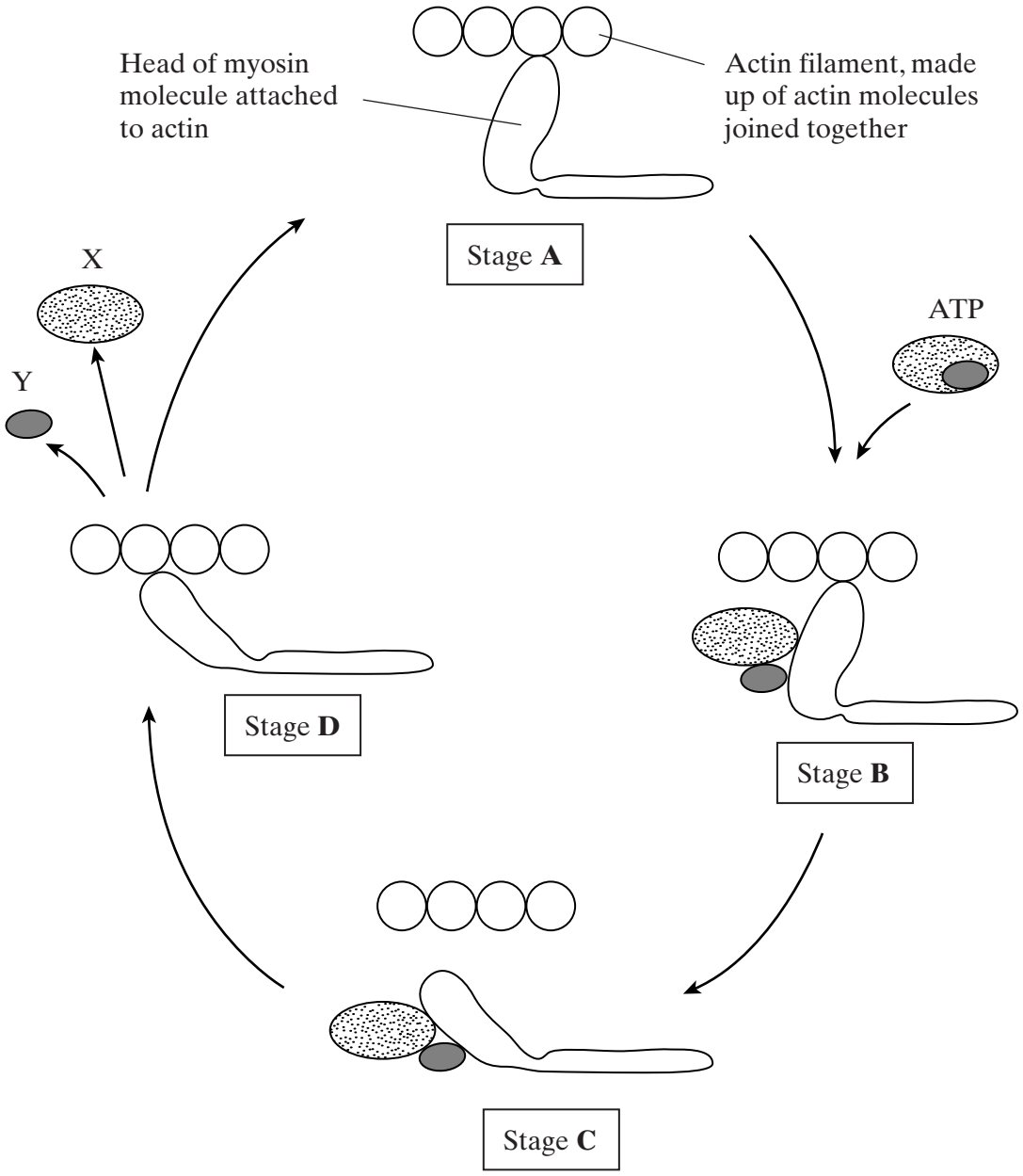
4 The diagram shows four stages in the cycle of actin/myosin cross bridge formation which results in contraction of a muscle.



(a) Name molecule **X** and ion **Y**.

X .....

Y .....

(1 mark)

(b) Use the information in the diagram to explain how actin moves past myosin. In your answer, refer to the stages **A**, **B**, **C** and **D**. (A description of the roles of calcium ions and tropomysin is not required.)

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(4 marks)

(c) After an animal dies, respiration stops and no more ATP is made. The muscles become rigid and fixed in their length. Use the information in the diagram to suggest an explanation for this.

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(1 mark)

6

TURN OVER FOR THE NEXT QUESTION

5 (a) Describe the trichromatic theory of colour vision.

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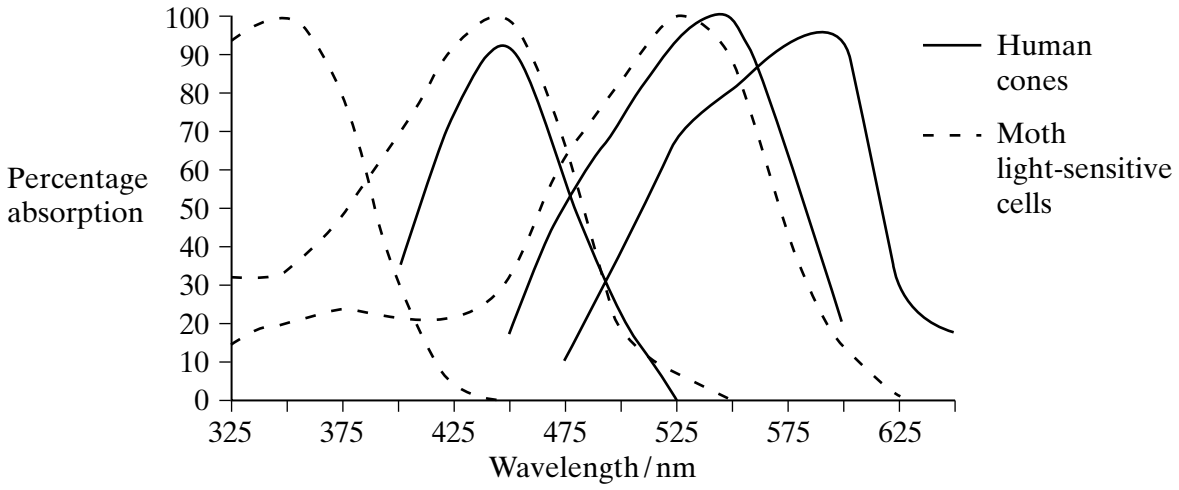
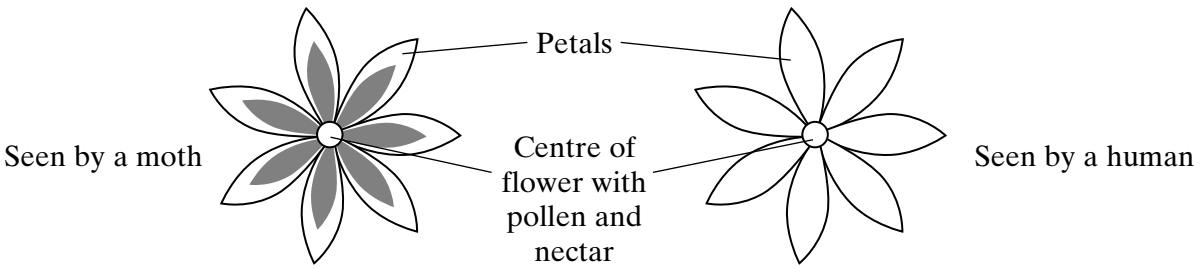
(3 marks)

(b) The graph shows absorption spectra for the light-sensitive cells found in the eyes of a species of moth and for cones in human eyes. The drawing shows the same flower when seen by a moth and a human.





(i) Describe the similarities and differences in absorption between light-sensitive cells of moths and human cones.

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(2 marks)

(ii) Explain how the moth sees a pattern on the flower and the human does not.

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(2 marks)

(iii) Suggest **one** advantage to the moth of seeing the pattern on the flower.

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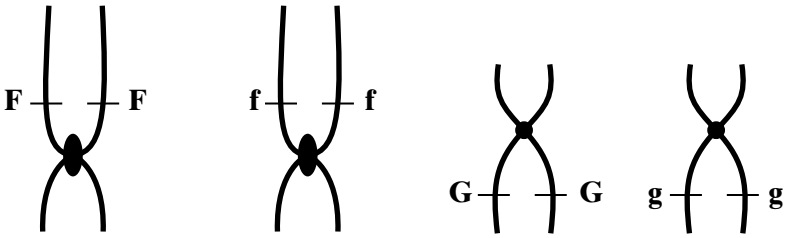
(1 mark)

8

TURN OVER FOR THE NEXT QUESTION

6 (a) The diagram shows the chromosomes in a cell at one stage of meiosis.



(i) What is the genotype of this cell?

..... *(1 mark)*

(ii) Explain how there came to be two copies of each allele of each gene at this stage of meiosis.

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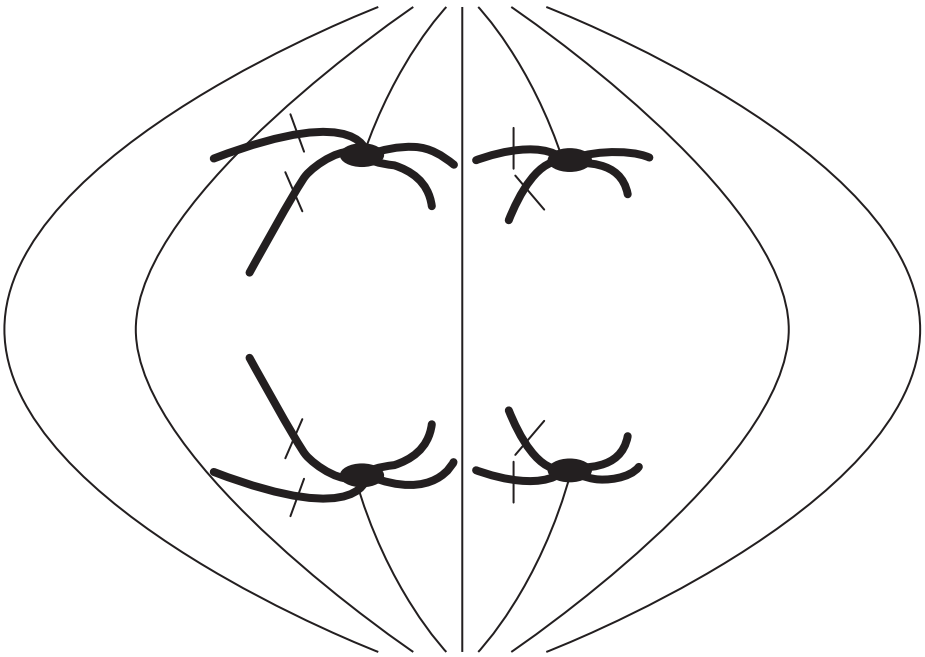
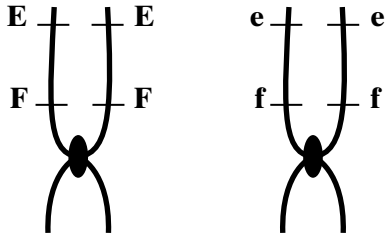
(2 marks)

(b) The diagram shows the same chromosomes on the spindle during meiosis. A gamete with the genotype **FG** was produced at the end of this meiotic division. Label the chromosomes to show the arrangement of the alleles that would lead to a gamete with the genotype **FG**.



(1 mark)

(c) The chromosome carrying **F** also carries **E**, as shown in the diagram.



Most of the gametes formed in meiosis had **F** and **E** together and **f** and **e** together, as in the original chromosomes. A few gametes contained **F** and **e** together and **f** and **E** together. Draw diagrams to show how these new combinations of alleles were produced by crossing over.

(3 marks)

7

TURN OVER FOR THE NEXT QUESTION

7 (a) Explain what is meant by

(i) an *allele*;

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(ii) a *sex-linked* gene.

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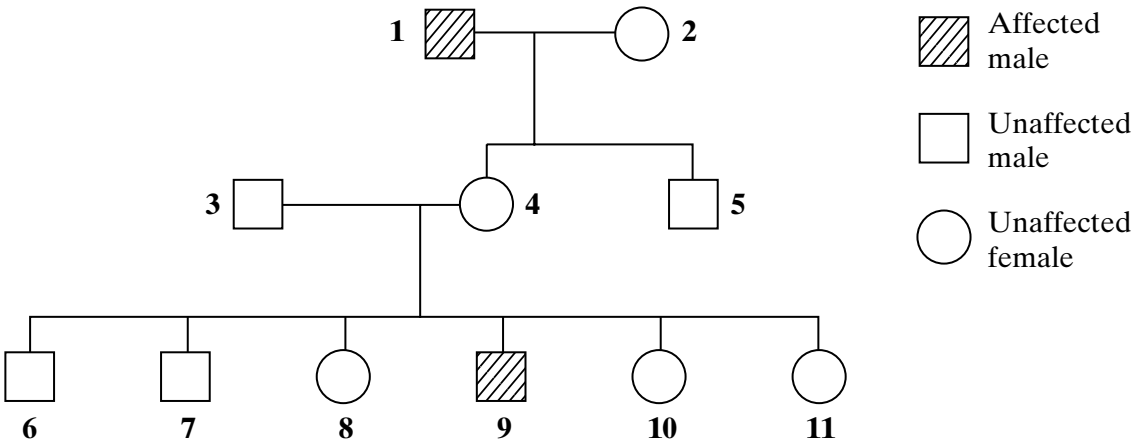
(2 marks)

(b) Becker muscular dystrophy is an inherited condition caused by an allele of a gene. Sufferers experience some loss of muscle strength. The diagram shows how members of one family were affected by the condition.



(i) Explain **one** piece of evidence from the diagram which shows that the allele for Becker muscular dystrophy is recessive.

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(2 marks)

(ii) The allele for Becker muscular dystrophy is sex-linked. Explain how individual **9** inherited the condition from his grandfather.

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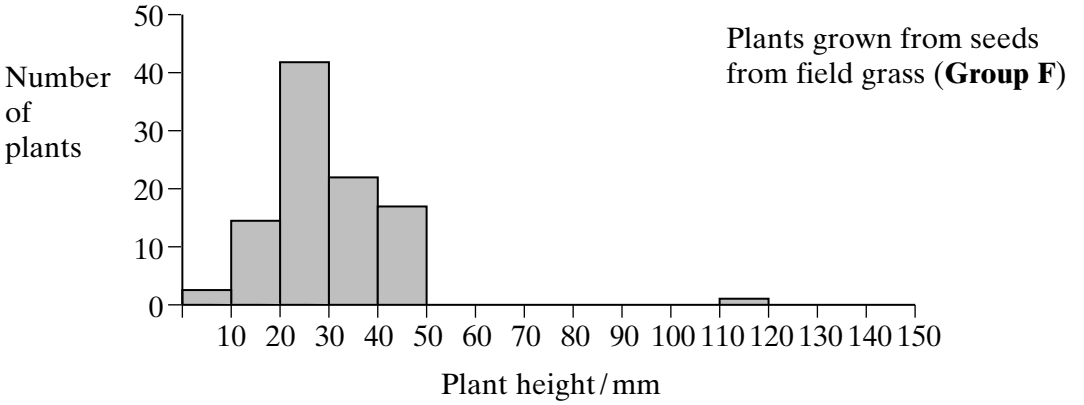
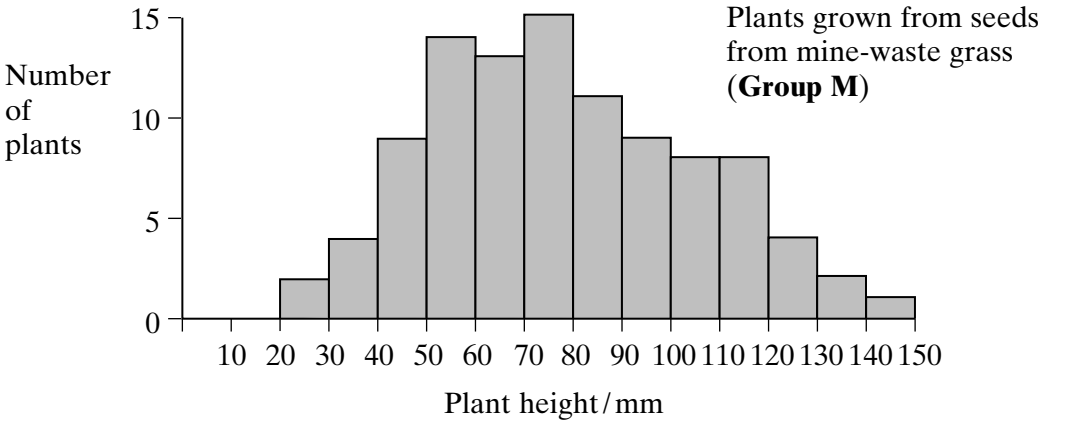
(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

8 Seeds were obtained from a species of grass growing in a field (**Group F**) and from the same species growing on the waste tip of an old copper mine (**Group M**). Both seed samples were grown in soil containing high concentrations of copper. After a set time, the height of the grass plants was measured to the nearest millimetre. The results are shown in the histograms.





(a) Describe the growth of **Group F** and **Group M** plants when grown in soil containing high concentrations of copper.

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(2 marks)

(b) Suggest an explanation for the difference in growth between **Group F** and **Group M** plants.

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(2 marks)

(c) Suggest an explanation to account for the one **Group F** plant that grew to 110 - 119 mm.

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(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

SECTION B

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

Answers should be written in continuous prose, where appropriate.
Quality of Written Communication will be assessed in these answers.

9 (a) Describe **three** features of all members of the animal kingdom which are absent from all members of the plant kingdom.

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(3 marks)

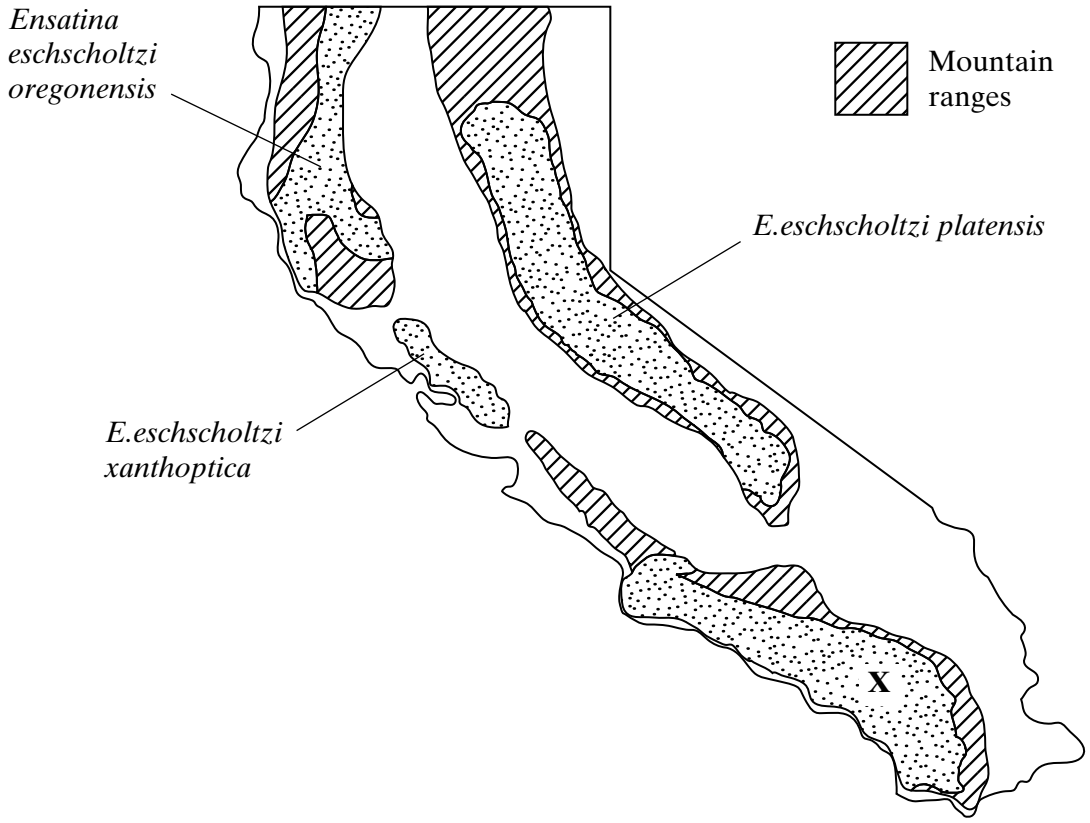
(b) *Ensatina eschscholtzi* is a species of salamander, a type of amphibian.
Complete the table to show the classification of this salamander.

Taxonomic group	Name
Kingdom	Animalia
	Chordata
	Amphibia
	Urodela
	Plethodontidae
Genus	
Species	

(2 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

(c) In California there are different types of *Ensatina eschscholtzi*, each with a characteristic appearance and found in its own area. They are sufficiently different from each other to be classified as subspecies. These may become new species with time. The map shows the distribution of populations of four subspecies.



(i) Suggest how speciation may be occurring in these salamanders.

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(4 marks)

(ii) Suggest **one** way in which scientists could find out whether the salamanders from the area marked **X** were a different species from those found in other areas.

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(2 marks)

(iii) Within each subspecies there is a range of phenotypes. Explain the factors that give rise to this variation.

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(4 marks)

15

TURN OVER FOR THE NEXT QUESTION

10 The kidney plays an important part in the regulation of blood water potential. This involves control of the amount of water reabsorbed from the filtrate produced in the kidney tubules. The amount of water reabsorbed affects the volume of urine produced, the rate at which the bladder fills and how often it has to be emptied.

(a) Explain how the loop of Henle maintains the gradient of ions which allows water to be reabsorbed from filtrate in the collecting duct.

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(5 marks)

(b) Explain how ADH is involved in the control of the volume of urine produced.

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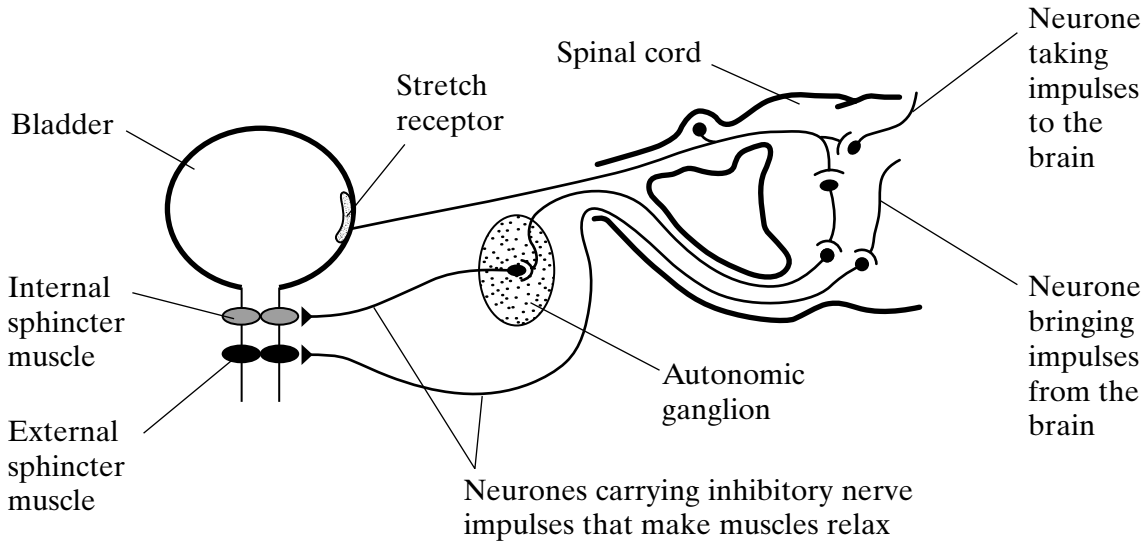
(4 marks)

(c) The diagram shows the systems involved in controlling the emptying of the bladder. In babies, emptying of the bladder is controlled by an autonomic reflex involving the internal sphincter muscle. Conscious control is learnt between the ages of two and three and involves the external sphincter as well.



Using information in the diagram,

(i) explain how the autonomic reflex arc is different from a simple reflex arc involving voluntary muscle;

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(2 marks)

(ii) explain how emptying of the bladder is controlled consciously.

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(4 marks)

15

END OF QUESTIONS

QWC

1