Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

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General Certificate of Education
January 2006
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Tuesday 24 January 2006 9.00 am to 10.30 am

For this paper you must have:
- 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.
- Answer the questions in **Section A** and **Section B** in the spaces provided.
- 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.
- The marks for questions are shown in brackets.
- Answers for **Section A** are expected to be short and precise.
- Answer questions in **Section B** in continuous prose where appropriate. Quality of Written Communication will be assessed in these answers.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1		9	
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
Quality of Written Communication			
TOTAL			
Examiner's Initials			

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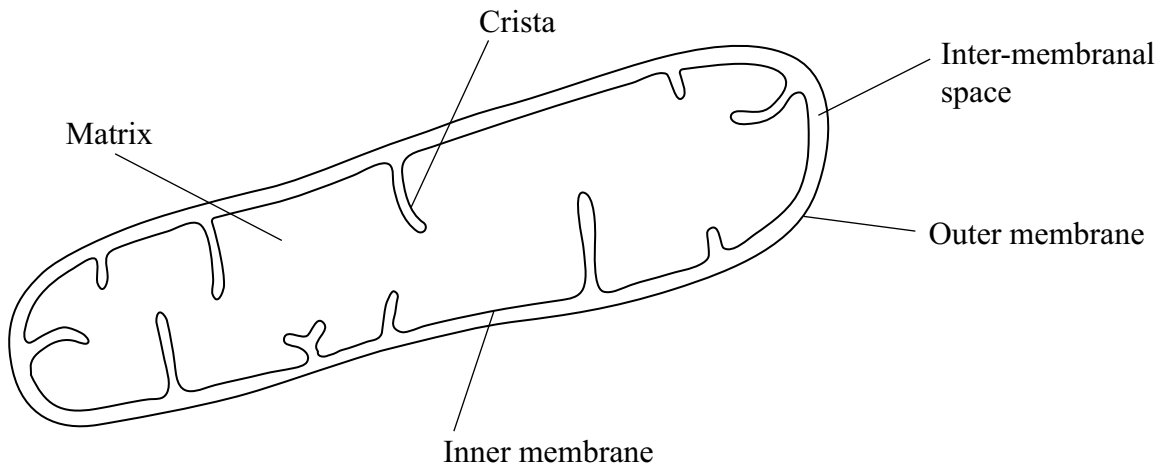
SECTION A

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

1 The diagram shows the structure of a mitochondrion.



(a) In which part of the mitochondrion does the Krebs cycle take place?

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(1 mark)

(b) Name **two** substances for which there would be net movement into the mitochondrion.

1 .....

2 .....

(2 marks)

(c) The mitochondria in muscles contain many cristae. Explain the advantage of this.

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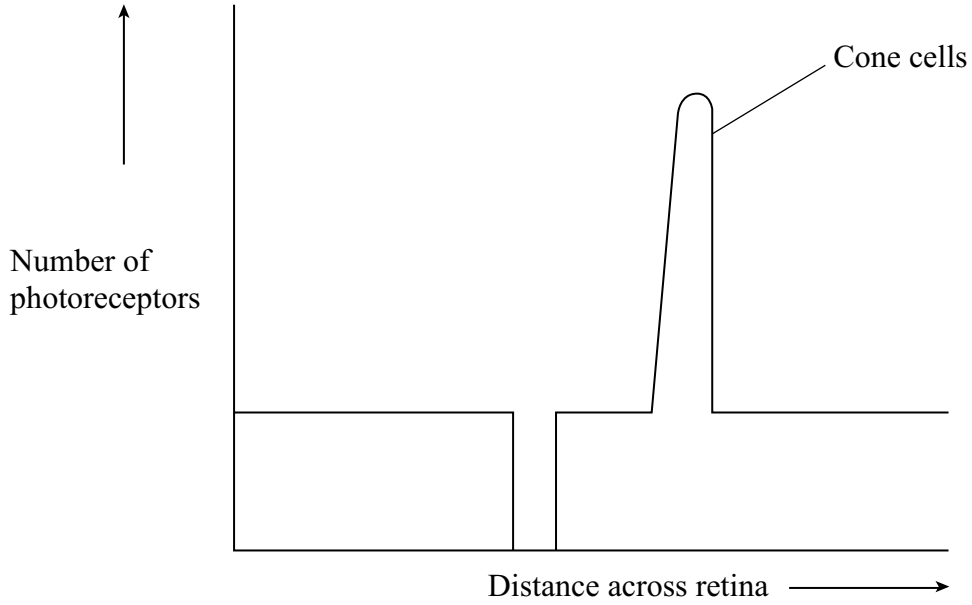
(2 marks)

5

2 The diagram shows the distribution of cone cells across the retina of a human eye.



(a) On the diagram draw a line to show the distribution of rod cells across the retina.

(2 marks)

(b) Nocturnal mammals are active at night. Describe how the number and distribution of rods and cones across the retina would differ in a nocturnal mammal from the number and distribution in a human. Explain your answer.

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(3 marks)

(c) Ageing causes a decrease in the elasticity of the lens. Explain how this affects the ability of the eye to focus on a near object.

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(2 marks)

7

3 (a) Describe how NADP is reduced in the light-dependent reaction of photosynthesis.

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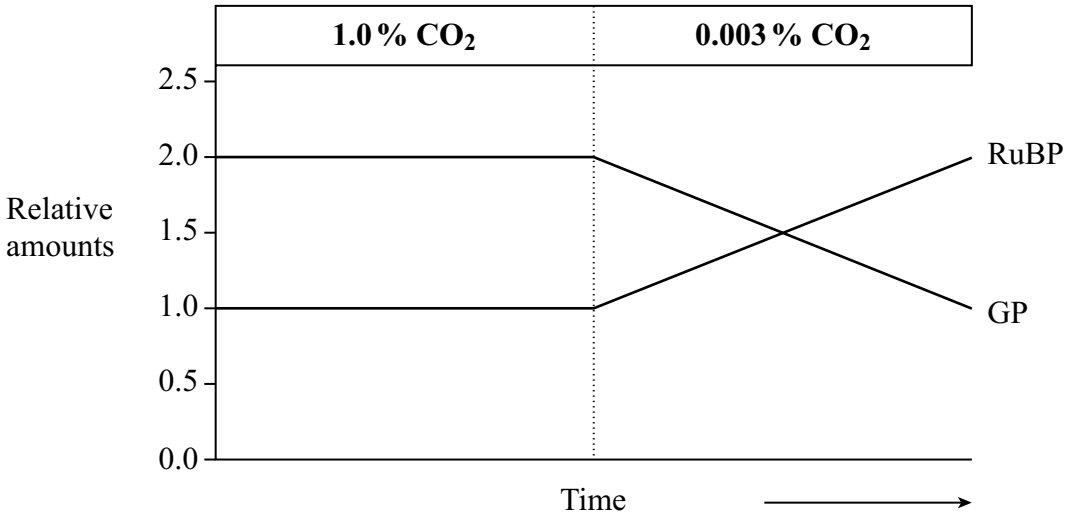
(2 marks)

(b) In an investigation of the light-independent reaction, the amounts of glycerate 3-phosphate (GP) and ribulose bisphosphate (RuBP) in photosynthesising cells were measured under different environmental conditions.

Figure 1 shows the effect of reducing the carbon dioxide concentration on the amounts of glycerate 3-phosphate and ribulose bisphosphate in photosynthesising cells.

Figure 1



(i) Explain why there is twice the amount of glycerate 3-phosphate as ribulose bisphosphate when the carbon dioxide concentration is high.

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(1 mark)

(ii) Explain the rise in the amount of ribulose bisphosphate after the carbon dioxide concentration is reduced.

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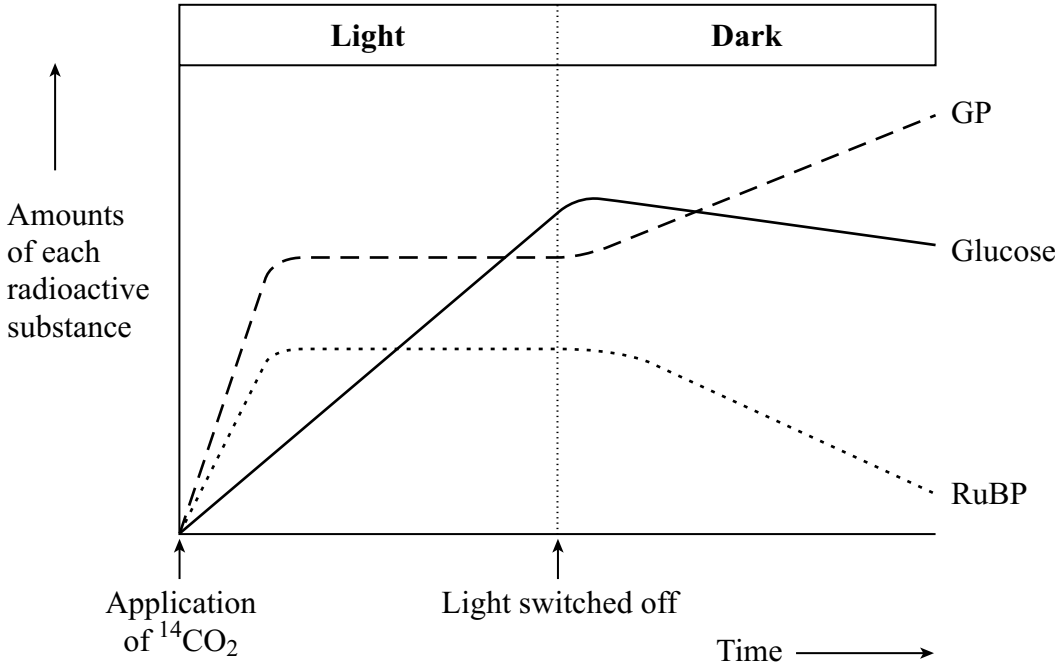
(1 mark)

(c) **Figure 2** shows the results of an experiment in which photosynthesising cells were kept in the light and then in darkness.

Figure 2



(i) In the experiment the cells were supplied with radioactively labelled $^{14}CO_2$. Explain why the carbon dioxide used was radioactively labelled.

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(1 mark)

(ii) Explain how lack of light caused the amount of radioactively labelled glycerate 3-phosphate to rise.

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(2 marks)

(iii) Explain what caused the amount of radioactively labelled glucose to decrease after the light was switched off.

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(1 mark)

8

4 (a) ABO blood groups in humans are an example of discontinuous variation, whereas height in humans is an example of continuous variation. Describe how discontinuous variation differs from continuous variation in terms of

(i) genetic control;

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(ii) the effect of the environment;

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(iii) the range of phenotypes.

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(3 marks)

(b) Genetically identical twins often show slight differences in their appearance at birth. Suggest **one** way in which these differences may have been caused.

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(1 mark)

4

5 Lake Malawi in East Africa contains around 400 different species of cichlids which are small, brightly coloured fish. All these species have evolved from a common ancestor.

(a) Describe **one** way in which scientists could find out whether cichlids from two different populations belong to the same species.

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(2 marks)

(b) During the last 700 000 years there have been long periods when the water level was much lower and Lake Malawi split up into many smaller lakes. Explain how speciation of the cichlids may have occurred following the formation of separate, smaller lakes.

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(4 marks)

(c) Many species of cichlids are similar in size and, apart from their colour, in appearance. Suggest how the variety of colour patterns displayed by these cichlids may help to maintain the fish as separate species.

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(2 marks)

8

6 Coat colour in Labrador dogs is controlled by two different genes. Each gene has a dominant and a recessive allele. The two genes are inherited independently but the effects of the alleles interact to produce three different coat colours. The table gives four genotypes and the phenotypes they produce.

Genotype	Phenotype
BbEe	black
bbEe	chocolate
Bbee	yellow
bbee	yellow

(a) What colour coat would you expect each of the following genotypes to give?

(i) **BBEe** .....

(ii) **bbEE** .....

(2 marks)

(b) A **BbEe** male was crossed with a **bbee** female. Complete the genetic diagram to show the ratio of offspring you would expect.

Parental phenotypes Black male × Yellow female

Parental genotypes **BbEe** **bbee**

Gametes

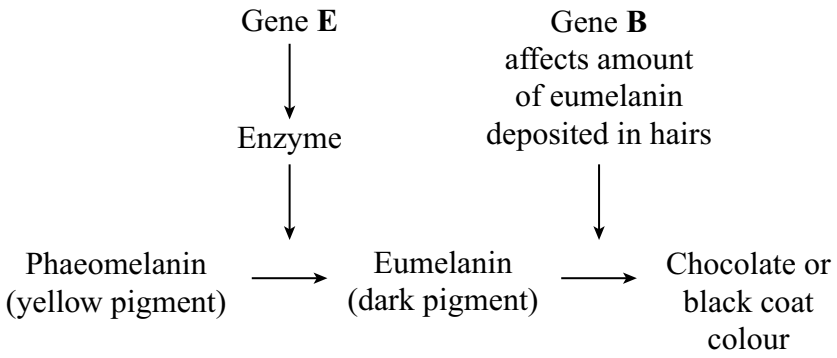
Offspring genotypes

Offspring phenotypes

Ratio of offspring phenotypes

(3 marks)

(c) The yellow coat colour of Labrador dogs is due to the presence of the pigment phaeomelanin in the hairs. The black and chocolate coat colours are due to different amounts of another pigment, eumelanin, deposited in these hairs. The more eumelanin there is, the darker the hair. The diagram shows the action of genes **E** and **B** in producing the different coat colours.



Use this information to explain how

(i) the genotype **bbee** produces a yellow coat colour;

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(2 marks)

(ii) the genotype **BbEe** produces a black coat colour.

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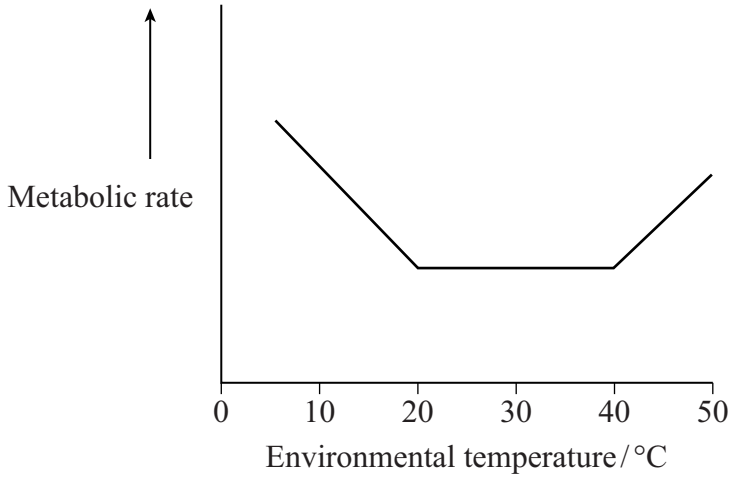
(2 marks)

9

7 The graph shows the effect of increasing the environmental temperature on the metabolic rate of a small mammal.



(a) Suggest **one** way of measuring the metabolic rate.

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(1 mark)

(b) The small mammal has ears which are usually pink, but they appear pale when the environmental temperature is low. Explain the pale appearance of the mammal's ears when the environmental temperature is low.

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(3 marks)

(c) Use your knowledge of thermoregulation to explain

(i) the change in metabolic rate of the mammal when the environmental temperature increases from 5 °C to 40 °C;

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(3 marks)

(ii) the increase in metabolic rate after 40 °C.

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(2 marks)

9

Turn over for the next question

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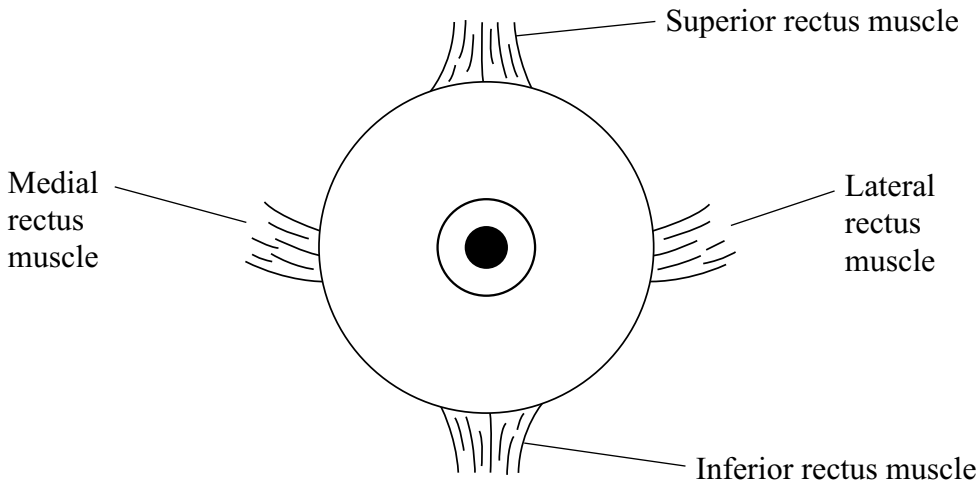
SECTION B

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

Answer questions in continuous prose, where appropriate.
Quality of Written Communication will be assessed in these answers.

8 The diagram shows some of the muscles that move the eye.



(a) Explain how the lateral rectus and medial rectus muscles enable the eye to move from side to side.

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(2 marks)

(b) A motorist sees a dog on the road. Describe how the different parts of the cerebral hemispheres are involved as the motorist sees the dog and presses the brake pedal.

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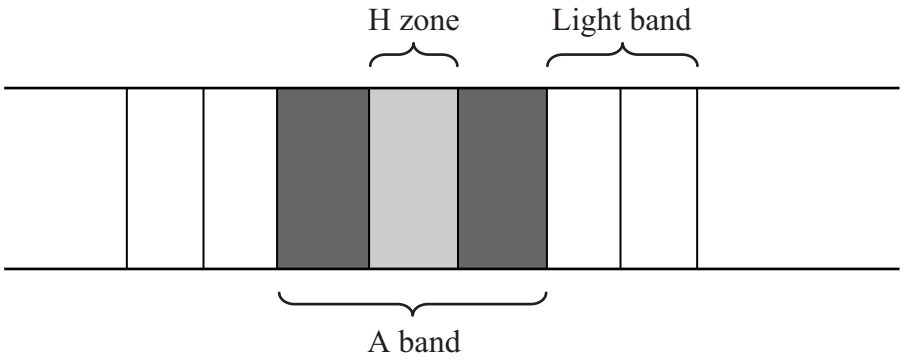
(3 marks)

Question 8 continues on the next page

(c) The diagram shows the banding pattern observed in part of a relaxed muscle fibril.



(i) Describe what causes the different bands seen in the muscle fibril.

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(2 marks)

(ii) Describe how the banding pattern will be different when the muscle fibril is contracted.

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(2 marks)

(d) There is an increase in the activity of the enzyme ATPase during muscle contraction. An investigation into muscle contraction involved measuring the activity of ATPase in solutions containing ATP, myosin and different muscle components. The table shows the results.

Solution	Contents	ATPase activity / arbitrary units
A	ATP, myosin and actin	1.97
B	ATP, myosin, actin and tropomyosin	0.54
C	ATP, myosin, actin, tropomyosin and calcium ions	3.85

(i) Explain the importance of ATPase during muscle contraction.

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(2 marks)

(ii) Using your knowledge of muscle contraction, explain the difference in the results between

A and **B**;

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(2 marks)

B and **C**.

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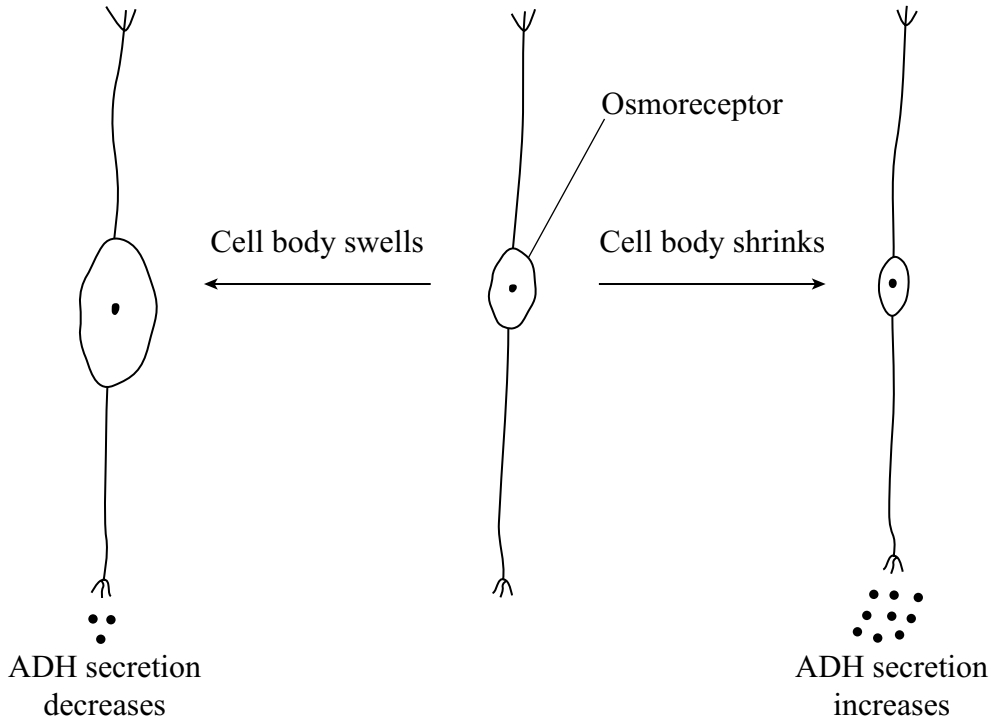
(2 marks)

15

9 Osmoreceptors are specialised neurones which secrete ADH. The amount of ADH secreted is dependent on the water potential of the blood. **Figure 3** shows how these osmoreceptors respond to changes in the water potential of the blood.

Figure 3



(a) (i) Where in the body is ADH released into the blood?

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(1 mark)

(ii) Use the information provided to explain how the osmoreceptors would respond after a person drinks a large volume of water.

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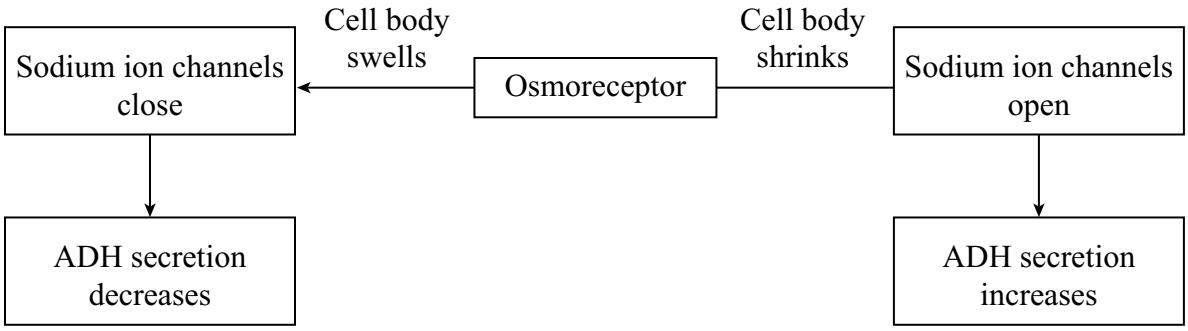
(2 marks)

(b) The membranes of the osmoreceptor contain sodium ion channels which open or close depending on the size of the cell. **Figure 4** shows how changes in the size of an osmoreceptor affect these sodium ion channels and ADH secretion.

Figure 4



When the water potential of the blood falls, the transmission of nerve impulses along the axon of an osmoreceptor leads to the secretion of ADH. Use the information provided in **Figure 4** to help explain how action potentials would be initiated by a change in the sodium ion channels and describe how nerve impulses would be transmitted along an osmoreceptor.

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(6 marks)

Question 9 continues on the next page

(c) The total amount of fluid filtered in the kidneys is normally 130 cm^3 per minute. When water intake is high, up to 15 % of this filtrate can be excreted as urine. Calculate the maximum volume of urine that could be excreted in one hour. Show your working.

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

(d) Diabetes insipidus is a disease in which there is a decrease in the amount of ADH secreted from osmoreceptors.

(i) Explain how a decrease in ADH affects the function of the kidneys.

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(2 marks)

(ii) Give **two** symptoms which you would expect to be associated with this disease.

1 .....

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2 .....

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(2 marks)

15

END OF QUESTIONS

QWC

1

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