Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2006
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Tuesday 20 June 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, where appropriate.

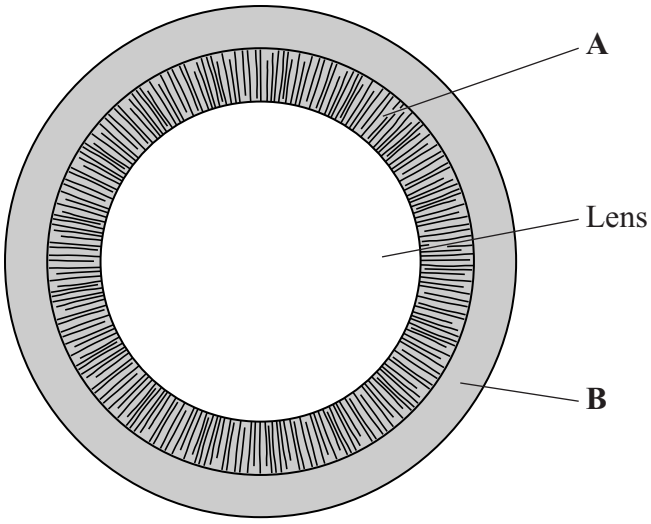
For Examiner's Use			
Number	Mark	Number	Mark
1		9	
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
Quality of Written Communication			
TOTAL			
Examiner's Initials			

SECTION A

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

1 **Figure 1** shows the structures in the human eye involved in focusing.

Figure 1



(a) Name structures **A** and **B**.

A .....

B .....

(2 marks)

(b) (i) Explain how the structures shown in **Figure 1** enable a person to focus on distant objects.

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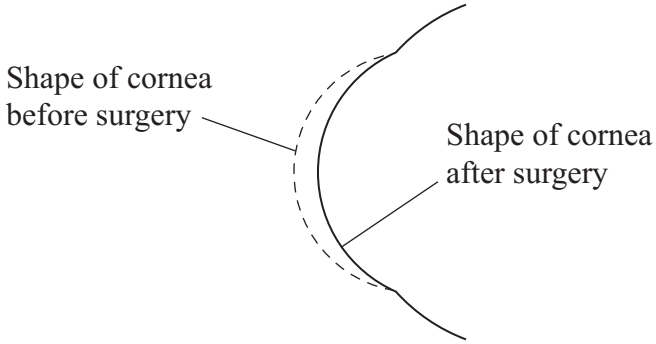
(3 marks)

(ii) Short-sighted people cannot focus clearly on distant objects. One way of correcting this condition is to use laser surgery to alter slightly the shape of the cornea. **Figure 2** shows the effect of laser surgery on the shape of the cornea.

Figure 2



Explain how laser surgery can correct short-sightedness.

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(2 marks)

7

Turn over for the next question

2 IQ test scores have been used as a measure of intelligence. Genetic and environmental factors may both be involved in determining intelligence. In an investigation of families with adopted children, the mean IQ scores of the adopted children was closer to the mean IQ scores of their adoptive parents than to that of their biological parents.

(a) Explain what the results of this investigation suggest about the importance of genetic and environmental factors in determining intelligence.

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(1 mark)

(b) Explain how data from studies of identical twins and non-identical twins could provide further evidence about the genetic control of intelligence.

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(4 marks)

5

3 (a) The cheetah, *Acinonyx jubatus*, and other cat species belong to the family Felidae. Complete the table to show the classification of the cheetah.

Kingdom	Animalia
	Chordata
	Mammalia
	Carnivora
Family	Felidae
Genus	

(2 marks)

(b) This system of classification is described as hierarchical. Explain what is meant by a hierarchical classification.

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(1 mark)

(c) Despite differences in form, leopards, tigers and lions are classified as different species of the same genus. Cheetahs, although similar in form to leopards, are classified in a different genus.

(i) Describe **one** way by which different species may be distinguished.

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(1 mark)

(ii) Suggest **two** other sources of evidence which scientists may have used to classify cheetahs and leopards in different genera.

1 .....

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2 .....

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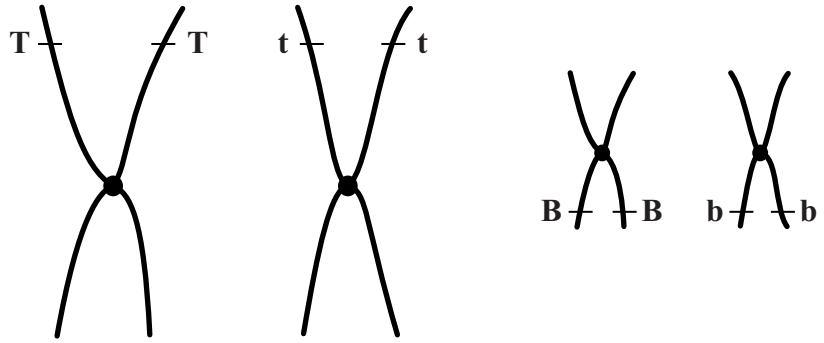
(2 marks)

6

4 (a) **Figure 3** shows two pairs of chromosomes from a plant cell. The letters represent alleles.

Figure 3



(i) Give all the different genotypes of the gametes which could be produced by this plant.

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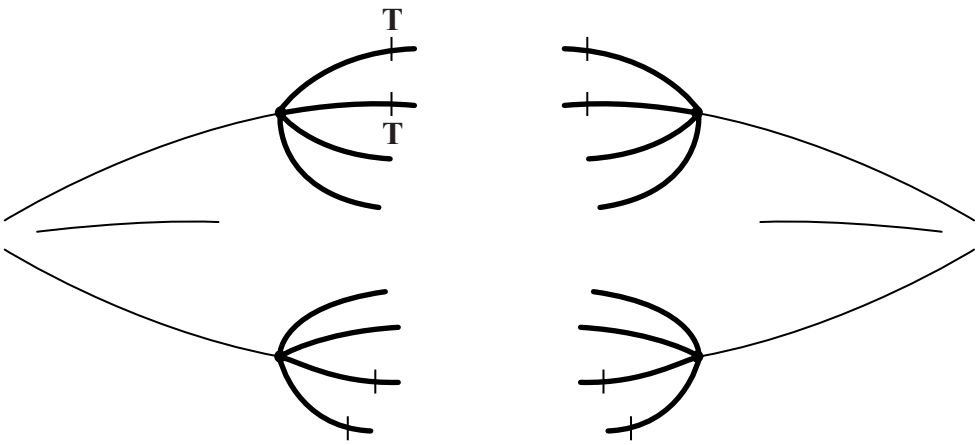
(1 mark)

(ii) **Figure 4** shows the same chromosomes on the spindle during meiosis. Complete the labelling of all the chromosomes to show the arrangement of the alleles that would result in the production of a gamete with the genotype **TB**.

Figure 4



(1 mark)

(iii) One chromosome has two copies of allele **T**. What occurs during meiosis which results in only one copy of the allele **T** being present in a gamete?

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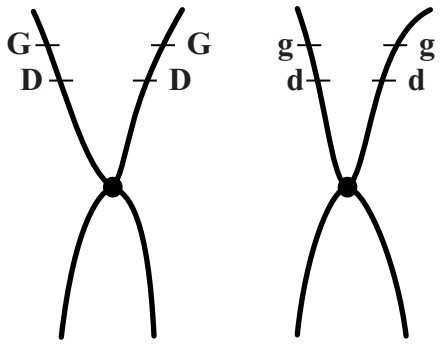
(1 mark)

(b) **Figure 5** shows another pair of chromosomes from the same plant cell. The table shows the numbers of gametes with each genotype produced by this plant.

Figure 5



Genotype of gametes	**GD**	**gd**	**Gd**	**gD**
Number of gametes	1096	1124	210	230

(i) Describe what happens during meiosis, which results in the new combinations of alleles, **Gd** and **gD**.

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(3 marks)

(ii) Suggest why there are fewer gametes with genotypes **Gd** and **gD** than **GD** and **gd**.

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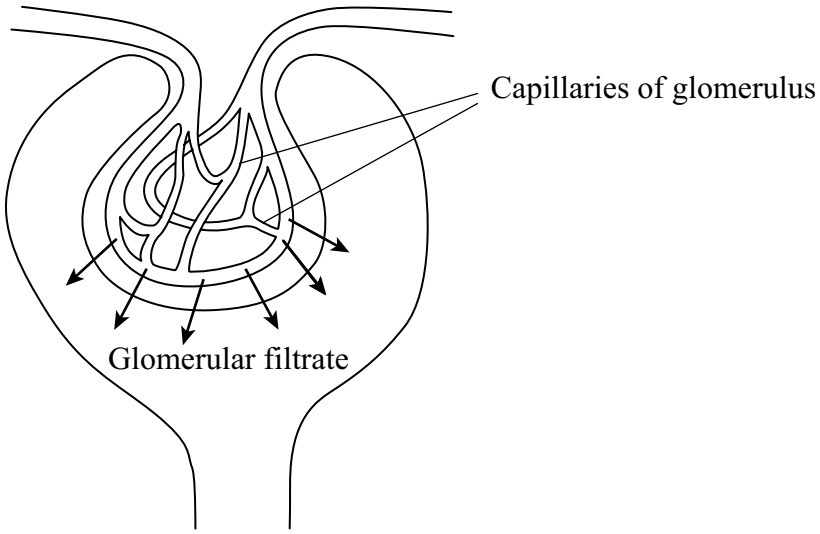
(1 mark)

7

5 The diagram shows a renal capsule where ultrafiltration occurs in the kidney.



(a) Apart from water and glucose, name **two** substances which will be present in the glomerular filtrate.

1 .....

2 .....

(1 mark)

(b) The glomerular filtration rate is the total volume of filtrate formed per minute. Explain the effect on the glomerular filtration rate of a large loss of blood from the body.

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(2 marks)

(c) Selective reabsorption from the glomerular filtrate occurs in the proximal convoluted tubule. Explain **two** ways in which the cells of the proximal convoluted tubule are adapted for reabsorption.

1 .....

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2 .....

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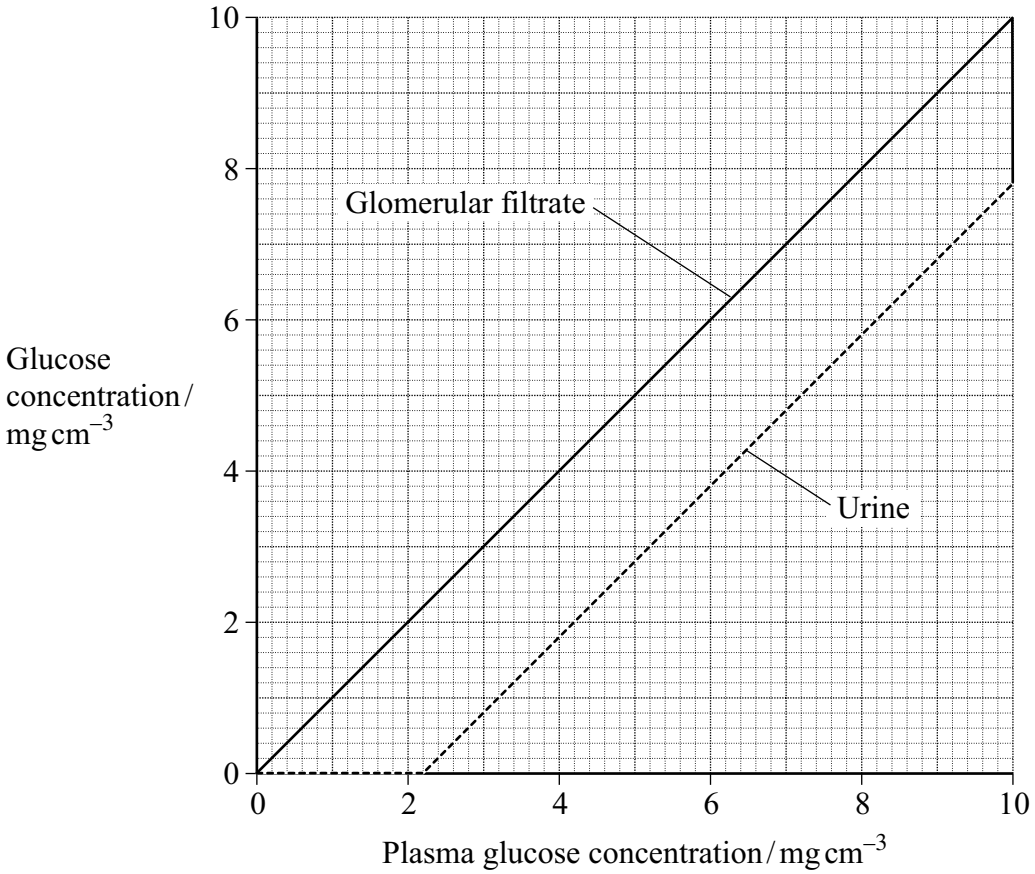
(2 marks)

(d) The threshold value is the maximum plasma glucose concentration at which all the glucose can be reabsorbed from the filtrate. An investigation was carried out to determine the threshold value for glucose reabsorption in the kidneys of a mammal. The graph shows the results.



(i) Explain the change in the glucose concentration in the urine as the plasma glucose concentration increases from 0 to 4 mg cm^{-3}.

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(2 marks)

(ii) A person with diabetes may have a plasma glucose concentration greater than the threshold value for glucose reabsorption. Explain what causes this raised plasma glucose concentration.

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(1 mark)

8

6 In a breed of cattle the **H** allele for the hornless condition is dominant to the **h** allele for the horned condition. In the same breed of cattle the two alleles $\mathbf{C^R}$ (red) and $\mathbf{C^W}$ (white) control coat colour. When red cattle were crossed with white cattle all the offspring were roan. Roan cattle have a mixture of red and white hairs.

(a) Explain what is meant by a *dominant* allele.

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(1 mark)

(b) Name the relationship between the two alleles that control coat colour.

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(1 mark)

(c) Horned, roan cattle were crossed with white cattle heterozygous for the hornless condition. Compete the genetic diagram to show the ratio of offspring phenotypes you would expect.

Parental phenotypes Horned, roan × hornless, white

Parental genotypes

Gametes

Offspring genotypes

Offspring phenotypes

Ratio of offspring phenotypes

(4 marks)

(d) The semen of prize dairy bulls may be collected for in vitro fertilisation. The sperms in the semen can be separated so that all the calves produced are of the same sex. The two kinds of sperms differ by about 3 % in DNA content.

(i) Explain what causes the sperms of one kind to have 3 % more DNA than sperms of the other kind.

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(2 marks)

(ii) Suggest **one** reason why farmers would want the calves to be all of the same sex.

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(1 mark)

9

Turn over for the next question

7 (a) The table contains some statements relating to biochemical processes in a plant cell. Complete the table with a tick if the statement is true or a cross if it is not true for each biochemical process.

Statement	Glycolysis	Krebs cycle	Light-dependent reaction of photosynthesis
NAD is reduced			
NADP is reduced			
ATP is produced			
ATP is required			

(4 marks)

(b) An investigation was carried out into the production of ATP by mitochondria. ADP, phosphate, excess substrate and oxygen were added to a suspension of isolated mitochondria.

(i) Suggest the substrate used for this investigation.

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(1 mark)

(ii) Explain why the concentration of oxygen and amount of ADP fell during the investigation.

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(2 marks)

(iii) A further investigation was carried out into the effect of three inhibitors, **A**, **B** and **C**, on the electron transport chain in these mitochondria. In each of three experiments, a different inhibitor was added. The table shows the state of the electron carriers, **W–Z**, after the addition of inhibitor.

Inhibitor added	**Electron carrier**			
	W	**X**	**Y**	**Z**
A	oxidised	reduced	reduced	oxidised
B	oxidised	oxidised	reduced	oxidised
C	reduced	reduced	reduced	oxidised

Give the order of the electron carriers in this electron transport chain. Explain your answer.

Order …… …… …… ……

Explanation .....

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(2 marks)

9

Turn over for the next question

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 (a) (i) What is meant by homeostasis?

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(1 mark)

(ii) Giving **one** example, explain why homeostasis is important in mammals.

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(2 marks)

(b) (i) Cross-channel swimmers experience a large decrease in external temperature when they enter the water. Describe the processes involved in thermoregulation in response to this large decrease in external temperature.

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(7 marks)

(ii) A person swimming in cold water may not be able to maintain their core body temperature and begins to suffer from hypothermia. Explain why a tall, thin swimmer is more likely to suffer from hypothermia than a short, stout swimmer of the same body mass.

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(2 marks)

(c) Cross-channel swimmers may suffer from muscle fatigue during which the contraction mechanism is disrupted. One factor thought to contribute to muscle fatigue is a decrease in the availability of calcium ions within muscle fibres. Explain how a decrease in the availability of calcium ions could disrupt the contraction mechanism in muscles.

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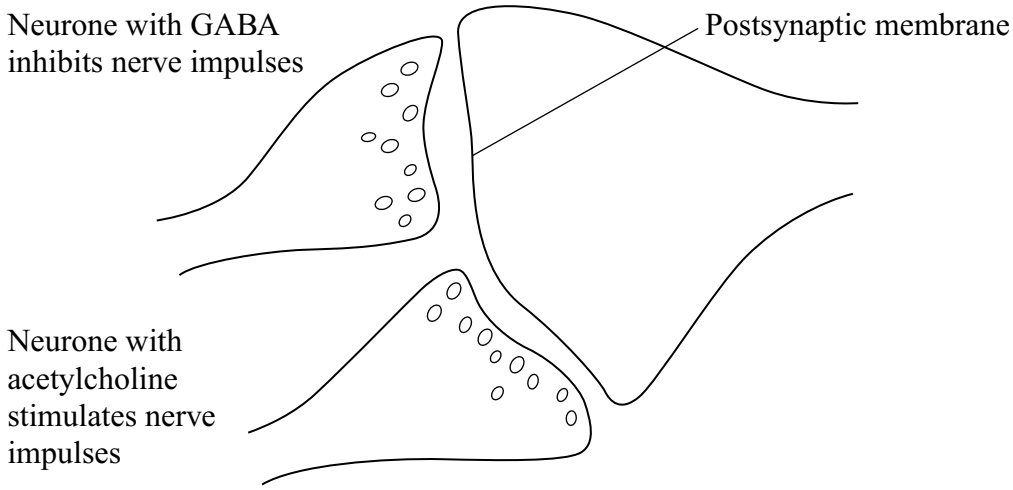
(3 marks)

15

Turn over for the next question

9 Acetylcholine is a neurotransmitter which binds to postsynaptic membranes and stimulates the production of nerve impulses. GABA is another neurotransmitter. It is produced by certain neurones in the brain and spinal cord. GABA binds to postsynaptic membranes and inhibits the production of nerve impulses. The diagram shows a synapse involving three neurones.



(a) Describe the sequence of events leading to the release of acetylcholine and its binding to the postsynaptic membrane.

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(4 marks)

(b) The binding of GABA to receptors on postsynaptic membranes causes negatively charged chloride ions to enter postsynaptic neurones. Explain how this will inhibit transmission of nerve impulses by postsynaptic neurones.

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(3 marks)

(c) Epilepsy may result when there is increased neuronal activity in the brain.

(i) One form of epilepsy is due to insufficient GABA. GABA is broken down on the postsynaptic membrane by the enzyme GABA transaminase. Vigabatrin is a new drug being used to treat this form of epilepsy. The drug has a similar molecular structure to GABA. Suggest how Vigabatrin may be effective in treating this form of epilepsy.

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(2 marks)

(ii) A different form of epilepsy has been linked to an abnormality in GABA receptors. Suggest and explain how an abnormality in GABA receptors may result in epilepsy.

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(3 marks)

(d) During an epileptic seizure muscular contractions may occur. In which part of the brain would neuronal activity produce muscular contractions of the right leg?

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(2 marks)

END OF QUESTIONS

14

QWC

1

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