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Tasmanian Certificate of Education

BIOLOGY

Senior Secondary 5C

Subject Code: BIO5C

External Assessment

2004

Part 1

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a result on the following criterion taken from the syllabus statement:

Criterion 4 Develop and evaluate experiments.

Section Total
/32

Pages: 11
Questions: 4

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CANDIDATE INSTRUCTIONS

Candidates **MUST** ensure that they have addressed **ALL** of the externally assessed criteria on this examination paper.

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

You should make sure you answer all parts within each question so that the criteria can be assessed.

The 2004 Biology Information Sheet can be used throughout the examination.

For Marker Use Only

Question 1

Refer to the following table, which shows the temperature and pH of four flasks set up by a student to investigate the rate of fermentation in yeast cells under various conditions. Each flask contained 50 mL of glucose solution and 0.3g of yeast.

Flask	Temperature (°C)	pH
1	35	7
2	70	7
3	10	7
4	35	4

One hypothesis being tested in this series of experiments is that pH affects the rate of fermentation.

(a) (i) State the independent variable in this hypothesis. (1 mark)

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(ii) State the dependent variable in this hypothesis. (1 mark)

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(b) To test the hypothesis that pH affects the rate of fermentation the student would have to compare the results from two of the flasks. Which flasks would the student need to compare? Explain your answer. (2 marks)

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(c) The student used only one flask for each set of conditions. Evaluate this decision. (2 marks)

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(d) List **TWO** factors that were kept constant in the experiment and explain why it is important to keep some factors constant. (2 marks)

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Question 1 continues opposite.

Question 1 (continued)

For Marker Use Only

(e) Formulate an alternative hypothesis that could be tested with the same set of data. Ensure that your hypothesis is more precise than the one given above. (3 marks)

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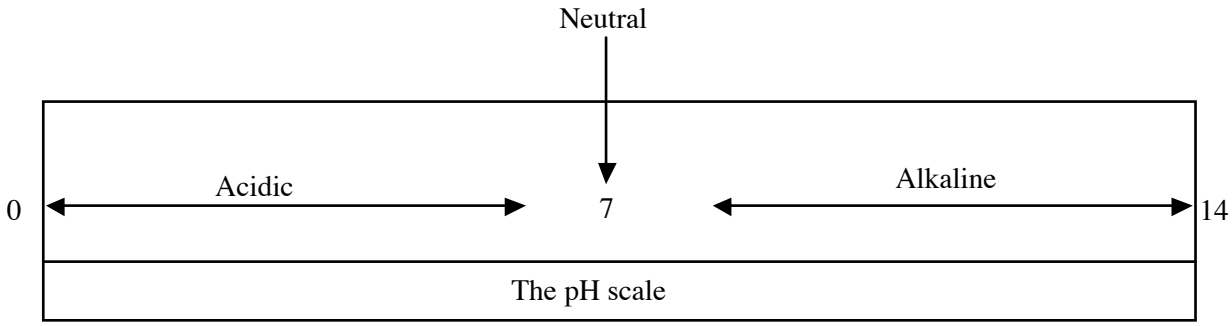
For Marker Use Only

Question 2

The following is an extract from a gardening website.



> Hydrangeas are amazingly versatile in that you can alter the flower colour by changing the pH of the soil. In acid soils, hydrangeas produce blue flowers. In alkaline soils, hydrangeas produce mauve, pink and red flowers.

In an investigation used to verify the effects of pH on the colour of hydrangea flowers a group of students hypothesised that:

'Hydrangea flower colour is different for each point on the pH scale between 4 and 10'

They also identified the following:

Independent variable:	pH
Dependent variable:	colour of flowers
Constant factors:	water, plant-food, light, humidity

Suggest experimental treatments that the students should set up in order to best test this hypothesis and predict results that will support and negate the hypothesis. (5 marks)

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For Marker Use Only

Question 3

In an investigation, babies suffering from an illness known as colic were divided into two groups. Those in group **A** were given a solution of lactase in their bottled milk and those in group **B** were given distilled water in their bottled milk.

The table shows the results of this investigation.

	Mean duration of colic symptoms/minutes	
	Before treatment	**After treatment**
Group **A** (lactase)	124.5	65.7
Group **B** (distilled water)	121.0	113.8

(a) Explain why distilled water was added to the milk of group **B**. (2 marks)

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(b) Describe two significant difficulties, faced by the researchers, when running a controlled experiment that accurately tests the link between lactase in milk and persistence of colic in babies. Use these two headings.

(i) Ethics: (2 marks)

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(ii) Methodology: (2 marks)

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(c) After consideration of the above results, suggest to the researchers what an appropriate follow-up experiment should investigate. (2 marks)

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For Marker Use Only

Question 4

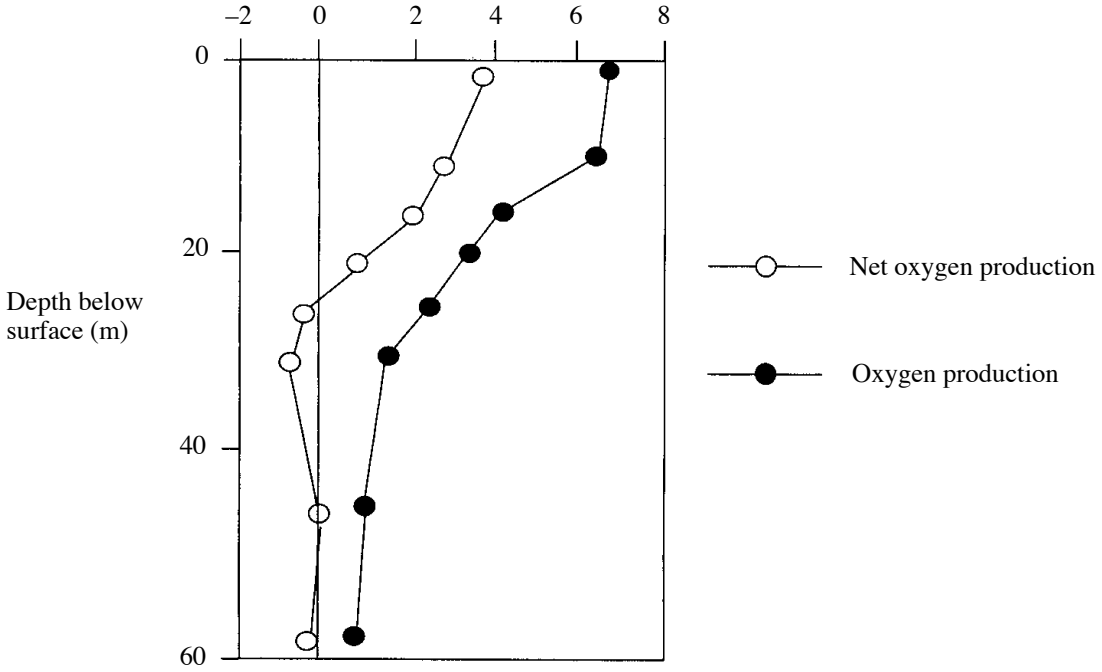
Very large numbers of microscopic algae exist in ocean communities away from land. Approximately half of all photosynthesis on Earth occurs in these algae. They also carry out cell respiration. Marine biologists investigated ocean water at a series of depths at many sites. They measured the **changes** in oxygen content of the water in the light and in the dark.

From their measurements they calculated:

- the rate of **oxygen production** by the photosynthesising algae.
- the rate of **oxygen use** in cell respiration by the whole community.

The difference between the rate of oxygen production and oxygen use is the **net oxygen production** of the community. The results for **one site** in the Southern Ocean (sampled in January 2001) are shown below.

Oxygen production and net oxygen production / μ mol O_2 dm^{-3} day^{-1}



(Source: P J le B Williams, *Nature*, (1998), 394, pages 55-57)

(a) (i) Using only the data in the graph, outline the relationship between depth and **net** oxygen production from 0 to 30 metres. (1 mark)

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(ii) Suggest a hypothesis to account for this relationship. (3 marks)

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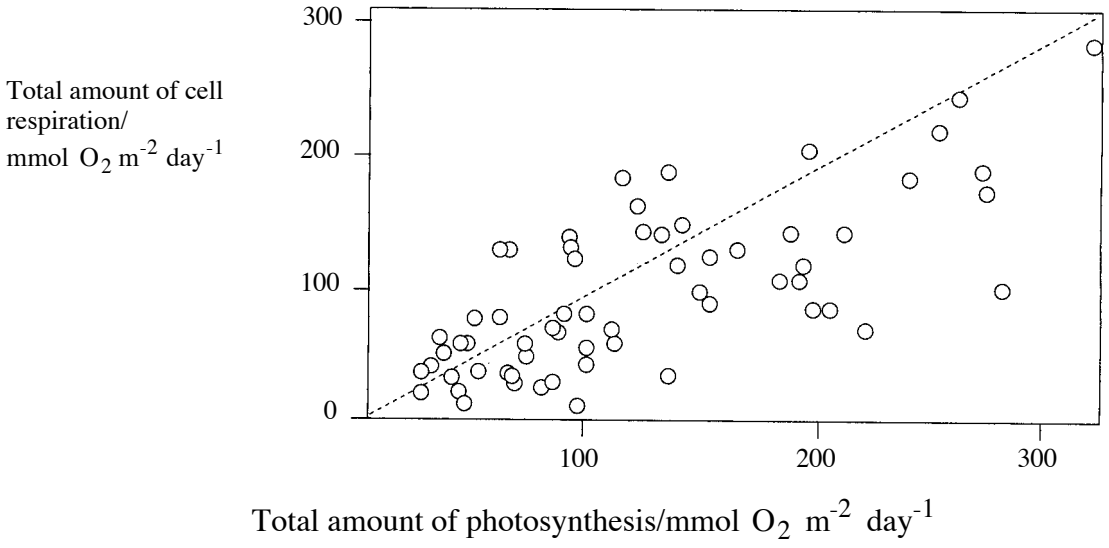
Question 4 continues opposite.

Question 4 (continued)

For Marker Use Only

The marine biologists combined the data for all depths and calculated the total amounts of photosynthesis and cell respiration for **many** ocean sites around the world (also sampled in January 2001). The results are plotted in the scattergram below.



(b) State **one** reason why the information presented in this scattergram is more valid (stronger) than the data in the first graph and one reason why this information is less valid (weaker) than that in the first graph.

Stronger: .....

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(2 marks)

Weaker: .....

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(2 marks)

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Tasmanian Certificate of Education

BIOLOGY

Senior Secondary 5C

Subject Code: BIO5C

External Assessment

2004

Part 2

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a result on the following criterion taken from the syllabus statement:

Criterion 7 Demonstrate knowledge and understanding of the chemical basis of life.

Section Total
/33

Pages: 11
Questions: 5

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CANDIDATE INSTRUCTIONS

Candidates **MUST** ensure that they have addressed **ALL** of the externally assessed criteria on this examination paper.

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

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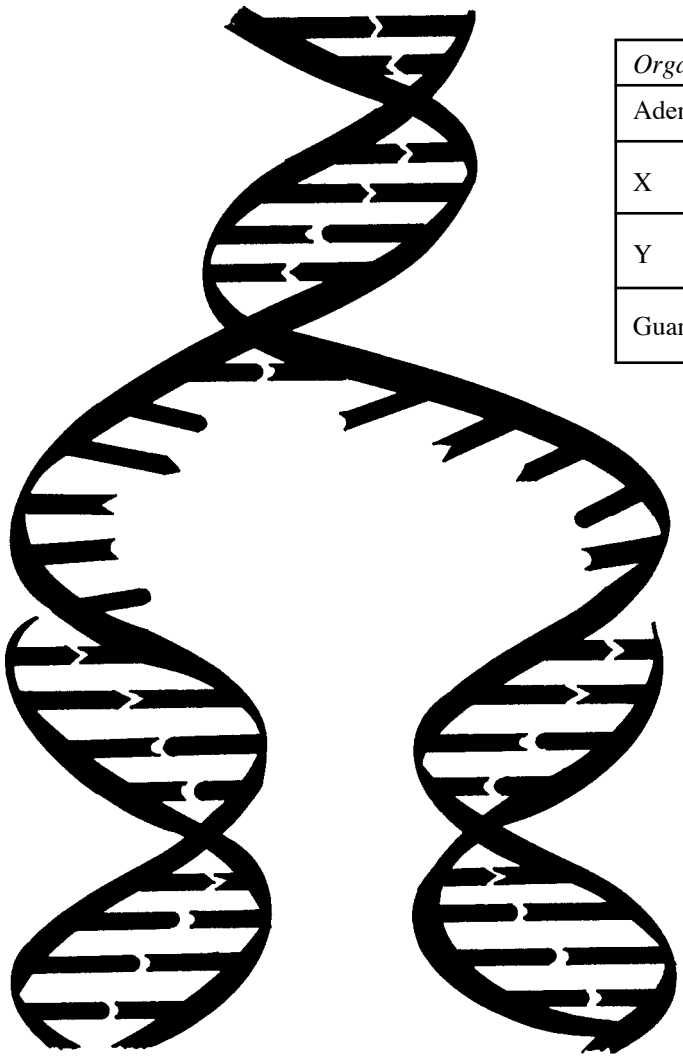
The 2004 Biology Information Sheet can be used throughout the examination.

For Marker Use Only

Question 5

The diagram below represents the behaviour of DNA strands during the early part of cell division.



Key:

Organic Base	*Symbol*
Adenine (A)	
X	
Y	
Guanine (G)	

Use the information in the diagram to help you answer the following questions.

(a) Identify the organic bases X and Y. (1 mark)

X: .....

Y: .....

(b) (i) Name the process shown in the diagram. (1 mark)

.....

Question 5 continues opposite.

Question 5 (continued)

For Marker Use Only

(ii) This process is sometimes referred to as 'semi-conservative' which means that half of the parent DNA strand is conserved in a new DNA strand. What is the significance of this? (2 marks)

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(c) What is the importance of the **sequence** of organic bases along a DNA strand? (2 marks)

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For Marker Use Only

Question 6

Refer to the following diagrams. Diagram 1 shows an enzyme and its substrate. Diagrams 2 and 3 show two possible outcomes of mixing the enzyme and its substrate. The enzyme catalyses a reaction that occurs in **human** cells.

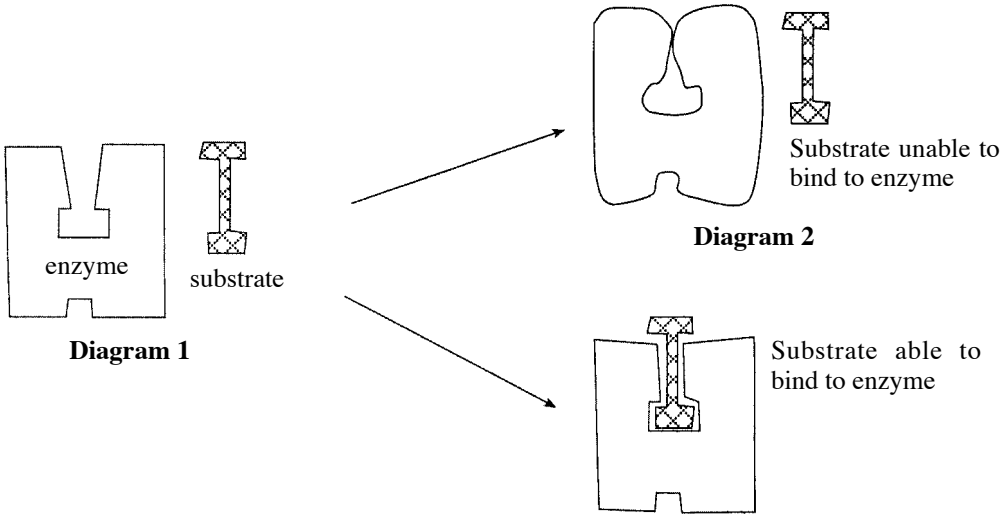

Diagram 1

Diagram 2

Diagram 3

(a) (i) State a likely temperature at which the binding in diagram 3 is occurring. (1 mark)

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.....

(ii) Outline two factors that could have led to the situation depicted in diagram 2.

Factor 1: .....

.....
(1 mark)

Factor 2: .....

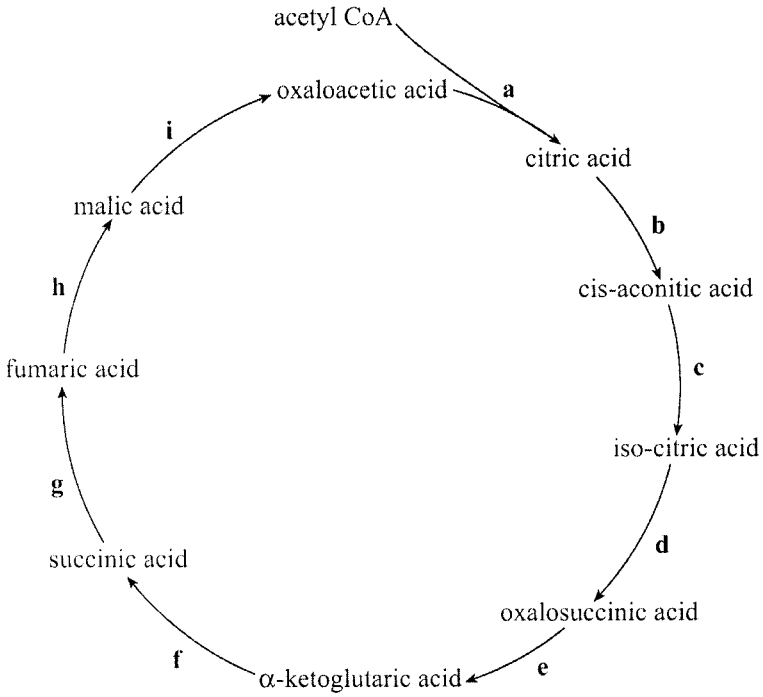
.....
(1 mark)

Question 6 continues opposite.

Question 6 (continued)

For Marker Use Only

(b) Refer to the following diagram, which shows part of an energy pathway. The pathway involves many small regulated steps, labelled **a** to **i**. Each step is catalysed by a different enzyme.



(i) Explain why a different enzyme is needed to catalyse each step in the pathway. (2 marks)

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(ii) Why are enzyme-regulated, stepwise chemical pathways important to living systems? (2 marks)

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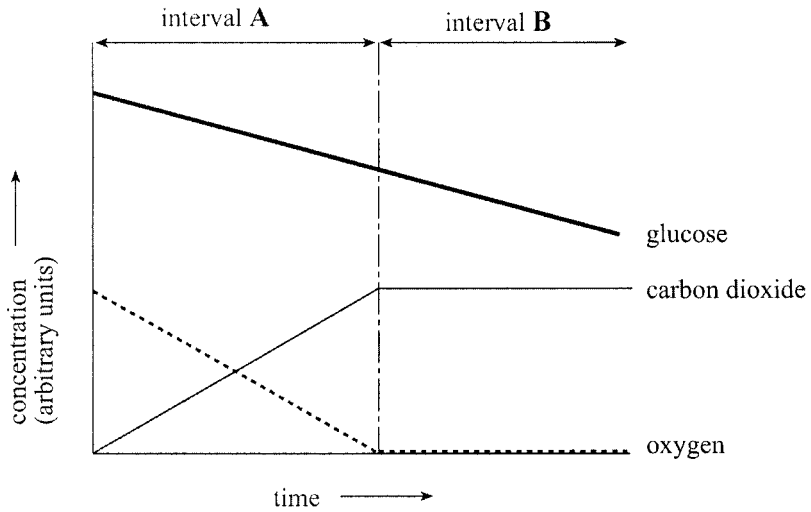
Question 7

For Marker Use Only

Refer to the following graph, which shows the levels of glucose, carbon dioxide, and oxygen over two continuous time intervals, interval **A** and interval **B**. The data for the graph came from an experiment in which active cells were added to a container of nutrient solution. The container was then sealed.



(a) (i) Name the process occurring during: (1 mark)

Interval A: .....

Interval B: .....

(ii) During interval A carbon dioxide is produced. What product/s are likely to form during interval B? (1 mark)

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(iii) Both processes release energy in the form of ATP. Which process releases more energy and explain why this is? (3 marks)

Process: .....

Reason: .....

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Question 7 continues opposite.

Question 7 (continued)

For Marker Use Only

(b) (i) Give two uses of energy from ATP in a liver cell. (1 mark)

1: .....

2: .....

(ii) Explain why ATP is better than glucose as an immediate energy source for cell metabolism. (2 marks)

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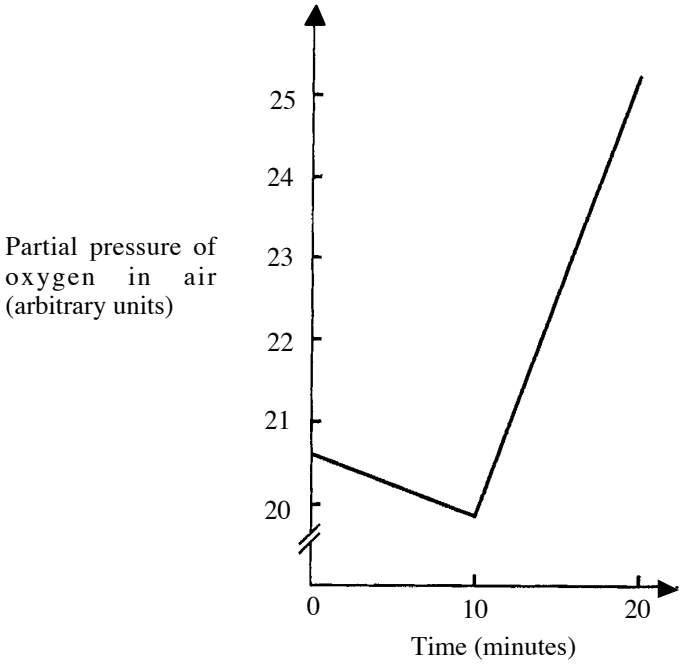
For Marker Use Only

Question 8

A group of students designed a series of experiments to investigate factors affecting the rate of photosynthesis in plants. The plants were enclosed in clear plastic boxes and kept in the dark for ten minutes. The plants in their boxes were then exposed to light for ten minutes. The students measured the oxygen concentration in the air surrounding the plants.

The results of their experiments are shown in the graph below.



(a) (i) Explain why the oxygen concentration in the air surrounding the plants can be used as a measure of the rate of photosynthesis. (1 mark)

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(ii) Explain why the oxygen concentration in the air surrounding the plants decreased during the first 10 minutes of the experiment. (2 marks)

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(b) The oxygen concentration in the air around these plants will not continue to increase indefinitely after the 20 minute mark. Suggest why not. (2 marks)

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For Marker Use Only

Question 9

(a) Starch is a polymer made up of glucose monomers.

(i) Proteins are polymers. What monomers are the components of proteins? (1 mark)

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(ii) Explain why triglycerides are not polymers and name the components that they are made up of. (2 marks)

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(b) When food passes through the gut, only a certain amount of the protein it contains is digested. The rest passes out of the body in the faeces. The digestibility coefficient is one way of measuring this.

$$\text{Digestibility coefficient} = \frac{\text{Nitrogen intake - Nitrogen in faeces}}{\text{Nitrogen intake}}$$

(i) Explain why nitrogen intake is a useful measure of protein intake. (1 mark)

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(ii) A lot of the protein in a vegetarian diet comes from cereals and vegetables. Use your knowledge of plant cells to explain why the digestibility coefficient for protein in vegetarian diets is lower than that for diets in which most of the protein comes from meat. (3 marks)

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Tasmanian Certificate of Education

BIOLOGY

Senior Secondary 5C

Subject Code: BIO5C

External Assessment

2004

Part 3

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a result on the following criterion taken from the syllabus statement:

Criterion 8 Demonstrate knowledge and understanding of cells.

Section Total
/32

Pages: 15
Questions: 6

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CANDIDATE INSTRUCTIONS

Candidates **MUST** ensure that they have addressed **ALL** of the externally assessed criteria on this examination paper.

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

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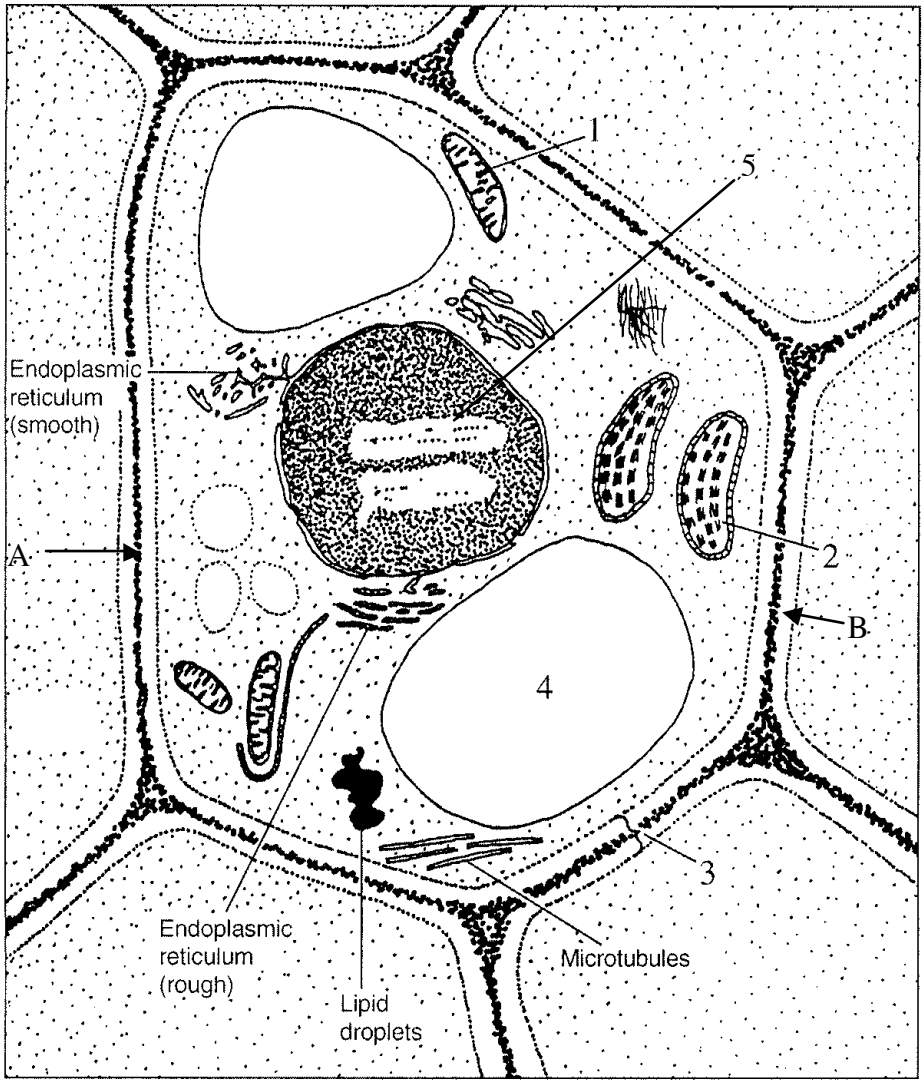
For Marker Use Only

Question 10

This question refers to the diagram of a generalised plant cell (shown below).



200 μm

Note: 3 is pointed to the bracketed section.

(a) (i) Name the structures labelled 1-4. (2 marks)

1: .....

2: .....

3: .....

4: .....

(ii) Identify the organelle (use the numbers) where you would find: (1 mark)

Respiratory enzymes: .....

Genetic Material: .....

Question 10 continues opposite.

Question 10 (continued)

For Marker Use Only

(b) Determine the width of the cell from A to B. (1 mark)

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(c) Animal cells lack structures 2 and 3. Explain **why** these structures are not found in the cells of animals. (2 marks)

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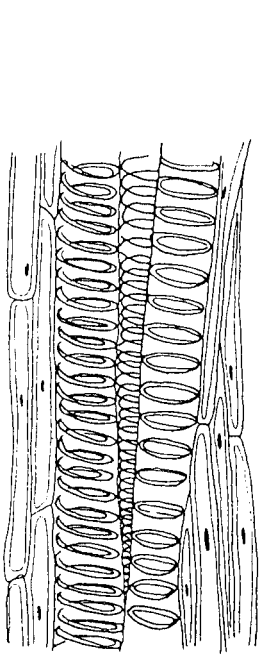
For Marker Use Only

Question 11

This question refers to the diagrams of cells from multicellular organisms.



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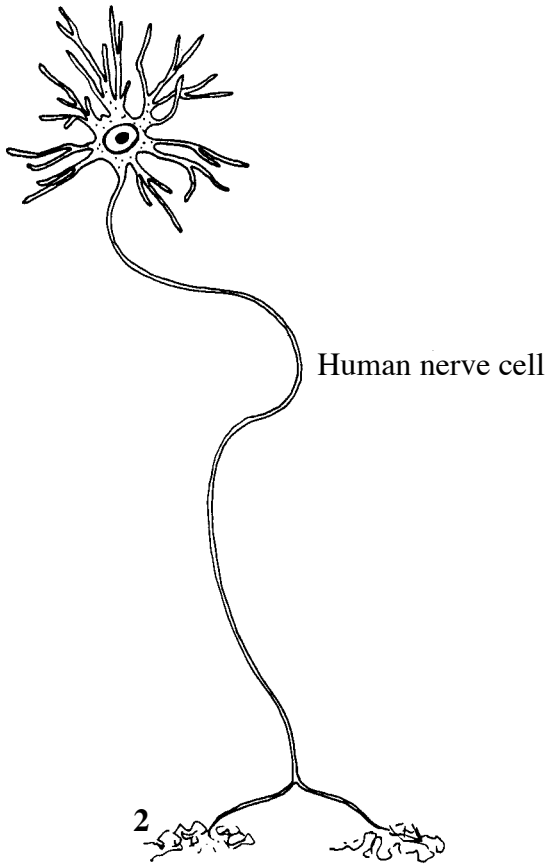
Xylem Vessels



Choose **one** of these two cell types and explain **two** ways in which its structure suits its particular function.

Cell type chosen: .....

Specialisations: (4 marks)

1: .....

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2: .....

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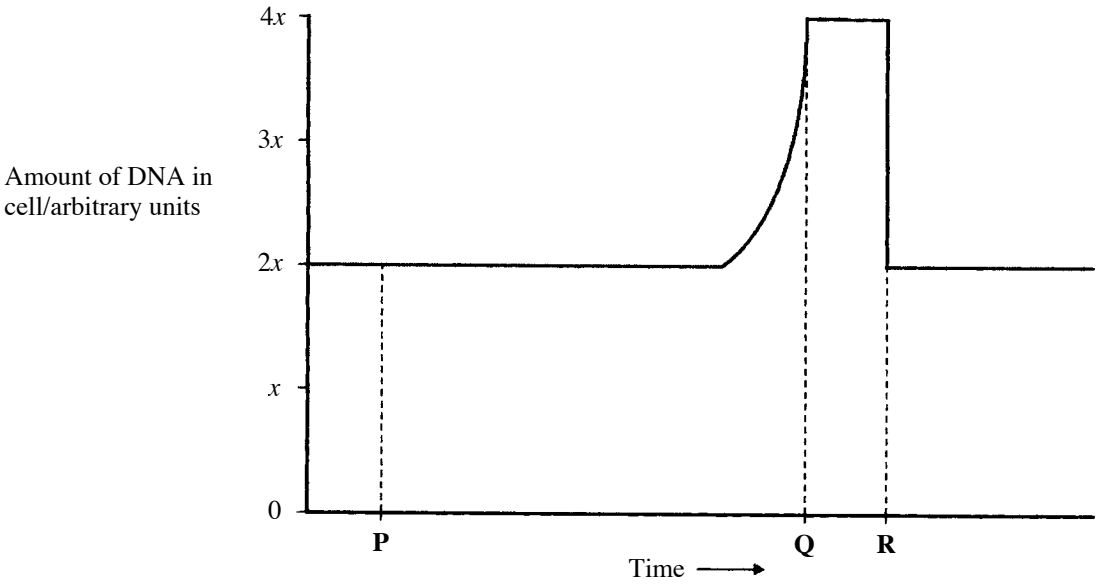
For Marker Use Only

Question 12

(a) The graph shows the amount of DNA in a cell during a cell cycle.



(i) Name the type of cell division illustrated by this graph; giving a reason for your answer. (2 marks)

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(ii) Explain the decrease in the amount of DNA present at time **R**. (1 mark)

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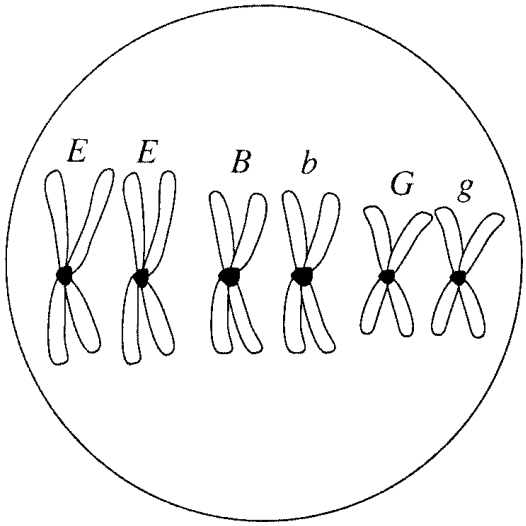
Question 12 continues opposite.

Question 12 (continued)

For Marker Use Only

(b) The diagram shows a cell containing three pairs of chromosomes just prior to a *meiotic* division.



Assuming that random segregation occurs, list the possible genotypes that could be produced at the end of this cell division and state the expected frequency for each genotype. (3 marks)

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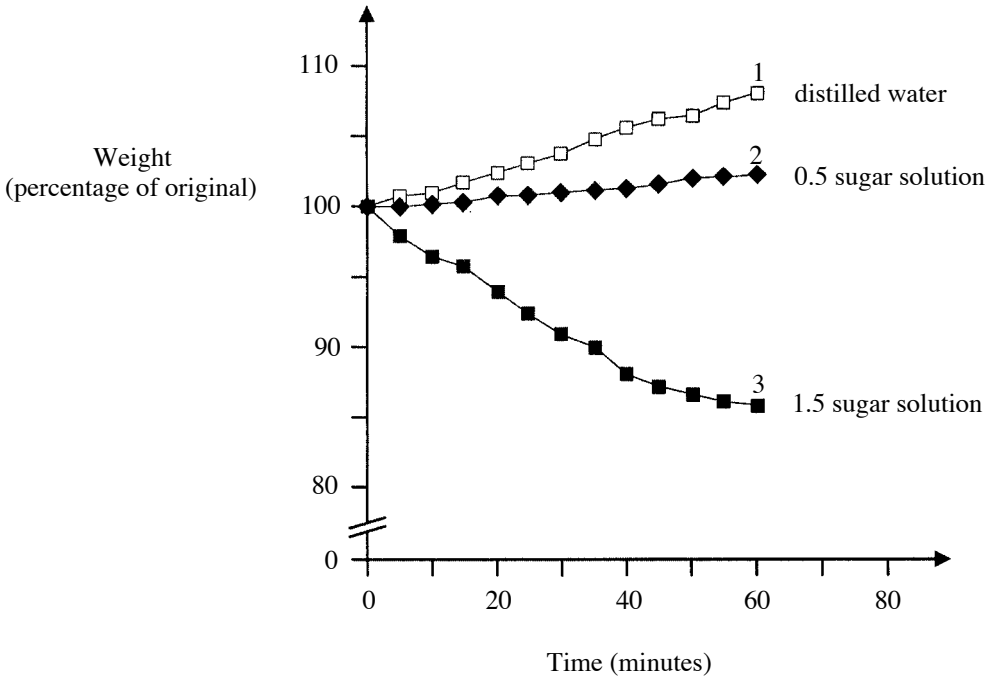
For Marker Use Only

Question 13

It is possible to dissolve and remove the outer hard shell of a hen's egg. This leaves just the cell membrane undamaged and the cell contents intact. Shells were removed in this way from several eggs and each egg was placed in one of three different solutions. (A unit of sugar is 318 grams, No calculations are necessary to answer this question.)

Solution 1	Distilled water (500 mL)
Solution 2	0.5 units of sugar in 500 mL distilled water
Solution 3	1.5 units of sugar in 500 mL distilled water

The weight of the eggs was recorded at regular time intervals over one hour. The results are presented below:



Explain what is happening in graphs 1 and 3.

(a) (i) Graph 1: (2 marks)

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(ii) Graph 3: (2 marks)

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Question 13 continues opposite.

Question 13 (continued)

For Marker Use Only

(b) Why is the slope of graph 2 almost horizontal? (2 marks)

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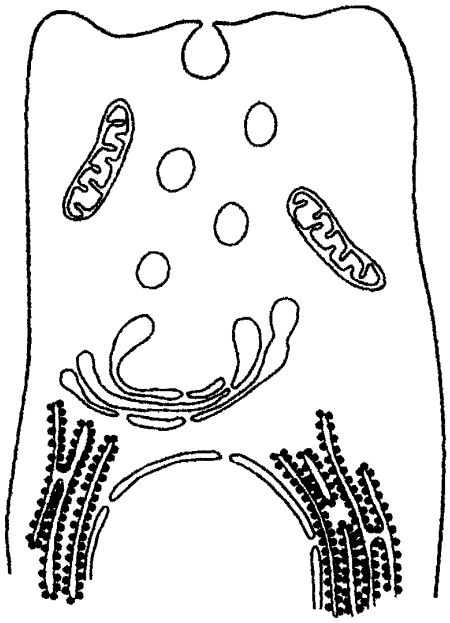
For Marker Use Only

Question 14

The diagram shows part of a cell that secretes enzymes.



Some cells similar to that shown in the diagram were grown in a culture. Radioactive amino acids were added to the solution in which they were being grown. The radioactivity acts as a label on the amino acid so that it can be detected wherever it is. This radioactive label allows amino acids to be followed through the cell. At various times, samples of the cells were taken and the amount of radioactivity in different organelles was measured. The results are shown in the table.

Time after radioactive amino acids were added to the solution/minutes	*Amount of radioactivity present/arbitrary units*		
	Golgi apparatus	*Rough endoplasmic reticulum*	*Vesicles*
1	21	120	6
20	42	68	6
40	86	39	8
60	76	28	15
90	50	27	28
120	38	26	56

Provide explanations for the changes in radioactivity that were observed in:

(i) The rough endoplasmic reticulum. (3 marks)

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Question 14 continues over the page.

Question 14 (continued)

For Marker Use Only

(ii) The Golgi apparatus. (3 marks)

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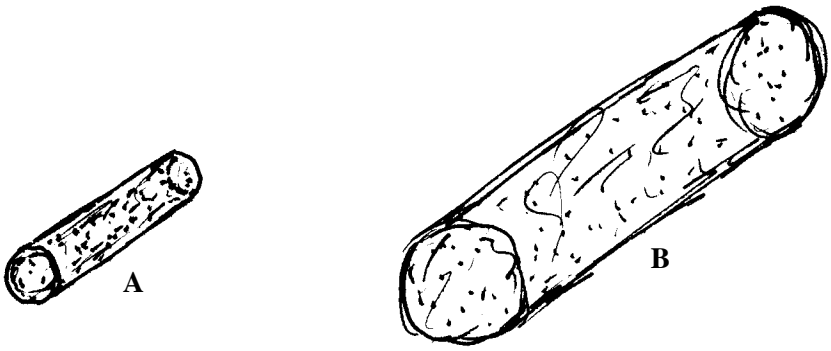
For Marker Use Only

Question 15

These are two very closely related species of unicellular, aquatic organisms. A study found that the smaller species (A) always out-competed the larger species when equal numbers of both were placed together in a nutrient rich environment. After exploring all possible differences between the species it was concluded that it could only be the difference in size that is causing the problem for species B.



Provide an explanation for the findings of this study. (4 marks)

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TASMANIAN QUALIFICATIONS AUTHORITY

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Tasmanian Certificate of Education

BIOLOGY

Senior Secondary 5C

Subject Code: BIO5C

External Assessment

2004

Part 4

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a result on the following criterion taken from the syllabus statement:

Criterion 9 Demonstrate knowledge and understanding of organisms.

Section Total
/30

Pages: 11
Questions: 5

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CANDIDATE INSTRUCTIONS

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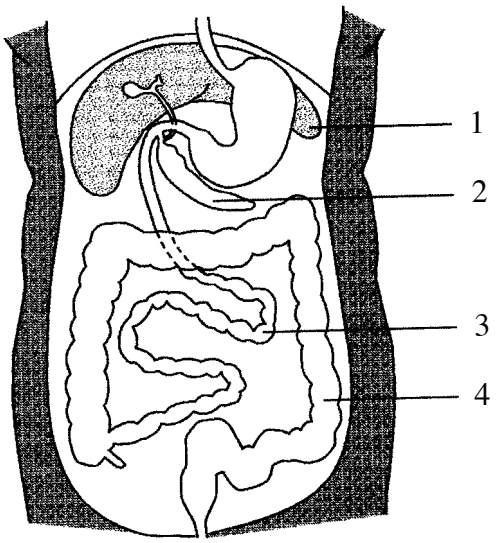
For Marker Use Only

Question 16



(a) Name the four labelled structures. (2 marks)

1. .....

2. .....

3. .....

4. .....

(b) The internal lining of the structure labelled 3 is well suited to its function. Discuss two ways in which this lining is suitable and explain why the efficiency of the function is improved in each case.

(i) (2 marks)

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(ii) (2 marks)

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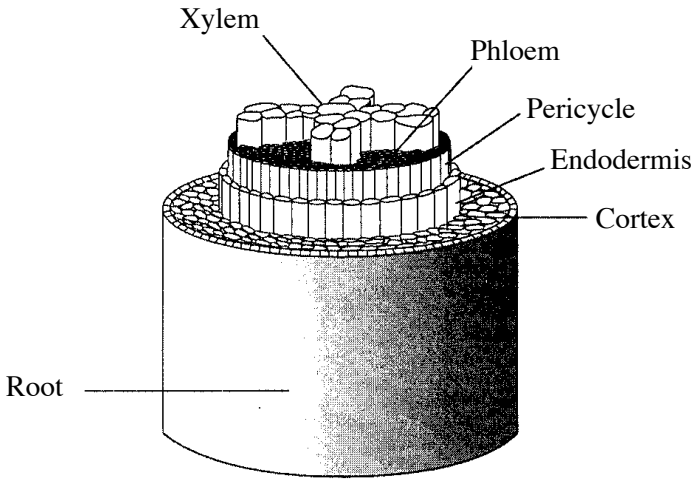
For Marker Use Only

Question 17

The diagram shows the arrangement of tissues in a young plant root.



Two of these tissues are responsible for transport.

(a) Complete this table to demonstrate your knowledge of plant transport. (3 marks)

Tissue Function	*Tissue Name*	*Source of transported material*
Water transport		
Transport of organic material		

(b) Describe how the process of transpiration plays a key role in maintaining the function of xylem tissue. (3 marks)

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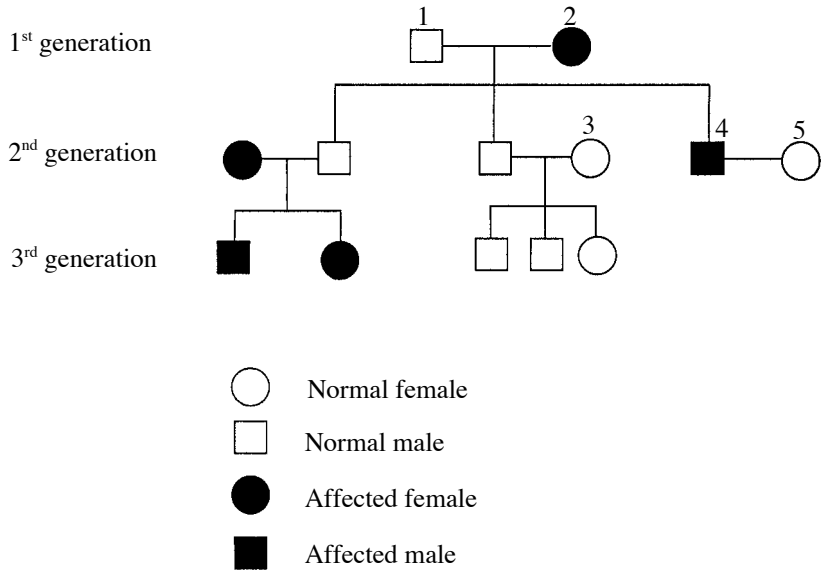
For Marker Use Only

Question 18

The allele for a particular disease is dominant over the normal gene.

The pedigree below represents a family in which some members have the disease.



(a) Show the genotype of individuals 1, 2, 3 and 4. (2 marks)

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(b) Predict the expected phenotypic and genotypic ratios of children produced by individuals 4 and 5. Show all working. (3 marks)

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Question 18 continues opposite.

Question 18 (continued)

For Marker Use Only

(c) A geneticist concludes that this is a sex-linked trait based on the fact that the female (2) passes the gene to her son (4). Discuss the validity of this conclusion. (2 marks)

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For Marker Use Only

Question 19

An animal reproduces sexually. After fertilisation of the egg cell, cell division of the zygote produces a ball of cells which implants in the uterus.

Two types of cell division are necessary to complete the process described above.

Discuss the significance of each type of cell division in terms of the survival of the animal species into future generations. (5 marks)

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For Marker Use Only

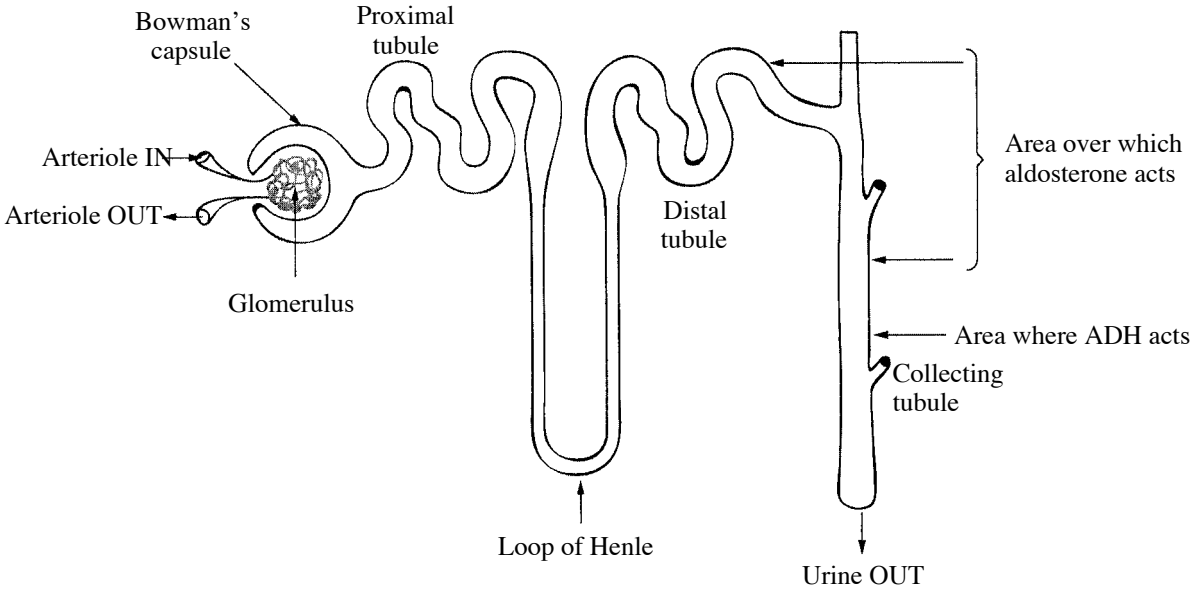
Question 20

The diagram represents a nephron which is the functional unit of the human kidney.

Nephrons make urine by:

- Filtering small molecules and ions from the blood
- Reabsorbing the needed amounts of useful material

Surplus or waste molecules and ions flow out as urine. Nephrons also play an important role in the maintenance of water balance.



Using some information from the diagram and your knowledge of homeostasis, outline the key features of a feedback model for the control of water balance in humans. (6 marks)

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PLACE LABEL HERE

Tasmanian Certificate of Education

BIOLOGY

Senior Secondary 5C

Subject Code: BIO5C

External Assessment

2004

Part 5

Time: 35 minutes

On the basis of your performance in this examination, the examiners will provide a result on the following criterion taken from the syllabus statement:

Criterion 10 Demonstrate knowledge and understanding of the interaction of organisms in their environment.

Section Total
/34

Pages: 11
Questions: 5

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CANDIDATE INSTRUCTIONS

Candidates **MUST** ensure that they have addressed **ALL** of the externally assessed criteria on this examination paper.

Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.

You should make sure you answer all parts within each question so that the criteria can be assessed.

The 2004 Biology Information Sheet can be used throughout the examination.

For Marker Use Only

Question 21

Research on a community in an arid environment near Shark Bay in Western Australia produced data on the diets of some of the common animals in the region. These data are presented below:

Animal	**Diet**
Dingo	Rabbit, dunnart, insects, plants, cats
Cat	Rabbit, dunnart
Rabbit	Plants
Dunnart	Insects
Insects	Plants

(a) In the space below, draw a food web of this community, showing all feeding relationships among the organisms listed above. Place each organism on its highest trophic level. (4 marks)

Trophic Level	
5	
4	
3	
2	
1	

Question 21 continues opposite.

Question 21 (continued)

For Marker Use Only

(b) Provide alternative terms for: (1 mark)

1st Trophic Level: .....

3rd Trophic Level: .....

(c) An important group of organisms is missing from this food web. Name this group. What ecological function does this group perform? (2 marks)

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For Marker Use Only

Question 22

Researchers studying the distribution of the poison Dieldrin in a natural community found the following Dieldrin concentrations in four different organisms.

Organism	Concentration of Dieldrin (parts per million)
Avena fatua	0.04
Elanus axillaris	25.0
Acrida conica	0.50
Sminthopsis crassicaudata	2.00

One of these organisms is the black-shouldered kite, a large predatory bird. On the basis of this information, which **one** of the four organisms is it most likely to be? Explain your answer in terms of biological magnification. (4 marks)

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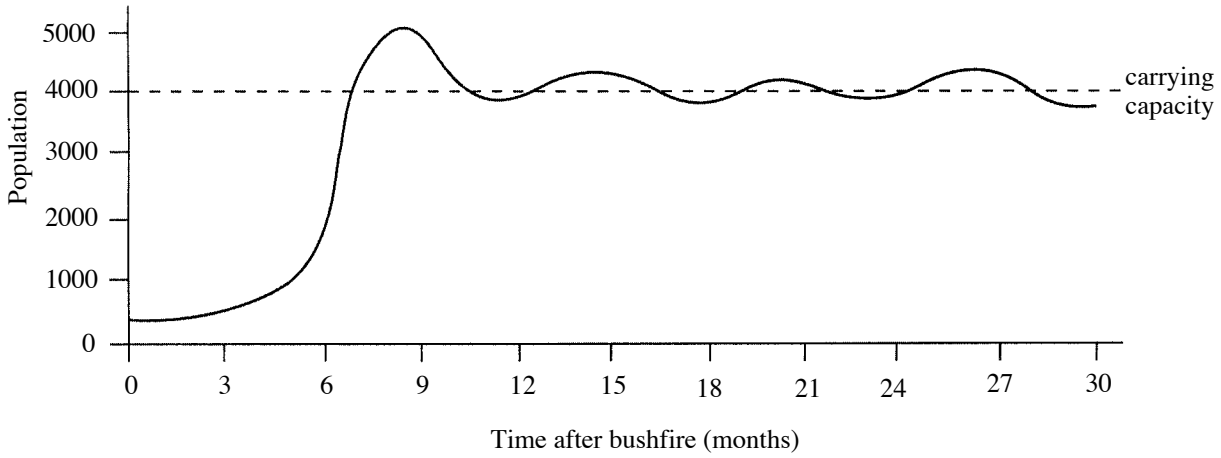
For Marker Use Only

Question 23

Refer to the following graph, which shows the changes in population of a species of native marsupial in an ecosystem for thirty months after a bushfire.



The carrying capacity of the ecosystem for this species of native marsupial is approximately 4000 individuals. This species of native marsupial did not migrate into or out of the ecosystem during the thirty months after the bushfire.

Comment on changes in the following factors as they apply to this particular population over this 30 month period.

(a) Birth and death rate: (2 marks)

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(b) Intraspecific competition: (2 marks)

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(c) Resource availability: (2 marks)

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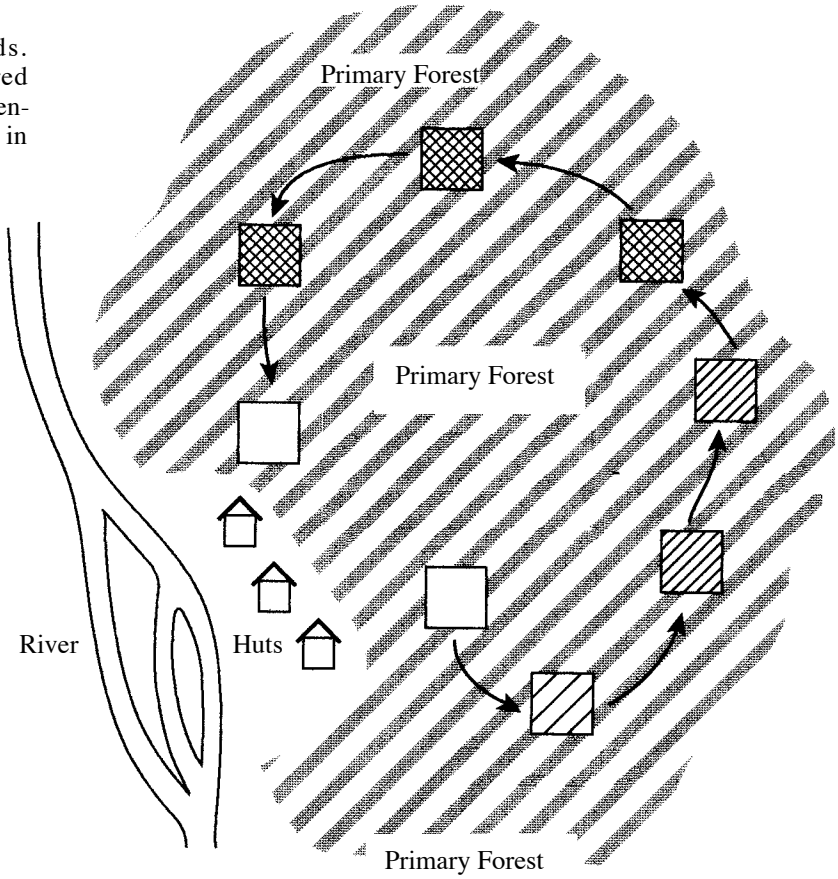
Question 24

For Marker Use Only

(a) Some ways of clearing forest for agriculture are described as sustainable. The diagram shows one way in which agriculture can continue indefinitely on infertile forest soils.

Key

- Next season's fields. Secondary forest cleared and burnt. Some nitrogen-containing substances lost in smoke.
- Cultivated fields
- Abandoned fields
- Secondary forest regrows. Nutrient levels restored in 8-10 years.



Use your knowledge of nitrogen cycling to explain:

(i) why crops can be grown in the cleared field for only two or three years. (2 marks)

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Question 24 continues opposite.

Question 24 (continued)

For Marker Use Only

(ii) how the concentration of nitrates in the soil is restored 8 – 10 years after cultivation is abandoned, assuming no fertilisers are added. (5 marks)

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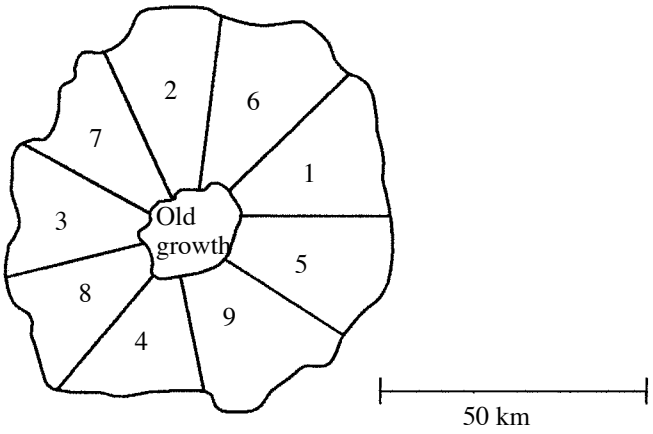
(b) Logging is the removal of mature trees from a forest. The diagram shows a method of sustainable logging of an area of tropical rainforest. Each of sectors 1 to 9 is logged in sequence and the 'old growth' area is never felled. Felling in each of the nine sectors takes a total of about 35 years.



Suggest how the pattern of logging shown in the diagram would help to conserve the rainforest community. (4 marks)

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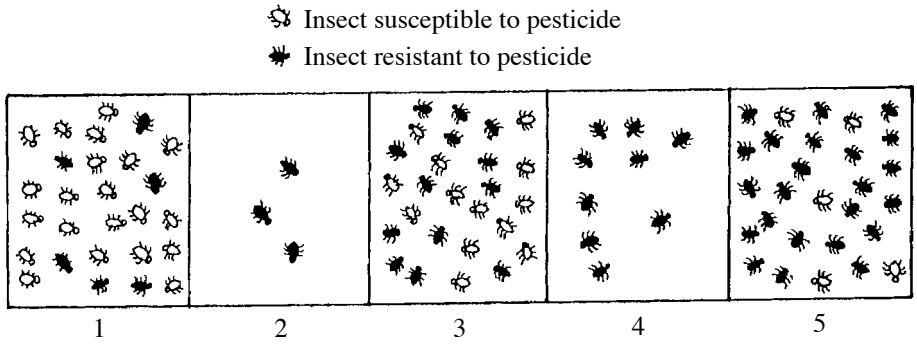
For Marker Use Only

Question 25

The sequence of five diagrams below show how pesticide resistance develops in a population of insects. Each insect symbol represents 10000 individuals. Assume there is no immigration or emigration.



Briefly explain, using your understanding of Darwin's theory of evolution, the steps in the development of pesticide resistance. You may refer to the steps using the numbers 1-5.

(6 marks)

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