BIOLOGICAL SCIENCES
STAGE 3 SAMPLE EXAMINATION

Section 7 of the New WACE Manual: General Information 2006–2009 outlines the policy on WACE examinations.

Further information about the WACE Examinations policy can be accessed from the Curriculum Council website at http://newwace.curriculum.wa.edu.au/pages/about_wace_manual.asp.

The purpose for providing a sample examination is to provide teachers with an example of how the course will be examined. Further finetuning will be made to this sample in 2008 by the examination panel following consultation with teachers, measurement specialists and advice from the Assessment, Review and Moderation (ARM) panel.

Western Australian Certificate of Education, Sample External Examination

Question/Answer Booklet

BIOLOGICAL SCIENCES
SAMPLE EXAMINATION
STAGE 3

Please place your student identification label in this box

Student Number: In figures | | | | | | | | |

In words _____

_____

Time allowed for this paper
Reading/planning time before commencing work: Ten minutes
Working time for paper: Three hours

Material required/recommended for this paper

To be provided by the supervisor
Question/Answer Booklet
Multiple Choice Answer Sheet

To be provided by the candidate
Standard items: Pens, pencils, eraser or correction fluid, highlighter and ruler.

Special items: Calculators satisfying the conditions set by the Curriculum Council for this course.

Important note to candidates
No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be attempted	Suggested working time minutes	Marks available
One: Multiple choice	10	10	15	20 (10%)
Two: Short answers	9	9	95	130 (65%)
Three: Extended answers	2	2	70	50 (25%)
			Total marks	200 (100%)

Instructions to candidates

1. The rules for the conduct of Curriculum Council examinations are detailed in the *Student Information Handbook*. Sitting this examination implies that you agree to abide by these rules.

2. Read every question carefully before you answer. Answer the questions according to the following instructions:

   Section One Answer **all** questions, using a 2B, B or HB pencil, on the separate Multiple Choice Answer Sheet. Do not use a ball point or ink pen.

   Section Two Answer in the spaces provided in this Question/Answer Booklet. Do not answer this section in the Standard Answer Book. A blue or black ball point or ink pen should be used.

   Section Three Write your answers in the Standard Answers Book. Your writing or printing must be **LEGIBLE**. Use a blue or black ball point or ink pen (not pencil) for this section.

3. Answers may be presented in a combination of different ways provided they communicate your ideas effectively. You may choose to:

   - present a clearly labelled diagram
   - write notes besides a clear diagram
   - write lists of points, with sentences which link them
   - write concisely worded sentences
   - use some other appropriate way to present ideas.

4. At the end of the examination your Question/Answer Booklet should be attached to the front of the Standard Answer Book/s with the paper binder provided.

SECTION ONE—MULTIPLE CHOICE *[20 marks]*

Suggested time: 15 minutes

This section has **ten (10)** questions. Record an answer for Questions 1–10 by marking your choice of alternative on the separate Multiple Choice Answer Sheet using a 2B, B or HB pencil. Each question is worth two marks. Marks are not deducted for wrong answers.

If you want to change an answer, rub out your first answer and mark the new choice. The answer sheet for Section One will be collected separately by the Supervisor.

Question 1

A scientist has been studying photosynthesis in Busy Lizzies (*Impatiens)*. After a warm weekend the scientist notices that the leaves on the plants have wilted. The scientist picks some leaves and finds that, after observing them under a microscope, the stomata are closed. The scientist concludes that the plants are suffering from water stress.

Which of the following statements best describes the effect of water stress on photosynthesis?

(a) There is no effect on photosynthesis itself, but the lack of water in the transport system prevents the transport of products of photosynthesis away from the leaf, thus inhibiting growth.

(b) The wilted leaves do not have sufficient surface area exposed to the sun to absorb light, thus preventing photosynthesis.

(c) The closed stomata prevent gas exchange, inhibiting carbon dioxide uptake and therefore reducing photosynthesis.

(d) The minerals transported with the water are depleted during the stomatal closing therefore reducing photosynthesis.

Question 2

Commercial chicken farmers go to great lengths to maintain a near-constant environmental temperature of around 30 degrees ^{0}C. What is the most likely reason for this?

(a) Chickens reduce their food intake at this temperature.
(b) The chicken's enzymes work best at this temperature.
(c) The risk of disease is minimised because of the ectothermic nature of most disease organisms.
(d) This matches the body temperature of the birds.

Question 3

Which of the following statements is true of natural ecosystems?

(a) Energy recycles through natural ecosystems.
(b) Nutrients flow through natural ecosystems.
(c) Natural ecosystems include living and non-living components.
(d) There is no heat energy loss from natural ecosystems.

Question 4
The Eastern coral snake *Micrurus fulvius fulvius* is brightly coloured, with red, yellow and black transverse rings along the body. The snakes are poisonous and their bite kills many animals quickly. Predators rarely attack these snakes and those that do are usually killed. Which of the following is the most likely explanation of why the snakes are rarely attacked?

(a) Only predators that avoid the snakes survive to breed.
(b) Predators are bitten and learn to avoid the snakes.
(c) The colouring camouflages the snakes.
(d) The predators that survive the snake's bite pass on resistance to their offspring.

Question 5
A non-poisonous snake called the scarlet king snake *Lampropeltis triangulum elapsoides* lives in the same habitat as the eastern coral snake. The two species have similar colours. A biologist reasoned that predators would not attack the scarlet king snake because they looked so much like the dangerous eastern coral snakes. Which of the following best defines this suggestion?

(a) It is an observation.
(b) It is an hypothesis.
(c) It is a theory.
(d) It is a conclusion.

Question 6 refers to the following information.

Data was obtained relating to the rates or oxygen release and uptake in plants. The plants were placed for 12 hours in the dark followed by 12 hours in the light. Temperature was constant throughout the experiment. The results are shown in the graph.

For copyright reasons this image cannot be reproduced in the online version of this document.

[Diagram adapted from: Institute of Biology, 2002]

Question 6
Which of the following is the most accurate estimate of the total volume of oxygen used by the plants for respiration during the 24 hours of the experiment?

(a) 50 cubic cm
(b) 600 cubic cm
(c) 1200 cubic cm
(d) 1800 cubic cm

Question 7
An endotherm moves from a cool place to a hotter one. Which of the following changes is most likely to occur?

(a) Skin muscles will contract to hold hairs erect.
(b) Blood vessels near the body surface will dilate (expand).
(c) Urine production will increase.
(d) Body temperature will fall to compensate.

Question 8
The following examples are used as evidence for evolution. Which example is the least convincing?

(a) Fossils showing a pattern of change over time in a group of organisms.
(b) Many related animals (e.g. lion and tiger) have very strong similarities in their DNA.
(c) Many organisms possess structures that are no longer as functional as they are in other species e.g. human tail bones compared to a dog's tail bones.
(d) Organisms generally resemble their parents more closely than they resemble other members of their species.

Question 9
Which of the following techniques is used to separate and arrange DNA fragments according to their size?

(a) Electrophoresis
(b) Southern blotting
(c) Polymerase chain reaction
(d) Probes

Question 10
Which of the following **best** describes a genome?

(a) An organism's complete set of DNA.
(b) An organism's complete set of genes.
(c) A cell's complete set of chromosomes.
(d) A cell's complete set of genes.

END OF SECTION ONE

SECTION TWO—SHORT ANSWERS *[130 marks]*

Suggested time: 95 minutes

Attempt all questions in this section. Write answers in the spaces provided. Diagrams may be used in your answer. Use a blue or black ball point or ink pen for written answers and pencil for diagrams. Make sure diagrams are clear and labelled.

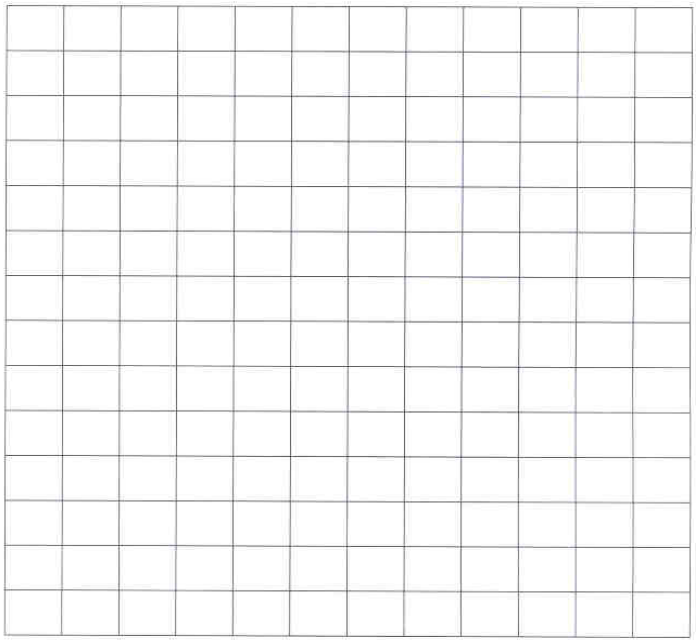
Question 1

While collecting aquatic animals in a stream, biology students observed fish that were eating insects living amongst the rocks on the stream bed. They hypothesised that predation by the fish was decreasing the population of the insects. To test this hypothesis, the students placed 10 wire mesh cages covering $1m^2$ of the stream bed. The mesh on the cages allowed the insects to enter and leave, but excluded fish from the inside of the cage. They also placed 10 wire frames of equal dimensions next to the wire mesh cages but without any mesh. These frames allowed both fish and insects to enter and leave without restriction. Each week for six weeks the students counted the number of insects in each of the cages and in each of the wire frames. They calculated the average number of insects in cages and the average number of insects in frames. The results are shown below.

Time in weeks	Average number of insects collected/m^2 Cages (fish excluded)	Frames (fish can enter)
1	65	70
2	70	75
3	Data lost	65
4	90	75
5	110	70

(a) On the grid provided, draw a line graph of these data for both cages and the wire frames.

[4 marks]



(If you wish to have a second attempt at this item, a second time the grid is repeated on page 29. If you do use the repeat grid, you must clearly cancel your working on the grid on this page and clearly indicate that the answer to be marked is on page 29).

SEE NEXT PAGE

(b) Use your graph to predict likely values for these readings had it been possible to measure them.

(i) Frames Week 6 _____

Cages Week 3 _____

(ii) In which prediction do you have greatest confidence? Explain why. *[4 marks]*

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(c) The students' original hypothesis was that predation by the fish decreased the numbers of insects on the stream bed. Do the experimental results support the hypothesis? Explain your answer by referring to the data collected and to the design of the experiment.

[4 marks]

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(d) (i) What is the control for this experiment? *[1 mark]*

_____

_____

(ii) Why is the control needed? *[1 mark]*

_____

_____

(iii) Give two reasons why the students did not use just one cage and just one wire frame. *[2 marks]*

_____

_____

_____

_____

(e) For the experiment described, name the: *[2 marks]*

(i) dependent variable. _____

(ii) independent variable. _____

(f) A student complained that the experiment was flawed because there was at least one uncontrolled variable. Name one uncontrolled variable and say why it is important. *[2 marks]*

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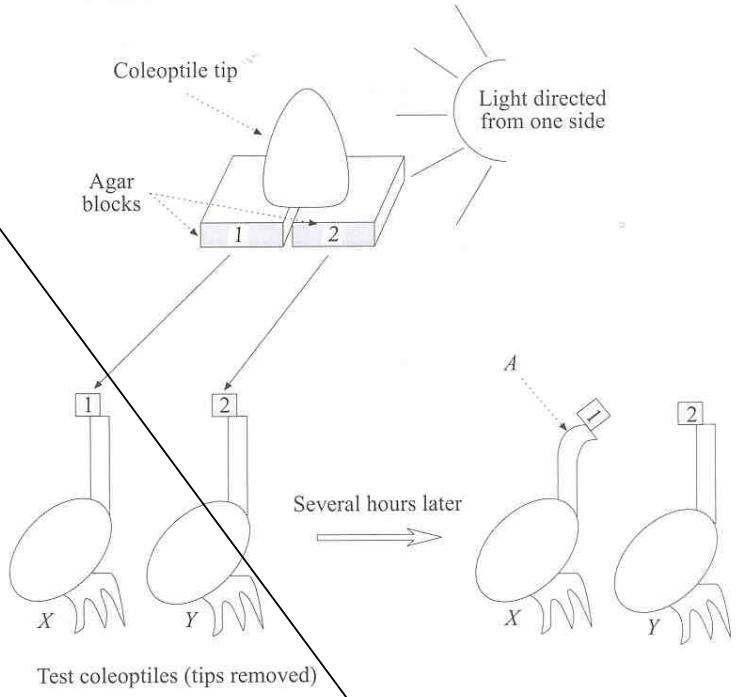
_____

Question 2

The diagram below shows an experiment on the growth of coleoptile tips from oat seedlings.



(a) Explain why coleoptile X bends more than coleoptile Y. *[4 marks]*

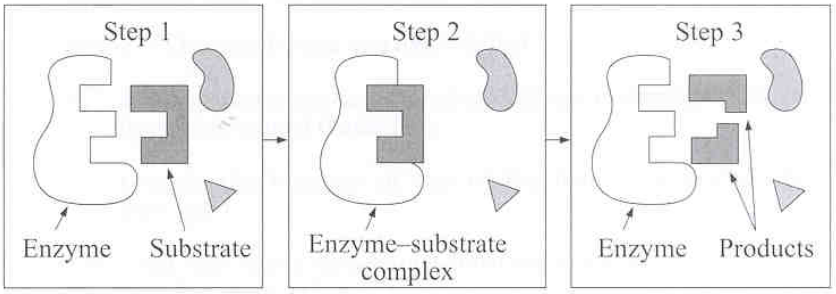
(b) Describe what happens to the cells in the stem of coleoptile X at point A on the diagram. *[2 marks]*

(c) Name the plant response being investigated in this experiment. *[1 mark]*

(d) State three advantages of this response to growing plants? *[3 marks]*

[From: Board of Studies New South Wales, 1996]

Question 3
The diagram represents a chemical reaction catalysed by an enzyme.



(a) How does this model explain the idea of enzyme specificity? *[2 marks]*

(b) Some drugs are effective in killing parasites because they block enzymes involved in biochemical pathways critical for the growth of the organism. Using a diagram similar to that above, illustrate and explain how these drug molecules could block the enzyme involved. *[5 marks]*

(c) The enzyme amalyse, which is found in saliva, promotes the breakdown of starch to maltose. If saliva is mixed with starch, eventually all the starch will be broken down regardless of the amount of saliva added. Explain why this occurs.

[3 marks]

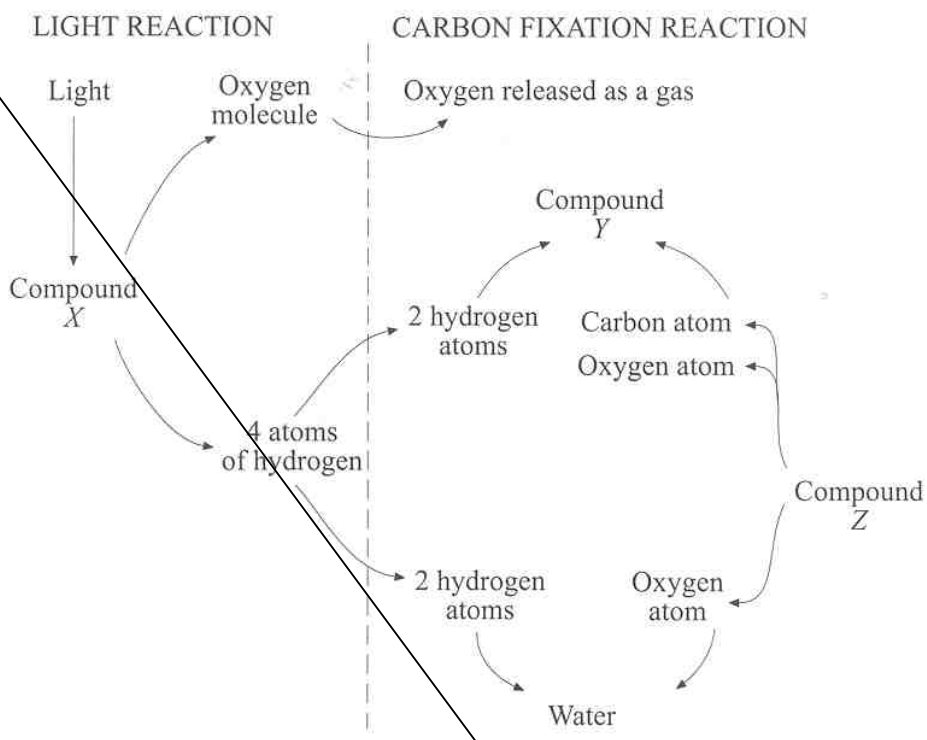
(d) Food containing starch is mixed with saliva in the mouth and the starch begins to break down due to the action of the amylase. Suggest what may happen to this rate of reaction when the food enters the stomach.

[4 marks]

[From: Board of Studies New South Wales, 1997]

Question 4

(a) Below is a greatly simplified diagram of the light reaction and the carbon fixation reaction.



(i) Name the process summarised in the diagram. *[1 mark]*

_____

_____

(ii) Where in the chloroplast does the light reaction occur? *[1 mark]*

_____

_____

(iii) Name the compounds X, Y, Z in the above diagram. *[3 marks]*

X _____

Y _____

Z _____

(iv) Plants sometimes have been called 'energy converters'. Briefly discuss this statement. *[3 marks]*

(b) Below are word equations that describe two forms of respiration.

I. sugar → lactic acid + energy
II. sugar + oxygen → water + carbon dioxide + energy

(i) Name the two forms of respiration. *[2 marks]*

I. _____

II. _____

(ii) Name and briefly outline one biochemical pathway which is common to both forms of respiration. *[2 marks]*

(iii) State how many molecules of ATP are produced by each of the two forms of respiration. *[2 marks]*

I. _____

II. _____

(iv) Name the site(s) **in the cell** where processes I and II take place. *[2 marks]*

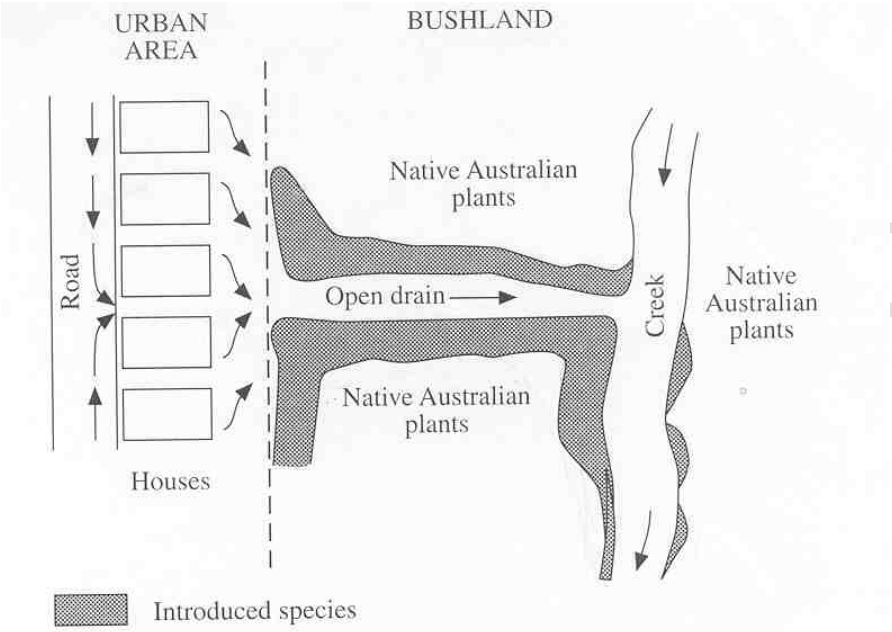
I. _____

II. _____

[From: Board of Studies New South Wales, 1996]

Question 5

The diagram shows a section of native Australian bushland that lies adjacent to an urban area. A drain takes stormwater from the road and nearby houses to a creek. The arrows indicate the direction in which water flows after a period of rain.



(a) Comment on the distribution of the introduced species and native Australian plants.

[2 marks]

_____

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_____

_____

(b) Give **two** possible reasons for the observed distribution of introduced species and native Australian plants.

[2 marks]

_____

_____

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(c) Suggest **four** possible methods for managing and/or eradicating the introduced species.
[4 marks]

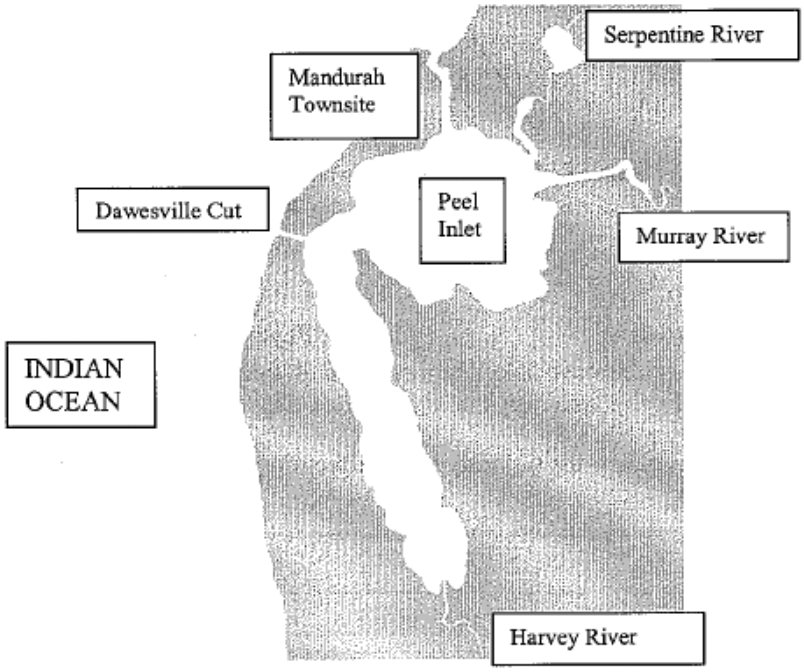
(d) Briefly describe the likely changes over time and possible impacts on the fauna and flora if no steps were taken to control or manage the introduced species.
[2 marks]

[From: Board of Studies New South Wales, 2000]

Question 6

Eutrophication is an environmental problem that occurs in inland water bodies such as lakes, rivers and inlets. It occurs when excessive nutrient levels in the water cause overgrowth of producer organisms. This can lead to major disruptions in the ecosystem.

The Peel Inlet near Mandurah in Western Australia is a popular area for water sports. The surrounding land is used mostly for agriculture. For several decades the Peel Inlet has had problems with eutrophication and water turbidity (cloudiness).



In 1995 the Dawesville Cut was completed south of Mandurah. This is a deep channel joining the inlet to the ocean. As a result the inlet waters are extensively flushed by the rise and fall of the tides and the waters of the inlet are circulated more effectively.

(a) (i) Name two possible sources of excess nutrients in the Peel Inlet. *[2 marks]*

_____

_____

_____

_____

(ii) Name two possible causes of water turbidity in the Peel Inlet. *[2 marks]*

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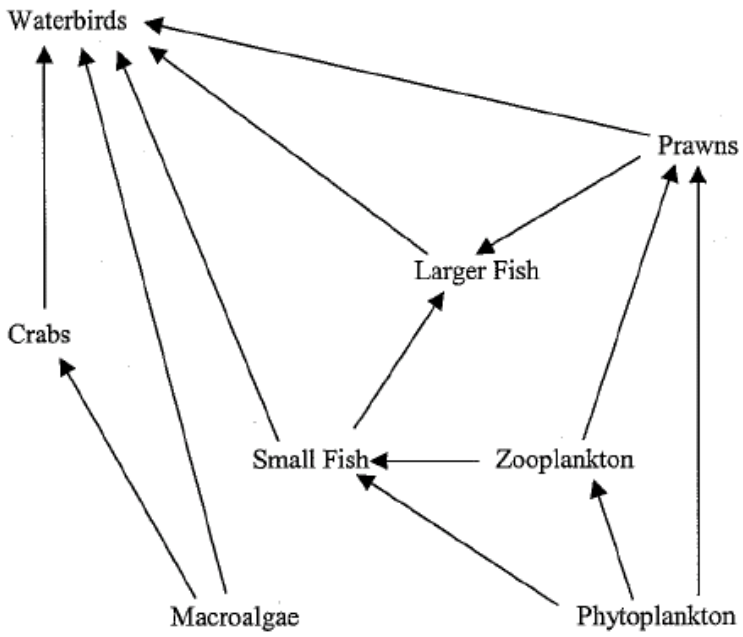
The diagram below shows a simplified food web for the Peel Inlet.



(b) (i) Briefly explain two ways the turbidity could affect the population of macro algae.

[2 marks]

(ii) Explain briefly how the turbidity would affect the populations of commercially important species such as larger fish, crabs and prawns.

[2 marks]

(c) Since the Dawesville Cut was opened tidal variation in water levels has increased, leading to greater areas of salt marsh. Mosquitoes breed in these salt marshes and have become a problem to people living in the area, both as a nuisance and as a carrier of disease. An obvious solution is to spray salt marsh areas with chemical insecticides to kill the aquatic mosquito larvae.
When spraying occurs, the concentration of the insecticide used is known to be harmless if sprayed on vertebrates living in the area. However, water birds have been known to become ill or even die some time later.

(i) Draw a biomass pyramid for the following food chain: *[2 marks]*

Phytoplankton ------- prawns ------- waterbirds

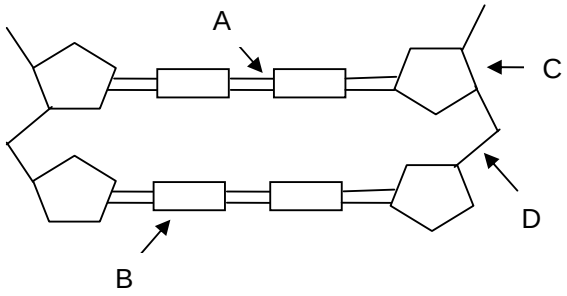
(ii) Briefly explain how the insecticide becomes more concentrated in each higher level of the food pyramid. *[2 marks]*

(iii) Give **two** reasons why spraying insecticide is bad for the ecosystem. Briefly explain your answers. *[2 marks]*

(iv) Suggest **two** methods, besides spraying, which could help reduce the mosquito population. *[2 marks]*

Question 7

(a) Label the following diagram of a section of DNA *[4 marks]*



A _____

B _____

C _____

D _____

(b) The stages of DNA replication can be summarised as follows:

- The two complementary strands of DNA separate: one as a template and one that is complementary to the template.
- The two complementary strands act as templates to produce a new complementary strand.
- DNA nucleotides are added according to the base pairing rule.
- Replication occurs simultaneously for both strands and the entire process is controlled by enzymes.

(i) State the purpose of DNA replication. *[2 marks]*

_____

_____

_____

(ii) Explain, using an example, what is meant by the base pairing rule. *[4 marks]*

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(iii) DNA replication is known as semi-conservative. What does the term 'semi-conservative' mean in terms of DNA replication.

[2 marks]

_____

_____

_____

_____

(iv) The following base sequence of DNA resulted from the replication of a segment of DNA.

C A T T A C G
G T A A T G C

Write down the base sequence of the original DNA segment in the space provided.

[1 mark]

— — — — — — —

— — — — — — —

(v) Certain enzymes, generally termed nucleases, are associated with DNA. These enzymes are involved in the synthesis, binding and break up of DNA. Would nucleases taken from one species work on the DNA of an entirely unrelated species? Explain your answer.

[2 marks]

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Question 8

Comparisons of the percentage differences in the amino acid sequence of the proteins of different species can indicate an evolutionary relationship between each species.
An example is the blood protein haemoglobin. The percentage difference in the amino acid sequence of the blood protein haemoglobin for the following species is given below.

Elephant and gibbon 19%
Platypus and elephant 32%

(a) Compared to the gibbon would you expect percentage differences in the amino acid sequence of platypus haemoglobin to be more or less than that of the elephant? Explain your answer.

[3 marks]

_____

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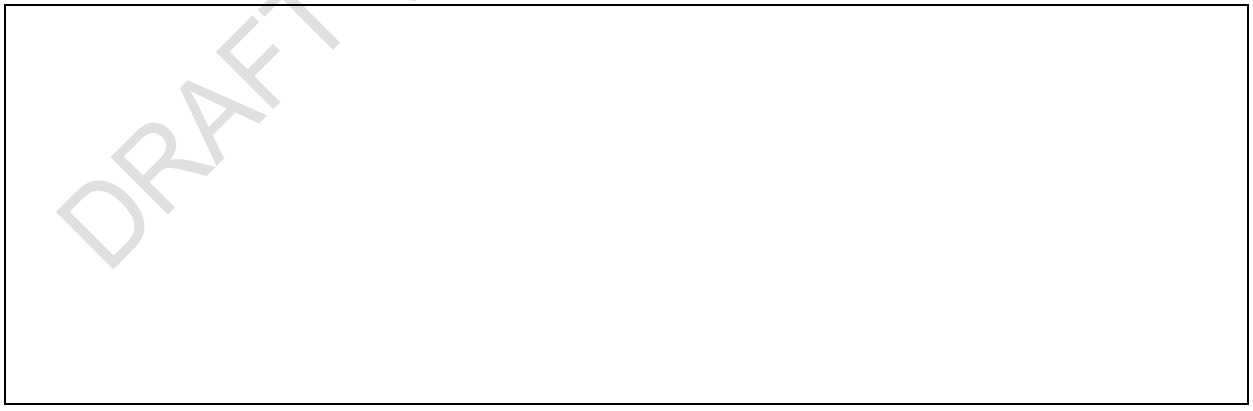
_____

(b) Using the information below, draw an hypothetical evolutionary relationship for the species, L, M, N and O in the space provided. Show all working.

[4 marks]

% differences in protein chains			
Species	M	N	O
L	5	24	35
M		20	30
N			34



SEE NEXT PAGE

(c) In the study of evolutionary relationships what is meant by the term ‘common ancestor’?
[2 marks]

_____

_____

_____

_____

d) Use your drawing from b) to answer the following questions.

(i) could species M have evolved from species L? Give a reason for your answer.
[2 marks]

_____

_____

_____

_____

(ii) approximately when, in mya, did species N first appear? *[1 mark]*

_____

_____

(iii) is species N the common ancestor of species L and species M? Explain your answer.
[2 marks]

_____

_____

_____

_____

Question 9
The table below shows the major steps in the production of recombinant DNA.

Steps	Required technique or 'tool'
Extraction of DNA from cells	
Cut DNA into specific fragments	
Arrange DNA fragments by length	
Locate particular DNA fragment	
Joining of DNA fragments	
Transporting DNA fragment into a cell	
Producing multiple copies	

(a) Complete the table by naming the appropriate technique tool for each step in the production of recombinant DNA. *[7 marks]*

(b) Define the term recombinant DNA. *[2 marks]*

_____

_____

_____

_____

(c) Could the same techniques or tools be used on all genetic material regardless of its source? Explain your answer.

[2 marks]

_____

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_____

(d) Briefly describe two applications of recombinant DNA technology.

[4 marks]

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END OF SECTION TWO

SECTION THREE—EXTENDED RESPONSE
Suggested time: 70 minutes

Section Three consists of two compulsory questions, 10 and 11. There are two parts to each question. You must answer ALL parts from both questions.

Question 10 carries twenty (20) marks and mainly tests your **knowledge** of syllabus content. Question 11 carries thirty (30) marks and mainly tests **how you apply** your understanding of biological principles.

ANSWER SECTION C IN THE STANDARD ANSWER BOOK. Answers may be presented in a combination of different ways provided they communicate your ideas effectively.

You may choose to:
- present a clearly labelled diagram
- write notes besides a clear diagram
- write lists of points, with sentences which link them
- write concisely worded sentences
- use some other appropriate way to present ideas.

Marks may be deducted for answers that are poorly presented or difficult to read. Use a blue or black ball point or ink pen for written answers and a pencil for diagrams.

Question 10
Answer both parts of this question ***[20 marks]***

(a) Using a named example of natural selection in action, explain how **one** selective force in the environment contributes to an evolutionary change.

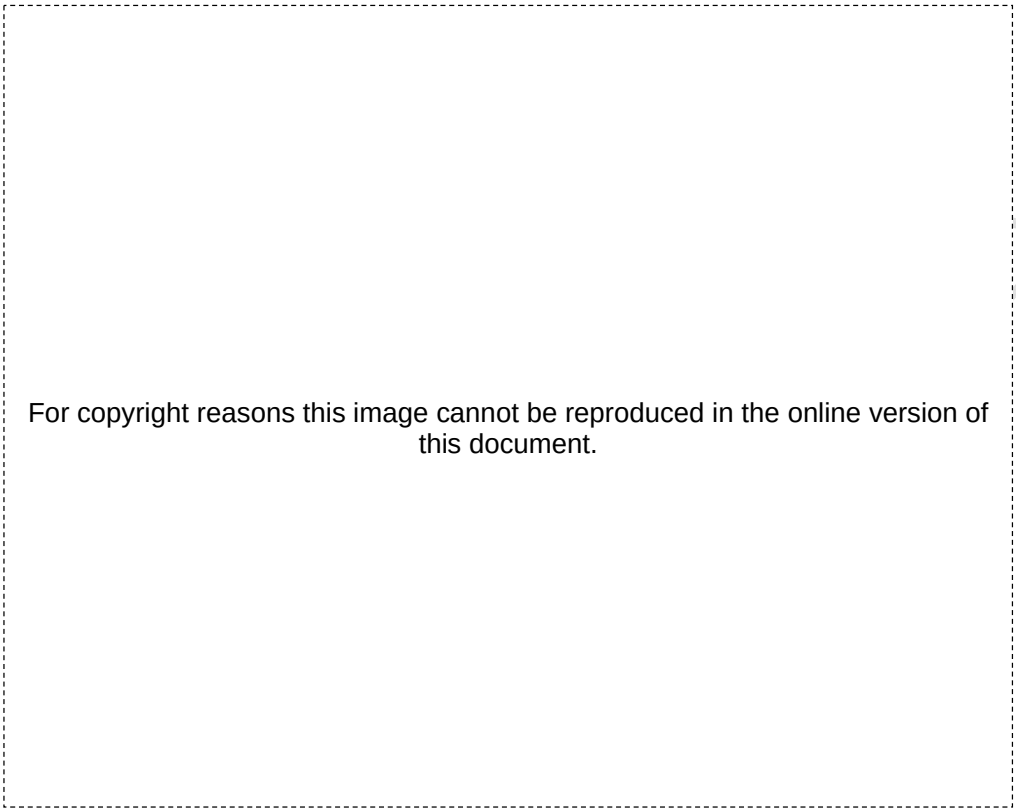
[10 marks]

(b) Terrestrial organisms need to maintain water balance to survive. Using a named plant example and a named animal example, briefly describe **four** adaptations for each example that allow each kind of organism to gain or conserve water in their natural environment.

[10 marks]

Question 11
Answer all parts of this question ***[30 marks]***

(a) The following diagram shows a simplified food web occurring in a freshwater lake community.



[Diagram adapted from: Bres & Weisshaar, 2000]

(i) Describe what information is conveyed by food webs in general and by this particular food web.

[7 marks]

(ii) Describe briefly any other useful items of information that may have been omitted or oversimplified for this food web and predict what may happen if the trout population is completely removed from the community?

[8 marks]

(b) A year 12 student sows 100 seeds of a plant species on a single garden bed. While the plants are growing, the student notices that 20 plants growing in one part of the garden bed are not as tall as the rest of the plants.

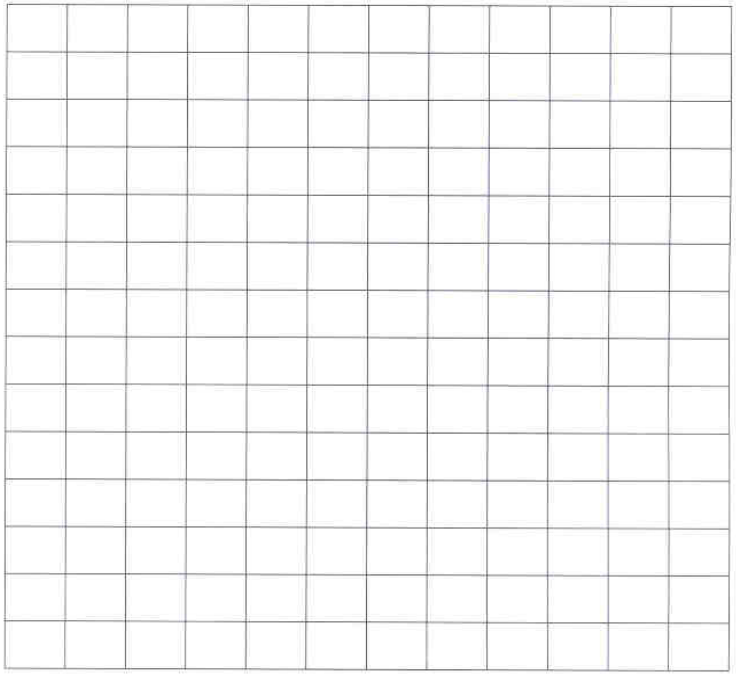
(i) Name five factors that may have caused the differences in size between the two groups of plants.

[5 marks]

(ii) Design an experiment that will provide convincing evidence to the world community of scientists that the student could carry out to determine whether one of the factors you named in part (i) is responsible for the reduced size of the group of 20 plants.

[10 marks]

Use the grid below to answer Section Two question 1(a) if you have cancelled your first attempt.



END OF PAPER

ACKNOWLEDGEMENTS

SECTION ONE

Question 6 Diagram adapted from: Institute of Biology. (2002). *British Biology Olympiad 2002: Part A questions* (Plant anatomy and physiology, q. 4). Retrieved January, 2006, from http://www.iob.org/downloads/116.pdf.

SECTION TWO

Question 2 Adapted from: Board of Studies New South Wales. (1996). *1996 Biology 2 Unit: Higher School Certificate Examination* (p. 22). Retrieved August, 2007, from http://www.boardofstudies.nsw.edu.au/hsc_exams/hsc2000exams/hsc00_biology/96BIOLGY.PDF.
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Question 3 Board of Studies New South Wales. (1997). *1997 Biology 2 Unit: Higher School Certificate Examination* (p. 17, q. 33(d)). Retrieved August, 2007, from http://www.boardofstudies.nsw.edu.au/hsc_exams/hsc2000exams/hsc00_biology/97BIOLGY.PDF.
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Question 4 Adapted from: Board of Studies New South Wales. (1996). *1996 Biology 2 Unit: Higher School Certificate Examination* (p. 17). Retrieved August, 2007, from http://www.boardofstudies.nsw.edu.au/hsc_exams/hsc2000exams/hsc00_biology/96BIOLGY.PDF.
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Question 5 Adapted from: Board of Studies New South Wales. (2000). *2000 Biology 2 Unit: Higher School Certificate Examination* (p. 43). Retrieved August, 2007, from http://www.boardofstudies.nsw.edu.au/hsc_exams/hsc2000exams/hsc00_biology/00biology.pdf.
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SECTION THREE

Question 11(a) Diagram adapted from: Bres, M., & Weisshaar, A. (2000). *Cooperative learning: Making connections in general biology*. Sydney: Brooks/Cole, p.18-4.

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