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*Marking Schedule  
and Examination  
Commentary  
2000*

**University Entrance,  
Bursaries and  
Scholarships  
Examination**

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# University Entrance, Bursaries and Scholarships Examination

## BIOLOGY 2000

### Marking Schedule and Examination Commentary

#### INTRODUCTION

This report is written to assist teachers and future students in University Bursaries Biology. Comments and guidelines are given below the marking schedule.

Markers considered that this year's paper compared well with previous years and had a good coverage of the prescription. Candidates performed better in Section 1 (apart from Questions 4 and 5) compared with the other sections.

Several of the questions in this year's paper integrated different aspects of a particular area of Biology. Generally, candidates found this style of question challenging. They either had difficulty recognising what the question required or found it difficult to draw together the knowledge and understanding from the different areas they had been taught. It would be useful for teachers to teach content in ways that show how the different aspects of the prescription are interrelated.

#### MARKING SCHEDULE

##### SECTION 1: ANIMAL BEHAVIOUR AND PLANT RESPONSES

(50 marks)

##### Question 1 (9 marks)

- (a) Positive (1) phototropism (1).  
*Positive on own = no mark.* [2]
- (b) Tropism: a directional growth response to directional environmental stimulus.  
Nastic: a growth response to non directional environmental stimulus. *Both needed.* [1]
- (c) Drawing A: Plumule and radicle both drawn growing horizontally. *Both needed* (1).  
Drawing B: Plumule drawn growing up, radicle drawn growing down. *Both needed* (1). [2]
- (d) (i) Gravity (1).  
(ii) Gravity (1). [2]
- (e) Shoots **grow up** to reach light (1).  
Roots **grow down** to soil for moisture/anchorage *not nutrients* (1). [2]

#### Comment:

Most candidates scored well on this question. Note that if the **name** of the growth response is asked for then tropic is not acceptable as an answer. In (b) many answers made no reference to the direction of the environmental stimulus.

##### Question 2 (13 marks)

- (a) C D A B *in this order.* [4]
- (b) Circadian rhythm (1) because it has a period of approximately 24 hours/it is active once per 24 hours.(1). [2]
- (c) Active at a time when most predators or competitors are not active/active at same time as prey/avoids desiccation. [2]
- (d) Rhythm continues in **absence** of external environmental cues (2 or 0)/controlled by internal clock (1). [2]
- (e) Longer. [1]
- (f) (i) Upsets rhythm/behaviour becomes random /sporadic (1).  
(ii) Entrain clock/activity becomes regular (1). [2]

#### Comment:

Answers to this question suggest there was confusion between the terms 'rhythm', 'cycle' and 'activity period'. There are many terms in Biology covering similar areas and candidates need to be able to clearly distinguish between them.

- (a) and (b) Generally well answered.
- (c) Candidates had problems clearly explaining an adaptive advantage of a circadian rhythm. Many stated that because nocturnal predators cannot see the weta at night this means it is less likely to be eaten.
- (d) A straightforward question requiring a standard definition. Candidates lost marks for not being specific enough, eg "constant conditions".
- (e) and (f) Well answered.

**Question 3**

(9 marks)

- (a) Most C F E D A B Least  
 • all correct (3)  
 • 2 letters in wrong place (2)  
 • C and B correct with up to 4 letters in wrong place (1)  
 • hierarchy reversed but table correct (1). [3]
- (b) D [1]
- (c) Age/size/length of time in group/experience/health status. *Any two.* [2]
- (d) Reduces aggression/individuals have a place/allocates (scarce) resources, eg *one of – food, mates, space, nest sites*/the best adapted individuals survive/breed and pass on their genes to offspring/dominant animals protect animals lower down hierarchy. *Any three.* [3]

**Comment:**

The basic principles of hierarchies appear to be well taught. Few students had problems with (a) and (b).

- (a) Answered satisfactorily but some candidates appeared to confuse factors influencing the position with the advantages of being higher up the hierarchy.
- (b) Not well answered with many candidates interpreting the question as asking for the advantages of group organisation rather than the advantages of hierarchical behaviour to the group.

**Question 4**

(9 marks)

- (a) Dominance status in **possums** determines mating success. (Not vasectomies affect number of pregnancies).  
*Must be stated as a hypothesis.* [1]
- (b) To compare the behaviour of one male on own versus two males together. [1]
- (c) To establish normal dominance behaviour/establish pregnancy rate. [1]
- (d) In both groups, pens with vasectomised possums had no conceptions after the vasectomy. Conceptions in non-vasectomised pens increased post treatment.  
 Group A: more pregnancies post treatment, Group B: more pre treatment.  
*Any two patterns.* [2]
- (e) Dominance status in possums does determine

mating success (1) because vasectomy of the dominant animal prevented conceptions even when other males were present (1). [2]

- (f) Dominant male able to inhibit reproduction by subordinate males(1) by behaviour or other means (1) or dominant male able to pass on more genes to next generation than lower status males (1 or 0). [2]

**Comment:**

This was the hardest question in the paper and all candidates found it challenging.

- (a) Most candidates were able to correctly write the hypothesis with only a few failing to write it in the correct form. Candidates who lost marks generally did so because they copied the sentence from the introduction and failed to apply it to possums.
- (b) Most candidates recognised that Group A was a control but did not explain why. It needs to be emphasised that answering "it is a control" is not acceptable at this level.
- (c) Candidates who answered this correctly explained it very well.
- (d) Having the same scale on both graphs would have helped candidate interpretation of this question. It was either answered well or candidates had no idea. Note that the use of pattern in the question implies a comparison over time. Patterns also need to be relevant to the hypothesis being tested.
- (e) Again not well answered. Most candidates failed to relate the results back to the proving or disproving of the hypothesis.
- (f) A hard question, which required candidates to think beyond the experiment to the wider implications. Some candidates managed to get the first mark, few obtained the second mark.

**Question 5**

(10 marks)

- (a) Allelopathy/antibiosis/amensalism. [1]
- (b) The ryegrass benefits from a continuous food supply/protected from desiccation. *Any one.* [1]
- (c) Endophytic means living inside a plant. [1]
- (d) (i) Endophyte infected ryegrass inhibits clover growth (at concentrations above 25%)(1).  
 (ii) Pacific cultivar decreases clover growth more than Nui. (1) [2]
- (e) The ryegrass extracts also contained nutrients or hormones from the leaves that increased clover growth (2 or 0). [2]

- (f) Clover is an important nitrogen fixer, not 'is a legume'. [1]
- (g) Endophyte infected ryegrass reduces clover growth(1). This reduces the quality of feed available to animals reducing weight/meat quality/milk production etc(1). [2]

**Comment:**

This question also challenged many candidates.

- (a) Well answered.
- (b) Generally well answered but some candidates failed to appreciate that a fungus is a living organism and requires a food source. Others appear to associate fungi only with moulds and rotting.
- (c) Better candidates either knew or were able to work out this answer.
- (d) The two graphs provided were challenging but also highlighted the poor graph interpretation skills of many candidates. Answers showed that candidates were concentrating on the effect of changing extract concentrations rather than comparing the patterns shown by the different lines.
- (e) A hard question. Candidates either interpreted the situation exactly as in the mark schedule or were completely wrong.
- (f) This question was intended to lead candidates into the answer for (g). Given the importance of clover to agriculture in New Zealand it was surprising how many candidates could not answer this correctly.
- (g) Like question 4 (f) this question required candidates to look at wider implications. Candidates had difficulty taking a finding from the experiment and applying the results to clover growth on a farm rather than in a laboratory.

**SECTION 2: GENETICS AND EVOLUTION**

(80 marks)

**Question 1**

(10 marks)

- (a) Enzymes unwind/cut DNA strand/DNA polymerase joins nucleotides to form new/complementary strand/new DNA is synthesised 5' to 3'/Okazaki fragments form on lagging strand/enzyme joins fragments/new DNA strand rewind back into helix.  
*Any three.* [3]  
Must mention one named enzyme to get full marks.
- (b) New DNA strand consists of 50% old strand and 50% new DNA. [1]

- (c) (i) Transcription (1)  
(ii) Translation (1)  
(iii) (DNA) replication (1) [3]
- (d) DNA polymerase cannot bind to short fragments/DNA will not have complete gene sequence/short fragments make nonsense DNA/fragments may not have complete gene sequence to make replication enzymes. *Any three.* [3]

**Comment:**

- (a) Poorly answered with many candidates totally misreading the question and describing protein synthesis or in some cases PCR.
- (b) From the range of answers such as 'it takes few risks' or 'it's quite conservative' it would appear that this basic concept is not being taught or candidates do not understand it.
- (c) Generally well answered with the main error being in (iii) where candidates assumed the diagram showed a retrovirus in action and wrote reverse transcription.
- (d) A hard question, with only a few candidates gaining full marks.

**Question 2**

(7 marks)

- (a) 47 [1]
- (b) Non-disjunction of chromosomes in **meiosis** or words meaning this. [1]
- (c) (i) eg  $\boxed{a b c d e} \rightarrow \boxed{a b c b c d e}$  (1)  
(ii) eg  $\boxed{a b c d e} \rightarrow \boxed{a d c b e}$  (1)  
Not  $\boxed{e d c b a}$  [2]

- (d) Point mutation: codon redundancy means correct amino acid can still be produced/some proteins can still function correctly with one different amino acid/if point mutation occurs near the end, protein may still be able to function/mutation may be recessive/may be repaired/may occur on intron therefore not expressed.  
Chromosomal mutation changes order of genes therefore affects quaternary protein structure/chromosomal mutation affects more than 1 gene, point mutation affects only 1 gene. *Any three.* [3]

**Comment:**

- (a) A straightforward question but not answered correctly by a surprising number of candidates.
- (b) Marks were lost here by use of incorrect biological terms such as spindles and chromatids failing to separate.

- (c) Generally done well, although for the inversion many candidates simply reversed the order of the genes.
- (d) Not very well done, with many incorrect ideas given. Codon redundancy was often described as meaning that more than one codon coded for a protein or gene. Many answers stated that gene mutations were less harmful because they occur in body cells whereas chromosomal mutations occur only in sex cells. A similar misconception was that only mutations occurring in sex cells are harmful because they are inherited. This is an area that needs careful teaching.

(ii) 25% (1) *Fractions, decimals and ratios acceptable.* [2]

**Comment:**

Candidates generally scored well in this question.

- (a) Answers showed that co-dominance is not clearly understood with many candidates not linking alleles to the effect on phenotype.
- (b) Answered well except for those who used different symbols from those given in the question.
- (c) Also well answered apart from some candidates who used a ratio of 1:4 as meaning 25%.

**Question 3**

(10 marks)

- (a) Unlinked genes are genes not on the same chromosome. [1]
- (b) Supplementary (genes)/epistasis. [1]
- (c) (i) purple (1)  
(ii) correct punnet square (1)  
ratio 9 purple: 3 red: 4 white (2)  
*1 mark if ratio without colours or colours incorrectly matched to numbers*

	FH	Fh	fH	fh
FH	FFHH	FFHh	FfHH	FfHh
Fh	FFHh	FFhh	FfHh	Ffhh
fH	FfHH	FfHh	ffHH	ffHh
fh	FfHh	Ffhh	ffHh	ffhh

[4]

- (d) (i) FfHh (1)  
(ii) ffhh (1)  
(iii) ffHh (1) ffhh (1)  
*Deduct 1 mark for each extra genotype.* [4]

**Comment:**

It was pleasing to see that many candidates scored full marks in this question. A number of candidates did not recognise supplementary genes in (b), but were still able to correctly complete the other questions.

**Question 4**

(5 marks)

- (a) Co-dominant means both alleles will show in the phenotype. [1]
- (b) I<sup>A</sup> i - blood group A (1) ii - blood group O (1)  
correct genotypes OR phenotypes only. (1)  
*Must use I and i.* [2]
- (c) (i) 50% (1)

**Question 5**

(8 marks)

- (a) A metabolic pathway is a series of **enzyme controlled** chemical reactions that convert compound(s) from one to another. [1]
- (b) (i) Excess: chorismate (1).  
(ii) Absent: prephenate, phenylpyruvate, phenylalanine. *All three* (1). [2]
- (c) Consequence: essential compounds not synthesised resulting in deficiency/if not supplemented by diet can cause deficiency/other compounds build up causing toxicity/phenylalanine needed to make proteins.  
*Any one.* [1]
- (d) DNA/genes code for proteins/proteins carry out many functions, eg structural, regulatory, immunological, catalytic, hormonal, enzymatic/enzymes control metabolic pathways which breakdown or synthesise chemicals needed for cellular functions/proteins are used to control what cell produces by switching on and off genes.  
*Any three* (3) plus use of metabolic pathway as an example (1). [4]

**Comment:**

Overall, this question proved difficult for candidates to score high marks. A more comprehensive study of this topic would be valuable.

- (a) Few candidates were able to give this definition.
- (b) Most candidates gained full marks, as it was a straightforward interpretation of the diagram.
- (c) Very few candidates were able to correctly describe a consequence, suggesting that the importance of metabolic pathways was not sufficiently emphasised.
- (d) This question required candidates to integrate different areas of molecular biology into one answer. Most were able to explain the link between DNA and proteins, but very few were able to explain how proteins control the

functioning of a cell. A few candidates just wrote about metabolic pathways.

**Question 6** (9 marks)

- (a) There was a geographic barrier/New Zealand was one island. [1]
- (b) Allopatric speciation. [1]
- (c) Gene flow is the movement of genes between populations. [1]
- (d) Different selection pressures acting on each sub species (1) and a continued barrier to gene flow/reproductive isolation (1). [2]
- (e) Ancestral population spread around New Zealand/geographic barrier forms or populations become geographically isolated/two gene pools (allele frequency) become different because of different selection pressures or founder effect or genetic drift/increased differences between two populations. [4]

**Comment:**

Speciation is a concept crucial to the understanding of the theory of evolution.

- (a) and (b) Well answered, apart from those candidates who thought that Cook Strait froze during the ice ages.
- (c) Many candidates who appeared to understand the concept failed to gain the mark because of the use of imprecise language.
- (d) Few candidates gained both marks. Most could identify the need for reproductive isolation, but not the need for different selection pressures.
- (e) A question that sought to explore candidates' understanding of the process of speciation. Only the best candidates gave rigorous answers. The others offered story-like scenarios which contained little detailed biology. Most candidates appeared to understand the basic process but had difficulty explaining why the two populations became genetically different.

**Question 7** (5 marks)

- (a) Convergent evolution. [1]
- (b) Occupy similar ecological niches/exposed to similar selection pressures. [1]
- (c) Adaptive radiation/divergent evolution. [1]
- (d) Different ecological niches caused by: different

location of feeding sites/type of food eaten/size (large birds can travel longer distances)/barrier to gene flow caused by: time of breeding/breeding in different locations on land/only one species breeding at same location. *Any two.* [2]

**Comment:**

- (a) Answered satisfactorily.
- (b) Candidates had difficulty using the correct terminology with many answering that the two warblers had similar habitats.
- (c) Answered correctly by better candidates.
- (d) Candidates need to be encouraged to be specific. 'Food' does not explain why different ecological niches have arisen.

**Question 8** (6 marks)

- (a) Mutation/independent assortment/crossing over/recombination. *Any one.* [1]
- (b) Lack of food/quality of food/disease. *Any two.* [2]
- (c) New curve with similar shape drawn to the right of the current curve. [1]
- (d) More alleles/genes for tallness. [1]
- (e) Gene flow/migration. [1]

**Comment:**

- (a) Not well answered, with many candidates stating that height was a result of adaptation.
- (b) A straightforward question looking at the effect of environment on genes. However it was poorly answered. A surprising number of answers displayed Lamarckian tendencies, eg "living in cold climates, small cars, crowded conditions".
- (c) Well answered.
- (d) Generally well answered, with the most common error being that there would be more dominant alleles in the gene pool.
- (e) Candidates generally had no idea of the answer.

**Question 9** (12 marks)

- (a) Large brow ridges/large jaw/sloping forehead/low cranial vault. *Any one.* [1]
- (b) Large cranium/'snout' less protrubant/reduced canines/foramen magnum centralised. *Any one.* [1]
- (c) Increased size of cranium/brain (1) processing language/sensory information/social interactions (1). [2]

- (d) (i) Foramen magnum moves from back to centre of skull (1) skull balanced on spine/less energy expenditure by muscles keeping skull upright (1).
- (ii) Rib cage flattened from front to back (1) moves centre of gravity close to spine, improves balance(1).
- (iii) Change from 'C' shape to 'S' shape (1) weight of chest sits above pelvis rather than further forward/improves balance/absorbs shock of walking (1).
- (iv) Bowl shape (1) supports weight of upper body/balance/enlarges valgus angle (1) or increased surface area (1) muscle attachment (1). [8]

**Comment:**

This question involved straight recall but candidates did not score high marks because of a failure to use biological terms and provide precise and clear answers.

- (a) Well answered.
- (b) Candidates had difficulty using correct terminology, eg smaller teeth instead of smaller canines.
- (c) Some candidates did not know precisely where the cranium is as their answers referred to changes in jaw size. Many candidates were able to identify the change but were vague about the reason for it. Others were of the impression that the increase in brain size caused an increase in intelligence.
- (d) Most candidates knew the skeletal changes but again had difficulty explaining the advantages of the changes.

**Question 10**

(18 marks)

- (a) First column top to bottom: B E A G  
Second column top to bottom: F H C D  
1 mark per two correct. [4]
- (b) 

<u>Development</u>	<u>Advantage</u>
(i) Upright walking (1)	Carry things/see greater distances (1).
(ii) Tools (1)	More efficient hunting/food preparation/wider diet (1)
(iii) Fire (1)	Defence/hunting/cooking/social/extended light hours. Any one (1).
(iv) Art/spirituality/(1)	Group bonding/communication/language/reduced disease/bury dead / abstract thinking. Any one (1).

 [8]

- (c) Less time spent finding food/time available for other tasks, eg art, pottery, spinning/trade of surplus food/animals used as "machines"/social complexity/decrease in nomadic lifestyle/job specialisation. Any four. [4]
- (d) (i) Multiregional – *H erectus* migrated out of Africa, spread throughout Europe and Asia. *H. sapiens* evolved simultaneously in all regions from the *H. erectus* populations. (1)  
(ii) Out of Africa – *H. sapiens* evolved in Africa and migrated out after *H. erectus*. (1) [2]

**Comment:**

Another straightforward question. However many candidates lost marks for not providing precise answers. Candidates who had learnt their material did well, especially in (a) and (b).

Note: quadrupedal movement is generally faster than bipedal so speed is not an advantage of bipedalism. In part (c) candidates had difficulty gaining marks, suggesting this is an area that needs more emphasis in teaching programmes. There was some apparent confusion that domestication took place soon after the development of tools.

- (d) These two hypotheses are very much current issues in evolution. While candidates are not expected to know detailed information about each they should be able to describe the differences. Teachers need to watch over simplification, eg "The replacement hypothesis means all modern humans are descended from one ancestral Eve".

**SECTION 3: CONTEMPORARY TECHNIQUES**  
(20 marks)

It was pleasing to see an improvement in marks in this section compared with previous years. Teachers and students appear to be more confident and consequently candidate understanding was clearly evident. There were still some answers which indicated that candidates had little idea as to what they were supposed to be answering. There are now many more published resources available and it is hoped that teachers and students will be able to make use of them.

**Question 1**

(10 marks)

- (a) A restriction enzyme recognises a specific sequence of DNA bases. [1]
- (b) Y or X. [1]
- (c) Gel electrophoresis. [1]
- (d) The fragments have a negative charge. [1]

- (e) Shorter fragments will travel more quickly/further through gel. [1]
- (f) Analyse DNA to establish family relationships (1). Aim: to increase genetic diversity/study gene pool(1). [2]
- (g) Contains genetic material from another organism. [1]
- (h) Used to cut the desired gene from the original DNA (1), cuts the organisms DNA so the gene can be inserted (1). [2]

**Comment:**

A straightforward question. Candidates who had studied the topic did well. Others had little idea as to what was required. Candidates had difficulty with the second mark in (f) where they had to make the link between the technique and how it could be useful to a scientist.

**Question 2**

(10 marks)

- (a) (i) 1. DNA (strand) (1)  
(ii) Provides site for the polymerase enzyme to start from/start synthesis of new DNA strand/binds to recognition site/start of replication (1).  
(iii) A - DNA has been separated/denatured (1).  
B - double stranded DNA made from single strand (1). [4]
- (b) High temperatures used to separate DNA strands/cooler temperatures allow primers to anneal/warmer temperatures allow attachment of bases/enzyme used in PCR (Taq DNA polymerase) works best at high temperatures. (not DNA polymerase works best at high temperatures). *Any two.* [2]
- (c) PCR cycle faster than using bacteria/it takes longer to engineer the vector in gene cloning, compared with the PCR cycle/PCR product does not need to be purified, bacterial does/no guarantee bacteria will take up desired gene, PCR always copies original DNA/PCR needs only a small amount of DNA, bacteria need a reasonable number of engineered vectors to ensure sufficient uptake. *Any two. Must state comparison to get mark.* [2]
- (d) PCR is used to increase the amount of DNA found at the crime scene. [1]
- (e) Contamination with DNA. [1]

**Comment:**

- (a) Generally answered correctly
- (b) Many candidates knew the role of temperature but failed to qualify how the temperature changes at each stage of the process.
- (c) This question was poorly answered as many candidates failed to make explicit the comparison between PCR and gene cloning.
- (d) Answered well.
- (e) Most candidates knew to avoid contamination but failed to say with what.

**SECTION 4: CONTEMPORARY BIOLOGY ISSUES  
ESSAY TOPICS****ESSAY MARKING SCHEDULE  
TWO MARKS /30 + /10 = /40**

- (1) Following the given criteria (30 marks)

**There are four aspects to be evaluated for this mark:**

- the biological aspects relating to the issue
- the ethical, social, and financial implications (where appropriate)
- a reasoned opinion about the issue
- essay is directed towards the question.

30 – 28 EXCELLENT	All four aspects covered thoroughly and accurately/statistics quoted are plausible/appropriate biological terms are used. <b>4 brilliant</b>
26 – 24 VERY GOOD	All four aspects covered well and accurately/statistics quoted are plausible/appropriate biological terms are used. <b>4 good</b>
22 – 20 GOOD	All four aspects covered/two aspects may be weak. <b>2 good, 2 poor</b>
18 - 16 COMPETENT	Attempt to cover all four aspects or two covered well, two missing.
14 – 12 FAIR	Superficial coverage of two or three aspects.
10 – 8 POOR	Significant omissions/errors/one aspect covered.
6 – 4 INADEQUATE	An attempt to write an essay/some relevant material presented.
0 OUTRAGEOUS	No essay or no relevant information presented



**(2) Communicating knowledge and ideas clearly, concisely and logically. (10 marks)**

10 EXCELLENT	A comprehensive answer that is written with flair.
8 VERY GOOD	Well structured, logical answer, no internal contradictions or repetitions, accurate grammar and spelling, wide command of language.
6 GOOD	One or two weaknesses in the features above (including structure/logic).
4 MEDIOCRE	Serious weaknesses in two or more features above (including structure/logic).
2 POOR	Poorly structured essay, difficult to follow, poor command of English.
0 INSUFFICIENT	Information presented does not enable an assessment to be made for this category.

**Comment:**

It was pleasing to see that the majority of candidates attempted an essay and that most were able to complete it.

Biological Control was by far the most popular topic with Genetically Modified Organisms second. The quality of essays presented in these two topics was fairly similar. Only a small proportion of candidates presented essays on Biodiversity.

The best essays were extremely thoroughly researched. Effective use was made of quotations and statistics to illustrate points and to support opinions. These candidates had used the planning space provided and as a result their essays were concise, had a logical structure and flowed. A table summarising the main points for this year's essay questions is attached at the end of this report.

The most disappointing feature of many essays was the trend highlighted in previous years – a lack of detailed biological knowledge. Although candidates are expected to research the issues surrounding their topic, it must be remembered that ultimately this is a biology essay. High marks can only be given to essays that cover the biological background to the topic and all opinions are supported with sound scientific reasons.

It is disturbing to see that there are still a number of centres from which the essays are virtually identical. The nature of this year's questions and the marking schedule

made it hard for these candidates to score more than half marks for pre-prepared essays. Teachers need to provide their students with the opportunity to practise answering different types of essay question.

**Biological Control**

The most popular topics were possums and rabbits. The essays were generally well researched with the main weakness being a tendency to focus on only the current biological control method.

Some guidance needs to be given to candidates on the selection of appropriate topics. The organism needs to be one that is recognised as an established pest or weed in New Zealand; White Spotted Tussock Moth does not meet this criterion. It also needs to be an organism where biological control is currently in use or significant scientific research is being carried out into biological control. Varroa bee mite has not yet reached this position in New Zealand.

**Genetically Modified Organisms**

Candidates who chose this topic had generally spent effective time researching the issues and many held strong personal opinions. Unfortunately the biology expressed in the essays was often sketchy and lacking in scientific detail. Teachers and candidates are encouraged to make sure that the information being presented is correct. Based on essays in this year's examination answers, toad genes have been inserted into 12 different organisms and vitamin A inserted into 5 different vegetable crops.

The biggest problem was a failure to provide New Zealand examples. While there is currently no commercial production of GMOs in New Zealand, considerable research is being carried out and it is not difficult to locate the information.

**Biodiversity in Aquatic Environments**

This topic was generally poorly answered with only a very small number of essays gaining more than half marks. Better candidates had spent time researching the New Zealand Biodiversity Strategy, the Resource Management Act and marine park legislation. Other sources of information are local Regional Councils and the Ministry for the Environment.

Many candidates had not noticed the change in the topic this year to incorporate the concept of biological diversity. Few candidates were able to explain what biodiversity was and link it to the biodiversity of their named environment. Other weaknesses included not actually naming an aquatic environment that they had researched and not describing the current methods for conserving biological diversity in their aquatic environment. The complexity of this topic means teachers need to provide a framework of knowledge

around which candidates can research their specific environment.

**General Comments**

This year's examination was probably slightly longer than previous years. Some better candidates left parts of questions unattempted.

Many candidates lost marks through an inability to write concise answers using correct biological terms or not giving qualified answers or explanations where required. This comment has been made often in the past and again teachers are encouraged to help their students develop these skills.

**Summary of Main Points for Essay Questions**

	<b>Biological Control</b>	<b>Biodiversity</b>	<b>Genetically Modified Organisms</b>
Biological aspects of issue	<ul style="list-style-type: none"> <li>Biological reasons for organism becoming a problem.</li> <li>Current and past biological control methods with description of advantages and disadvantages.</li> </ul>	<ul style="list-style-type: none"> <li>Description of biodiversity found in the named aquatic environment.</li> <li>Current conservation methods used in that area. May also include some discussion of methods used in other areas.</li> </ul>	<ul style="list-style-type: none"> <li>Describes the biology involved in the development of GMOs (does not necessarily have to be a technique currently carried out in New Zealand).</li> <li>Describes some uses of plant or animal GMOs.</li> </ul>
Implications	<ul style="list-style-type: none"> <li>Discusses biological, ethical and social implications of chemical and/or biological control methods. This can be done in the context of the quote.</li> </ul>	<ul style="list-style-type: none"> <li>Discusses biological, ethical and social implications of protecting named aquatic environment.</li> </ul>	<ul style="list-style-type: none"> <li>Discusses biological, ethical and social implications of GMOs. This can be done in the context of the quote.</li> </ul>
Reasoned opinion	<ul style="list-style-type: none"> <li>Is biological control the best approach for controlling the named organism? Reasons need to be biologically based.</li> </ul>	<ul style="list-style-type: none"> <li>Are the methods currently being used suitable for ensuring biological diversity?</li> </ul>	<ul style="list-style-type: none"> <li>The best outcome for New Zealand. Reasons need to be biologically based.</li> </ul>
Answers the question	<ul style="list-style-type: none"> <li>New Zealand example.</li> <li>Reasons for search for alternatives to chemical controls (not necessarily just for the named organism).</li> </ul>	<ul style="list-style-type: none"> <li>Refers to a <b>named</b> New Zealand environment.</li> <li>Relevance of quote to current conversation methods.</li> <li>Should at least one fifth of aquatic areas be protected?</li> </ul>	<ul style="list-style-type: none"> <li>Some discussion of what is happening in New Zealand.</li> <li>Discusses likely ethical lines referred to in the quote.</li> <li>Discusses the issues that the Royal Commission needs to consider.</li> </ul>