2005 Senior External Examination

Biological Science

Chief Examiner Report for Candidates and Teachers

General comments

Two differences from previous years' sample responses that should be noted are the absence of marks/star values in Paper One and the inclusion of criteria descriptors for Paper Two. In Paper One, each question, or part thereof, was of the same value, allowing for levels of achievement to be awarded. The criteria descriptors used in Paper Two, which assessed the candidates' ability to demonstrate higher-order thinking processes though Complex Reasoning Processes-type questions, were used to allow for a variety of laterally responsive responses and individuality to be considered during the marking process.

Candidate performance

In 2005, candidates generally performed well across the two examination papers covering the seven topics in the current syllabus. A total of 47 candidates sat the examination with 77% achieving at a Sound level of achievement or higher, which is very encouraging. While the number of candidates who sat the examination is fewer than in previous years, many candidates showed a depth and quality in their responses that reflected the good teaching practices of teaching centres offering Biological Science. Candidates who carefully read the questions and considered the specific requirements in their responses were best able to demonstrate the depth of their knowledge and higher-order thinking processes.

Marking panel comments

Markers noted the following points:

- **Illegible responses** – considerable time spent trying to decipher poor handwriting that was small and cramped, or large and untidy, delayed the marking process and made it difficult for markers to follow some candidates' responses. Other responses could not even be interpreted enough for a grade to be awarded.
- **Poor spelling** – common words used in Biological Science were frequently misspelt (e.g. "environment", "genetic").
- **Lack of examples** – some questions required candidates to use examples to demonstrate their depth of understanding. By not using an example they may have shown their "rote" learning of the topic, but have not given the marker any latitude to award credit for the answer owing to a lack of demonstrated *understanding* and ability to *apply* it to a real situation.

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- **Little knowledge of experimental design** – in general, responses to questions concerning controls, variables and experimental design were not done particularly well, considering that this is a fundamental aspect of science and a compulsory part of the Biological Science syllabus. While candidates showed some initiative, most showed no real understanding of the need for, and application of, some of these basic principles of experimental design. Candidates should be exposed regularly to experimental investigations that step outside the traditional "recipe-style" practicals, and tutors should encourage the application of candidates' own knowledge in investigating biological fundamentals in laboratory work.
- **Extended answers** – many questions did not require the wordy responses provided by some candidates. Often the simple answer was lost in the extensive language produced. The markers also required a long time to read what could have been put into a single dot point response. Some candidates failed to take note that all parts of questions were worth the same – thus indicating the level of response required.
- **Use of diagrams** – many candidates did not use diagrams effectively or accurately. Using diagrams as an assessment tool allows the markers to accurately assess the multiliteracy ability of the candidates, as well as their depth of real understanding.

General comments on each section

Paper One Part A — Multiple choice

Multiple-choice questions offer candidates an opportunity to begin the examination in a relatively easy format, and this was reflected in the very low level of non-responses. Candidates needed to slow down and read the questions a little more carefully but still achieved a satisfactory result in both Knowledge and Scientific Processes questions – exceeding the minimum requirements for Sound Achievement.

Paper One Part B — Short answer

The short-answer questions were designed to allow candidates opportunities to demonstrate their depth of understanding and their ability to apply this knowledge as well as to exemplify their skills in the Scientific Processes criterion. Scientific Processes responses were handled particularly well with a large number of correct responses from candidates.

Again, a very low non-response rate reflected the candidates' overall desire to attempt all questions. One particular question was omitted by six candidates. This question involved the use of a diagram, a task with difficulties previously mentioned. Candidates should be familiar with demonstrating their knowledge and skills in a variety of forms.

Question 1a — Predation and parasitism within populations and communities

Candidates found it difficult to link both concepts in one answer.

Question 1b — Relationships between organisms in populations and communities

Many overlooked the requirement to use a diagram.

Question 2 — Need for a standardised classification system

This was generally well answered but some candidates did not supply two acceptable reasons.

Question 3 — Use of the insect key

This was very well done. Candidates had obviously been exposed to the use and purpose of keys.

Question 4 — Likening twinning to asexual reproduction

Many candidates did not have a clear understanding of asexual reproduction to use in comparison to the process of twin formation.

Question 5 — Need for regular watering of an air-conditioned office plant

Most candidates did not refer to the diagram as required, nor did they mention sugar concentrations as being crucial to the osmosis process.

Question 6 — Sex-linked recessive traits

Candidates demonstrated a fairly good level of understanding of genetic crosses of this type, although some needed more accurate knowledge of the usual protocols of cross-notation. Many failed to carry through the work done in Part A to obtain a correct answer in Part B, indicating a shallower depth of understanding.

Question 7 — Differing roles of mRNA and tRNA

Lack of diagrams as instructed affected many candidates' responses but this question also had a relatively high level of non-responses, indicating a lack of deeper knowledge of this rather intricate process as required by the syllabus.

Question 8 — Convergent evolution

Most candidates answered this question and received credit for their response, with a very general level of knowledge and not the higher level of understanding of the theory of evolution that the question aimed to elicit.

Question 9 — Experimental design of banded snail distribution

While most candidates answered Parts A and B well, responses to Part C concerning experimental design were incomplete and sketchy, reflecting a lack of immersion in correct scientific practices.

Paper Two — Complex Reasoning Processes

Complex Reasoning Processes questions are designed to allow candidates an opportunity to demonstrate their ability to engage in higher-order thought processes – that is, their ability to show creative responses to multi-step and challenging problems using logical thought processes based on their biological knowledge. Candidates revealed an overall lack of experience in tackling these type of problems. There are only three standards that are used to grade candidates' responses, with a Sound Achievement being the lowest (refer to the syllabus). Candidates should be exposed to more opportunities to extend their higher-order thinking skills with emphasis on focusing on what is being asked for, and on checking that this has been achieved.

Question 1 — Analogy between a factory and the workings of a body cell

Many candidates did not properly read this question and supplied evidence of a detailed knowledge of the greater body systems but, in doing so, failed to answer the question totally and thus could not receive any credit for what were often lengthy responses.

Question 2 — Effect of a compound on the production of heat from plant cells

Candidates either showed their ability to link several pieces of information together logically or did not. An ability to acknowledge the production of heat during respiration was pivotal to candidates' success in this question. Incomplete answers, where a candidate did not examine the whole experimental set-up, were common.

Question 3 — Cooloola monster classification

While most candidates were correct in their decision to place the monster in a new family, they lacked experience in providing complete answers to finalise their responses.

Question 4 — Cyanide production and predation rates

Most candidates provided extensive answers to this question, but missed the crucial link that a higher level of predation would result in **more** production of the cyanide to protect the plant from grazing – a lack of predation would end up with **no** cyanide production. This showed a simple lack of foresight when examining the question as a whole – again, due to a lack of experience. Many candidates may have rushed this question, which was the last in the paper.

Marking scheme

The marking scheme used by the panel of markers is attached. It is not intended as a set of model answers to the questions in the examination paper, but has been provided as a guide to assist teaching centres in the preparation of candidates for the Senior External Examination in Biological Science.

Revision of the syllabus

The draft revised external senior Biology syllabus has now been published. It is expected that the revised syllabus will be examined from 2007 onwards. A sample examination paper will be published by mid-2006.

Paper One

Part B

Short answers

Time: approximately 120 minutes

This part has nine questions.

Answer all questions in the spaces provided.

Question 1

(a) Explain the difference between predation and parasitism within a population and within a community.

predation - prey is captured and consumed, "host" dies

parasitism - host is encountered and rarely dies

(K)

(b) Use an example to explain the relationship between organisms within a population and a community.

Populations are groups of the same species interacting (eg possums) to breed, compete etc

Communities are groups of different species interacting (eg possums, lorikeets, orchids, insects) to compete, prey on etc

(K)

Question 2

State (two) reasons why a standardised classification system is necessary.

- communicate biological knowledge efficiently
- understand relationships of organisms to one another
- explore biodiversity

(K)

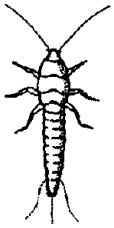
Question 3

Study the six illustrations of insects, labelled A–F, and the associated key. Use them to answer the questions that follow.

A

B

C



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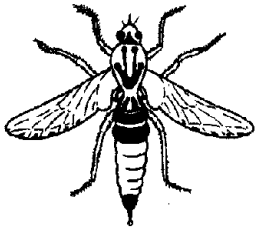

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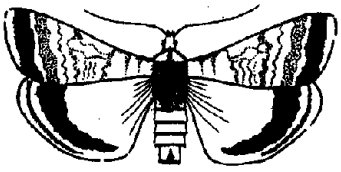

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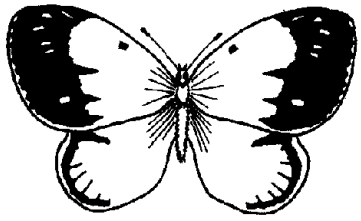


KEY

1.	a) wings absent	- go to number 2
	b) wings present	- go to number 3
2.	a) three tail filaments	- silverfish
	b) two tail filaments	- springtail
3.	a) one pair of wings	- go to number 4
	b) two pairs of wings	- go to number 5
4.	a) end of abdomen pointed	- robber fly
	b) end of abdomen not pointed	- go to number 6
5.	a) club-shaped antennae	- clouded yellow butterfly
	b) pointed antennae	- large yellow moth
6.	a) wings larger than body	- green lacewing
	b) wings shorter than body	- hoverfly

(a) Identify insects A, B and C (2 correct is OK)

A Springtail

B hoverfly

C silverfish

(SP)

(b) Identify insects D, E and F (2 correct is OK)

D robberfly

E large yellow moth

F clouded yellow butterfly

(SP)

(c) What visible characteristics would help you to classify any of these organisms initially as an insect?

2 OK.
- 3 part body (head, thorax, abdomen)
- 1 pair antennae
- 3 pairs legs

(K)

Question 4

The production of twins may be brought about by either the fertilisation of one egg that subsequently divides into two, or the separate fertilisation of two eggs at the same time. Explain how one of these types of twin formation can be likened to asexual reproduction.

- asexual reproduction is creation of identical cells

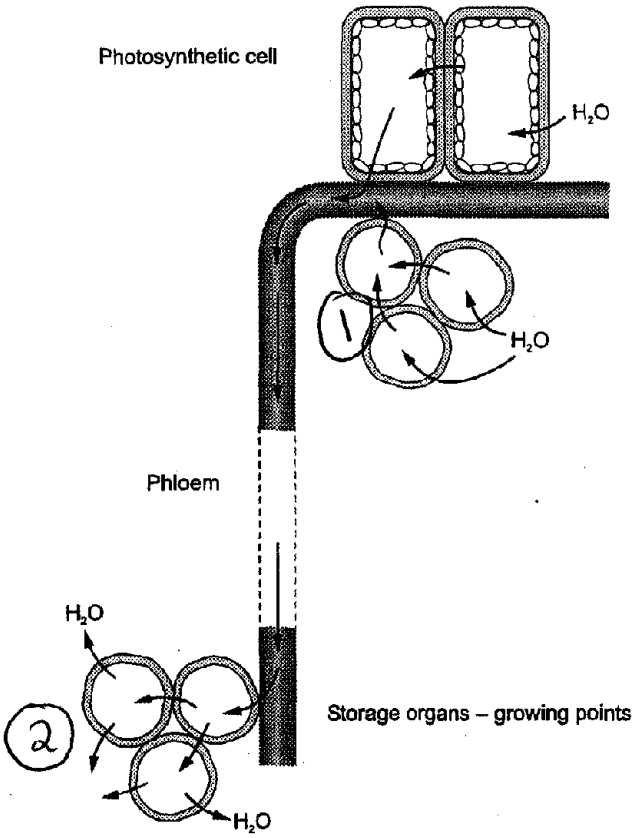
- twin production by a fertilised egg then splitting into two identical cells

- but non-identical twins are two different egg/sperm combinations producing genetically non-identical cells

(SP)

Question 5

Use the information provided in the diagram below to explain why an indoor plant would need regular watering in an air-conditioned office[1] to prevent it from wilting or becoming water stressed. (Note: the chemical symbol for water is H_2O)



(1) cells high in sugar have water diffusing into them (photosynthetic cells)

(2) cells lower in sugar have water diffusing out of them into the atmosphere

So when air conditioning removes this water from the air it is easier to diffuse water out (gradient) and plant then wilts if not watered regularly

(SP)

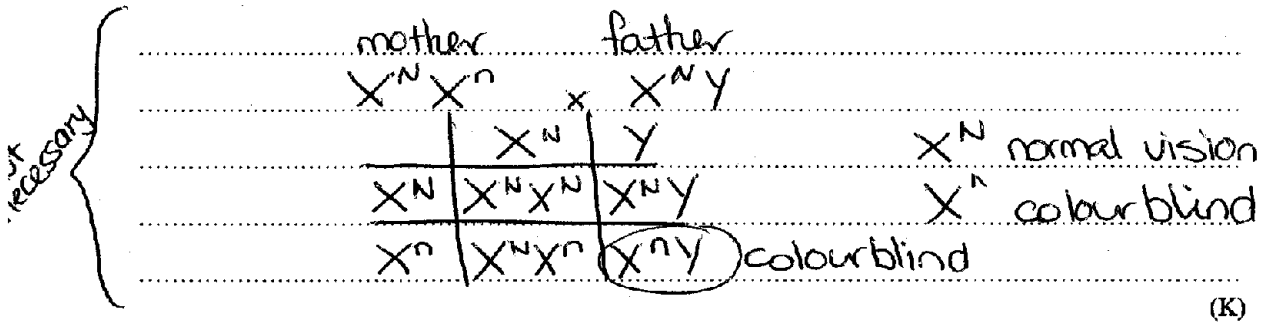
Question 6

Human males have two different sex chromosomes, an X and a Y. Females have two X chromosomes. There is so little information able to be carried on the Y chromosome that the genes carried on the X chromosome in a male are almost always expressed whether they be dominant or recessive.

Red-green colour blindness is inherited as a sex-linked recessive trait. A couple was surprised to learn that one of their sons was colour blind since neither of them showed this trait.

(a) Explain how this could have occurred.

- sex-linked recessive so the mother could carry it on her X chromosome as a carrier and not show the trait



(K)

(b) From which of the boy's grandparents could this allele have come, if none of them showed the trait?

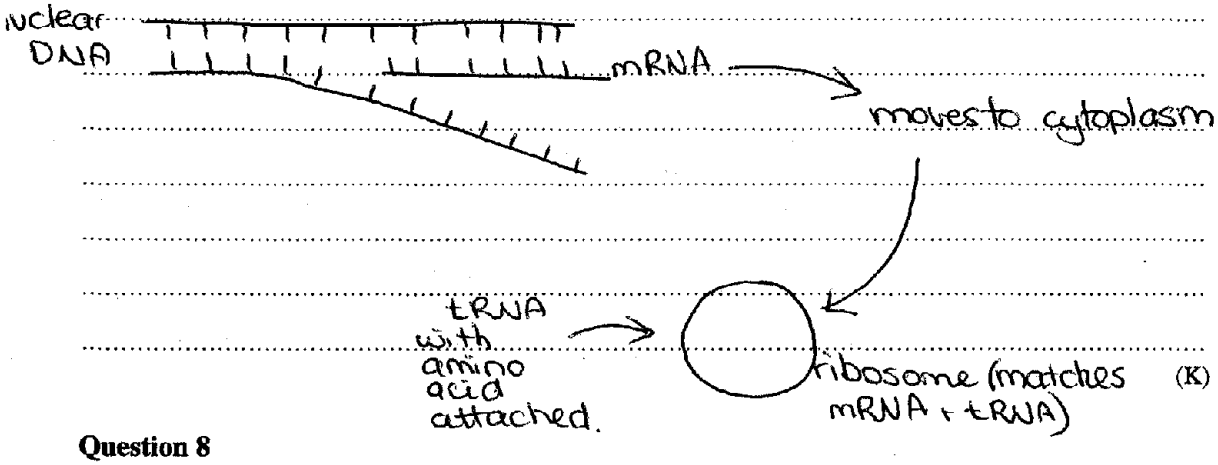
maternal grandmother

(K)

Question 7

Using a relevant diagram, discuss the differing roles of mRNA (messenger ribonucleic acid) and tRNA (transfer ribonucleic acid) in protein synthesis.

mRNA - copy DNA in nucleus and takes the information to ribosome
tRNA - brings amino acids to ribosome to make proteins



(K)

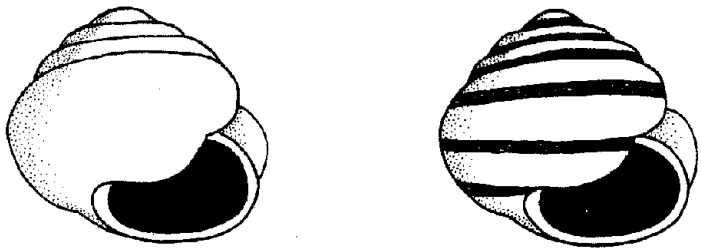
Question 8

Many organisms may look similar in structure but are unrelated in terms of classification. Dolphins and sharks are one example of this. They are both aquatic, streamlined and similar in external structures. Briefly compare the adaptations each has in order to survive in the same aquatic environment.

adaptations – streamlined to move through water
– fins for steering, movement

Question 9

Below are drawings of a banded and unbanded variety of the snail species *Cepaea nemoralis*.



Unbanded Banded

Snails were collected from two different sites at random and the numbers recorded as shown in the table below.

Site	Number of snails	
	Banded	Unbanded
Grassland	29	70
Under low shrubs	89	10

(a) How might samples have been collected randomly?

quadrats or transects.

(K)

(b) Suggest a hypothesis to account for the relative abundance of banded snails under low shrubs.

mottled/shade patterns make banded snails harder to see for predators

(SP)

(c) Design a simple experiment to test one of your hypotheses. Include title, aim, hypothesis, materials and methods used to carry out the experiment.

Many variations - must use correct format and deal with variables

eg place banded snails in grassland
or place unbanded snails under shrubs
or cut back shrubs

(SP)

Paper Two

Question No.	1

Nucleus - control cellular activities
- Managing Director

Cytoplasm - fluid content of cell, contains ions enzymes food organelles
- factory floor

Cell membrane - encloses cell, controls movement of substances
- Factory wall with delivery and exit points

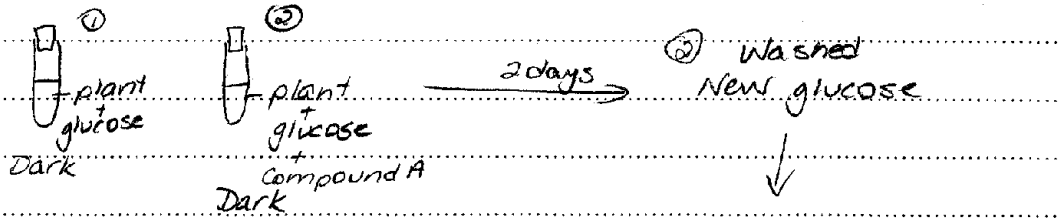
Mitochondria - cellular respiration
food + Oxygen ⇒ Energy
⇒ Machine shop

Vacuole - membrane bound liquid filled space - intracellular digestion + water balance
⇒ Spaces / cupboards

Endoplasmic Reticulum - layers of intracellular membranes
⇒ Walls in factory

Golgi apparatus - proteins + polysaccharides assembled + packaged for export

Question No.	2



Results

Rise in temp. No rise Rise

Hypothesis

Compound A inhibits the plant respiring (producing heat)
(The presence of)

Controls

Plant mixture
Same amount of mixture
Both in dark
Same length of time

Variables

Tube 2 - had Compound A
- later washed + treated as tube 1

Interpretations + Conclusions

Compound A prevents the production of heat, and indication that respiration has occured (glucose is needed for respiration). Once compound A is removed (after washing), the plants are able to produce heat again.

Question No.	3

	Cooloola Monster	Gryllotalpidae	Cylindrichetidae
Wings	♂ underdeveloped ♀ wingless	Yes	No
Antennae	short		
Legs	modified-digging	modified-digging	
Move	stomping		
Body	♀ large abdomen short stout legs		long cylindrical body
Live	Burrows -out at night		Underground

The Cooloola Monster has some features in common with both the Gryllotalpidae and the Cylindrichetidae, but not sufficient to put them in the same family. The ♂ of the Cooloola Monster have underdeveloped wings, species of Gryllotalpidae can fly and Cylindrichetidae have no wings. The only similarity with Gryllotalpidae is modified legs for digging and the only characteristic in common with Cylindrichetidae is living underground - not a structural characteristic.

Question No.	3

Compound A doesn't have a long term effect on the cells, the effect is only present when the compound is in the mixture

Compound A prevents respiration while it is present

Question No.	4

A produce substrate a } lacking
L release l }

A L - gives off cyanide when leaves crushed
+ produce spontaneously at low temp

(a) Low altitude High Predation
⇒ no cyanide as predation is high
∴ genotype aa ll - animals don't get navsea etc

(b) Edge of shrubs some predation
⇒ Aa ll
have cyanide but not release
⇒ some predation

(c) High mountain no predation
(low temperature)
⇒ AA LL
Produce + release cyanide when crushed, also release at low temperatures
∴ predators stay away from clover

Natural selection retains a mixture of genotypes each plant has characteristics that help it survive in its environment, so the alleles are not selected against

Question No.	4

⇒ Packaging of the useful products

⇒ Machine shop

2005 BIOLIGCAL SCIENCE EXTERNAL EXAMINATION SUGGESTED MARKING SCHEME
PAPER TWO - COMPLEX REASONING

QUESTION 1

	VHA - VERY HIGH ACHIEVEMENT	HA - HIGH ACHIEVMENT	SA - SOUND ACHIEVMENT	N
Solve Challenging Problems	Response demonstrates a ***high*** ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Response demonstrates ***competence*** in their ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Response demonstrates a ***some success*** in their ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Candidate response does not satisfy other standards for exit criteria.
	Response demonstrates a ***high*** ability to respond to challenging novel tasks.	Response demonstrates ***competence*** in their ability to respond to challenging novel tasks.	Response demonstrates ***some success*** in their ability to respond to challenging novel tasks.	Candidate response does not satisfy other standards for exit criteria.
Use Creative Thinking	Response demonstrates a ***high*** level of originality in design.	Response demonstrates a ***competence*** in their ability to show a level of originality in design.	Response demonstrates ***some success*** in their ability to show a level of originality in design.	Candidate response does not satisfy other standards for exit criteria.

OVERALL STANDARD ACHIEVED FOR QUESTION 1 RESPONSE - A B C N

2005 BIOLIGCAL SCIENCE EXTERNAL EXAMINATION SUGGESTED MARKING SCHEME
PAPER TWO - COMPLEX REASONING

QUESTION 2

	VHA - VERY HIGH ACHIEVEMENT	HA - HIGH ACHIEVEMENT	SA - SOUND ACHIEVEMENT	N
Solve Challenging Problems	Response demonstrates a ***high*** ability to combine several of the scientific processes into a coherent strategy for a given task.	Response demonstrates ***competence*** in their ability to combine several of the scientific processes into a coherent strategy for a given task.	Response demonstrates ***some*** ability to combine several of the scientific processes into a coherent strategy for a given task.	Candidate response does not satisfy other standards for exit criteria.
Making Logical Decisions	Response demonstrates a ***high*** ability to select relevant knowledge and/or data and a procedure to reach a conclusion or support an argument.	Response demonstrates ***competence*** in their ability to select relevant knowledge and/or data and a procedure to reach a conclusion or support an argument.	Response demonstrates ***some*** ability to select relevant knowledge and/or data and a procedure to reach a conclusion or support an argument.	Candidate response does not satisfy other standards for exit criteria.
	Response demonstrates a ***high*** ability to make inferences or predictions consistent within a set of assumptions.	Response demonstrates ***competence*** in their ability to make inferences or predictions consistent within a set of assumptions.	Response demonstrates ***some*** ability to make inferences or predictions consistent within a set of assumptions.	Candidate response does not satisfy other standards for exit criteria.

OVERALL STANDARD ACHIEVED FOR QUESTION 2 RESPONSE - A B C N

2005 BIOLIGCAL SCIENCE EXTERNAL EXAMINATION SUGGESTED MARKING SCHEME
PAPER TWO - COMPLEX REASONING

QUESTION 3

	VHA - VERY HIGH ACHIEVEMENT	HA - HIGH ACHIEVEMENT	SA - SOUND ACHIEVEMENT	N
Solve Challenging Problems	Response demonstrates a ***high*** ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Response demonstrates ***competence*** in their ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Response demonstrates ***some success*** in their ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Candidate response does not satisfy other standards for exit criteria.
Use Creative and/or Critical Thinking	Response demonstrates a ***high*** ability to identify assumptions on which claims are based.	Response demonstrates ***competence*** in their ability to identify assumptions on which claims are based.	Response demonstrates ***some*** ability to identify assumptions on which claims are based.	Candidate response does not satisfy other standards for exit criteria.
	Response demonstrates a ***high*** ability to evaluate the worth of ideas and the authority on which claims are based.	Response demonstrates ***competence*** in their ability to evaluate the worth of ideas and the authority on which claims are based.	Response demonstrates ***some*** ability to evaluate the worth of ideas and the authority on which claims are based.	Candidate response does not satisfy other standards for exit criteria.
	Response demonstrates a ***high*** ability to critically examine the adequacy of data.	Response demonstrates ***competence*** in their ability to critically examine the adequacy of data.	Response demonstrates ***some*** ability to critically examine the adequacy of data.	Candidate response does not satisfy other standards for exit criteria.

OVERALL STANDARD ACHIEVED FOR QUESTION 3 RESPONSE - A B C N

2005 BIOLIGCAL SCIENCE EXTERNAL EXAMINATION SUGGESTED MARKING SCHEME
PAPER TWO - COMPLEX REASONING

QUESTION 4

	VHA - VERY HIGH ACHIEVEMENT	HA - HIGH ACHIEVEMENT	SA - SOUND ACHIEVEMENT	N
Solve Challenging Problems	Response demonstrates a ***high*** ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Response demonstrates ***competence*** in their ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Response demonstrates a ***some success*** in their ability to assemble several pieces of learned information and procedures and integrate them to complete a task.	Candidate response does not satisfy other standards for exit criteria.
	Response demonstrates a ***high*** ability to combine several of the scientific processes into a coherent strategy for a given task.	Response demonstrates ***competence*** in their ability to combine several of the scientific processes into a coherent strategy for a given task.	Response demonstrates ***some*** ability to combine several of the scientific processes into a coherent strategy for a given task.	Candidate response does not satisfy other standards for exit criteria.
Making Logical Decisions	Response demonstrates a ***high*** ability to select relevant knowledge and/or data and a procedure to reach a conclusion or support an argument.	Response demonstrates ***competence*** in their ability to select relevant knowledge and/or data and a procedure to reach a conclusion or support an argument.	Response demonstrates ***some*** ability to select relevant knowledge and/or data and a procedure to reach a conclusion or support an argument.	Candidate response does not satisfy other standards for exit criteria.
	Response demonstrates a ***high*** ability to justify an outcome based on given or generated information.	Response demonstrates ***competence*** in their ability to justify an outcome based on given or generated information.	Response demonstrates a ***high*** ability to justify an outcome based on given or generated information.	Candidate response does not satisfy other standards for exit criteria.
Use Creative and/or Critical Thinking	Response demonstrates a ***high*** ability to evaluate the worth of ideas and the authority on which claims are based.	Response demonstrates ***competence*** in their ability to evaluate the worth of ideas and the authority on which claims are based.	Response demonstrates ***some*** ability to evaluate the worth of ideas and the authority on which claims are based.	Candidate response does not satisfy other standards for exit criteria.

OVERALL STANDARD ACHIEVED FOR QUESTION 4 RESPONSE - A B C N