2006 Assessment Report

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2006 Biology GA 3: Written examination 1

GENERAL COMMENTS

This examination was the first for the reaccredited *Biology VCE Study Design*. The emphasis throughout the Study Design is on developing knowledge and understanding of the principles and concepts of biology and their application to a range of contexts. Overall the students performed well on questions related to photosynthesis, immune response, enzymes and plasma membranes. Protein synthesis was well understood, as shown by student responses to Section B Question 1, but drawing labelled diagrams of the monomers of RNA (Section B, Question 8) was not done well. Students performed less well on questions related to homeostasis and signalling molecules (from Area of Study 2) and applications of molecular biology in medicine (from Area of Study 1).

Teachers and students are reminded that the set of key skills (refer to page 12 of the Study Design) are examinable. Question 3c. from Section B demonstrates how skills developed through completing activities such as experiments can be applied. Students also need to revise science concepts such as pH (Question 5b. of Section B: low pH acidic, high pH basic) and interpreting data (Section B, Question 6).

Teachers and students are also encouraged to visit the VCAA website for VCE Biology www.vcaa.vic.edu.au/vce/studies/biology/biologyindex.html to access resources provided to support VCE Biology. These resources are updated regularly and include opportunities for teacher professional development, student workshops, articles and relevant links.

SPECIFIC INFORMATION

Section A – Multiple-choice questions

The table below indicates the percentage of students who chose each alternative. The correct answer is indicated by shading.

Question	% A	% B	% C	% D	Comments
1	7	17	22	54	This question tested students' understanding of carbohydrate structure. Polysaccharides are carbohydrate polymers made up of carbohydrate monomers. Glucose (alternative C), the product of photosynthesis, is the most significant of these monomers.
2	19	16	57	7	Students had to distinguish between energy requiring reactions and energy producing reactions. Glycolysis (alternative A) is the initial stage of glucose breakdown during cellular respiration. During this catabolic (exergonic) reaction, two three-carbon molecules are produced as well as two molecules of ATP.
3	83	6	3	9	
4	11	19	54	16	Cellulose (alternative B) is a component of all plant cells, but no animal cells.
5	25	17	5	53	Proteins are made of amino acids, which all contain the element nitrogen.
6	11	12	19	58	This question required an understanding of the processes of photosynthesis. This included the order of the two significant parts, the light dependent reactions and light independent reactions (the Calvin cycle), and the role of each.
7	1	50	44	5	Alternative B is the only antibody with identical combining sites that are complementary to one of the shapes of the antigens on the bacterial surface shown. The specificity of antibody-antigen reactions is consistent with identical combining sites.
8	66	3	9	22	Naturally acquired antibodies, for example those acquired by a fetus (alternative D), have no greater life than those acquired artificially through injection, therefore alternative B was correct. Students should have an understanding of the similarities and differences between the two types of acquired antibodies.
9	4	9	75	12	
10	19	24	4	53	Signal transduction is new to the curriculum and the application of its principles to neurons was difficult for many.
11	9	26	44	21	Only a small section of each of the four chains was given, therefore

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					alternative B was incorrect, and each amino acid is specified by a group of three nucleotides and not a single nucleotide, therefore alternative D was incorrect.
12	5	1	11	83	
13	7	32	53	7	The letter U in a nucleic acid sequence indicates that the nucleic acid involved must be RNA. Also, in a pairing situation, nucleotide U pairs with A, therefore alternative B is incorrect.
14	3	92	1	4	
15	17	12	6	65	
16	12	74	7	7	
17	8	37	40	15	Microfilaments are part of the skeleton framework within the cytosol of a cell. Although they may assist in the movement of material they are not hollow and do not package or transport, therefore alternative A is incorrect. Golgi apparatus packages for export from a cell, therefore alternative B is incorrect. Transport of material within a cell occurs through the endoplasmic reticulum (alternative C).
18	12	42	16	30	Students needed to know the relationship between the differential structure of an organelle and the role of each part in order to answer this question.
19	84	5	8	4	
20	3	89	1	7	
21	9	4	3	84	
22	43	17	23	17	The creation of thousands of different kinds of B cells is made possible during cell development in the bone marrow when a particular part of the genetic material undergoes a multitude of changes.
23	11	6	66	16	
24	10	76	10	3	
25	5	5	21	69	Although alternative D was the correct answer to this question, all students were awarded a mark to ensure that no one was penalised by the ambiguity in the introductory material of the question.

Section B – Short-answer questions

The following areas caused some concern for assessors when marking the papers.

- Many students wrote their responses to the short-answer section in pencil, rather than in pen as instructed. Students should be aware that pencil can be very difficult to read and may result in writing that can be very difficult to interpret.
- Many answers contained words that were spelt incorrectly. Whilst students' spelling and grammar are not assessed, students need to be aware that errors in spelling that caused a lack of clarity in meaning could result in failure to gain credit for the answer. For example, words such as glycogen, glucagon and glucose may be indistinguishable if spelt incorrectly.

Students should be reminded that writing with a pen, and using legible handwriting and correct spelling are all important.

Question 1

Question 1a.

Marks	**0**	**1**	**Average**
%	60	40	**0.4**

The emphasis is on the study of all proteins because of the interaction between proteins, and the reliance that some have on others.

Although this question was well answered by many students, others failed to identify either of the points above.

Questions 1b.

Marks	**0**	**1**	**Average**
%	70	30	**0.3**

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Structures may be important because:

- of the ability of the protein to stretch or contract (elongate or shorten) in particular situations
- pleating may strengthen the molecule and that may be important for its function
- particular structures may provide an active or binding site for an enzyme or other molecule.

Few students appeared to understand that secondary-structure proteins may have a particular function in that state, with many writing only about them being part of a tertiary-structure protein. Answers that gave general comments, such as 'the protein could be an enzyme', without explaining the relevance of structure received no credit.

Question 1c.

Marks	0	1	2	3	Average
%	36	22	22	19	**1.3**

Function of protein	Example
structural	collagen, keratin, silk, cytoskeleton, cilia, fibrin, fingernails
transport	haemoglobin, protein carrier, serum albumin
regulatory	hormone (or specific example), enzyme (or specific example), major histocompatibility complex (MHC)

This question was generally well answered. Incorrect answers generally referred to compounds such as carbohydrates and other non-protein compounds.

Question 2

This question could be considered in the context of homeostasis. Students who applied the principles of cell transduction to a specific example, such as the control of blood sugar, were able to give specific examples and relate part a. to part d. as instructed.

Question 2a.

Marks	0	1	Average
%	54	46	**0.5**

The most common answer was 'hormone' or the name of a specific hormone. Other acceptable answers included glucose, glucagon, insulin and neurotransmitter compound.

Because steroid hormones pass readily through cell membranes to receptors within the cytosol, answers involving these were not accepted.

Question 2b.

Marks	0	1	Average
%	54	46	**0.5**

Students were required to comment on the specificity of the relationship between molecule M and the receptor; for example, specificity of structures.

Question 2c.

Marks	0	1	Average
%	64	36	**0.4**

Answers could have been specific examples such as cyclicAMP (cAMP), or more general responses such as different proteins, different enzymes or secondary messenger molecules.

Question 2d.

Marks	0	1	Average
%	64	36	**0.4**

An answer to this question had to be consistent with the answer already given in part a. For example, if glucagon was given in part a., the expected answer to part d. would be 'conversion of glycogen into glucose'.

A general answer in part a. usually resulted in a broader answer to part d. General answers that were accepted included ideas such as increase/decrease in production of mRNA and increase/decrease in protein synthesis.

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If the answer to part a. was incorrect but the answer to part d. was consistent with the previous answer, students were awarded the mark for d.

In general, this question demonstrated that students lacked a good understanding of signal transduction. Many were unable to relate it specifically to homeostasis or another appropriate setting. Terms such as molecule and compound are not well understood.

Question 3
There were many good answers to Questions 3a. and 3b.

Question 3a.

Marks	0	1	Average
%	43	57	**0.6**

A drug that has been man made to prevent the action of a particular infective agent and hence prevents the development of the particular disease.

Vaccines and antibodies are not designed drugs and were inappropriate answers.

Question 3b.

Marks	0	1	2	3	Average
%	40	19	21	20	**1.2**

Some students failed to understand that a designed drug needs only to prevent initial entry of the virus **or** prevent exit from an initially infected cell to be effective, hence making the task longer than necessary. A common error was an attempt to coat every cell of the body with the drug rather than inhibit the entry of virus particles or prevent their spread once entered.

Although many students' diagrams were excellent, others failed to act as a supporting means of communication about the process being verbally described. Some diagrams were completely irrelevant.

Question 3c.

Marks	0	1	2	3	Average
%	38	32	23	6	**1.0**

Points for consideration in the experiment that students were asked to design included:

- the selection of the mice. These should have been two large groups of identical mice kept in the same environmental conditions
- the number of mice in each group. It was preferable for students to state a specific number (of reasonable magnitude) in each group, instead of simply describing a 'large' group. If no mention was made of the size of the group, then the idea of replication of the experiment needed to be mentioned
- the infection of both groups with the virus against which the drug has been designed. One of the groups then needed to receive no further treatment (the control group), the other group (the trial group) receives the drug under investigation
- after a few days, each of the groups needs to be examined and the number of mice that have developed the viral disease in each group counted. If the number of mice in the trial group is significantly less than the number in the control group, the drug has been effective.

Common errors in the experiments described included selecting only two mice without referring to repetition of the experiment; not mentioning the similarity of the mice and/or environment; injecting mice with the virus and then waiting days or weeks before the drug was used; administering the drug first and then exposing the mice to the virus days or weeks later; and general statements about comparing the results, without any reference to what result would indicate effectiveness of the drug.

Experimental design is integral to science and this question exposed many deficiencies in students' knowledge and understanding of the process. Students need more practical experience with appropriate examples.

Question 4
This question required students to have an understanding of the various types of respiration, in particular the different stages of aerobic respiration. Students demonstrated a poor understanding of these processes.

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Question 4a.

Marks	0	1	Average
%	61	39	**0.4**

Acceptable answers were anaerobic respiration, glycolysis or fermentation.

The most common incorrect answers given were photosynthesis and aerobic respiration.

Question 4b.

Marks	0	1	Average
%	55	45	**0.5**

Cristae, inner membranes or membrane folds needed to be specified; simply stating 'membranes' was not sufficient.

A common incorrect response was grana.

Question 4c.

Marks	0	1	Average
%	25	75	**0.8**

Any of the following answers were accepted:

- field crickets eat crops
- the compound may be effective as a pesticide/insecticide against crickets
- the chemical may be used to get rid of crickets.

Question 4d.

Marks	0	1	Average
%	67	33	**0.4**

The presence of 2,4-dinitrophenol caused trial 1 to produce heat (instead of ATP). There was no chemical in the control group, therefore ATP was produced, not heat.

The two situations had to be compared in order to gain the mark.

Question 4e.

Marks	0	1	Average
%	78	22	**0.2**

The enzyme denatured, or an increase in heat killed/damaged the cells.

Students who gave poor expressions such as 'enzymes dying' or 'chemical is used up' received no credit.

Question 4f.

Marks	0	1	2	Average
%	11	59	30	**1.2**

Students needed to indicate an initial rise in the temperature occurring faster than in trial 1 and a decline that commenced no later than time interval 5. Two examples of appropriate sequences for trial 2 (from the commencement) include 28, 29 30, 36, 23, 21, 19 and 28, 29, 36, 30, 28, 24, 19.

This part of the question was generally well answered.

Question 4g.

Marks	0	1	Average
%	84	16	**0.2**

Various answers to this question were possible, depending on when the pyruvate was to be added.

- If it was added at the beginning of the experiment, there would be no effect because pyruvate is used before the electron transport process.
- If the pyruvate was added after the experiment, there would be no effect because the toxin has already destroyed the enzymes or cricket cells (many students wrote crickets in error).

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- If the answer referred to Krebs Cycle, there may have some ATP as replacement by the addition of pyruvate.

Stating that some ATP would be produced independent of electron transport was also acceptable.

Question 5

This question involved the principles of homeostasis. It was expected that the example chosen would be unfamiliar to most, if not all, students. However, students were expected to have gained an understanding of the principles of homeostasis through the study of exemplar situations and to be able to apply them to the unfamiliar situation given.

Few students were able to answer the question with homeostatic principles in mind. In addition, many were hampered by a lack of basic biological knowledge.

Question 5a.

Marks	0	1	Average
%	90	10	**0.1**

Either of:

- because of high solubility in water, carbon dioxide is more readily removed by fish (or some other statement referring to the greater availability of water for fish than mammals)
- because carbon dioxide is more difficult to remove by breathing/air (or some other statement explaining that mammals have less water to remove carbon dioxide than fish).

Many answers repeated the statements within the question, and many students' language was inappropriate; for example, 'fish breathing'.

Question 5b.

Marks	0	1	2	Average
%	74	23	3	**0.3**

An increase in blood pH indicates that the blood is becoming more alkaline. Homeostatic mechanisms would operate to reduce the blood pH; that is, to increase the acidity of the blood. This would be achieved with an increase of carbon dioxide in the blood, hence appropriate answers were:

- heart as the effector would reduce the rate of beating to reduce carbon dioxide loss
- intercostal muscles, diaphragm, rib cage or lungs as the effector would reduce the rate of ventilation/breathing to reduce carbon dioxide loss.

Many students incorrectly assumed that an increase in pH meant an increase in acidity.

Question 5c.

Marks	0	1	Average
%	64	36	**0.4**

This question could have been answered in the context of the pearl divers hyperventilating either before or after they dive.

If writing about prior to dive, hyperventilation increases carbon dioxide loss, therefore reduced levels of carbon dioxide reduce the urge to breathe, therefore it allows divers to remain under water for longer, as it takes longer for carbon dioxide to build up in the blood.

If writing about after the dive, because of rapid deep breathing to restore oxygen levels or to reduce carbon dioxide levels.

Many incorrect statements were given that incorporated ideas such as the divers 'breathing under water'. Breathing must be done out of water. Students should think about appropriate experiences in their own day-to-day living in order to help them to better understand a particular/unfamiliar situation.

Question 5d.

Marks	0	1	Average
%	73	27	**0.3**

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A lower level of carbon dioxide reduces the urge to breathe, resulting in a person running out of oxygen before carbon dioxide builds up to a level to stimulate breathing.

Question 6
The majority of students showed little or no understanding of the nervous system and its involvement in control systems.

Question 6a.

Marks	0	1	2	3	4	Average
%	57	20	19	2	1	**0.7**

point R	**Signalling molecule**	neurotransmitter, or an appropriate specific transmitter such as noradrenaline or acetyl choline
	Type of cell producing the molecule	neuron, nerve cell or sensory neuron
point S	**Signalling molecule**	neurohormone, or an appropriate specific neurohormone such as prolactin releasing hormone or antidiuretic hormone (ADH)
	Type of cell producing the molecule	neurosecretory cell or neuron

Point **R** was much better understood than point **S**.

Question 6b.

Marks	0	1	2	Average
%	58	39	3	**0.5**

Two points were required to be made.

- It provides a greater level of control, or balanced control. Alternatively, students could make some reference to homeostasis.
- Multiple levels of stimulation/inhibition, or fine level of control, or some aspect of small change in level of stimulus.

Question 7
This question was generally well answered.

Question 7a.

Marks	0	1	2	Average
%	18	49	33	**1.2**

ai.
There were many possible answers to this question, including: waxy layers on outside surface; intact or thick cuticle; and chemicals that repel potential pathogens such as insects.

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Some examples of appropriate answers include: intact skin; chemicals (enzymes) in tears of eyes/mouth; mucus in nose, respiratory system and intestine; and pH and digestive enzymes in intestine.

Cell wall and cell membrane respectively for parts i. and ii. were not accepted.

Question 7b.

Marks	0	1	Average
%	53	47	**0.5**

A plant could respond by:

- growing ‘gall’ tissue around the area containing the infective agent to prevent spread to other areas
- producing chemicals such as tannins
- producing ‘gum’ to seal off the wounded area
- dropping the infected part (leaf) to inhibit spread to other parts.

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One of the above answers was required. Some students failed to take into account that the infection had occurred and therefore gave inappropriate answers.

Question 7c.

Marks	0	1	2	Average
%	31	43	26	**1.0**

Some examples of acceptable features include: presence of phagocytes; increase in blood flow to area of infection; chemicals released by damaged cells; clot or scab forms at infective area; and increased permeability of capillaries allows free movement of white blood cells.

Two features were requested, therefore students needed to clearly state and describe the two features they were writing about. The most common error was for students to write an extended and unspecific comment on inflammation in the space for the first feature, but leave the second space blank.

Question 7d.

Marks	0	1	Average
%	62	38	**0.4**

Immune system cells have receptors that are able to distinguish the different kinds of (MHC) on all cells and hence have the ability to detect and distinguish self from non-self.

Insufficient knowledge about this feature often led to incomplete answers.

Question 7e.

Marks	0	1	Average
%	26	74	**0.8**

Antibodies

Question 7f.

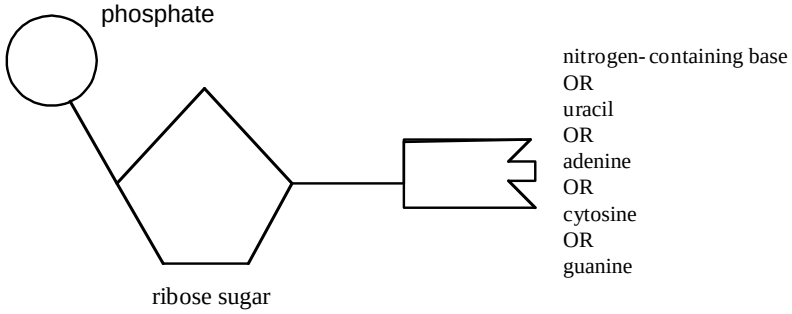
Marks	0	1	2	Average
%	44	43	13	**0.7**

Although many students understood that mast cells release histamines, they failed to receive the mark allocated for the idea that allergens react with specific IgE antibodies which are attached to mast cells and cause the rupture of the mast cells.

IgE antibodies are important players in allergy reactions.

Question 8a.

Marks	0	1	2	Average
%	67	14	19	**0.5**



This part of the question was very poorly answered. The difference between the polymer RNA and its constituent monomers was not clear to many students. Many who knew the names of the monomer parts were often confused as to how those parts were organised within the molecule.

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Words alone were insufficient; there had to be some attempt to present a labelled diagram, as required by the question. 'Ribose sugar' rather than just 'sugar' was expected; however, specific or general indications of a nitrogenous base were accepted. The shapes of each of the parts did not have to be as specific as shown here but did have to be presented in the correct order of connection. Reverse images, correctly labelled, were also accepted.

Question 8b.

Marks	0	1	Average
%	63	37	**0.4**

Either of the following responses was acceptable:

- T cells increase to reach optimum at year one and HIV increases for about six months and then declines (significantly)
- T cell concentration increases in response to HIV infection, then HIV level drops.

The question asked for comment on events 'in the first year'. Failure to consider the appropriate portion of the graph resulted in irrelevant answers. Students were expected to refer to at least two elements of the graph.

Question 8c.

Marks	0	1	Average
%	72	28	**0.3**

Answers needed to relate the swelling of the lymph nodes to their role within defence mechanisms against infective agents, in this case the HIV virus.

Question 8d.

Marks	0	1	Average
%	22	78	**0.8**

The majority of students correctly identified that the immune system had been effectively destroyed.

Question 8e.

Marks	0	1	Average
%	50	50	**0.5**

Viruses continually mutate in random ways, and increasing the number of drugs used increases the chance that one of the drugs may be able to inhibit the action caused by a random change.

Many students failed to provide a sufficient explanation, instead simply repeating information that was given in the question.

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