2018 VCE Biology examination report

General comments

The 2018 Biology examination was the second examination for the *VCE Biology Study Design 2017–2021*.

Unit 4, Area of Study 3 was important to the examination as students could draw on the knowledge and skills gained from designing and undertaking their own investigations. This was particularly useful for Question 11.

Students' examinations were again marked online. Students were required to write within the designated spaces on the pages of the examination, and this requirement was adhered to by most students. It is important that students follow the instructions provided on the examination, in particular using a blue or black pen for Section B to ensure a clear image is provided. If students are asked to annotate or draw a diagram, such as in Question 4a., this may be done in pencil so that the answer can be changed by the student if necessary.

In Section B, questions worth more than two marks generally required students to develop answers from the situations provided. This required a thoughtful approach, and students at times were required to provide extended answers.

In many instances, students were required to make comparative statements – such as in Questions 5aii., 8c. and 9b. – and some students found this difficult. Some students struggled to use and interpret data, such as in Questions 5aii., 9ci. and 9cii.

Many students presented responses of an outstanding standard. Students who set out their answers logically were more likely to gain marks than those who produced answers that appeared to be rushed and lacking in thought. It is important that students read questions carefully, plan their answers prior to writing, and use the marks allocated and the answer space given as a guide to the required depth of the answer. Many students answered a question correctly but then contradicted that answer. When a question asks students to provide an explanation, it is important that they provide extra information to demonstrate their knowledge and they should not just repeat information from the stem of the question in their answers.

Students need to make full use of the reading time; this is a particularly important time for them to understand the information provided and to formulate answers. It was clear that those students who organised their time well were able to convey their knowledge. Many students presented carefully written and well-expressed answers.

While spelling is not directly assessed, if a word has different possible meanings or the word is not identifiable, then the student will not gain the mark.

Students should feel confident to use suitable abbreviations such as DNA, ATP and NADH, and chemical symbols such as H_2O. If students wish to use another abbreviation and are not sure of its appropriateness, then they should write it out in full.

Students are reminded that the set of key science skills (refer to pages 10 and 11 of the study design) are examinable, and school-assessed coursework provides students with firsthand experience that can be applied to examination questions.

Specific information

This report provides sample answers or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding resulting in a total more or less than 100 per cent.

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	11	76	10	3	
2	7	7	83	3	
3	7	3	3	87	
4	13	71	6	10	
5	5	19	69	6	
6	8	9	78	5	
7	6	5	7	82	
8	27	8	63	2	
9	60	11	20	9	
10	74	18	4	4	
11	4	19	63	14	
12	4	7	29	59	
13	9	65	12	14	
14	9	79	5	7	
15	12	53	27	8	The arrows in the middle of each diagram indicated the direction of the reaction, relative to the left or right reaction. Option C has one of the reactions reversed and hence was incorrect.
16	16	73	9	2	
17	76	8	10	5	
18	10	4	12	73	
19	16	20	52	12	
20	2	3	89	6	
21	72	5	20	3	
22	6	12	54	27	
23	3	32	3	62	
24	2	75	18	5	
25	82	12	3	3	
26	89	5	3	3	
27	58	10	9	23	
28	6	6	1	88	
29	64	10	2	23	
30	1	1	97	1	
31	21	75	2	2	
32	5	3	13	79	
33	3	89	7	1	
34	3	8	4	85	

Question	% A	% B	% C	% D	Comments
35	42	34	19	4	The resistance of bacteria to antibiotics is due to natural selection, where the less sensitive bacteria survive and reproduce.
36	7	4	6	83	
37	22	64	4	10	
38	8	18	66	8	
39	8	77	13	2	
40	20	5	72	4	

Students are reminded to read each alternative before deciding on their answer. By doing this, they may realise that they have not chosen the correct answer or that they may have misunderstood the question in their first reading.

Section B

Areas of concern in Section B included the following.

- Many students did not make comparative statements when required, such as in Questions 5aii., 8c. and 9b.
- Many answers contained words that were spelt incorrectly. While students' spelling and grammar are not directly assessed, errors in spelling can cause a lack of clarity in meaning and failure to gain marks for the answer. As a general guide, if a word is misspelt but the word is obvious, then it will be accepted.

Question 1a.

Marks	0	1	2	3	Average
%	48	17	19	16	1.1

The ribosome binds to or reads the mRNA and tRNA brings in specific amino acids or the tRNA anticodon is complementary to the mRNA codon. The amino acids are joined by condensation polymerisation.

Students were required to state what occurred at the ribosome, not just restate translation. The description of corresponding instead of complementary tRNA anticodons and mRNA codons was too imprecise to gain the mark. Students were then required to make a valid point about the production of the protein tryptase.

Question 1b.

Marks	0	1	2	3	Average
%	26	23	29	21	**1.5**

Organelle	Role
rough endoplasmic reticulum	transports tryptase within cell, including to the Golgi body
Golgi body	packages tryptase into vesicles for export from the cell
vesicles	carries tryptase to plasma membrane where it fuses and releases the tryptase from the cell
plasma membrane	vesicles fuse with it and are released by exocytosis
mitochondria	provides the energy required, e.g. for packaging

Some students wrote RER or ER but these were not suitable abbreviations and were only accepted if the student defined their abbreviation.

Question 2a.

Marks	0	1	2	Average
%	38	31	31	**1**

Two of:

- mitochondria are damaged and release cytochrome c
- caspases would be activated and/or released
- destruction of organelles or a named organelle or the plasma membrane.

Question 2b.

Marks	0	1	2	Average
%	33	47	20	**0.9**

Programmed cell death can be used to remove damaged or non-functioning cells and also remove cells that are no longer required, for example, plasma cells in the immune system or the cells that comprise the webbing between the fingers.

Removal of virally infected cells was also accepted but removal of infected cells or pathogens was not accepted.

Question 2c.

Marks	0	1	2	Average
%	75	22	3	**0.3**

- increase in production of trigger signals, TNF2 or death receptor proteins or decrease in inhibitors such as BCl-2
- increased production of caspases
- a change in gene functioning, leading to excessive cell death

The question required students to explain what brought about **excessive** cell death; however, many students explained why cell death occurred.

Question 3a.

Marks	0	1	2	Average
%	62	34	4	0.5

Suitable examples of chemical barriers in plants include:

- the secretion of a toxin or an odour that is harmful or unfavourable to pathogens
- the production of enzymes that affect pathogen functioning.

Students also used specific terms such as chitinases, oxalic acid, phenols, saponins and glucanases, which were suitable.

Question 3b.

Marks	0	1	2	Average
%	19	34	47	1.3

Examples of ways the body prevents pathogens from entering include:

- intact skin
- nose lined with thick, sticky mucous
- fine nasal hairs to trap pathogens
- lysozymes in tears and saliva.

Question 3c.

Marks	0	1	2	Average
%	58	3	39	0.8

Complement proteins can damage the plasma membranes of bacteria and attract other cells such as macrophages to an area.

Natural killer cells kill cells infected by a virus or release cytokines/cytotoxic granules/chemicals.

Question 4a.

Marks	0	1	2	Average
%	41	28	31	0.9

Diagrams should have shown that the material to be taken up by the cell is surrounded by an area of the plasma membrane and a vesicle forms around the ingested material inside the cell. The toxin and membrane should have been labelled.

If a student illustrated a vesicle outside the cell and all other information was correct, they could score one mark only.

Some students illustrated exocytosis, but this was not what the question required.

Question 4b.

Marks	0	1	Average
%	32	68	0.7

The effect would be:

- to break the quaternary structure of the protein so that polypeptides no longer hold together
- denature the protein.

Question 4c.

Marks	0	1	2	3	Average
%	51	23	18	8	**0.9**

The patient's immune system would recognise Botox antigens as non-self antigens and initiate an immune response, producing antibodies to the Botox antigen. Memory B cells would be produced and bring about a larger/quicker response to subsequent injections.

Question 5ai.

Marks	0	1	Average
%	3	97	**1**

1958

Question 5aii.

Marks	0	1	2	Average
%	8	48	44	**1.4**

Observed trends are, for example, when the number of cases increase there is an increase in the number of deaths, and the number of cases and deaths both decline.

Some students did not make comparative statements about the two graphs.

Question 5b.

Marks	0	1	2	Average
%	16	45	39	**1.3**

Herd immunity is where most of the community is immune and this helps to protect, for example, babies or those few individuals who cannot be vaccinated, or due to the reduced number of infected individuals there are fewer hosts to pass the disease to others.

Question 6a.

Marks	0	1	2	Average
%	39	40	21	**0.8**

A structural gene codes for a protein that becomes part of the structure or function of an organism and a regulatory gene controls another gene.

Question 6b.

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

The genes are regulated by (one of the following):

- Genes are involved so there may be different regulatory sequences of on/off times at each location.
- Genes are expressed for different lengths of time in the embryo. The shorter limb could be a result of the gene switching off earlier or switching on later.
- Post-transcriptional modification/different introns cut out leads to different regulating proteins in each location.

Question 6c.

Marks	0	1	2	3	Average
%	23	34	34	9	**1.3**

- Galápagos finches: The BMP4 gene is a gene for a signalling protein that is responsible for beak formation in Galápagos finches. The longer the gene is expressed in the embryo, the more BMP4 and the larger the beak that develops. This allowed diversity in beak shape and length in populations of finches and different phenotypes for natural selection.
- African cichlid fish: The BMP4 gene is responsible for jaw formation in African cichlid fish. When BMP4 is overexpressed in the embryo, it can change the jaw shape. This allowed diversity in jaw shape and length in populations of cichlids and different phenotypes for natural selection.

Many students produced confused responses.

Question 7a.

Marks	0	1	2	3	Average
%	50	37	12	1	**0.7**

Natural variation exists in a population through mutations that may have created new alleles or by different allele combinations in sexual reproduction.

Changes in chromosome number may change phenotype.

Question 7b.

Marks	0	1	2	Average
%	20	43	37	**1.2**

The lower genetic diversity was due to the founder effect. The two individuals will not have all the variations of alleles as seen in the original population, the descendants of these two individuals will not be able to inherit other alleles and there will be less variation in phenotypes of the lizards.

Question 7c.

Marks	0	1	2	Average
%	42	35	23	**0.8**

The decrease may have occurred due to different selection pressures on the smaller islands. Over this time period, those lizards with shorter hind legs are at an advantage, and are more likely to survive, reproduce and pass the trait to their offspring.

Some students incorrectly stated that the change was due to a lack of use of the hind legs or the lizards' need driving the change.

Question 8a.

Marks	0	1	2	Average
%	26	32	42	**1.2**

Methotrexate has a similar structure to folic acid and may attach to the active site of the enzyme, thus reducing the binding of the inactive form to the enzyme.

Some students incorrectly referred to the active site of folic acid.

Question 8b.

Marks	0	1	2	3	Average
%	23	14	23	41	**1.8**

Cell growth is affected as there is less binding of the inactive form and therefore less of the active form of folic acid produced. DNA production is then inhibited and less rapid growth of cells occurs.

Question 8c.

Marks	0	1	2	Average
%	34	34	32	**1**

- Antibiotics would not be suitable as the disease is autoimmune and antibiotics work against bacteria.
- Antibiotics could be suitable as bacterial infections are thought to be a trigger for psoriasis or a bacterial infection may have been established in the skin as the person may have scratched and infected their skin.

Question 9a.

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

The length of the line suggests that *Pakicetus* is extinct.

Question 9b.

Marks	0	1	2	3	Average
%	36	44	4	16	**1**

Students were required to give a feature of the transitional fossil that would be advantageous in an aquatic environment and another feature that would be advantageous in a terrestrial environment. They were then required to provide an advantage of each given feature. Examples of suitable answers are provided below.

Aquatic adaptation/advantage	Terrestrial adaptation/advantage
heavy bones to enable organism to sink/stay submerged	flat feet/hooves to walk on land
paddle-like limbs/webbed feet to assist swimming	four walking legs to walk on land
nostrils/eyes at top of head for surface breathing/vision	short legs for walking in mud

The feature needed to feasible in a fossil. Presence of lungs or gills was not feasible as these would not fossilise.

Question 9ci.

Marks	0	1	2	Average
%	15	24	61	**1.5**

Examples of possible responses include:

- The hippopotamus and the killer whale both have a relatively recent mammal ancestor 55 million years ago or diverged under different selection pressures and adapted to different environments.
- The bronze whaler and the blacktip reef shark both have a shark ancestor 23 million years ago or diverged under different selection pressures and adapted to different environments.

Question 9cii.

Marks	0	1	2	Average
%	40	13	47	**1.1**

Examples of possible responses include:

- humpback whale and whale shark: both adapted to ocean swimming with big, streamlined bodies and tails. They are both filter feeders, straining plankton through sieve-like structures in the mouth
- killer whale and bronze whaler: both have a dorsal fin for efficient swimming.

Some students confused divergent and convergent evolution, either by providing examples or explanations of the other type of evolution or by answering the opposite for each type of evolution.

Question 9d.

Marks	0	1	2	Average
%	26	41	32	**1.1**

Evidence could be gained by:

- interbreeding the burrunan dolphin and the common bottlenose dolphin to see if they produce fertile offspring
- DNA hybridisation using DNA samples from both species to see if there are many complementary DNA sequences.

Question 9e.

Marks	0	1	2	Average
%	13	57	30	**1.2**

Possible outcomes could be that:

- the burrunan dolphin evolves into a species separate from that in the Gippsland Lakes as there are different selective pressures acting on the populations
- the burrunan dolphin becomes extinct due to human impact pressure/overfishing/disturbance/ pollution
- if a conservation group looks after the dolphin groups, they may increase in number.

Question 10a.

Marks	0	1	2	3	Average
%	24	15	20	41	**1.8**

Both are transgenic organisms as transgenic organisms have genes from a different species.

Bt cotton has genes from *Bacillus thuringiensis*, while GM rice has genes from *Erwinia uredovora* and *Narcissus pseudonarcissus*.

Question 10b.

Marks	0	1	Average
%	32	68	**0.7**

Reducing insect damage means that the cotton plants will grow more and produce more cotton, therefore increasing crop yield.

Question 10c.

Marks	0	1	2	3	4	Average
%	6	10	24	32	28	**2.7**

	Social implication	Biological implication
Bt cotton	• farmers cannot use saved seeds; therefore it is expensive as they need to buy new seeds each year • may cause skin disease, reducing quality of life for farmers • less money available as need to buy seed, which impacts on other areas of life, such as food, education, etc. • could increase yield, resulting in more money and potential increases in standard of living	• might contribute to skin diseases in farmers • reduces the environmental impacts of pesticides • genes might get into weed crops and reduce the number of predators for insects that feed on Bt cotton
Golden rice	• farmers can save rice to be used in the next year's harvest, which can lead to increased profits • golden rice improves socioeconomic levels because of a reduction in death and disease • reduced deaths may lead to decreased birth rates • proven safe	• improved nutrition through increased intake of vitamin A • saves lives as avoids vitamin A deficiency • increased intake of vitamin A improves health, leading to benefits to the community

Question 11a.

Marks	0	1	Average
%	80	21	**0.2**

Examples of possible responses include:

- that red algae photosynthesise faster than green algae in green light
- that red algae use CO_2 faster than green algae when exposed to green light.

Question 11b.

Marks	0	1	2	3	Average
%	8	31	45	16	**1.7**

Controlled variables (three of):

- number of balls in each tube
- number of drops of phenol red added
- the volume of CO_2 present initially/initial pH
- temperature
- amount of algae

As the colour and level of carbon dioxide changed during the experiment, students were required to acknowledge the amount at the beginning of the experiment.

Question 11c.

Marks	0	1	2	Average
%	24	32	44	**1.2**

Independent variable: type of algae

Dependent variable: level of CO_2/time for colour change/colour of solution/pH

Question 11d.

Marks	0	1	2	Average
%	44	51	5	**0.6**

The hypothesis would be refuted/not supported if the indicator changes or changes faster with the green algal balls than the red algal balls and if both changed at the same rate/gave the same results.

The answer to this question was dependent upon the student's answer to part a.

Question 11e.

Marks	0	1	Average
%	83	17	**0.2**

This is a good suggestion because it enables the students to judge whether the colour change is due to photosynthesis, which requires light, or another reaction occurring in the tubes.

Question 11f.

Marks	0	1	2	Average
%	87	13	1	0.2

Suitable suggestions included:

- There may be more living algal cells trapped in the red algal balls than the green algal balls, giving an increase in photosynthesis.
- The phenol red may affect the rate of photosynthesis in green algae more than in red algae.
- There may be differences in the rate of cellular respiration between the two types of algae.