

2018 VCE Biology (NHT) examination report

General comments

Section A of the examination comprised 40 multiple-choice questions. Section B comprised short and extended-answer questions, totalling 80 marks. Many Section B questions required students to develop answers from the situations provided; this required a thoughtful approach. Unit 4, Area of Study 3 was an important part of the examination, where students could draw on the knowledge gained in their school-assessed coursework.

Students were required to write within the designated spaces on the pages of the examination. It is important that students follow the instructions provided on the examination, in particular using a blue or black pen for Section B, rather than pencil, which may not scan well. If students are asked to annotate or draw a diagram or graph, such as in Question 11cii., this may be done in pencil so that the answer can be changed if necessary.

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. Students should not repeat the stem of the question in their answers.

Students need to make full use of the reading time. This is an important time for them to understand the information provided in Section B and a time to formulate answers.

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

Students should feel confident to use suitable abbreviations such as DNA, ATP and NADH, and chemical symbols such as H₂O. If students wish to use another abbreviation and are not sure of its appropriateness, then they should write out the word or term in full.

Teachers and students are reminded that the set of key science skills (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.

Section A – Multiple-choice questions

Question	Answer
1	B
2	A
3	D
4	B
5	A
6	D
7	B
8	C
9	B
10	A
11	C
12	C
13	B
14	A
15	D
16	B
17	C
18	D
19	D
20	C
21	C
22	C
23	A
24	D
25	B
26	D
27	A
28	B
29	C
30	D
31	B
32	C
33	C
34	B
35	A
36	B
37	D
38	C
39	C
40	B

Section B

Question 1a.

Chlorophyll absorbs light energy, water is split to form hydrogen ions or oxygen gas, and oxygen will diffuse out through the plasma membrane.

Question 1bi.

Both of:

- light-dependent stage
- light-independent stage/Calvin cycle/carbon fixation.

Question 1bii.

- At low light intensities the amount of ATP and NADPH produced is smaller OR there is less energy to produce H^+ as fewer chlorophyll molecules are excited.
- In the carbon fixation/light-independent stage, less glucose is produced at lower light intensities.

Question 2a.

Dendritic cells:

- display antigens on their surface
- present antigens to T cells/activate T helper cells or T cytotoxic cells.

Question 2b.

- can't form plasma B cells
- the plasma B cells would normally produce specific antibodies, cause agglutination or target the bacteria to be destroyed.

Question 2c.

Monoclonal antibodies would be artificially made to bond/attach to the CD20 antigen and they would then (one of):

- flag cancer cells to other immune system cells for destruction
- trigger cell-membrane destruction or apoptosis
- block cell growth by blocking the connection between a cancer cell and proteins that promote cell growth
- deliver radiation or chemotherapy treatment. Because of a monoclonal antibody's ability to connect with a cancer cell, the antibody can be engineered as a delivery vehicle for other treatments.

Question 3a.

- RNA polymerase attaches to the promoter region.
- DNA helix unwinds and one side is used as a template strand.
- RNA polymerase reads the template strand.
- RNA polymerase joins nucleotides that are complementary to the template DNA strand.

Question 3b.

Exons

Question 4a.

Caspases cleave specific proteins in, for example, the nucleus and cytoplasm of the cell.

Question 4b.

- They use endocytosis to engulf the apoptotic bodies.
- The apoptotic body is then destroyed using enzymes/digested.

Question 5a.

- Decreases the number of T helper cells as cell death occurs.

And either:

- Therefore, there would be fewer T cytotoxic cells to fight the HIV-infected cells or fewer specific antibodies produced by plasma cell to bind to the HIV virus.
- No T helper cells would be present to stimulate T and B cell differentiation.
- T helper cells would no longer be present to bind to antigen-presenting cells (dendritic cells, macrophages) and therefore will not trigger the recruitment of lymphocytes.
- There would be more T cells for the virus to infect and promote the illness.

Question 5bi.

Increased (two of):

- mast cell activation
- histamine release
- blood flow to the area
- swelling
- blood vessel dilation
- clotting factors.

Question 5bii.

Constant inflammation (one of):

- would cause persistent pain, redness and heat, and wastes energy needed to fight HIV infection
- brings more lymphocytes and phagocytes to the inflamed area, preventing them from being used to fight infection elsewhere.

Question 6a.

To enable a comparison to be made between the treated and untreated sides of the rat

Question 6b.

Two of:

- same amount of cream applied to each rat
- same side of the rat applied with cream each time
- age and gender of rats.

Question 6c.

The molecule joins to a receptor on the surface of the cell, which indicates that it cannot enter the cell.

Question 6d.

Stage A – reception

Stage B – signal transduction

Stage C – cellular response

Question 6e.

- There is a decrease in concentration of proteins 1–6 in the treated skin.
- There is an increase in proteins 7–11 in the treated skin.
- Two proteins (7 and 9) are only present in the signalling pathway of the treated skin.

Question 7a.

The presence of a vestigial pelvis is evidence that an ancestor would have had hind limbs like those of the *P. portelli* fossil.

Question 7b.

The age of the fossil molluscs would have been worked out using radiometric potassium–argon or uranium–lead dating in which percentages of the parent isotope and its breakdown product are measured. The radiometric dating is done on igneous rock layers associated with the sedimentary layers in which the fossil molluscs have been found elsewhere in the world.

Question 7c.

The technique of stratigraphy is used, which assumes that fossils of a particular species will occur in sediments of the same age wherever they are found. Given that the *P. portelli* fossils are found in the same sedimentary layer as the molluscs, they must be the same age.

Question 8a.

Any one of the characteristics and a logical advantage it gives. For example:

- Large toe pads enable the canopy-dwelling lizards to cling to the broad leaves and so exploit the food supply in this habitat.
- Small body/short legs enable the twig-dwelling lizards to cling to twigs and not fall off.

Question 8b.

Mutations in the ancestral population of the *Anolis* species on each island enabled some members of the populations to exploit different habitats. Further mutations in the groups occupying the different habitats gave them both a selective advantage for living in their particular habitat and progressively led to reproductive isolation from those occupying other habitats. Eventually the populations occupying the different habitats became different species.

Question 8c.

The similarities and differences in the base sequences of the DNA of the different species are studied. Those species with the most similar base sequences of DNA are assumed to have had a more recent common ancestor.

Question 8d.

Species 8 is more closely related to species 5 (than to species 1) because, according to the phylogenetic tree, species 8 and species 5 have a more recent common ancestor than species 8 has with species 1.

Question 8e.

The following are examples of acceptable answers:

- The phylogenetic tree shows that the canopy-dwelling lizards on each island are more closely related to the other lizard species on the island than they are to canopy-dwelling lizards on other islands. This means that instead of the canopy-dwelling lizards having evolved once and then having moving to the other islands, the canopy-dwelling lizards on each island each evolved separately from ancestral lizards of unknown appearance.
- The phylogenetic tree shows that the canopy-dwelling lizards on each island are more closely related to the other lizard species on the island than they are to canopy-dwelling lizards on other islands. This shows that there has been independent evolution on each island from a common ancestor, as there was the same environment pressure in the canopy on each of the islands.

Question 9a.

The more times the experiment is repeated, the more accurate the results/minimises the impact of random errors in data/accounts for genetic variation.

Question 9b.

If genes are switched off/removed and the embryo no longer functions/develops, that particular gene is essential for embryonic growth.

Question 9c.

Acts as molecular scissors that cut the DNA strands at a specific sequence/location.

Question 9d.

Join DNA strands

Question 9e.

Benefits (one of):

- eliminate deadly genetic diseases from people before they are born
- improve IVF success rates

Concerns (one of):

- introducing genetic changes that could be passed down to future generations
- creating genetically modified babies
- using viable embryos for scientific research that are then destroyed
- potentially incorrect DNA edits
- making changes to the DNA of human embryos could accidentally introduce an error into the human gene pool, inadvertently creating a new disease that could be passed onto future generations

Question 9f.

A primer attaches to complementary DNA nucleotides. The addition of the primer and its joining to complementary nucleotides then allows the DNA polymerase to begin copying. Two primers are needed as the nucleotide sequence is different at the start and finish of the section of DNA that must be copied.

Question 10a.

A disease outbreak that spreads globally or a large geographic area

Question 10b.

The two studies had different questions/aims or target groups (for example, different population cohorts at different stages of treatment/recovery) and used different methods. Thus, they can both reach a different conclusion and still be valid because they are different studies.

Question 10c.

- Yes, they should, as a precaution. Since Tamiflu/Relenza halved the death rate of people in hospital, it is worth spending the money to avoid the risk of many people dying in a pandemic.
- No, because it has only a minor effect on most people who get the flu and there are still side effects. It would be cheaper to save the drugs for those who get so sick they need hospitalisation.

Question 10d.

Drugs designed through rational design have a complementary molecular structure to an active site on an enzyme. Relenza binds to the (active site on) neuraminidase protein on the influenza virus and inhibits its function, so newly reproduced viruses cannot escape from the host cell to infect others.

Question 10e.

Aspect of treatment or prevention method	Relenza	Influenza vaccine
duration of effect	short acting	long acting
chance of herd immunity being achieved	None	high

Question 11a.

The following are examples of possible answers:

- If the pH of the solution is changed, then the rate of the production of oxygen is altered.
- Higher pHs increase the rate of production of oxygen OR a low pH does not result in the production of oxygen.

Question 11b.

In Flask 1 the pH is neutral, the enzyme is able to work efficiently, and hydrogen peroxide is being broken down to water and oxygen at the fastest/optimal rate.

Adding 50 mL of alkaline buffer solution will increase the pH of the solution. This change in pH may denature some of the enzyme molecules, or conditions may not be optimal for the enzyme's operation and therefore the rate of the reaction will be slowed down, as seen by the lower percentage of oxygen produced.

Adding 50 mL of acidic buffer solution to the solution has a greater effect on the activity of the enzyme. The pH of the solution may have been altered so that most of the enzyme molecules were denatured and the reaction is very slow or does not proceed.

Question 11ci.

To determine the percentage of oxygen produced without enzyme present and then to act as a comparison for all other results

Question 11cii.

Students should have drawn a line that was the same as that for Flask 3. The line should not have gone below the initial percentage of oxygen.

Question 11d.

- Measuring the pH of the solution indicates how much the 50 mL of buffer solution changed the pH.
- Run the experiment for a longer amount of time to check if the percentage of oxygen in the flask plateaus.
- Conduct the experiment over a range of pHs to determine optimal pH for enzyme activity.
- Repeat the experiment.

Question 11e.

Accuracy of measurement is how close the measurement is to the true value. Precision of measurement is how close each repeated measurement is to the other measurements.